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Behavioural Intention to Use a Contact Tracing Application: The case of StopCovid in France

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Abstract

This research aims to study citizens' intention to download and use the COVID-19 tracing app in France. The theoretical framework considered the theory of technology acceptance model, the theory of goal-directed behaviour, and the theory of privacy to explain the intention to use the COVID-19 tracing app. The methodology included an online survey to examine the theoretical model, which was tested using structural equation modelling. The results show that anticipated emotions, perceived usefulness, privacy concerns, and perceived permission sensitivity significantly contribute towards the intention to adopt the StopCovid app. Subjective norms and goal desire do not exert a direct impact. These findings provide both theoretical and practical implications by adding the extrinsic social value dimension to the analyses of the StopCovid app and presenting antecedents for enhancing its design and safety.

Keywords: technology acceptance model, contact tracing app, privacy, perceived usefulness, subjective norms, SEM

1 Introduction

Despite the rapid development of online public services and mobile applications, few mobile applications (hereinafter, apps) have been created by governments to meet citizens' medical treatment needs. The apps created are related to functions such as security (Hamilton et al., 2011), health (Mishra and Singh, 2008), and city life (Tang et al., 2021). Due to the COVID-19 pandemic, since 2020, there has been a rapid increase in creation and adoption of mobile service apps dedicated to monitoring and preventing the spread of the infection. An Indian study (Bassi et al., 2020) found 346 mobile apps engaged in disseminating information about and monitoring the pandemic. These mobile apps, like those used to manage diabetes or addictions, were part of the mobile health services. At first this app seems like a simple contact tracing app, but the analysis of its functions makes it a particularly innovative case study in the world of mobile services. The app has a double purpose: not only does it offer an individual service (declare yourself if you are positive and be informed of the positive status of the people you meet), but also a service to the community (monitor the spread of the pandemic, establish a network of contacts, and centralise statistics). Through its use, the app provides real extrinsic value oriented towards oneself (functional value) and towards others (social value) in a rare case of dual-purpose use (Holbrook, 2006). There are apps that provide this service, such as Waze, which allows traffic jam management by mapping red zones (general interest) and proposing an alternative route (personal interest), but it is offered by a private company with a business goal. StopCovid was the first public health app proposed by the French government in response to the pandemic. Its pioneering nature call for a better understanding of users' adoption intentions. Other countries, like Singapore and Germany (Altmann et al., 2020), have also attempted to contain the epidemic with digital

solutions based on contact traceability between citizens. These approaches, based on the analysis of effects (Rowe et al., 2020), do not consider the perspective of individual tracing.

To date, few field studies have looked at the antecedents of the adoption of such digital apps, especially after they have been effectively launched. Altmann et al. (2020) examined the acceptability of app-based contact tracing for COVID-19 in France, Germany, Italy and the UK, from March 20 to April 10, 2020 (before such an app was launched) and concluded that 74.8% of their sample would probably download such an app. Nevertheless, results in June 2020, one to two months after its launch, showed a very low download rate. Once the social value of an app that maps contacts has been explained, it is difficult to understand what individual reasons can push citizens to accept such digital tracing. In a systematic review of the literature, Weichbroth (2020) analysed 790 articles on mobile applications' perceived usefulness, and presented the frequency of appearance of 75 attributes cited as useful by users. None of these items were related to the social value of an app.

Since Sebetci (2015) highlighted citizens' use of mobile apps to access public services (e.g. government apps), 'dedicated mobile apps, social networks, and online communications now support governments in all stages of crisis management' (Rowe et al., 2020, p. 546). For example, fear appeals are utilized to emphasize the threats that will befall citizens if they do not follow the governments' recommendations (Walton, 2013; Rowe et al., 2020). However, most studies have focused on the added value from the usage perspective; the basic premise has been that the acceptance and use of an application provides an immediate and personal added value to its user. The value dimensions that have gained prominence during the pandemic mainly comprise extrinsic value towards the self, such as efficiency (Holbrook, 2006), or performance excellence (Mathwick et al., 2001).

During 2014–2016, when the Ebola epidemic affected Sierra Leone and Guinea, they developed smartphone apps for digital contact tracing (Sacks et al., 2015; Danquah et al., 2019; Rowe et al., 2020). Alibaba, in collaboration with the Hangzhou municipality and the Chinese government, developed and deployed the first smartphone app for COVID-19 contact tracing in February 2020. However, although these apps provided cheaper, timely, and more accurate contact-tracing data than manual methods (Danquah et al., 2019; Rowe et al., 2020), they encountered ‘limitations in security and privacy issues because of the short timeframe for development, infrastructure complexity, local collaboration, and coordination challenges’ (Sacks et al., 2015; Danquah et al., 2019; Rowe et al., 2020).

Based on the widespread acceptance of mobile apps worldwide, the French government decided to launch an app to track the pandemic, and StopCovid was launched on 2 June 2020. This app was previously presented to the French Senate on 6 May to restore the citizens’ freedom of movement after a strict lockdown (Rowe, 2020) and limit the virus diffusion identifying potential infections.

Following Kalgotra et al. (2021), we focus on phases 2 and 3 of the life cycle PISL (Pandemic Information Support Lifecycle). StopCovid was positioned in the ‘prevention and preparation’ and ‘response’ phases, relying on potential massive use of the app by French citizens, with a role upstream of the vaccination campaign (phase 4 of PISL) because the solution (the vaccine) was not available then. It is, therefore, a tracing tool that allowed measuring the spread and prevention of COVID-19. It was a first response but not curative, only evaluative of the progress of the epidemic. As Trang et al. (2020) mention, the app has three important dimensions that define a tracing app. It has an individual and collective purpose, can only work with access to personal data (Sharma & Bashir, 2020), and remains active in the background in the smartphone system.

Our research shows a unique analytical perspective as it explores the acceptance and use of StopCovid, covering two main objectives. First, it adds the dimension of extrinsic social value (orientation towards others) to the traditionally studied values concerning the StopCovid application (Sweeney and Soutar, 2001). Second, it also focuses on the personal gain from using the app. Thus, the use of this app not only (and primarily) provides for the protection of others through socially responsible behaviour, but also enables citizens to ensure their own protection through collective adoption. However, the app usage is limited by personal data management perceptions; as the common gain is deferred, users fail to perceive the value they can provide by adding their movement history.

In this context, it must be noted that although the personalization–privacy paradox (Sutanto et al., 2013) provides immediate value, it could also slow down the acceptance of the application. According to Rowe (2020, p.1), it is ‘an extreme case of the privacy paradox where the government plays on the immediate benefits and downplays long-term concerns (for privacy)’.

