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The Adoption of Contact-Tracing Applications and the Integration of a Health Pass: A Prosocial Rationality in the Privacy Calculus?

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ABSTRACT

Contact tracing applications (CTAs) have been presented as important tools in the fight against the Covid-19 pandemic. In France, the government developed the ‘StopCovid’ CTA which later became ‘TousAntiCovid.’ This research aims at understanding the determinants of the use of this CTA and of the intention to integrate the health pass. To do that, this study focuses on the perceived value of its use based on the privacy calculus theory. A quantitative study was conducted using a sample of 779 French people. The results show that the use of the CTA and the intention to integrate the health pass are influenced, as hypothesized, by perceived value, distrust towards the government, and personal innovativeness. Perceived value is positively influenced by social and individual benefits, as well as social influence, and, to a lesser extent, negatively influenced by social risks but not by individual risks.

KEYWORDS

Contact-Tracing, Covid-19, Distrust Towards Government, Privacy Calculus, Social Benefits, Social Risks

INTRODUCTION

Contact Tracing and the Health Pass: A Prosocial Rationality in the Privacy Calculus

When faced with the medical and economic consequences of the Sars-CoV-2 pandemic, governments around the world sought digital solutions to contain the spread of the virus. This was done in particular through Contact Tracing Applications (CTAs), which were initially designed to notify users they came in contact with a known Covid-positive individual. CTAs have

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been described as “one of the most important public health measures for addressing infectious disease outbreaks and epidemics” (NIH Record, 2021, p. 6). However, the adoption speed and scale necessary for the CTA to effectively reduce the spread of the virus soon appeared to be overwhelming as studies estimated that 80% of smartphone users or 56% of a given population would have to use the application (Hinch et al., 2020). These figures vary greatly according to reproduction rate (Hellewell et al., 2020)¹. This meant that governments were plunged into a CTA policy conundrum: rapid and massive adoption at the scale of entire populations was required, but coercive measures aimed at boosting adoption could crystallize fears regarding CTAs and prove to be counterproductive.

CTAs were launched in challenging times that were characterized by feelings of distrust towards governments, political institutions, and scientists. In both North America (Bagchi et al., 2020) and Europe (France24, 2020), disapproval levels ran high against the measures taken to fight the pandemic. This climate of distrust was reinforced by the “overall skepticism of the technology sector in recent years” (Bagchi et al., 2020). Although the use of CTAs has been described as a moral obligation (NIH Record, 2020), adoption rates of early CTAs remained low in many countries including France (Viseur, 2021).

CTA downloads in France remained extremely low for over a year from their launch until the government announced that a health pass would be implemented, which would be required to attend public gatherings and gain access to social spaces beginning 9 August 2021. Designed for citizens to prove their health or vaccination status using a QR code, this individual certificate could be integrated into the CTA or printed. Following the implementation of these measures, downloads of the application reached 30 million on 18 August 2021 and 50 million² on 24 January 2022 (Vitard, 2022). These measures, however, gave rise to academic controversy (Arruabarrena, 2020; Rowe, 2020), generated a great deal of fraud (Michel, 2022), and fueled further distrust towards the government among the general public, the press (Casilli et al., 2020), and civil liberties groups (La Quadrature du Net, 2021).

Because CTAs were developed as a collective tool to address a collective action problem (Riemer et al., 2020), research on their adoption has recently developed social approaches to the privacy calculus in order to understand how benefits to society influence individual decisions (Hassandoust et al., 2021; Trang et al., 2020; Trkman et al., 2021). Possible surveillance, discrimination, and the alienation dynamics in CTA design and implementation have all been denounced (Rowe et al., 2020). These fears have only partially been integrated into a privacy calculus to assess their influence on adoption decisions (Abramova et al., 2022). If, however, individuals’ prosocial attitudes influence the assessment of the application’s benefits, we can hypothesize that these attitudes also influence their assessment of the risks.

Therefore, building on a survey of French citizens, we analyzed how these individual and social risks and benefits influence CTA adoption and the intention to integrate the health pass into the application. In particular, we investigated this intriguing privacy calculus at a time in France when individuals were not yet subject to the restrictive measures of a mandatory health pass for accessing certain places. This meant that people still had a certain amount of freedom to weigh the individual and social risks and benefits of CTA adoption. This investigation aims to help understand the factors driving CTA adoption, if some of them can help prevent restrictive measures, and on a theoretical level, if it makes sense to consider collective factors in cases when digital technologies include this social dimension.

Our research objective can be divided into two main research questions:

- RQ1: How do the individual risks and benefits associated with the use of a CTA influence its adoption and intention to integrate the health pass?
- RQ2: How do the social risks and benefits associated with the use of a CTA influence its adoption and intention to integrate the health pass?

