Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Original Research

Attitudes and opinions on quarantine and support for a contact-tracing application in France during the COVID-19 outbreak

M. Guillon*, P. Kergall

Université de Montpellier, Montpellier Recherche en Economie, Avenue Raymond Dugrand, 34960 Cedex 2, Montpellier, France

A R T I C L E   I N F O

Article history:
Received 18 May 2020
Received in revised form
11 August 2020
Accepted 31 August 2020
Available online 12 October 2020

Keywords:
COVID-19
Quarantine
Risk perception
Contact tracing
Cross-sectional studies

A B S T R A C T

Objectives: We aim to identify the factors associated with support and compliance with general quarantine and with the acceptability and potential use of a contact-tracing mobile phone application among French respondents. Study design: We conducted a cross-sectional study between April 16th and May 7th 2020 using online questionnaires. Methods: The sample was reweighted to be representative of the French population by age and sex, region and education level. Ordered logistic, logistic and negative binomial regressions were used to estimate the factors associated with quarantine support, with the opinion on quarantine extension, with the number and type of trips outside the quarantine home and with the acceptability and potential use of a contact-tracing application. Results: After reweighting, full data for regression analyses were available for 1849 respondents. Attitudes and opinions regarding quarantine are correlated with the perceived COVID-19 threat, the perceived benefits of quarantine, trust in the government, well-being during quarantine and risk preferences. Trust in the government, perceived individual health consequences in case of COVID-19 infection and time preferences are associated with the willingness to use a contact-tracing application. Conclusions: Our analysis indicates that prevention campaigns that stress the individual risk in case of infection or the benefits of quarantine could foster compliance to quarantine protocols. Remote psychological support might also promote quarantine adherence among individuals most distressed by the quarantine. Moreover, public communications should focus on restoring trust among the population as trust is strongly correlated with the willingness to use a contact-tracing application.

Introduction

Countries relied on non-pharmaceutical interventions (NPIs) to fight the COVID-19 epidemic in early 2020. Among NPIs, quarantine interventions were very effective in reducing COVID-19 transmissions. A modelling study conducted for 11 European countries estimated that general quarantine alone allowed for a reduction of 81% in the number of COVID-19 infections.

In France, general quarantine was implemented from March 17th to May 11th 2020. Such containment measures can have large social and economic impacts which might reduce their acceptance. Most studies on individual compliance with quarantine measures in epidemic situations were conducted after the outbreaks of Severe Acute Respiratory Syndrome (SARS), H1N1, H5N1, Middle East Respiratory Syndrome (MERS) or Ebola disease. A recent review showed that quarantine adherence is mainly correlated with knowledge about the disease, social norms related to quarantine, perceived benefits of quarantine and perceived risk of the disease. However, while providing useful information, results of previous studies are difficult to transpose to the French COVID-19 general quarantine. Recent surveys on quarantine acceptance were conducted in France. The COCONEL study, conducted in early April 2020, found that 87% of respondents considered the general quarantine as the only effective strategy to fight the COVID-19 epidemic. In this study, quarantine support was found higher among female, older and wealthier respondents. General quarantine measures were eased in Europe in the past few months. Meanwhile, contact-tracing applications, which can be very effective to control the COVID-19 epidemic if used by enough people, have been developed in numerous countries. However, recent studies conducted in the US, the UK or in European countries...
have shown that data privacy is a major barrier in the use of contact-tracing applications.\textsuperscript{17–22} The willingness to use such applications was also found to be correlated with fear of COVID-19\textsuperscript{17,18} and with risk factors for and personal experience of COVID-19.\textsuperscript{21} Two studies are available regarding the acceptability of a contact-tracing application among the French population. In a study conducted on March 26th and 27th 2020, 80\% of French respondents declared being willing to install a contact-tracing application.\textsuperscript{22} On pooled data from France, the UK, Italy, Germany and the US, this study also investigates the factors associated with the acceptability of digital contact tracing. Privacy and low government trust appear as barriers to the adoption while regional COVID-19 mortality rates are unrelated to the willingness to use the application, and the role of COVID-19 risk perceptions is not investigated. In a more recent survey conducted on April 4th and 5th 2020, only 44\% of French respondents were willing to use a contact-tracing application with higher acceptability found among men, older respondents and those not able to telework during the quarantine.\textsuperscript{24} Optimistic results found by Altmann et al.\textsuperscript{21} might be linked to their study timing as it was conducted when the epidemic was skyrocketing in France and before digital contact tracing had been widely discussed in French media. In early April 2020, media coverage and associated controversies around the development of a contact-tracing application by the French government greatly increased. Technical features of the forthcoming StopCovid application were only released by the Minister of Health on April 8th 2020.

The objective of this study is twofold. Using an online survey conducted between April 16th and May 7th 2020 among French respondents, we aim to identify the factors associated with (1) support and compliance with the general quarantine and with (2) the acceptability and potential use of a contact-tracing mobile phone application.

Methods

Recruitment of participants

Participants were recruited between April 16th and May 7th 2020 using an online questionnaire posted on generic Facebook groups and on the websites of local newspapers. Participants were presented with an information letter before being asked whether they agreed to participate. The information letter mentioned the strict anonymity of data collected and the following eligibility criteria: to be aged 18 years and older and living in France during the general quarantine.