The major question this paper addresses is: which factors determine the usage adoption of StopCovid, particularly when this app remains a kind of location-based service impacted by privacy concerns. This study contributes to the existing research in three significant ways. First, we consider the technology acceptance model for a contact tracing app by examining the effect of perceived usefulness on its usage, which extend results on health apps (Yousaf et al., 2021). While previous research includes the impact of privacy concerns on the behavioural intention of using a contact tracing app (Sharma et al., 2020; Trang et al., 2020; Fox et al., 2021), there is still a gap in the literature as the models tested do not include an

analysis of such apps' goal desire that affects behavioural intention (individual and collective objectives). Second, to this end, besides the technology acceptance model (TAM) and the theory of privacy, our model incorporates the goal-directed behaviour (MGB) model. As in other research (e.g. Sharma et al., 2020), we extend the privacy theory by a model inspired by the theory of planned behaviour (TPB), which is, in our paper, the MGB, and consider the role of broader social factors in influencing citizens' acceptance of government surveillance. Third, in contrast to existing research focused on the intention to download the contact tracing app (Sharma et al., 2020; Trang et al., 2020), we consider the intention to use the app. All these contribute to various research to extend and integrate the privacy with other theoretical perspectives to develop a more global view in technology acceptance. The main extension to marketing theory is that this study will be the first to use and test the MGB model in a contact tracing mobile context. Findings from this study have strategic implications as they would help the government understand the determinants of citizens' intention to use a contact tracing app.

The rest of the paper is structured as follows. After presenting the context, Section 3 focuses on the theoretical framework and the research model. Section 4 describes the methodology. A presentation of results follows in sections 5. Section 6 discusses the theoretical and managerial implications. Section 7 concludes the paper with limitations of the study and avenues for future research.

2 Context: StopCovid, an app unlike others

StopCovid was conceived and deployed by the French government after almost two months of strict lockdown. The government rejected the idea that the algorithm be developed by any foreign company (such as Apple or Google) as 'citizens may fear that their personal and health data may be monetized' (Rowe, 2020, p. 2). CNIL, set up in 1978 in France to protect

digital privacy, gave a favourable recommendation for the app, the information system set up for this purpose, and contact tracing following the traditional method (Rowe, 2020). In France, besides StopCovid, the social security personnel also identified people who had been in contact with potentially infected people. The app uses the phone's Bluetooth signal to detect when two app users are close to each other. Users are notified if someone they have come in contact with tests positive, by sharing basic data such as the Bluetooth ID. Referred to as pseudo-identifiers, these data are suites of numbers, letters, or signs that cannot identify a person.

According to the EU's General Data Protection Regulations (GDPR), users can suppress and delete data on the server and unsubscribe. Despite these privacy protection features, three weeks after the launch of the app, only 3% of the population over 15 years had downloaded it. This application is code as PEGI 3 (Pan European Game Information) level. That's mean than the level of privacy and content is the lowest proposed. Developed for game usage control, this PEGI ranking is now used for all mobile application. The score is from 3 (few intrusive app, no violent content) to 12 (very intrusive or very violent content app). StopCovid was made available on the main application outlets (App Store and Google Play) from 2 June to 22 October. To evaluate the emotions aroused by this application, a preliminary study was conducted. We extracted all the comments of the users, adding up to 828 comments on App Store and 4630 on Google Play, which were analysed to highlight the most cited themes. The intention of use was cited in 63.25% of the comments, the notion of private data capture in 28.8%, the notion of public utility/civil act in 22.30%, and the fact that the French Government developed the application in only 8%.

The French government decided to promote StopCovid to instil social responsibility among citizens who might be negligent and contribute to the spread of the infection. It was

not mandatory to use StopCovid; rather, the aim was to demonstrate how individual behaviour and self-security could contribute towards ensuring social safety. Many users in France refrain from sharing data owing to their perception of privacy risk and individual freedom limits. However, when recommended by government (Hofmann and Morgeson, 1999), individuals engage in socially responsible behaviours based on their perception of individual freedom.

3 Theoretical Framework and Hypotheses Development

3.1 Proposed framework

To better understand StopCovid's acceptance process, this study applied three research streams: technology acceptance model (TAM), goal-directed behaviour (MGB), and privacy. A variety of theoretical perspectives have been developed to address the adoption of IT innovations; TAM, originally proposed by Davis (1986), is one of the most widely used models (Mortenson and Vidgen, 2016). This model is based on the theory of reasoned action (Fishbein and Ajzen, 1975) and TPB (Ajzen, 1991), and uses two key variables, perceived ease of use (PEU) and perceived usefulness (PU), as fundamental determinants of user acceptance (Venkatesh et al., 2003; Mac Callum and Jeffrey, 2013).

Given the growth of IT innovations, several studies have examined technology adoption patterns by exploring extended TAMs. TAM has traditionally been used to understand the perception of private data management in the context of retailing (capturing customer data, purchasing behaviour) (Lee, 2009), online shopping (Erjavec and Manfreda, 2021) or in the context of mobile services, such as m-banking apps (Kala Kamdjoug et al.; 2021), m-payment (Liébana-Cabanillas et al., 2018; Ramos de Luna et al., 2019), e-health (Papa et al., 2020; Yousaf et al., 2021; Huarng et al., 2022) and location-based services. It is in this last

orientation that StopCovid is positioned, to be a true service application that is especially promoted and monitored by the State (Sharma et al., 2020; Trang et al., 2020; Fox et al., 2021; Velicia-Martin et al., 2021).

This study also extends to TAM. Considering healthcare and location aspects of StopCovid, two theories were added: goal-directed behaviour (MGB) and privacy. Indeed, the desire to protect oneself from COVID-19 and resist its spread could influence the intention to use this app. We enrich the conceptual model by integrating a personal objective variable derived from the analysis of emotions on individual actions (Bagozzi et al., 1998). This approach allows integrating the duality of StopCovid, namely the personal and the societal interests associated with its use (Bagozzi et al. 2016). More precisely, the model of goal-directed behaviour expands and deepens TPB by introducing anticipated emotions, and subjective norms and desires (Perugini and Bagozzi, 2001). As in Sharma et al. (2020), we extend the privacy theory by a model inspired by TPB: MGB.

Finally, the integration of work on privacy and the privacy paradox allow for consideration of the risk of disclosing users' private health data and geographical tracing (Tung-Sheng et al., 2008; Sutanto et al., 2013; Gu et al., 2014; Arunkumar, 2015). Privacy has been used as an extension to TAM (Ambrose and Basu, 2012). In the context of health and IT, Kamal et al., (2020) and Velicia-Martin et al. (2021, p. 5) define privacy as 'how safe a user feels that the personal health information shared with a technological system will only be used for the stated purpose and not shared with others'. Velicia-Martin et al. (2021, p. 13) concluded that 'people do not care about privacy when it comes to health issues'. Rahimi et al. (2018) analysed 134 research questions related to the use of mobile health applications. They found that while the use of TAM was systematic in each study, only four studies highlighted privacy. Notably, the integration of this concept is not a recent development.