In the highly political global crisis context of the application's deployment, it is not possible to explain CTA adoption and intention to disclose data through the privacy calculus alone as adoption manifests differently when it is voluntary, as in the United States, encouraged, such as in Australia, nudged in France (Rowe et al., 2020), or mandated like in South Korea and China (Riemer et al., 2020). Beyond the technical features and implementation characteristics that vary from country to country (Sun et al., 2021), the CTA literature highlights other factors that influence these choices such as personal innovativeness, the social influence of peers (Jansen-Kosterink et al., 2020), and distrust towards the government (Jennings et al., 2021; Rowe et al., 2020). This raises a third research question:

RQ3: How do distrust of government, social influence of peers, and personal innovativeness influence the adoption of a CTA and the intention to integrate the health pass into it?

First, we will present our approach to the privacy calculus, the social factors we integrate into it, and develop eight research hypotheses to answer our research questions. The risks and benefits of information disclosure largely depend on the type of information collected, data sensitivity, political context, type of technological application, and cultural variables (Smith et al., 2011). We will then describe the French case of the TousAntiCovid application. The methodology of the survey and its measuring instruments will then be presented, followed by the results. Finally, the practical and theoretical scope of our results will be discussed.

THEORY AND SOCIAL PRIVACY CALCULUS MODEL

The privacy calculus theory provides a relevant framework for understanding the factors that influence the decision to use a CTA and to further disclose vaccination data. From its origins in the theory of reasoned action, the theory of planned behavior (Ajzen, 1991), and the cost-benefit rational choice theory (Becker, 1974), the privacy calculus has been widely used to explain why individuals adopt various digital systems such as e-commerce (Dinev & Hart, 2006), mobile applications (Wang et al., 2016), and the Internet of Things (IoT) (Kim et al., 2019). In its original form, this theory posits that individuals evaluate the anticipated benefits and costs (Laufer & Wolf, 1977) of using a system from a consequentialist perspective.

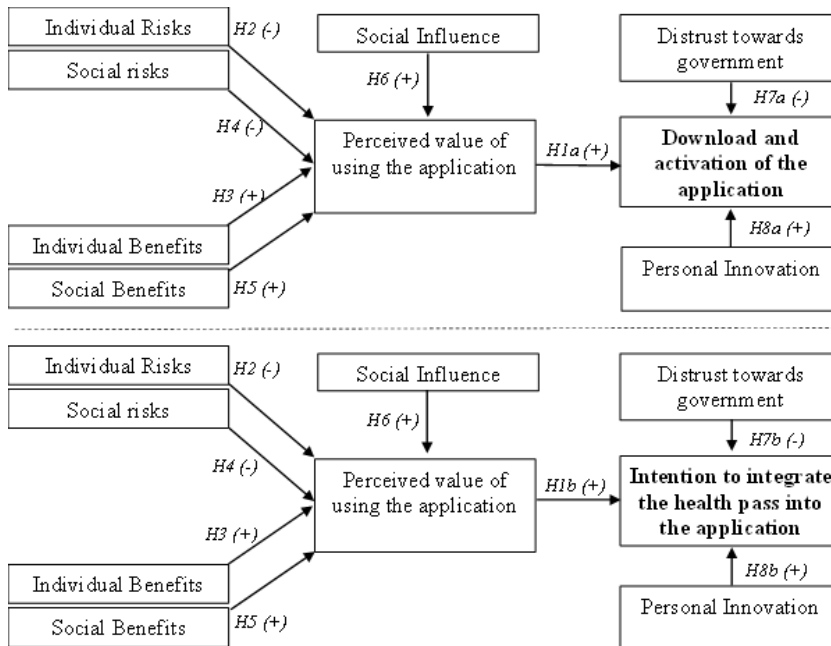
The COVID-19 pandemic led governments to push for the adoption of digital technologies at a high speed and large scale. This provides a unique context for improving our understanding of digital technology adoption decisions. Since the beginning of the pandemic the privacy calculus theory has contributed to our understanding of CTA adoption (Hauff & Nilsson, 2021). More importantly, in the face of such large-scale challenges, CTA adoption takes on a singularly collective dimension. Although recent research has begun to incorporate collective considerations into the privacy calculus (Hassandoust et al., 2021; Hauff & Nilsson, 2021; Parker et al., 2020; Trang et al., 2020), some of the social risks identified in the literature (Pagliari, 2020; Rowe, 2020; Zhang et al., 2020) have not yet been incorporated into research aimed at identifying the explanatory factors of CTA adoption.