Dependent variables of interest

The level of agreement with the general quarantine was measured on a Likert-type scale ranging from 1 (‘strongly disagree’) to 5 (‘strongly agree’). Participants were asked how many times in the past seven days they went out of their quarantine home by categories of trips. We created two variables; the total number of trips outside the quarantine home over the last 7 days, and a dummy variable coded as 1 if respondents went out for physical activity or brief walk(s) at least once in the past 7 days and 0 otherwise. Respondents were also asked whether general quarantine should be extended beyond May 11th 2020, its official end date at the time of the survey, and if yes by how many weeks. We created a dummy variable for the opinion regarding the need for quarantine extension and a variable representing the length in weeks the respondents thought the general confinement should last after May 11th 2020.

Respondents were presented with a description of a contact-tracing application: installation would be voluntary and data collected anonymous, the application would run through Bluetooth without recording the precise location of users. The users would be notified if they had a close contact with an infected person during the last 15 or 20 days without the infected person’s identity being revealed. Respondents were asked whether they found the use of a contact-tracing application acceptable and whether they would personally install it. Two dummy variables were created and coded as 1 if respondents had a positive opinion about the acceptability (‘Rather acceptable’ or ‘totally acceptable’) and use (‘1 would probably install it’ or ‘1 would definitely install it’) of the contact-tracing application and 0 otherwise.

Independent variables of interest

The Health Belief Model\textsuperscript{25,26} was used as a theoretical framework to investigate the factors associated with attitudes and opinions regarding the general quarantine and with the contact-tracing application acceptability and potential use. Fig. 1 provides a graphical representation of the theoretical framework.

The perceived threat related to COVID-19 was measured using three one-item variables: the perceived probability of contracting the disease, the perceived health impacts of the COVID-19 epidemic in France and the individual health consequences in case of infection.

Perceived benefits were measured using two one-item variables: the perceived efficacy of the general quarantine and trust in the government to handle the health crisis. Respondents were asked whether they agreed with two assertions stating that ‘the general quarantine is effective to protect the general population from the COVID-19 epidemic’ and ‘I trust the government to limit the health effects of the COVID-19 epidemic’.

Respondents were also asked how often since the beginning of the quarantine they felt anxious, depressed, isolated or bored on a scale from 1 (‘never’) to 5 (‘always’). These items were reverse-scored and summed to create a well-being index (ranging from 0 to 16) used as a measure of perceived barriers to explain attitudes and opinions regarding the general quarantine ($\alpha = 0.7676$).

Cues to actions were measured using two one-item variables: the experience of COVID-19 symptoms (either personal or among closed ones) and the perceived respect of quarantine rules by the general population. Regarding the latter, respondents were asked whether they agreed with the assertion that ‘most people in France respect the general quarantine rules’.

Individual modifying factors include socio-economic and demographic characteristics (gender, age, region, education level, matrimonial status, income, labour market situation since the beginning of the general quarantine), perceived health status, conditions of quarantine (type of housing, size and number of people living in the quarantine home, presence of person(s) aged under 18 and presence of dogs in the quarantine home) and time and risk preferences. For risk preference, respondents were asked to rate themselves on a scale from 0 (‘extremely careful’) to 10 (‘extremely adventurous’). The French-validated 15-item short form of the Barratt Impulsiveness Scale (BIS 15) was used as a measure of present preference.\textsuperscript{27} Internal consistency of the BIS is acceptable ($\alpha = 0.7688$).
Data analysis

To reduce bias due to sample selection, regression analyses were conducted on a reweighted sample representative of the 20- to 74-year-old mainland French population by age and sex, region and education level. Appendix A provides details regarding the reweighting procedure.

Factors associated with the level of agreement with the general quarantine were estimated using an ordered logistic model. Regression analyses for the opinion on whether quarantine should be extended, for the dummy variable on physical activity or brief walking trips, and for the acceptability and potential use of the contact-tracing application were run using logit models. The number of trips outside the quarantine home in the last seven days and the opinion on the number of additional weeks of quarantine required were estimated using negative binomial regressions, given evidence of overdispersion. All regression analyses were run using Stata®, version 15.

Descriptive statistics

We collected 2751 questionnaires. Full data were available for 1909 respondents. The response rate is 69%, and almost half of partially completed questionnaires were stopped before completing the first part on socio-economic and demographic characteristics. Only respondents aged between 20 and 74 years old could be retained in the reweighting analysis to match the age categories of the French National Institute for Statistical and Economic Studies. A total of 1849 observations were then used in regression analyses.

Table 1 provides the key summary statistics before reweighting. Among respondents, 15% rather or totally disagreed with the general quarantine while 11.2% neither agreed nor disagreed. During the last 7 days, the mean number of trips was 4.98 and less than half of respondents (44.8%) went out for brief walk(s) or physical activity. More than half (53%) of the respondents thought the general quarantine should have been extended by 1.78 week. Regarding the contact-tracing application, 42.1% of the respondents found it rather or totally acceptable and only 38.4% declared they would probably or definitely install it.

Fig. 2 presents the evolution of the mean values for attitudes and opinions regarding quarantine between April 16th and April 30th 2020, when 95% of survey responses were collected. The general quarantine agreement level and the number of additional weeks of quarantine needed decreased over time. Meanwhile, the mean number of trips in the last seven days and the share of respondents who went out for brief walk(s) or physical activity increased. Between April 16th and 30th, two major governmental media interventions occurred: the Prime and Health Ministers held an epidemic situation update on April 19th and the Prime Minister publicly presented the national reopening strategy on April 28th. No change in attitudes or opinions regarding quarantine is noticed around these two interventions.