Zhang et al. (2014), Andrews et al. (2014), Steininger and Barbara (2015), and Gartrell et al. (2015) focused on user perceptions of the management of collected data; however, it was not until 2018 that the integration of privacy into the acceptance models of health apps was undertaken, notably by Esmacilzadeh (2018).

3.2 TAM

We considered only PU because PEU is no longer of great interest with the general use of apps on smartphones. Wu and Wang (2005) and Im and Young (2012) found that PEU is not related with the intention to use mobile commerce. Yang (2013) had noted the low contribution of this variable to the acceptance of mobile apps, which was confirmed by Velicia-Martin et al. (2021) for a COVID-19 app. Therefore, PEU does not seem relevant for an app like StopCovid, which has simple functionalities. Velicia-Martin et al. (2021) studied the acceptance of the COVID-19 tracing app incorporating TAM when such an app was not yet available in Spain. Consistent with TAM, it was confirmed that perceived usefulness was the main explanatory variable for app downloads, and that apprehension about possible loss of privacy would not be a significant barrier.

For StopCovid, we considered its perceived usefulness of self-protection and fighting ability against the spread of COVID-19 (Davis et al., 1989). We hypothesised that this variable positively influences the intention to use a COVID-19 tracing app (Velicia-Martin et al., 2021). The adoption intention was defined by users' intention to download and use this app to determine their own risk of contracting COVID-19 from possible contact with positive cases. Following Hong and Tam (2006), we hypothesised that since StopCovid is a tool to help individuals achieve personal and civic goals, perceived usefulness positively influences the intention to use StopCovid (Huang et al., 2022; Liébana-Cabanillas et al., 2018; Ramos de Luna et al., 2019). Therefore, the following hypothesis was formulated.

H1: Perceived usefulness has a positive influence on the intention to use StopCovid.

3.3 *Model of Goal-Directed Behaviour*

3.3.1 Anticipated emotions and goal desire

The anticipated emotions include new decision criteria regarding a person's goal. The model of Goal-Directed Behaviour suggests that 'desires are the proximal causes of intentions, and the traditional antecedents of intention in the theory of planned behaviour work through desires' (Perugini and Bagozzi, 2001, p. 79). MGB was tested in several studies that analysed body weight regulation, effort expended in studying (Perugini and Bagozzi, 2001), adoption of smoking cessation (White and Thomas, 2016), adoption of e-monitoring for mental health (Schulster et al., 2017), and adoption of an educational coaching app (Shahidi et al., 2018).

Parker et al. (1995) were the first to consider anticipated emotions; they found that anticipated regret reduced the intention to commit automotive infarctions. Bagozzi et al (1998) argued that people, when deliberating to act in goal-directed situations, consider the emotional consequences of both achieving and not achieving a sought-after goal. Positive and negative anticipated emotions are positively correlated but differentiated (Bagozzi et al., 1998). These emotions function as independent variables based on a decision process that considers judged consequences of goal achievement and failure.

How anticipated emotions function is contingent on one's appraisal of goal achievement/failure, which continually evolves depending on the context. In the case of COVID-19, the collective goal may be that the pandemic ends and is eliminated from France and the world. The positive emotions would be to feel delighted, excited, glad, happy, and satisfied. The negative emotions would be to feel ashamed, depressed, disappointed,

frustrated, guilty, and worried (see Table 2). Positive and negative emotions were selected from Bagozzi et al. (1998) and Perugini and Bagozzi's (2001) framework.

For the use of StopCovid, the goal desire was considered to be focusing on both individual and collective objectives. The individual objective protects individuals and those who matter to them from COVID-19 and the collective objective helps fight against the spread of COVID-19 in France and worldwide. Therefore, the following hypotheses were formulated.

H2: Positive emotions have a positive influence on goal desire.

H3: Negative emotions have a positive influence on goal desire.

Based on the MGB model, goal desire has a positive influence on the intention, which means that it mediates anticipated emotions' influence on the intention to use StopCovid, giving us the fourth hypothesis (White and Thomas, 2016).

H4: Goal desire has a positive influence on the intention to use StopCovid.

3.3.2 Subjective norms

The concept of subjective norms (or social influence) is related to one's belief about others' reaction to own behaviour (Ajzen and Fishbein, 1980). In MGB, subjective norms were shown to have a positive influence on goal desire, possibly because people with whom we share a bond often influence our goals. This relationship may be significant in the case of COVID-19, owing to its impact on health and the economy and, in turn, on different businesses, such as bars, restaurants, and hotels. Therefore, the following hypothesis was formulated.

H5: Subjective norms have a positive influence on goal desire.

People would perceive StopCovid as useful if others who influenced their behaviour used it too (Baker et al., 2010). Subjective norms have a proven positive direct effect on perceived usefulness (Hong and Tam, 2006; Ramos de Luna et al., 2019; Venkatesh and Davis, 2000) and the intention to use technology (Hong and Tam, 2006; Venkatesh et al., 2003) when mandatory but not voluntarily. More recently, in the case of sharing location devices (Beldad and Kusumadewi, 2015), of permission-based location-aware mobile advertising (Richard and Meuli, 2013), of location-based services (Meng and Choi; 2019) and of contact tracing apps (Sharma et al., 2020; Fox et al., 2022), researchers identified subjective norm as a predictor of technology acceptance. Fox et al. (2021) considered the previous link before the launching of a contact tracing app in Ireland. Sharma et al. (2020) considered the same link for the intention to download a contact tracing app in the future. In this paper, we considered the impact of subjective norms on the intention to use the StopCovid app. Therefore, the following hypotheses were formulated.

H6: Subjective norms have a positive influence on perceived usefulness.

H7: Subjective norms have a positive influence on the intention to use StopCovid.

3.4 Privacy

Information privacy refers to the ‘claim of individuals, groups or institutions to determine when, how and to what extent information about them is communicated to others’ (Westin, 1967, p.7). Information privacy concerns are linked to an ‘individual’s subjective view of fairness within the context of information privacy’ (Campbell, 1997; Malhotra et al., 2004). The very nature of a tracing application is to capture individual data such as geolocation or hardware identification (Trang et al., 2020), with the tacit agreement of the user to allow the capture of this information. At the same time, the perception of risks related to the management of private data puts the user in a position of strong cognitive dissonance. The

fact that StopCovid does not allow any personalized settings reinforces this mistrust of data use. The feeling of losing control of the information increases resistance to use.

The relationship between the use-value of an application and the risk linked to the disclosure of private data has been the subject of several consumer behaviour studies. Keith et al. (2013) evoked the concept of 'calculation of private life' to define the concept of data disclosure by the user. However, the literature also shows that certain users may not focus on value optimization, but rather have a more complex relationship between smartphone dependence and the risk of personal data disclosure.