We therefore develop a privacy calculus model accounting for risks and benefits at both the individual and social level (Figure 1). These four variables influence users' perceived value of the application, and ultimately, their use of the application and their intention to further disclose personal data by integrating the health pass into the app. To account for factors beyond this rational calculus, we also consider the impact of the social influence of peers, the personal innovativeness of individuals and their distrust towards the government and its management of the health crisis.

ADOPTION OF THE APPLICATION AND INTEGRATION OF THE HEALTH PASS

Individuals weigh perceived risks against perceived benefits, and from this subjective calculation they infer a value they would derive from adopting the CTA. The value that individuals assign to using

Figure 1. Influence of the privacy calculus



the app is the first level of this evaluation (Kim et al., 2007) that influences their adoption behavior (Culnan & Armstrong, 1999). This adoption decision is seen as a cost-benefit analysis (Trang et al., 2020) in which the collection of personal data and related risks are one of the main costs derived from usage (Culnan & Armstrong, 1999). Indeed, privacy concerns are one of the main barriers to the adoption of digital technologies (Dinev & Hart, 2006; Malhotra et al., 2004; Smith et al., 2011).

In the case of the French TousAntiCovid CTA, it is important to make a distinction between two data disclosures: by adopting and using the application, users consent to the disclosure (1) of data about their proximity with other individuals, their possible contamination, and their app usage behavior. Although this data is pseudonymized, researchers have identified that re-identification is possible (Bonnetain et al., 2020). Individuals may also wrongly perceive additional risks to their privacy. However, the integration of the health pass into the application implies an additional disclosure (2) of vaccination status data or test results.

Although the literature does not differentiate between these two disclosures, the type of data concerned, associated risks, and related benefits are all different. The present study will therefore distinguish between adoption of the application and intention to disclose vaccination data through the integration of the health pass.

The majority of research on CTAs and the privacy calculus measures user attitudes rather than user behavior through intention to download the application. Users, however, may declare themselves unwilling to use the app due to privacy risks but then use it regardless—a discrepancy between stated attitudes and behaviors that is described in the literature as a privacy paradox (Dinev & Hart, 2006; Rowe, 2020; Smith et al., 2011). We therefore focus on adoption behavior rather than intention to use the application, and hypothesize the following:

H1a: The perceived value of using a CTA positively influences the download and use of a CTA.

We have chosen to analyze intention to integrate the health pass into the CTA for several reasons. When we collected our data at the end of June 2021, days before the government announced the

restrictive measures to come, few people had integrated their pass into the application, and many had yet to receive the vaccine. In other words, our study was conducted during a period in which the health pass was not yet mandatory for certain activities. Analyzing intention to integrate the health pass into the application before these measures were announced and implemented was, therefore, an opportunity to identify the factors that influence intention to disclose vaccination and test data before incentives influenced the calculus. We hypothesize the following:

H1b: The perceived value of using a CTA positively influences intention to disclose vaccination status or test data through the integration of the health pass.

Individual Risks and Benefits

Concerns over data privacy, storage, and access by third parties can represent a significant barrier to the adoption of digital technologies, especially when such technologies collect sensitive information such as health data (Kim et al., 2019). Prior research has shown that users are particularly wary about the incorporation of privacy principles in CTA design (Trang et al., 2020).

Despite the data minimization principles applied in the design of the French CTA, users could still be identified by exploiting the telemetry and analysis functions that were activated by default without obtaining user consent (Johan et al., 2022). Other risks have been highlighted. For example, the information stored in clear text in the European 2D-DOC datamatrix can be read by any third-party QR-Code reading application (CNIL, 2021). Research on CTAs has confirmed the importance given to these risks in adoption decisions by showing a negative association between the perception of these risks and intention to use a CTA (Chan & Saqib, 2021; Hassandoust et al., 2021; Kaptchuk et al., 2020), or lower intention among privacy-sensitive individuals (Trang et al., 2020).

H2: Individual privacy risks negatively influence the perceived value of a CTA.

Conversely, individuals may also perceive benefits from the use of a technology and the disclosure of their data (Smith et al., 2011). For example, CTAs send notifications in cases of recent contact with a person who has been identified as contaminated or present in an outbreak area, which means that the app user can isolate themselves quickly. The application also provides information on vaccination and testing procedures and local epidemic trends. Individuals may thus consider that using the application is a way of protecting themselves from the virus, of receiving information on potential health risks, or facilitating pandemic-related procedures and processes (Walrave et al., 2020). However, these benefits are not necessarily perceived by individuals and do not necessarily motivate adoption (Trang et al., 2020). For example, the possibility that application effectiveness may be reduced by the detection of false positives and negatives (Whitelaw et al., 2020) could raise doubts about CTA efficacy. To reflect the possible influence of these perceived benefits, we hypothesize:

H3: Perceived individual benefits positively influence the perceived value of using a CTA.