Regression analyses on opinions and attitudes regarding the general quarantine

Table 2 presents the regression analysis results for the opinions (panel A) and attitudes (panel B) regarding the general quarantine. Female and older respondents tend to be less in favour of a quarantine extension (column 2) while they tend to declare a higher number of trips (column 4). Older respondents are also more likely to go out for physical activity or walks (column 5). More educated respondents express lower support for a quarantine extension (columns 2 and 3) or for physical activity or walks (column 5). We find positive correlations between the perceived health impacts of COVID-19 in France and the quarantine agreement level (column 1), the opinion on quarantine extension (column 2) and its length of extension (column 3). On the contrary, a negative
### Table 1
Descriptive statistics.

| Variable                        | Mean (standard deviation) | N (%)  |
|---------------------------------|---------------------------|--------|
| **Sex**                         |                           |        |
| Male                            | 443 (24.0%)               |        |
| Female                          | 1406 (76.0%)              |        |
| **Age**                         |                           |        |
| 20–29                           | 650 (35.2%)               |        |
| 30–39                           | 346 (18.7%)               |        |
| 40–49                           | 310 (16.8%)               |        |
| 50–59                           | 303 (16.4%)               |        |
| 60–74                           | 240 (13.0%)               |        |
| **Region**                      |                           |        |
| Auvergne-Rhône-Alpes            | 84 (4.5%)                 |        |
| Bourgogne-Franche-Comté         | 14 (0.8%)                 |        |
| Bretagne                        | 215 (11.6%)               |        |
| Centre-Val de Loire             | 30 (1.6%)                 |        |
| Grand Est                       | 244 (13.2%)               |        |
| Hauts-de-France                 | 38 (2.1%)                 |        |
| Ile-de-France                   | 148 (8.0%)                |        |
| Normandie                       | 26 (1.4%)                 |        |
| Nouvelle-Aquitaine              | 28 (1.5%)                 |        |
| Occitanie                       | 899 (48.6%)               |        |
| Pays de la Loire                | 58 (3.1%)                 |        |
| Provence-Alpes-Côte d’Azur      | 65 (3.5%)                 |        |
| **Level of education**          |                           |        |
| < A level                       | 120 (6.5%)                |        |
| A level                         | 266 (14.4%)               |        |
| > Two-year university diploma   | 1200 (64.9%)              |        |
| **Matrimonial status**          |                           |        |
| Single                          | 522 (28.2%)               |        |
| In a relationship, civil union or married | 1122 (60.7%) |        |
| Divorced or separated           | 180 (9.7%)                |        |
| Widowed                         | 25 (1.4%)                 |        |
| **Monthly income**              |                           |        |
| <1000 euros                     | 332 (18.0%)               |        |
| 1000–2000 euros                 | 736 (39.8%)               |        |
| 2000–4000 euros                 | 567 (30.7%)               |        |
| >4000 euros                     | 135 (7.3%)                |        |
| Not applicable or not wishing to answer | 79 (4.3%)     |        |
| **Work situation during general quarantine** |                        |        |
| Teleworking                     | 639 (34.6%)               |        |
| Working at usual working place  | 273 (14.8%)               |        |
| Not working but usually works   | 391 (21.1%)               |        |
| Not working, unemployed before general quarantine | 134 (7.2%) |        |
| Not working, student before general quarantine | 179 (9.7%)      |        |
| Not working, inactive or retired before general quarantine | 233 (12.6%) |        |
| **Perceived health status**     |                           |        |
| Poor or very poor               | 76 (4.1%)                 |        |
| Fair                            | 397 (21.5%)               |        |
| Good                            | 882 (47.7%)               |        |
| Very good                       | 494 (26.7%)               |        |
| **Type of housing during general quarantine** |                        |        |
| House                           | 882 (47.7%)               |        |
| Flat with exterior space        | 750 (40.6%)               |        |
| Flat without exterior space     | 217 (11.7%)               |        |
| **Size of general quarantine home (m²)** | 90.50 (51.06)           |        |
| **Household number(s) during general quarantine** |                        |        |
| 1                               | 368 (19.9%)               |        |
| 2                               | 731 (39.5%)               |        |
| 3                               | 343 (18.6%)               |        |
| 4                               | 277 (15.0%)               |        |
| 5 or more                       | 130 (7.0%)                |        |
| **Presence of <18 in general quarantine home** |                        |        |
| No                              | 975 (52.7%)               |        |
| Yes                             | 874 (47.3%)               |        |
| **Presence of dog(s) in general quarantine home** |                        |        |
| No                              | 1529 (82.7%)              |        |
| Yes                             | 320 (17.3%)               |        |
| **General quarantine agreement** |                            |        |
| Totally disagree                | 108 (5.8%)                |        |
| Rather disagree                 | 170 (9.2%)                |        |
| Neither agree nor disagree      | 208 (11.2%)               |        |
| Rather agree                    | 779 (42.1%)               |        |
| Totally agree                   | 584 (31.6%)               |        |
| **Number of trips in the last 7 days** | 4.98 (5.52)              |        |
correlation is found between perceived COVID-19 health impacts and physical activity or walking trips (column 5).

Respondents with a high or very high perceived risk of infection express higher support for the general quarantine (column 1). An intermediate perceived risk of infection is also associated with a higher number of trips (column 4) and a higher probability of physical activity or walking trips (column 5). These surprising results could be explained by a reverse effect of the number of trips on the perceived risk of infection with respondents going out more often being aware of their higher risk of infection.

The perceived health consequences in case of infection are positively correlated with the quarantine agreement level (column 1) and the length of quarantine extension (column 3). This variable is also negatively correlated with trips for physical activity or walks (column 5). The perceived efficacy of the general quarantine is positively correlated with the quarantine agreement level (column 1) and with the number of additional weeks of quarantine required (column 3).