Malhotra et al. (2004) defined Internet Users' Information Privacy Concerns (IUIPC) as 'the degree to which an Internet user is concerned about online marketers' collection of personal information, the user's control over the collected information and the user's awareness of how the collected information is used'. They proposed a 10-item scale and a causal model around this construct, and showed that IUIPC negatively impacts trusting beliefs and positively impacts risk beliefs. Trusting beliefs positively impact behavioural intention (to reveal personal information), risk beliefs negatively impact this intention, and releasing more sensitive information was perceived as more risky than releasing less sensitive information (Milne and Gordon, 1993).

Formalized by Arunkumar (2015), the privacy paradox broadened the context of smartphone privacy by distinguishing data privacy linked to the technical aspect of network communication from contextual privacy linked to geographical positioning and the identification of a user and his usage (e.g. the use of apps and Internet research). These investigations established a relationship between technical issues and behavioural implications. Sutanto et al. (2013) showed that personalizing the functions of an application counterbalances the perception of privacy risk. Although several studies have attempted to

formalize this paradox (Graeff and Harmon, 2002; Norberg and Horne, 2007), Tung-Sheng et al. (2008) were the first to describe the unclear relationship between dependence, personalization, and the apprehensions associated with the disclosure of personal data.

Indeed, Gu et al.'s (2014) study might lead us to infer that StopCovid owners' (the French government) awareness of maintaining data privacy and the transparency of the data collected might shape perception of risk privacy. We measure this perception through the perceived permission sensitivity, an extension of the measure used by Pentina et al. (2016). Users' experience and, particularly, their previous risk exposure can alter this perception.

Finally, as in the case of any new digital service, mass effect and perceived image of the service play a moderating role in the adoption process. Notably, the involvement of the user in a social cause contributes towards reducing usage barriers (Wang et al., 2016; Wottrich et al., 2018). This can be determined through a simple calculation of the maximization of the use-value of the application (Zhang et al., 2009). Such an evaluation would reveal the extent to which users' civic responsibility is influenced by their privacy risk perception.

Studies on the adoption of m-services have emphasized the recurring adoption barrier posed by risk perception linked to the collected data (Chen and Li, 2017; Degirmenci, 2020). These experiences and the privacy risk dimensions were considered by StopCovid developers. During the installation of the app, the users are provided with information explaining aspects related to data capture and storage (this information was made available after user manipulation) to minimise the sense of risk.

The calculation of privacy ratio following Keith et al. (2013) seems negative for many French citizens. Since the advent of the internet, citizens have expressed concerns over unauthorized secondary use of their data (Malhotra et al., 2004). Trust in the internet and the

government are significant in the intention to use an e-government service (Nemeslaki et al., 2016). The control over personal information is manifested by voice (i.e. approval, modification) or exit (i.e. opt-out) (Malhotra et al., 2004). Lack of control over the information collected may contribute to privacy concerns (Sutanto et al., 2013). Therefore, as Keith et al. (2013) stated, there is very little compensation for the negative aspects of the use of an app that is suspected of possible unauthorised use of data or user's lack of control. Therefore, the acceptance and the use of the app is based on individual involvement in the collective health of the country (Wottrich et al., 2018), even though this expected behaviour is in line with the personalization vs. privacy paradox (Tung-Sheng et al., 2008).

Gu et al. (2017, p. 21) argued that '...in the app download stage, perceived permission sensitivity is central to users' privacy concerns'. Based on the privacy calculus model (Pentina et al., 2016), the perceived permission sensitivity is presented in our model as a positive antecedent to privacy concerns. The higher the perceived permission sensitivity, the more the perceived importance of the privacy concerns variable. This point is consistent with the behaviour observed during the deployment of the app in France. Therefore, the following hypothesis was formulated.

H8: Perceived permission sensitivity has a positive influence on privacy concerns for StopCovid.

Calculation of user's risk/risk opportunity allows the user to create a privacy concerns score. Privacy concerns have been studied widely, including the health technology and government surveillance domains. Sharma et al. (2020) and Fox et al. (2021) considered privacy concerns in contact tracing apps. Contrary to their expectation, Fox et al. (2021) found that privacy concerns had no impact on the adoption intention (pre-launch) of the contact tracing app (post-launch) in Ireland but had an impact on usage intention.

StopCovid does not offer customised settings and is aimed at the French population, regardless of the user's expertise in the use of geolocation apps. This aspect increases the level of fear (real or fictitious). This double specificity (no personalization and consideration for the level of expertise) was discussed in Malhotra (2004) and was in line with the risks of rejection formulated by privacy concerns. The higher the score, the higher the users' intention to not use the app (Xu, 2019; Fox et al., 2021; Kala Kamdjoug et al., 2021). Therefore, the following hypothesis was formulated.

H9: Privacy concerns have a negative influence on the intention to use StopCovid.

3.5 *Mediating effects*

We added two hypotheses to test the indirect or mediation effects. Subjective norms indirectly (and positively) affect the intention to use StopCovid through perceived usefulness (Venkatesh et al., 2003; Hong and Tam, 2006), leading to the following hypothesis.

H10: Perceived usefulness mediates the positive relationship between subjective norms and the intention to use the StopCovid app.

As in Perugini and Bagozzi (2001), we hypothesized that anticipated emotions (positive and negative) and subjective norms indirectly influence the intention through goal desire, leading to our final hypothesis.

H11: The goal desire positively mediates the effects of anticipated emotions (positive and negative) and subjective norms on the intention to use the StopCovid app.

Figure 1 presents the research model.

Fig. 1 Research Model.

4 Method

4.1 Data collection

The questionnaire was originally written in English and later translated into French. It was double-checked by the authors and back-translated to avoid mistakes during the translation process. The questionnaire was designed to be self-administered in the months after the launch of the app. An access panel company sent email invites to participants for the survey. Its completion time was 10–15 minutes. Online respondents were given a presentation of the app proposed by the access panel company.

The final sample comprised 366 respondents (representing only those above 20 years of age; 47.3% were male). We used multiple-choice questions to collect data on the demographic profile of the participants and their use of the mobile tracing service (Table 1). The participants belonged to multiple age groups between 20 and 80 years (mean: 48 years; standard deviation: 16 years). Nearly half had a monthly income between 2000 € and 4000 €. A majority are working, with nearly 40% executives, or higher intellectual or intermediate professionals. The proportion of the sample that used the app accounted for 9.6%; however, only 1.9% considered StopCovid as the most suitable method to fight against COVID-19. Other measures to fight the spread of the infection included use of masks (49.5%) and the imposition of a lockdown (31.7%). Of the sampled respondents, only 27.1% use (19.7%) or used (7.4%) a tracing app, and 25.7% experienced data misuse. The most used tracing app related to following an itinerary. On average, the intention to use StopCovid was 2.6/5. On average, older adults' intention (2.86) was greater than the younger's (2.65), but the difference was not significant.