Social Risks and Benefits

Unlike in e-commerce contexts, the costs and benefits of CTA use go beyond the individual level. Since CTAs are designed to be a technological solution to a collective problem, social factors may also influence individuals' assessment of their value. One advantage of the privacy calculus is that it provides a flexible framework for analysis as demonstrated by the large number of positive and negative variables it can incorporate to account for situational elements (Fox et al., 2021).

The literature highlights how individuals do not focus their cost-benefit analysis exclusively on individual risks and benefits. Research conducted in the context of the COVID-19 pandemic

has shown that prosocial attitudes can influence an individual's analysis of the benefits of a CTA (Trang et al., 2020). Various factors have been used to account for this duality of benefits (idem), such as how it contributes to saving lives, reducing infections, protecting the public health system, reducing government restrictions, and helping economic recovery (Hassandoust et al., 2021; Hauff & Nilsson, 2021).

We therefore hypothesize the following:

H4: Perceived social benefits positively influence the perceived value of using a CTA.

These potential social benefits may be accompanied by social risks that can influence the perceived value of using a CTA. Recent research on the design and implementation of technological solutions to pandemic issues has also highlighted the short- and long-term social risks that these technologies may generate (Zhang et al., 2020; Pagliari, 2020). The press and civil liberties groups have also expressed their concerns. The political declarations and protests against the health pass also show that some parts of the general population also perceive such risks.

Although privacy risks are seen as one of the main barriers to the adoption of technology (Dinev & Hart, 2006), in the case of CTAs, they may take on a collective dimension due to the size of the target population. The issues of exclusion (Pagliari, 2020) and digital divide (Beaunoyer et al., 2020), potentially inequitable restrictions between groups (Klenk & Duijf, 2021; Parker et al., 2020), and potential generalized surveillance (Zhang et al., 2020) have been put forward as collective risks. Individuals who are more sensitive to personal freedoms were also found to be less likely to use surveillance technologies (Wnuk et al., 2021). Some recent studies have found that these social considerations have a stronger influence on the privacy calculus than individual risks, especially when related to the fear of mass surveillance (Abramova et al., 2022). These risks and the accumulation of restrictive measures have led to instances of large-scale fraud as well as demonstrations by health pass opponents, such as the 237,000 demonstrators who took a stand in August 2021 (Le Monde, 2021). These fears are linked to the weighing of social risks by individuals, and we make the following hypothesis:

H5: Perceived social risks negatively influence the perceived value of using a CTA.

Other Factors

Beyond the privacy calculus, research has highlighted other factors that influence the decision to use a CTA. In particular, peer influence, the personal innovativeness of individuals, and distrust of institutions can all influence behaviors and intentions.

Social Influence of Peers

Beyond these rational aspects of the cost-benefit analysis, the perceived value of using a CTA may be influenced by other more emotional or hedonic factors (Wiegard & Breitner, 2019). Individuals may rely on the opinions of trusted peers to reduce the complexity of risk assessment. Peer influence is one of the factors that influences the adoption of new technologies in models such as the Unified Theory of Acceptance and Use of Technology (UTAUT) method (Venkatesh et al., 2003), and has been found to influence CTA adoption (Hassandoust et al., 2021; Li et al., 2021; Walrave et al., 2021) or intention to adopt a CTA (Duan & Deng, 2021; Fox et al., 2021; Thiéé et al., 2021). This leads to the following hypothesis:

H6: The social influence of peers positively influences the perceived value of CTAs.

Distrust Towards the Government

Trust in institutions has long been studied as an antecedent to technology adoption in the privacy calculus literature on e-commerce or location-based digital services (Xu et al., 2005). In situations of uncertainty, trust plays a key role in determining users' risk-taking behavior regarding technologies (Malhotra et al., 2004), including those developed and promoted by governments (Bélanger & Carter, 2008; Chan et al., 2010). However, research on the adoption of CTAs has yet to show any significant influence of institutional trust on their adoption (Hassandoust et al., 2021; Kurtaliqi et al., 2022; Reith et al., 2021; Thiée et al., 2021) except for a small influence of trust beliefs in an Australian study (Lin et al., 2021). The literature on trust offers a possible explanation for this limited influence by considering trust and distrust as two different variables instead of the two ends of a single continuum (Lewicki et al., 1998). From this perspective, distrust is associated with feelings of suspicion, antipathy, or resentment (Jennings et al., 2021) and seen as “the active expectation that the behaviors of other actors jeopardize personal security” (Chang & Fang, 2013, p. 150). Recent work has suggested that this approach to trust and distrust can explain different threat perceptions and behavioral adaptations in the face of the epidemic (Jennings et al., 2021). For instance, as a form of high distrust towards institutions, belief in government conspiracy theories was found to be associated with lower respect of preventive measures against the virus (Oleksy et al., 2021). We thus hypothesize:

H7a: Distrust towards the government's ability to manage the epidemic negatively influences the download and use of CTAs.