Trust in the government to handle the health crisis is positively correlated with the quarantine agreement level (column 1) and negatively correlated with the opinions on its extension (columns 2 and 3) which indicates a greater support for the official epidemic control strategy among respondents who trust the government. Trust in the government is also positively correlated with the number of trips (column 4) and with trips for physical activity or walks (column 5). French general quarantine rules were less strict than those applied in other highly affected countries, and the mandatory certificate of movement included a rather large number of reasons for trips outside the quarantine home (e.g. trips for individual physical activity were authorised once a day). Respondents trusting the government might have felt more confident in taking authorised trips during the quarantine, which might explain the correlations we find between trust in the government and trips out of the quarantine home.

The well-being index is positively correlated with the quarantine agreement level (column 1), the opinion that quarantine should be extended (column 2) and the length of this extension
We also find a negative correlation between the well-being index and the probability of physical activity or walking trips (column 5). The belief that quarantine rules are broadly respected is negatively correlated with the opinion that quarantine should be extended (column 2) and the length of this extension (column 3). Respondents perceiving a higher level of compliance with the quarantine rules might be more likely to think that the first quarantine period was effective in controlling the epidemic and that its extension is unneeded.

The risk preference measure is negatively correlated with the opinion on quarantine extension (column 2) and with the number of additional weeks of quarantine required (column 3) while it is positively correlated with the number of trips (column 4) and with trips for physical activity or walks (column 5). Risk adverse respondents also tend to be less in favour of a general quarantine extension, maybe because such extension is perceived as a source of economic or social risk. Interestingly, respondents scoring higher on the impulsivity scale tend to favour an extension of the quarantine (column 2) and to support a longer extension (column 3). One explanation could be that impulsive respondents express higher support for a quarantine extension as a commitment strategy to reduce their risk of infection in the near future.

Regression analyses on the acceptability and potential use of the contact-tracing application

Table 3 presents the results of the regression analyses for the acceptability (column 1) and the potential use (column 2) of the contact-tracing application.

Compared with those aged 20–29 years, respondents aged between 40 and 49 years tend to find the contact-tracing application less acceptable and are less likely to use it (columns 1 and 2). The acceptability and the potential use of the tracing application appear higher in some (Île-de-France) but not in all (Grand Est) highly affected regions (columns 1 and 2).

A positive correlation is found between the perceived health consequences in case of COVID-19 infection and the willingness to use the tracing application (column 2). Trust in the government to handle the health crisis is strongly and positively correlated with the acceptability and the potential use of the contact-tracing application (columns 1 and 2). Finally, impulsivity is negatively correlated with the potential use of the contact-tracing application (column 2). Then, respondents who are less future oriented express a lower willingness to use the contact-tracing application.

Discussion

Consistent with the theoretical framework provided by the Health Belief Model, attitudes and opinions regarding the general quarantine are associated with the perceived threat related to COVID-19, the perceived benefits of quarantine, trust in the government and individual modifying factors. Perceived health impacts of COVID-19 in France are strongly correlated with the quarantine agreement level, with the opinions on its extension and with trips for physical activity and walks. Perceived health consequences in case of infection are positively correlated with the opinion on the number of additional weeks of quarantine needed and negatively correlated with trips for physical activity and walks. The perceived efficacy of quarantine is positively correlated with the support for the quarantine and its extension. Trust in the government is associated with more support for the epidemic control strategy. Well-being during the general quarantine is also positively correlated with the support for the quarantine and its extension. Finally, risk preference is correlated with more trips and with less support for the quarantine extension.

In line with the available literature, our results confirm the importance of the perceived disease risk, the perceived benefits of quarantine and trust in the government in support and
## Table 2
Results of regression analyses on opinions and attitudes regarding the general quarantine.