Table 1 Demographics details.

4.2 Measurement

The questionnaire was based on previously validated measures and used a five-point Likert scale (from ‘*Strongly disagree*’ to ‘*Strongly agree*’), except for perceived permission sensitivity. The intention to adopt StopCovid corresponds to the intention to use this app and isolate and take the test if one **comes** in contact of a potentially infected person. Subjective norms were measured in a more traditional way than that in Perugini and Bagozzi (2001). Goal desire was measured by three items. In the pandemic, goal desire may have been prompted by the desire to protect oneself from and fight against the spread of COVID-19. According to Perugini and Bagozzi (2001), for the measure of anticipated emotions, participants were asked to express the felt intensity of each emotion expressed in the subjunctive conditional (see Table 2). Privacy measures were adapted from Gu et al. (2017). To address the app’s privacy concerns, we decided to add surveillance and medical issues from Xu et al. (2012) (used in Degirmenci (2020)) and Buchanan et al. (2007). The operationalized variables are described in Table 2.

Table 2 Concepts, labels, items, and source.

First, we studied the reliability and validity of the scales to assess the measurement instruments used to test the constructs. Then, a structural equation modelling approach was used to test the causal structure of the conceptual model via AMOS. We used the maximum likelihood fit function. In addition, following the recommendations of Anderson and Gerbing (1988), we used a two-step approach.

5 Results

5.1 Reliability and validity of scales

All loading estimates were found to be significant ($p < .001$). However, we eliminated a few items to obtain an adequate fit (see Table 3). The loading estimates were between 0.7 and 0.97. The inner coherence of a measurement scale was ensured by Cronbach's alpha reliability coefficient (>0.7). Jöreskog's ρ coefficients were high for all scales (>0.7). Thus, each item was better explained by the related construct than by chance. Regarding convergent validity, the items' weights of the relationships (between the measures and their constructs) were statistically different from zero. The average extracted variance between each construct and its measures was higher than 0.5. Hence, the model was satisfactory for convergent validity.

Table 3 Reliability and convergent validity results.

Regarding discriminant validity, the analysis recommended by Bagozzi and Yi (1991) relies on a comparison of the chi-square values of the model to be tested. This approach allows the correlations between the different constructs to be free and facilitates a model where the correlations between the constructs are set to 1. If the difference in degrees of freedom is significant, it can be inferred that the tested model is better than the constrained model, and that the constructs are different. In this study, these indicators yielded satisfactory results.

As the questionnaire was designed to be self-administered, common method bias check was conducted using Harman's single-factor test. A single factor accounted for less than 50% of the total variance, proving that it was not a significant issue (Podsakoff et al., 2003).

5.2 Structural equation modelling

Regarding the structural model, all indicators were satisfactory (RMSEA=0.052; NFI=0.946; CFI=0.972; TLI=0.969; and $\chi^2/df=1.979$). Table 4 reports the results of the hypothesis testing. As predicted in TAM, perceived usefulness positively influenced the intention to use StopCovid ($\beta=0.889$, $p<.001$; H1 was supported). Anticipated emotions contributed to goal desire ($\beta=0.327$, $p<.001$; H2 was supported; $\beta=0.373$, $p<.001$; H3 was supported). Subjective norms positively influenced goal desire ($\beta=0.201$, $p<.001$; H5 was supported), but contrary to what we expected to find, goal desire did not influence the intention to use StopCovid (H4 was not supported). Further, subjective norms did not relate to the intention to use StopCovid (H7 was not supported). However, these positively influenced perceived usefulness ($\beta=0.925$, $p<.001$; H6 was supported). Regarding privacy, perceived permission sensitivity positively contributed towards privacy concerns ($\beta=0.775$, $p<.001$; H8 was supported), which negatively influenced the intention to use StopCovid ($\beta= -0.048$, $p<.05$; H9 was supported).

Table 4 Structural model results (direct effects).

We now consider the last hypotheses on mediating effects. We used a bootstrapping approach suggested by Preacher and Hayes (2008) to examine the indirect effects of subjective norms on the intention to use StopCovid via perceived usefulness. We found a significant positive indirect effect of subjective norms on the intention to use through the mediation of perceived usefulness (H10 was supported: $\beta=0.82$ [%90 CI:0.68 to 0.98]). As

goal desire did not influence the intention to use StopCovid, it could not mediate the effects of anticipated emotions and subjective norms on the intention to use (H11 was not supported). Figure 2 presents the final validated model.

Fig. 2 Final Validated Model.

6 Discussion

All hypotheses of the conceptual model were validated, except for the hypotheses testing the direct influence of goal desire and subjective norms on the intention to use StopCovid. First, according to TAM (Davis, 1989), perceived usefulness had a positive impact on the intention to use the app.

Positive and negative anticipated emotions have an impact on goal desire. In line with Perugini and Bagozzi (2001) found that negative anticipated emotions did not predict desires to exercise and diet but predict desires to study. More recently, according to White and Thomas (2016) it appears that only positive anticipated emotions had an impact on desire to quit smoking. Shahidi et al. (2018) found that negative anticipated emotions did not influence the desire to use a coaching app service for studies. ‘The findings of past research regarding the role of negative emotions in the MGB have been inconsistent’ (White and Thomas, 2016, p. 80). However, our result suggests that a relapse in smoking or adding extra weight, for example, may not be perceived to be as important as failing in declining COVID-19 (White and Thomas, 2016).

Contrary to the findings of Perugini and Bagozzi (2001), but as Shahidi et al. (2018), this study found that goal desire does not impact the intention to use StopCovid. This may be related to privacy concerns about the app, centralised storage of data, or Bluetooth technology. Bluetooth technology is ‘notoriously fraught with data breaches and data breach

vulnerability is considered a risk to data privacy' (Culnan and Williams, 2009; Rowe, 2020). Additionally, the app was not promoted enough by the government and not considered among the most effective ways to fight against the disease, as reflected in our results.

The lack of influence of goal desire on the intention to use StopCovid may also be attributed to the fact that the app should have been included in other government efforts to fight against the pandemic, such as increasing the number of hospital beds and increased testing. Even the few people alerted by StopCovid had to wait several weeks before accessing a COVID-19 test.