H7b: Distrust towards the government's ability to manage the epidemic negatively influences intention to disclose personal data through the integration of the health pass into a CTA.

Personal Innovativeness

As the propensity to try and experiment with new technologies of any kind (Agarwal & Prasad, 1998), personal innovativeness is generally considered to directly influence the intention to adopt a technology (Jarvenpaa et al., 2000) and its intensive use, sometimes to the point of addiction (Kuem et al., 2021). In adoption theories, personal innovativeness is an individual trait that explains why some individuals adopt technologies before others. This favorable attitude towards technology has also been identified as a significant antecedent to the acceptance of CTAs (Jansen-Kosterink et al., 2020). We therefore hypothesize:

H8a: Personal innovativeness positively influences the adoption of CTAs.

H8b: Personal innovativeness positively influences intention to disclose personal data through the integration of the health pass into the CTA.

Control Variables

The gender and age of respondents were also analyzed as demographic control variables. In the literature, these variables have been found to influence CTA adoption (Li et al., 2021). Age is a complex variable that may be relevant notably due to differences in vulnerability between populations. Past a certain age, older people may feel more at risk, while adolescents and young adults may consider themselves less vulnerable. Conversely youngsters are more likely to have a smartphone and use it often, or even exhibit problematic dependency behavior (Gentina and Rowe, 2020), while retired people are far less likely to be intensive users.

METHODOLOGY

Before reporting our data collection procedure and sample characteristics and questionnaire design and measurement instruments, we first describe the case of the French CTA.

The French Case of the TousAntiCovid App

As part of the fight against the spread of COVID-19, the French government launched its first application called StopCovid on 2 June 2020. The aim of this tool was to break contamination chains through digital contact tracing and warn users who had been in close proximity to a person who had tested positive for COVID-19. Results were mixed as Chevallier (2020) noted:

Results after three months of existence have not significantly changed: around two million downloads, 72 people alerted for risky contacts after 1100 people had declared themselves positive in the application. In its new September 14th report, the CNIL noted the absence of elements that would make it possible, as things stood, to evaluate the usefulness of the system and therefore the proportionality between the infringement of rights and the pursued general interest objective. (p. 527)

On the eve of the second lockdown in October 2020, this initial application was replaced by TousAntiCovid as a part of the “test, warn, and protect” government strategy. TousAntiCovid is based on the same principle and technology as its predecessor but evolved into a “hub” (i.e., a platform that brings together several digital services). It was described by some observers as a “veritable Swiss Army knife” for managing the epidemic. In addition to identifying contacts and notifying potentially infected persons, TousAntiCovid provides detailed information on the epidemic (at both the national and local level) and on protective measures and recommendations. It also supports the automated creation of travel certificates and plays a role in the vaccination campaign by displaying personalized health notifications (e.g., reminders/dates for pass validity or information about what to do in case of infection).

Adoption of the app remained very limited until the government announced that people would need a health pass to access restaurants, museums, and other public spaces. This record of personal vaccination and contamination³ can be accessed by people working at these places through an app by scanning the individual’s health pass QR code, either in paper format or through the TousAntiCovid app. We collected our data at this pivotal moment of the epidemic, days before the government announced these coercive measures, at a time when concerns over privacy (Bonnetain et al., 2020), uncertain health benefits (CNIL, 2020), and discrimination and threats to freedom were rising (La Quadrature du Net, 2020a, 2020b) with the extended scope of the CTA. In particular, opponents were worried that the health pass would eventually become a vaccination pass (which happened six months later in spite of government promises) that would prohibit non-vaccinated citizens from accessing certain places.

Data Collection, Sample Characteristics, and Questionnaire Structure

Data collection was carried out between 28 June and 8 July 2021 via a panel company specialized in collecting quantitative data for researchers. Our questionnaire was administered online to a sample of 779 French citizens (sample characteristics are detailed in Table 1). We used three main criteria: (1) our sample had to consist of half of participants who downloaded the CTA and half who did not download it, (2) it had to be diverse in terms of age, gender and degree, and (3) it had to include various profiles in terms of attitude and behavior towards COVID-19 (perception of the seriousness of the virus, decision to be vaccinated or not). Moreover, only individuals who had a smartphone and who gave their consent to answer the questionnaire participated in the study. Regarding the response rate, 68.63% of the panel completed the online survey.