### Panel A: Opinions regarding the general quarantine

| General quarantine agreement | Quarantine extension (Yes/No) | Quarantine extension length | Trips in the last 7 days | Physical activity or walking trips |
|-----------------------------|-----------------------------|---------------------------|------------------------|----------------------------------|
| **Female (Ref: Male)**      |                             |                           |                        |                                  |
| 0.789                       | 0.470*                      | 1.073                     | 0.853*                 | 1.110                            |
| (0.471,1.321)               | (0.245,0.900)               | (0.752,1.532)             | (0.728,0.999)          | (0.637,1.936)                    |
| **Age (Ref: 20–29 years)**  |                             |                           |                        |                                  |
| 0.735                       | 0.312**                     | 0.704                     | 1.089                  | 1.996                            |
| (0.299,1.802)               | (0.120,0.808)               | (0.458,1.083)             | (0.805,1.473)          | (0.830,4.800)                    |
| 0.818                       | 0.946**                     | 0.818                     | 1.460                  | 5.032**                          |
| (0.226,2.963)               | (0.523,1.375)               | (1.054,2.047)             | (1.784,14.197)         | (5.032,5.035)                    |
| 50–59                       | 0.622                       | 0.183**                   | 1.021                  | 1.573**                          |
| (0.188,2.057)               | (0.619,1.685)               | (1.117,2.215)             | (3.187,11.173)         | (3.937,3.937)                    |
| 1.908                       | 0.865                       | 1.276                     | 7.035**                |                                  |
| (0.478,7.614)               | (0.414,1.809)               | (0.844,1.931)             | (3.188,35.672)         |                                  |
| **Region (Ref: Auvergne-Rhône-Alpes)** |                             |                           |                        |                                  |
| Bourgogne-Franche-Comté     | 5.114                       | 16.33**                   | 6.601***               | 1.330                            |
| (0.623,42.010)              | (2.191,121.643)             | (2.105,20.699)            | (0.832,2.128)          | (0.572,20.218)                   |
| Bretagne                    | 0.735                       | 0.312**                   | 0.704                  | 1.089                            |
| (0.299,1.802)               | (0.120,0.808)               | (0.458,1.083)             | (0.805,1.473)          | (0.830,4.800)                    |
| Centre-Val de Loire         | 0.489                       | 1.732                     | 1.005                  | 1.459                            |
| (0.093,2.583)               | (0.493,2.048)               | (0.909,2.340)             | (0.459,1.988)          | (0.266,0.531)                    |
| Grand Est                   | 1.045                       | 1.165                     | 0.995                  | 1.799                            |
| (0.208,5.046)               | (0.547,1.465)               | (1.381,2.801)             | (0.450,1.950)          | (1.799,1.799)                    |
| Hauts-de-France             | 1.470                       | 0.873                     | 1.491                  | 1.392                            |
| (0.412,2.431)               | (0.767,2.901)               | (0.960,2.019)             | (0.218,2.760)          | (0.776,0.776)                    |
| Île-de-France               | 1.792                       | 1.005                     | 1.187                  | 1.356                            |
| (0.592,5.429)               | (0.652,1.519)               | (0.947,1.941)             | (0.608,6.684)          | (2.041,2.041)                    |
| Normandie                   | 2.522                       | 3.076                     | 1.454                  | 2.420***                         |
| (0.583,10.910)              | (0.736,2.874)               | (1.588,3.688)             | (0.278,6.928)          | (1.388,1.388)                    |
| Nouvelle-Aquitaine          | 1.966                       | 0.695                     | 1.356                  | 1.448**                          |
| (0.723,3.50)                | (0.493,2.048)               | (0.909,2.340)             | (0.802,1.395)          | (2.098,2.098)                    |
| Occitanie                   | 0.350                       | 0.292*                    | 1.084                  | 1.910***                         |
| (0.096,1.279)               | (0.635,1.850)               | (1.377,2.649)             | (0.554,7.946)          | (5.088,5.088)                    |
| Pays de la Loire            | 1.704                       | 0.910                     | 1.148                  | 2.574***                         |
| (0.525,5.534)               | (0.638,2.066)               | (1.809,3.661)             | (1.005,19.852)         | (4.468,4.468)                    |
| Provence-Alpes-Côte d’Azur  | 2.390                       | 0.857                     | 0.747                  | 1.952                            |
| (0.386,14.812)              | (0.343,1.879)               | (0.457,1.219)             | (0.265,14.368)         | (1.952,1.952)                    |