Contrary to our initial expectations, but as in Venkatesh et al. (2003) and more recently in Erjavec and Manfreda (2021), subjective norms did not directly influence the intention to use StopCovid. This could be linked to the fact that downloading or using the app is voluntary (Venkatesh et al., 2003). Another reason could be that the number of our sample (and of the whole population) who downloaded the app or received the alerts (that they had come across infected individuals and should isolate and take a test) was too small to recommend the app to others. However, subjective norms had a direct impact on the intention to adopt the contact tracing app (before the launch of the app) in Ireland, according to Fox et al. (2021), or for Sharma et al. (2020) for the future download of a contact tracing app. This impact was also confirmed in location-based services context (Richard and Meuli, 2013; Beldad and Kusumadewi, 2015; Meng and Choi; 2019). On the contrary, it was not confirmed for consumer smoking cessation (White and Thomas, 2016) and for a coaching app for studies (Shahidi et al., 2018).

StopCovid was not highly promoted by the government at this time and even the prime minister publicly acknowledged that he had not downloaded it on his phone. Among the critical factors for the effectiveness of the app, as Rowe (2020) outlines, it is important to

have correct information qualifying people as infected and contagious, which was not the case at the time, as testing capacity was quite low.

Rowe (2020) also stresses the high likelihood that when a contagious person meets another infected one, they both have a smartphone. However, despite the large number of smartphone users in France, 77% according to La Quadrature du Net (2020a), people tend to keep their phones in a jacket or in a bag, and often visit people, colleagues, or go to meetings without it. Therefore, a small number of the respondents' friends and relatives promoted the app among their friends and relatives.

An indirect influence of subjective norms on the intention was measured thanks to perceived usefulness. Although one might not intend to use an app, the influence of others may make them evaluate the app's usefulness. Studying the adoption of mHealth by students, Garavand et al. (2019) found that social influence has no significant influence on usage behaviour. They suggested as an explanation that the decision to adopt mHealth mobile apps was personal and confidential but stressed that social influence could be a predictor of mHealth usage because of the ease of getting help from family members and friends through these.

Following Perugini and Bagozzi (2001), subjective norms were found to have a positive impact on goal desire. In other words, if people important to individuals encouraged them to use StopCovid, it would influence their goal desire to protect themselves and fight against COVID-19 (As for a service adoption in Shahidi et al., 2018).

The construct PPS (a serial number based on the Bluetooth id of the personal device and the Bluetooth id of the nearby devices) positively influenced privacy concerns. These are perceived as context-sensitive data by users and reinforce the significance of private data management or perception of privacy concerns.

As in Fox et al. (2021) and in Kala Kamdjoug et al. (2021) (mobile banking app adoption), privacy concerns have a negative influence on the intention to use a contact tracing app. The negative link between privacy concern and the intention to adopt the app shows that the ‘*calculation of private life*’ (Keith et al., 2013) does not favour usage intention. Gu et al. (2017) showed that the popularity of an app mitigates privacy concerns.

6.1 *Theoretical implications*

This research contributes to the innovation adoption theories by proposing a new extended TAM to explain the intention to use a tracing app, StopCovid, to monitor COVID-19 in France. Similar to past studies, our model shows the importance of perceived utility in app adoption, which extends findings in health app adoption (Yousaf et al., 2021).

It also contributes to the literature on contact tracing apps (Sharma et al., 2020; Trang et al., 2020; Fox et al., 2021) by considering the impact of the goal desire aspect of such apps (individual and collective) on the intention to use it. By introducing MGB in our model, we extended TAM and the results in a different context than service (White and Thomas, 2016; Shahidi et al., 2018) on the one hand and the privacy theory by a model inspired by TPB on the other (Sharma et al., 2020). We enrich the acceptance model by adding anticipated emotions perceived by the user (Liébana-Cabanillas et al., 2018; Huarng et al., 2022). This investigation shows that goal desire could not help in carrying out the effects of anticipated emotions and subjective norms on the intention to use StopCovid.

We also extend the literature on the impact of subjective norms considering the intention to use, and not only the intention to download, the contact tracing app (Sharam et al., 2020; Fox et al., 2021). The introduction of these new variables allows to better highlight the process of acceptance (or not) of the use of an application that works in the background and captures several personal information. We are here in the field of studies allowing to

better understand the acceptance of a service application whose use is particularly simple but perceived as very intrusive.

The influence of privacy concerns is significant in this health application, while it is not important in geolocation apps, such as apps related to tourism, for instance.

StopCovid is unique in that it is based on both the intrinsic added value (knowing that one has been in contact with an infected person) and the extrinsic social value (Hoolbrook, 1996) of informing known or unknown people with whom one has been in contact of the risk of infection.

Thus, our research proposes an original contribution by modelling the impact of variables already known and derived from validated models to an application in which individual interest is counterbalanced by collective interest. Hence, we shed new light on the privacy paradox concept (Sheng et al. 2008). The technical choice of geolocation coupled with Bluetooth identification is relevant here. Unfortunately, the poor image of tracing systems (except in tourism and GPS driving apps) probably worked against StopCovid's positive perception.

6.2 Managerial implications

Explaining the antecedents of using StopCovid is an important issue to explore as other countries have been more successful with similar tracing apps. Decision makers need to better understand how perceived usefulness, subjective norms, anticipated emotions, goal desire, and privacy concerns are related to the intention to use health tracing apps to help prioritize managerial intervention and resources allocation.

Our results suggest that subjective norms only have an indirect effect on the intention to use StopCovid, informing managers that it is worthwhile to invest in communication to encourage the use of StopCovid. The results also indicate that goal desire does not influence

the intention to use StopCovid. Once the French government recognized the lack of promotion, it corrected the mistake for the updated version, *TousAntiCovid*.

Privacy concerns may be a problem in France because of its centralized system to store data and the perceived lack of transparency about what is collected, discouraging people from downloading and using the app. *TousAntiCovid* is based on a decentralized technology to create data security perceptions among users, but this option has not been selected by the government.

For the mobile application industry and especially for future general interest applications, our research shows that the subjective norm has an indirect effect on usage intention. It is interesting to note that the PEGI display that was supposed to reassure users did not work (maybe because of the lack of knowledge of this codification by citizens), the rumour propagated on the networks was stronger than the common interest. The next development of general interest applications should therefore focus their communication on usage and use influencers to convince people to use them without presenting the details of the privacy level. Usage trumps reason.

The ‘measure effect’ is another managerial implication. Sherman (1980) showed that if people are asked about their intention, it increases the probability of them act according to their responses. This measure effect is a ‘nudge’ (Thaler and Sunstein, 2008), a mild incentive that can be used by organisations and could be more effective than direct appeals. This research encouraged respondents to download the app because despite its perceived privacy defects, it would act against the virus spread. By 21 February 2022, this app had been downloaded by 54,200,000 people, 3,384,554 had been notified of being potentially positive, and 3,334,411 had been declared positive. These measures are now available in *TousAntiCovid*.