The questionnaire was structured as follows:

First, we measured actual behavior towards the app: download and activation. Second, the respondents were asked to read a detailed description of the TousAntiCovid app and the data it collects—this description is based on an official governmental communication. Third, individuals

Table 1. Sample Profile

Variable	%
Gender	
Woman	51
Men	49
Age	
18-24	8
25-34	18
35-49	25
50-64	26
>65	23
Diploma	
None	2
College degree	3
Vocational degree	20
Undergraduate degree	56
Postgraduate degree	19
Download of the Mobile App	
Have downloaded the mobile app	43
Have downloaded the mobile app then uninstalled it	7
Have not downloaded the mobile app	50
Activation of the Mobile App	
Have activated the mobile app	65
Have activated the mobile app then deactivated it	16
Have activated the mobile app then deactivated it occasionally	18
Have not activated the mobile app	4
Perceived Severity of Covid-19	
It is serious	55
It is not serious	45
Vaccination	
Received one dose of the vaccine	21.5
Received two doses of the vaccine	42.5
Unvaccinated	36

were asked to express their degree of agreement with items measuring the different variables of this research: individual and social benefits, risks, perceived value of the app, social influence, distrust toward the government and personal innovativeness. The questionnaire ended with the measurement of socio-demographic variables (age, gender, etc.).

Choice and Psychometric Qualities of Measurement Scales

The measurement scales are all drawn from previous literature, with the exception of those developed for this study (see Appendix). They have, where necessary, been adapted to increase contextual relevance. With the exception of the question about activation of the TousAntiCovid app, all items were presented in a 5-point Likert format.

Table 2 summarizes the main psychometric characteristics of the measurement scales used in this study. Each of the scales was validated by means of a confirmatory factor analysis with bootstrapping (500 iterations) in a PLS-Path Modeling approach (Vinzi et al., 2010). All of the indicators were good and showed good validity (Average Variance Extracted) and reliability (Rho DG) of the scales.

RESULTS

In order to test the proposed research model (see Figure 1), we relied on a PLS-PM approach (Vinzi et al., 2010). The model provides a good quality since the Goodness of Fit (GoF) indices are good (above 0.9) and stable (Table 3).

The individual and social benefits and risks, together with peers' social influence explain 62.4% of the variance in the perceived value of the app. The higher the expected benefits (individual and social) and perceived social influence, the higher the perceived value. Hypotheses 3 to 6 are validated while hypothesis 2 is rejected. The perceived individual risk has no influence on the perceived value of the app (Table 3).

Perceived value, distrust towards the government and personal innovativeness have a significant influence on the activation of the application ($R^2 = 0.624$) and on intention to integrate the health pass ($R^2 = 0.403$). The more innovative individuals are, the more they download the application and intend to integrate their health pass. Conversely, the more distrustful they are of the government, the less they download the application and the less they intend to integrate their health pass (Table 3). Hypotheses 1, 7, and 8 are then validated.

Table 4 summarizes the results of the hypotheses we tested in this study.

In the next section, we discuss these findings with regard to theory and prior research. We then elaborate on the limits of our work and highlight avenues for future research.

DISCUSSION

This research contributes in several ways to our understanding of the adoption of CTAs and, in a broader sense, to the mass adoption of technologies that have consequences beyond the realm of the individual. In the context of a country like France where Senate members were coerced (Rowe et al., 2020) but adoption could be considered nudged and not mandated (Riemer et al., 2020; Rowe et al., 2020), our results show that (1) perceived value of the app, distrust of government, and personal innovativeness explain a significant part of CTA download, activation, and intention to integrate the health pass. They further indicate that (2) perceived value is, in turn, positively influenced by social and individual benefits and social influence, and to a lesser extent, negatively influenced by social risks.