| **Education level (Ref: < A level)** |                             |                           |                        |                                  |
| A level                     | 0.544                       | 0.431                     | 1.234                  | 0.992                            |
| (0.230,1.289)               | (0.156,1.188)               | (0.738,2.075)             | (0.749,1.314)          | 2.862*                           |
| Two-year university diploma | 0.393*                      | 0.175***                  | 0.488**                | 0.957                            |
| (0.157,0.981)               | (0.279,0.852)               | (0.802,1.395)             | (0.118,7.129)          | 5.133**                          |
| > Two-year university diploma | 0.639                       | 0.107***                  | 0.690                  | 1.417**                          |
| (0.270,1.512)               | (0.392,1.215)               | (1.074,1.870)             | (2.332,15.153)         | (5.944,5.944)                    |
| **Health impacts of COVID-19 in France** (Ref: Not serious at all or not very serious) |                             |                           |                        |                                  |
| Moderately serious          | 2.169**                     | 6.066***                  | 2.078***               | 1.003                            |
| (1.156,4.068)               | (2.883,12.766)              | (1.392,3.102)             | (0.790,1.272)          | 0.264***                         |
| Rather or very serious      | 3.256**                     | 5.915***                  | 2.540***               | 1.025                            |
| (1.568,6.765)               | (1.628,3.963)               | (0.792,1.326)             | (0.180,0.941)          | 0.411**                           |
| (continued on next page)    |                             |                           |                        |                                  |
| Panel A: Opinions regarding the general quarantine | Panel B: Attitudes regarding the general quarantine |
|-------------------------------------------------|--------------------------------------------------|
| **General quarantine agreement** | **Trips in the last 7 days** | **Physical activity or walking trips** |
| **Quarantine extension (Yes/No)** | **Quarantine extension length** | **Incidence rate ratio (90% CI)** | **Incidence rate ratio (90% CI)** | **Odd ratio (90% CI)** |
| **General risk preference** | **Incidence rate ratio (90% CI)** | **Odd ratio (90% CI)** |
| **Present preference (BIS 15 impulsivity scale)** | **Observations** | |
| **Respect of the general quarantine rules by most people** | |
| **Individual risk of infection by COVID-19** | (Ref: Low or very low) | |
| Intermediate | 1.682 (0.918,3.080) | 0.756 (0.397,1.443) | 1.007 (0.742,1.368) | 1.257* (1.024,1.542) | 2.159* (1.100,4.237) |
| High or very high | 2.398* (1.009,5.699) | 2.055 (0.921,4.587) | 1.219 (0.873,1.703) | 0.799 (0.638,1.001) | 1.515 (0.622,3.689) |
| **Individual health consequences in case of infection by COVID-19** | (Ref: Low or very low) | |
| Intermediate | 1.965* (1.045,3.695) | 1.981 (0.928,4.232) | 1.507* (1.056,2.151) | 0.935 (0.758,1.154) | 2.159* (1.009,5.699) |
| High or very high | 1.072 (0.282,4.073) | 2.520 (0.954,6.656) | 1.677** (1.145,2.456) | 0.862 (0.661,1.124) | *0.668,0.410 |
| **Efficacy of the general quarantine** | (Ref: Totally or rather disagree) | |
| Neither agree nor disagree | 1.260 (0.549,2.890) | 5.337** (1.663,17.127) | 2.191** (1.270,3.779) | 0.980 (0.573,1.075) | 1.657 (0.564,4.861) |
| Rather or totally agree | 8.200*** (3.131,21.476) | 1.972 (0.820,4.747) | 1.52** (1.042,2.223) | 0.809 (0.601,1.124) | 0.615 (0.264,1.432) |
| **Trust in the government to handle the health crisis** | (Ref: Totally or rather disagree) | |
| Neither agree nor disagree | 0.811 (0.409,1.606) | 0.724 (0.324,1.617) | 0.597** (0.406,0.877) | 0.980 (0.573,1.075) | 0.986,3.873 |
| Rather or totally agree | 2.831** (1.291,6.209) | 0.295*** (0.140,0.620) | 0.467*** (1.033,1.606) | 1.288* (0.954,6.656) | 2.390* (1.097,5.208) |
| **Well-being index during the general quarantine** | (Ref: Neither had them or know someone who had them) | |
| Personal experienced symptoms | 0.682 (0.296,1.572) | 1.095 (0.431,2.781) | 1.204 (0.725,2.001) | 1.123 (0.818,1.540) | 0.435 (0.162,1.166) |
| Household member(s) experienced symptoms | 0.760 (0.201,2.865) | 57.71*** (4.672,712.859) | 2.572** (1.171,5.649) | 1.564 (0.997,2.452) | 0.793 (0.198,3.175) |
| Acquaintance(s) experienced symptoms | 1.267 (0.646,2.484) | 1.414 (0.749,2.667) | 1.079 (0.810,1.436) | 1.121 (0.915,1.374) | 0.451(0.159) |
| **Respect of the general quarantine rules by most people** | (Ref: Totally or rather disagree) | |
| Neither agree nor disagree | 1.095 (0.559,2.146) | 0.740 (0.341,1.603) | 0.754 (0.549,1.036) | 0.930 (0.738,1.171) | 0.616 (0.305,1.243) |
| Rather or totally agree | 0.758 (0.292,1.969) | 0.965** (0.183,0.730) | 0.482*** (0.335,0.693) | 1.021 (0.824,1.265) | 1.184 (0.623,2.247) |
| **General risk preference** | 0.931 (0.813,1.065) | 0.769*** (0.672,0.879) | 0.859*** (0.808,0.913) | 1.073*** (1.029,1.119) | 1.188** (1.051,1.343) |
| Present preference (BIS 15 impulsivity scale) | 1.028 (0.986,1.072) | 1.133*** (1.071,1.198) | 1.061*** (1.038,1.108) | 1.008 (1.094,1.022) | 1.044 (0.994,1.096) |
| Observations | 1849 | 1849 | 1849 | 1849 | 1849 |