7 Limitations, Future Research, and Conclusion

This study presents limitations that future research must acknowledge and address. Respondents recruited online may not be fully representative of the population, and their digital literacy and willingness to share data may be higher than others. The sample was representative of French people above 20 years only, so the findings cannot be generalized beyond.

Renewing this study after the second lockdown, which started on 30 October 2020, would have made it possible to measure the difference in the intention to use *TousAntiCovid*. It has a different design, supplies a lot of information about the spread of COVID-19 in France, and lists testing locations. It has been better promoted than StopCovid. People had to download the app to fill up the form to go out during this lockdown, but they could also obtain it through government websites.

The perception of the importance of collective and individual security probably increased. All places open to the public encouraged the downloading of the app after the lockdown by explaining that everyone's safety (and keeping restaurants and cafés open) depends on the actions of each individual. A stronger focus on personal social value could perhaps encourage collective action.

TousAntiCovid takes into account phases 4 and 5 of the life cycle (Kalgota et al., 2021) by proposing the inclusion of a curative measure. Currently, vaccination justification, health pass and results of tests can be stored in the app. These added features may have improved the effect of goal desire on the intention to use the app. Additionally, with fewer rumours spread on data privacy, privacy concerns may have decreased as the use of the app increased.

Future research must also consider social and government influence. Trust in government could be a relevant factor to explain the intention to use the contact tracing app. We could extend the findings of Beldad and Kusumadewi (2015) on location-sharing apps and Robin and Dandis (2022) on contact tracing apps. Combining with the trust, risk-reduction mechanisms could be proposed by considering the perceived risk in our future model (Marriott and Williams, 2018).

Furthermore, an extension of the conceptual framework by integrating innovation diffusion (Liébana-Cabanillas, 2018) would be a next step. It would be interesting to test our research model with the latest updated version of the app. Based on more incentives for social engagement, the impact of anticipated emotions on the intention to use through goal desire would be validated.

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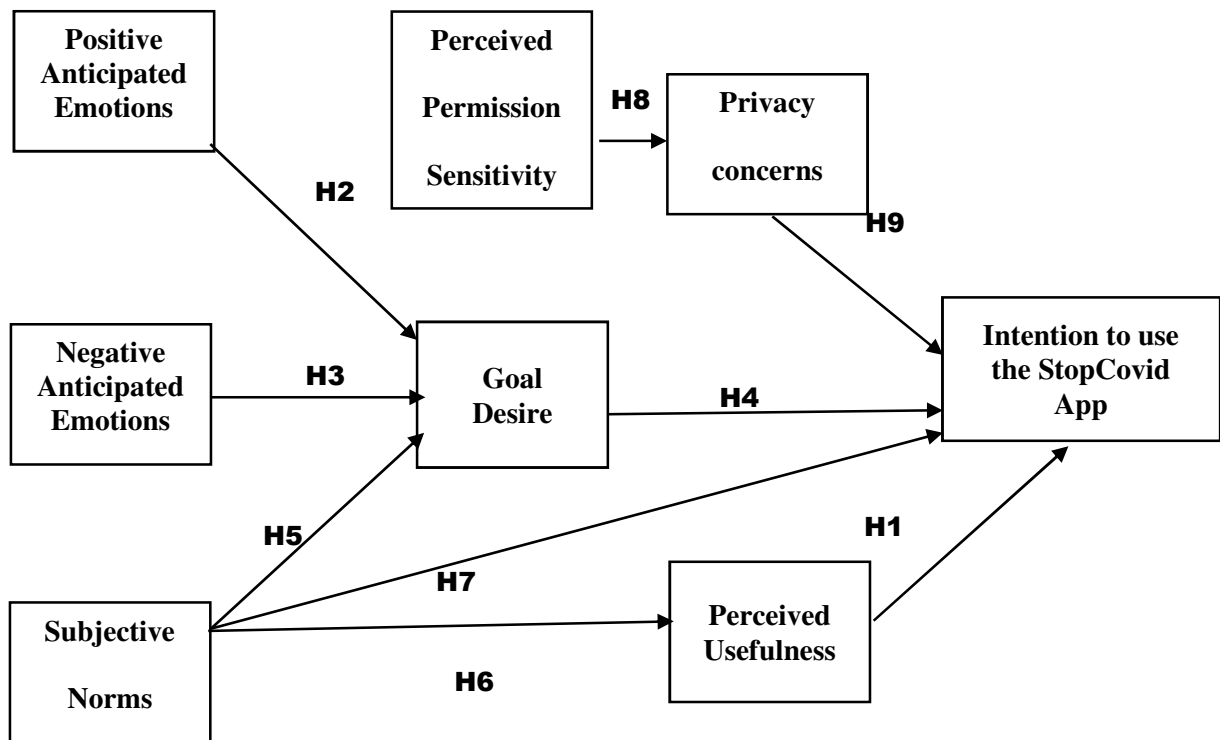
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Figure legends

Fig. 1. Research Model.

Fig. 2. Final Validated Model.

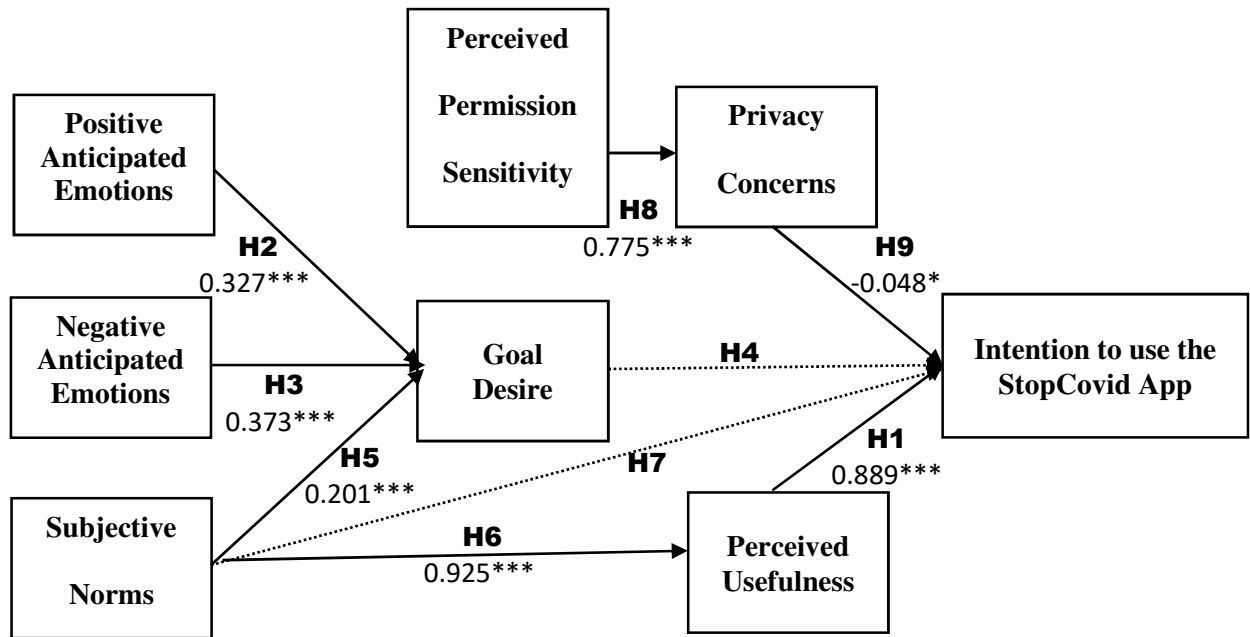


Mediating effects:

H10: Subjective Norms → Perceived usefulness → Intention to use the StopCovid App

H11: Anticipated emotions and Subjective Norms → Goal Desire → Intention to use the StopCovid App

Fig. 1 Research Model.