Influence of Individual Risks and Benefits

The nonsignificant influence of perceived privacy risks on the perceived value of the app is a surprising result, suggesting perceived individual risks do not explain low adoption figures. This result contrasts with prior research on the adoption of CTAs (Duan & Deng, 2021; Hassandoust et al., 2021; Hauff & Nilsson, 2021; Kurtaliqui et al., 2022; Tran & N'Guyen, 2021), and more generally, with the literature on adoption decisions involving privacy risks (Cheng et al., 2021; Xu et al., 2011). For instance, through the perspective of a health risks versus privacy risks trade-off, Tran and N'Guyen (2021) found a negative influence of privacy risks on the perceived value of using the CTA. Conversely, this

Table 2. Overview of measurement scales

Variables	Items	Loading	Average Variance Extracted	Rho DG
Individual Benefits	IB1: Using this application will allow me to protect myself against Covid-19	0.930	0.867	00.963
	IB2: By using this application I will be more effective in protecting myself against Covid-19	0.940		
	IB3: By using this application it will be easier for me to protect myself against Covid-19	0.935		
	IB4: By using this application I will save time and effort to protect myself from Covid-19	0.919		
Social Benefits	SB1: By using the TOUSANTICOVID application, I will help to protect the health system and help healthcare workers	0.931	0.874	0.954
	SB2: By using the TOUSANTICOVID application, I will help to avoid further restrictions	0.945		
	SB3: It is important that the use of the TOUSANTICOVID application increases to save lives	0.929		
Individual Risks	IR1: Activating the TOUSANTICOVID application presents risks related to the identification of my smartphone when I activate Bluetooth	0.929	0.838	0.940
	IR2: Using the TOUSANTICOVID application presents risks related to the analysis of my activity on the application	0.927		
	IR3: Downloading the TOUSANTICOVID application and activating Bluetooth may lead to unexpected problems	0.888		
Social Risks	SR1: By asking me to install and use this application the government threatens my freedom of choice	0.924	0.809	0.896
	SR2: I think that the TOUSANTICOVID application can lead to discrimination	0.873		
Perceived Value	PV1: I think that the benefits of using the TOUSANTICOVID application can outweigh the risks	0.924	0.860	0.925
	PV2: The value that I derive from using the TOUSANTICOVID application is more important than the information that is collected about me	0.930		
Social Influence	SI1: People who are important to me think I should install and use this app	0.948	0.902	0.949
	SI2: People in my entourage advise me to install and use this application	0.952		
Distrust Toward the Government	DG1: I am skeptical as to whether the government will take our interests into account when making decisions	0.869	0.841	0.941
	DG2: I think the way the government will manage the app is unreliable	0.942		
	DG3: I think the government will not be trustworthy in its management of this application	0.938		
Personal Innovativeness	PI1: When I hear about a new smartphone application, I look for ways in which I could use it	0.908	0.817	0.931
	PI3: Among my acquaintances, I am the first to test new applications	0.882		
	PI3: I like to experiment with new applications	0.920		

Table 3. Influence of variables

Influence of Variables on Perceived Value		
Latent Variable	Value (Bootstrap)	Critical Ratio (CR)
Individual Benefits	0.284	13.859
Social Benefits	0.312	16.113
Individual Risks	0.006	0.226
Social Risks	-0.054	-2.690
Social Influence	0.250	9.560
Influence of Variables on the Adoption and Activation of TousAntiCovid		
Latent Variable	Value (Bootstrap)	Critical Ratio (CR)
Perceived Value	0.267	13.771
Distrust Government	-0.213	-11.485
Innovativeness	0.128	6.215
Influence of Variables on Intention to Integrate the Health Pass		
Latent Variable	Value (Bootstrap)	Critical Ratio (CR)
Perceived Value	0.347	20.661
Distrust Government	-0.320	-18.546
Innovativeness	0.156	7.516
Main Quality Indices of the Model		
	GoF	GoF Bootstrap
Absolute	0.667	0.667
Relative	0.984	0.977
External model	0.999	0.997
Internal model	0.985	0.980

Table 4. Results of the hypotheses tests

Hypothesis	Results
H1 a&b: Perceived value of using a CTA positively influences (a) the download and use of a CTA and (b) intention to disclose vaccination status or test data through the integration of the health pass	Supported
H2: Individual privacy risks negatively influence the perceived value of a CTA	Rejected
H3: Perceived individual benefits positively influence the perceived value of using a CTA.	Supported
H4: Perceived social benefits positively influence the perceived value of using a CTA	Supported
H5: Perceived social risks negatively influence the perceived value of using a CTA	Supported
H6: The social influence of peers positively influences the perceived value of CTAs	Supported
H7 a&b: Distrust towards the government's ability to manage the epidemic negatively influences (a) the download and use of CTAs and (b) intention to disclose personal data through the integration of the health pass into a CTA	Supported
H8 a&b: Personal innovativeness positively influences (a) the adoption of CTAs and (b) intention to disclose personal data through the integration of the health pass into the CTA	Supported

result tends to lend credence to another set of studies that either found a nonsignificant relationship or a very limited influence of perceived privacy. For instance, in Abramova et al. (2022), privacy risks were found to influence intention to use but not actual use of the CTA. Based on a mediation analysis, the authors suggest that privacy risks indirectly contribute to intentions to use and actual use through fears of mass surveillance. Likewise, Fox et al. (2021) could not find a significant influence of privacy risks on the intention to adopt then to use a CTA in Ireland. The authors explain this result through social exchange theory and suggest that individuals tend to discount the risks when their relatives accept a vulnerability over societal benefits.