All regressions include controls for socio-economic and demographic characteristics (gender, age, marital status, education level, income, labour market situation since the general quarantine and self-rated health status) and controls for the conditions of quarantine (type of housing, size and number of people living in the quarantine home, presence of person(s) aged under 18 and presence of dogs in the quarantine home).

An odd ratio or an incidence rate ratio between 0 and 1 indicates a negative correlation. An odd ratio or an incidence rate ratio greater than 1 indicates a positive correlation. *P < 0.10, **P < 0.05, ***P < 0.01. BIS, Barratt Impulsiveness Scale.
Table 3
Results of regression analyses on the acceptability and potential use of the contact-tracing application.

|                          | Digital contact tracing acceptability | Digital contact tracing potential use |
|--------------------------|---------------------------------------|--------------------------------------|
|                          | Odd ratio                              | Odd ratio                            |
|                          | (90% CI)                               | (90% CI)                             |
| Female (Ref: Male)       | 0.822                                 | 0.775                                |
|                          | (0.484,1.396)                          | (0.440,1.364)                        |
| Age (Ref: 20–29 years)   |                                       |                                      |
| 30–39                    | 0.517                                 | 0.829                                |
|                          | (0.214,1.248)                          | (0.310,2.082)                        |
| 40–49                    | 0.250**                               | 0.172***                             |
|                          | (0.097,0.646)                          | (0.067,0.441)                        |
| 50–59                    | 0.771                                 | 0.970                                |
|                          | (0.293,2.029)                          | (0.342,2.756)                        |
| 60–74                    | 0.341                                 | 0.623                                |
|                          | (0.110,1.052)                          | (0.188,2.066)                        |
| Region (Ref: Auvergne-Rhône-Alpes) |                   |                                      |
| Bourgogne-Franche-Comté  | 1.042                                 | 1.444                                |
|                          | (0.205,5.308)                          | (0.359,5.810)                        |
| Bretagne                 | 12.91***                              | 17.20**                              |
|                          | (3.180,52.440)                         | (4.003,73.878)                       |
| Centre-Val de Loire      | 0.053                                 | 1.035                                |
|                          | (0.139,3.071)                          | (0.220,4.874)                        |
| Grand Est                | 2.389                                 | 1.506                                |
|                          | (0.597,9.563)                          | (0.366,6.202)                        |
| Hauts-de-France          | 4.395**                               | 6.699***                             |
|                          | (1.269,15.221)                         | (1.930,23.259)                       |
| Ile-de-France            | 4.901**                               | 7.592***                             |
|                          | (1.583,15.168)                         | (2.438,23.645)                       |
| Normandie                | 0.880                                 | 0.602                                |
|                          | (0.171,4.535)                          | (0.064,5.652)                        |
| Nouvelle-Aquitaine       | 1.715                                 | 4.048*                               |
|                          | (0.475,6.184)                          | (1.056,15.521)                       |
| Occitanie                | 9.064***                              | 16.21***                             |
|                          | (2.965,27.710)                         | (4.934,53.248)                       |
| Pays de la Loire         | 3.854*                                | 1.534                                |
|                          | (1.039,14.294)                         | (0.379,6.204)                        |
| Provence-Alpes-Côte d'Azur| 10.19**                             | 26.03***                             |
|                          | (2.263,45.852)                         | (4.964,136.547)                      |
| Education level (Ref: < A level) |                   |                                      |
| A level                  | 11.61***                              | 13.12***                             |
|                          | (4.784,28.187)                         | (5.226,32.918)                       |
| Two-year university diploma | 3.946**                             | 1.937                                |
|                          | (1.584,9.834)                          | (0.693,5.415)                        |
| > Two-year university diploma | 2.429*                            | 1.918                                |
|                          | (1.025,5.756)                          | (0.756,4.868)                        |
| Health impacts of COVID-19 in France (Ref: Not serious at all or not very serious) | | |
| Moderately serious       | 0.812                                 | 0.846                                |
|                          | (0.405,1.625)                          | (0.390,1.835)                        |
| Rather or very serious   | 0.920                                 | 1.136                                |
|                          | (0.458,1.850)                          | (0.514,2.510)                        |
| Individual risk of infection by COVID-19 (Ref: Low or very low) | | |
| Intermediate             | 0.936                                 | 0.549                                |
|                          | (0.520,1.685)                          | (0.298,1.013)                        |
| High or very high        | 1.593                                 | 1.598                                |
|                          | (0.731,3.471)                          | (0.713,3.581)                        |
| Individual health consequences in case of infection by COVID-19 (Ref: Low or very low) | | |
| Intermediate             | 1.064                                 | 1.501                                |
|                          | (0.556,2.035)                          | (0.773,2.917)                        |
| High or very high        | 2.149                                 | 2.962**                              |
|                          | (0.907,5.090)                          | (1.254,6.995)                        |
| Trust in the government to handle the health crisis (Ref: Totally or rather disagree) | | |
| Neither agree nor disagree | 2.524**                             | 2.701**                              |
|                          | (1.210,5.264)                          | (1.278,3.709)                        |
| Rather or totally agree  | 4.522***                              | 5.853***                             |
|                          | (2.283,8.955)                          | (2.886,11.941)                       |
| Symptoms of COVID-19 (Ref: Neither had them or know someone who had them) | | |
| Personally experienced symptoms | 1.659                               | 1.852                                |
|                          | (0.741,3.715)                          | (0.800,4.289)                        |
| Household member(s) experienced symptoms | 0.808                              | 0.179                                |
|                          | (0.253,2.579)                          | (0.030,1.069)                        |
| Acquaintance(s) experienced symptoms | 0.632                              | 0.542                                |
|                          | (0.333,1.198)                          | (0.294,1.001)                        |

(continued on next page)
compliance with quarantine. Our analysis also complements previous analyses by investigating the role of well-being during quarantine and risk preferences on attitudes and opinions regarding the quarantine and shows that both factors are strongly correlated with support and compliance with quarantine.

We find lower willingness to use a contact-tracing application among our respondents than among those of earlier studies conducted in France. It might indicate a decrease in the acceptability of digital contact tracing as the public debate around the StopCovid application moved forward in France. While a two-phase study conducted between March and April 2020 on representative samples of the French population showed a deterioration of the trust in the government over time,28 our results, as those of Altmann et al.,23 underline that trust in the government is of the utmost importance in the willingness to use the contact-tracing application. Compared with previous studies, our results also show that willingness to use a contact-tracing application is positively correlated with the perceived health consequences in case of COVID-19 infection. While the role of time preference was never explored, we also find that impulsivity (i.e. low future preference) is negatively correlated with the willingness to use a contact-tracing application.

The main limitations of our study lie in the data used in the analysis. First, given our recruitment process, our sample is not representative of the French population. We then conducted regression analyses on a sample that was reweighted to be representative of the French population by age and sex, region and education level. Nevertheless, our recruitment process might also have led to the self-selection of respondents more concerned with COVID-19 than the general population. Moreover, the cross-sectional design used in our study also makes conclusions about causal effects difficult. Our regression results might have alternative interpretations in case of reverse causality or if unobserved factors affect both our dependent and independent variables. We nonetheless included multiple socio-economic and demographic characteristics as control variables to limit the omitted variable concern.

Despite these limitations, our results provide new information that might help guide future communication strategies during infectious disease outbreaks in France. For example, our analysis indicates that prevention campaigns stressing out the individual consequences in case of infection, the nationwide health consequences of the epidemic or the benefits of quarantine could foster compliance with quarantine measures. The positive correlations we find between the well-being index and attitudes or opinions regarding the general quarantine also indicate that remote psychological support might promote quarantine adherence among individuals most emotionally distressed by the quarantine. In parallel to other NPIs, digital contact tracing might be useful to help prevent a new general quarantine in case of a second wave of COVID-19 infections in fall 2020. However, the StopCovid application has only reached 2.3 million downloads since its release in June 2020. Our results indicate that public communications should focus on restoring trust among the population as trust is of prominent importance in the willingness to use the contact-tracing application. Our analysis also indicates that stressing out the individual consequences in case of COVID-19 infection or the short-term benefits of using the StopCovid application could be useful to promote its adoption among the French population.

Author statements

Ethical approval

Not required given strict anonymity of participants.

Funding

None.

Competing interests

None declared.

Data availability

The data underlying this article will be shared on reasonable request to the corresponding author.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2020.08.026.