H10: Subjective Norms → Perceived Usefulness → Intention to use the StopCovid App (indirect effect 0.82)

Standardized coefficients are reported: * p<.05 *** p<.001

Fig. 2. Final Validated Model.

Table 1 Demographics details.

Descriptive Variable	Frequency (%)
Age (Mean 48 years, Standard deviation 16 years)	
[20,24]	9.2
[25,39]	25.2
[40,54]	30.1
[55,64]	15.9
[65,79]	19.6
Gender	
Men	47.3
Women	52.7
Income	
<1200 €	6.3
[1200, 2000[21.4
[2000, 4000[48.5
>4000 €	23.8
Socio-Professional Category	
Self-employed workers (farmers, artisans, traders and entrepreneurs)	3.6
Executives, higher intellectual professions and liberal professions	20.8
Intermediate professions	18.1
Employees and workers	21.1
Retirees	23.6
Other inactive	12.8

Table 2 Concepts, labels, items, and source.

Concept	Item description	Adapted from
Intention to use the StopCovid app	In the coming weeks, <ol style="list-style-type: none"> 1. I will absolutely definitely try to use this app and 2. I will certainly, make an effort to try this app and 3. I plan to use this app and take the test if I am at a risk of contamination.	(Perugini and Bagozzi, 2001)
Perceived Usefulness	<ol style="list-style-type: none"> 1. Using this mobile app would increase my chances of protecting myself and fighting against the spread of COVID-19. 2. I would find this app useful in my daily life. 3. Using this app would help me feel more secure. 	(Davis, 1989)
Goal Desire	<ol style="list-style-type: none"> 1. I desire to protect myself and fight against the spread of COVID-19. 2. Protecting myself and fighting against the spread of COVID-19 is something that I want to do. 3. I have a strong desire to protect myself and fight against the spread of COVID-19. 	(Perugini and Bagozzi, 2001)
Positive anticipated emotions	If the spread of COVID-19 decreases and disappears from France and the world, I will feel delighted, excited, glad, happy, and satisfied.	(Perugini and Bagozzi, 2001)
Negative anticipated emotions	If I do not contribute towards to COVID-19 decline and disappearance from France and the world, then I will feel ashamed, depressed, disappointed, frustrated, guilty, and worried.	(Perugini and Bagozzi, 2001)
Subjective Norms	People who are important to me would... <ol style="list-style-type: none"> 1. ...want me to use this app to protect myself and fight against the spread of COVID-19. 2. ...approve my use of this app to protect myself and fight against the spread of COVID-19. 3. ... encourage me to use this app. 	(Mathieson, 1991)
Perceived permission sensitivity	If I were to download and use this app, <ol style="list-style-type: none"> 1. then the permissions requested by StopCovid should be (tracing, Bluetooth, identifier...) _____. (1 = very few, 5 = a lot) 2. then the personal information requested by StopCovid should be _____. (1 = very insensitive, 5 = very sensitive). 3. then the potential risk related to the permission requests of the app should be _____. (1 = very low, 5 = very high). 	(Gu <i>et al.</i> , 2017)
Privacy concerns	If I were to download and use this app, <ol style="list-style-type: none"> 1. I think StopCovid would over-collects my personal information. 2. I will worry that StopCovid will leak my personal information to irrelevant third parties. 3. I would be concerned that StopCovid would violate my privacy. 4. I would be concerned that StopCovid would misuse my personal information. 5. I would be concerned that the app may monitor my activities on my mobile device. 6. I will be concerned about who might access my medical records electronically. 	Items 1 to 4 (Gu <i>et al.</i> , 2017) Item 5 (Xu <i>et al.</i> , 2012) Item 6 (Buchanan <i>et al.</i> , 2007)

Table 3 Reliability and convergent validity results.

Construct	Item	Standardized Loading	α	Jöreskog ρ	AVE
INT	1	0.961	0.970	0.971	0.917
	2	0.947			
	3	0.964			
PU	1	0.889	0.945	0.944	0.848
	2	0.949			
	3	0.924			
GDE	1	0.794	0.870	0.880	0.710
	2	0.865			
	3	0.867			
POSE	1	0.939	0.952	0.955	0.841
	2	0.849			
	3	0.935			
	4	0.942			
	5	*			
NEGE	1	*	0.779	0.777	0.538
	2	0.700			
	3	0.714			
	4	*			
	5	*			
	6	0.783			
SN	1	0.907	0.949	0.949	0.861
	2	0.934			
	3	0.942			
PPS	1	0.779	0.866	0.870	0.692
	2	0.790			
	3	0.919			
PC	1	0.875	0.971	0.971	0.850
	2	0.926			
	3	0.96			
	4	0.973			
	5	0.943			
	6	0.847			

Note. INT: Intention to Adopt StopCovid App; PU: Perceived Usefulness; GDE: Goal Desire; POSE: Positive Anticipated Emotions; NEGE: Negative anticipated emotions; SN: Subjective Norms; PPS: Perceived permission sensitivity; PC: Privacy concerns.

AVE: average variance extracted. *: Item is not considered because of a low loading estimate.

See Table 2 for details on the items.

Table 4 Structural model results (direct effects).

Hypothesis	Effect	Path coefficient (Standardized)	t value	Supported
H1	PU → INT	0.889***	12.32	Yes
H2	POSE → GDE	0.327***	6.29	Yes
H3	NEGE → GDE	0.373***	5.85	Yes
H4	GDE → INT	0.006	0.28	No
H5	SN → GDE	0.201***	4.11	Yes
H6	SN → PU	0.925***	28.07	Yes
H7	SN → INT	0.063	0.89	No
H8	PPS → PC	0.775***	17.71	Yes
H9	PC → INT	-0.048*	-2.35	Yes

Note: * p<.05, *** p<.001