References

1. Ferguson N, Laydon D, Nedjati Gilani G, Imai N, Ainslie K, Baguelin M, Dighe A. Report 9: impact of non-pharmaceutical interventions (NPIs) to reduce COVID19 mortality and healthcare demand. Available from, https://www.imperial.ac.uk/ media/imperial-college/medicine/sph/ide/gida-fellowships/Imperial-College-COVID19-NPI-modelling-16-03-2020.pdf; 2020.
2. Flaxman S, Mishra S, Gandy A, Unwin HJT, Mellan TA, Coupland H, Monod M. Estimating the effects of non-pharmaceutical interventions on COVID-19 in Europe. Nature 2020:1–8.
3. DiGiovanni C, Conley J, Chiu D, Zaborski J. Factors influencing compliance with quarantine in Toronto during the 2003 SARS outbreak. Biosecurity Biodefense Strategy, Pract Sci 2004;2(4):265–72.
4. Blendon RJ, DesRoches CM, Celtron MS, Benson JM, Meinhardt T, Pollard W. Attitudes toward the use of quarantine in A public health emergency in four countries: the experiences of Hong Kong, Singapore, Taiwan, and the United States are instructive in assessing national responses to disease threats. Health Aff 2006;25(Suppl1):W15–25.
5. Hsu CC, Chen T, Chang M, Chang YK. Confidence in controlling a SARS outbreak: experiences of public health nurses in managing home quarantine measures in Taiwan. American J Infect Control 2006;34(4):176–81.

6. Reynolds DL, Garay JR, Deamond SL, Moran MK, Gold W, Stya R. Understanding, compliance and psychological impact of the SARS quarantine experience. Epidemiol Infect 2008;136(7):997–1007.

7. Tracy CS, Rea E, Upshur RE. Public perceptions of quarantine: community-based telephone survey following an infectious disease outbreak. BMC Publ Health 2009;9(1):470.

8. Lau JT, Kim JH, Tsui HY, Griffiths S. Anticipated and current preventive behaviors in response to an anticipated human-to-human H5N1 epidemic in the Hong Kong Chinese general population. BMC Infect Dis 2007;7(1):18.

9. Seale H, McLawns ML, Heywood AE, Ward KE, Lowbridge CP, Van D, Mactytey CR. The community's attitude towards swine flu and pandemic influenza. Med J Aust 2009;191(5):267–9.

10. Kavanagh AM, Bentley RJ, Mason KE, McVernon J, Petrony S, Fielding J, Studdert DM. Sources, perceived usefulness and understanding of information disseminated to families who entered home quarantine during the H1N1 pandemic in Victoria, Australia: a cross-sectional study. BMC Infect Dis 2011;11(1):2.

11. Kim EY, Liao Q, Yu ES, Kim JH, Yoon SW, Lam WW, Fielding R. Middle East respiratory syndrome in South Korea during 2015: risk-related perceptions and quarantine attitudes. American J Infec Control 2016;44(11):1414–6.

12. Desclaux A, Badji D, Ndione AG, Sow K. Accepted monitoring or endured experience. Compliance and psychological impact of the SARS quarantine experience. Ebola contacts' perceptions in Senegal.

13. Altmann S, Milsom L, Zillessen H, Blasone R, Gerdon F, Bach R, Abeler J. Acceptability of app-based contact tracing for COVID-19: cross-country survey evidence. 2020. Available from, https://papers.ssrn.com/sol3/papers.cfm?abstract_id¼3590505.

14. France Soir - MIS Group. Impact du confinement sur les français lié à la crise sanitaire Covid-19 [Internet]. 2020. Available from: http://www.francesoir.fr/lifestyle-bien-etre/accepteriez-vous-detre-trace-electroniquement-pour-eviter-la-propagation-des-.

15. Rosenstock IM. Why people use health services. Milbank Mem Fund Q 1966;44(3):94–127.

16. Rousset F, Vigneau F. Adaptation et validation d'une version brève en langue française du questionnaire d'impulsivité de Barratt (BfS-15). Eur Rev Appl Psychol 2016;66(6):317–24.

17. Jansen-Kosterink SM, Hurmuz M, den Ouden M, van Velsen L. Predictors to use mobile apps for monitoring COVID-19 symptoms and contact tracing: a survey among Dutch citizens. 2020. Available from, https://www.medrxiv.org/content/10.1101/2020.06.02.20113423v1.

18. Wiertz C, Banerjee A, Acard OA, Ghosh A. Predicted adoption rates of contact tracing app configurations—insights from a choice-based conjoint study with a representative sample of the UK population. 2020. Available from, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3589199.

19. Thorneloe R, Epton T, Fynn W, Daly M, Stanulewicz N, Kasiano A, Chapman S. Scoping review of mobile phone app uptake and engagement to inform digital contact tracing tools for Covid-19. 2020. Available from, https://psyarxiv.com/qet96i/.

20. Williams SN, Armitage CJ, Tampe T, Dienes K. Public attitudes towards COVID-19 contact tracing apps: a UK-based focus group study. 2020. Available from, https://www.medrxiv.org/content/10.1101/2020.05.14.20102269v1.

21. Zhang B, Kreps S, McMurry N. Americans' perceptions of privacy and surveillance in the COVID-19 Pandemic. 2020. Available from, https://osf.io/9wz3y/.

22. Simko L, Calo R, Roesner F, Kohno T. COVID-19 contact tracing and privacy: studying opinion and preferences. 2020. Available from: https://arxiv.org/abs/2005.06056.

23. Altmann S, Milsom L, Zillessen H, Blasone R, Bach R, Abeler J. Acceptability of app-based contact tracing for COVID-19: cross-country survey evidence. 2020. Available from, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3590505.