To further clarify, first, we cannot discount the fact that national cultural differences between samples may explain some of this difference (Riemer et al., 2020) in addition to the time of data collection. For instance, Tran and N'Guyen (2021) data were collected early in the pandemic (October and November 2020), while the data for our study were collected after the third lockdown and eight months after the initial app was released. By that time, the spread of the pandemic and its more visible consequences (restrictive measures and the number of COVID-19 related deaths) could have led our respondents to discount individual risks to privacy. It is also worth noting that our study, along with Abramova et al. (2022) and Fox et al. (2021), includes actual use⁴ as a dependent variable as opposed to an intention to use or adopt the app. This difference could reflect a privacy paradox whereby respondents do not act in accordance with their declared concerns about privacy risks. Lastly, the nonsignificant influence of individual risks could be explained by the type of considered calculus, since some of the studies supporting the individual risk hypothesis do not account for social benefits and risks (Duan & Deng, 2021; Tran & N'Guyen, 2021).

Our results also point to the significant influence of individual benefits; although, previous research has raised doubts about their influence when they were found to have less of an influence over intention to use a CTA than social benefits had (Trkman et al., 2021) or were counter-productive in some instances (Trang et al., 2020). One key difference with the Trkman et al. (2021) study lies in the items selected to measure individual benefits. Whereas the authors chose to measure individual benefits in terms of avoiding restrictions such as bans on travelling, outdoor activities, and social gatherings, our study, along with other studies (Li et al., 2021), focused on self-protection from the virus. We did not test other personal incentives such as monetary rewards (Munzert et al., 2021) or priority access to tests and food deliveries (Wiertz et al., 2020) because they would strongly contravene with cultural values in France (Rowe, 2020). Such measures could also lead to a paradoxical situation where they could increase perceived social risks of discrimination or restrictions of freedom. The influence of individual benefits on the perceived value of using a CTA, or how to best combine CTAs with social benefits (Trang et al., 2020) remains unclear in the literature. Although a further quartile analysis to account for different groups of citizens led Trang et al. (2020) to conclude that “the helpfulness of self-benefit appeals can backfire” and that “societal-benefit appeals are effective only when used on their own.” (Trang et al., 2020, p. 422), our results suggest that individual benefits are an important antecedent to the perceived value of the app when the health benefits rather than the monetary incentives are considered.

Influence of Social Risks and Benefits

A key result of the present research lies in the important influence of social benefits on the perceived value of using a CTA. This supports recent research on CTA adoption (Abramova et al., 2022; Hassandoust et al., 2021). It is a result that points to limits of “the traditional individual perspective of IS acceptance”, which appear “insufficient for capturing the peculiarities of CTAs” (Abramova et al., 2022, p. 2).

We measured the influence of social and individual benefits separately to account for the weight of their respective role in the adoption of CTAs. By showing that both significantly influence the perceived value of using a CTA, we contribute to a growing body of research which, despite the different measures for individual and social benefits, shows that prosocial and altruistic reasoning

should be accounted for when studying the adoption of technologies that have consequences beyond the individual (Abramova et al., 2022; Hassandoust et al., 2021; Li et al., 2021; Trang et al., 2020; Trkman et al., 2021). Unlike in Trkman et al. (2021), individual benefits were found to influence the perceived value of using the CTA almost as much as social benefits. Further research is needed to assess the relative importance of different individual and social benefits.

To the best of our knowledge, our study is the first to test the influence of perceived discrimination risks and restrictions of freedom. Although we found a negative influence on perceived value, this influence remains limited compared to results of other studies where other social risks such as fears of mass surveillance were measured (Abramova et al., 2022). The timeframe of our studies, before actual restrictions were set, may explain why individuals were not perceiving risks of discrimination as social risks. Social risks do, however, influence the perceived value of using a CTA more than individual privacy risks do, confirming that individuals' fears about the effects of CTAs may lie more at the social level (Abramova et al., 2022). Another explanation may lie in the French context, where the social benefits of contact tracing were strongly emphasized by the government and its health ministry, while the social risks were emphasized to a smaller audience by senators, the French data protection authorities, and activists such as La Quadrature du Net (Rowe, 2020; Rowe et al., 2020).

Although we cannot assess whether perception of discrimination risks influences the perceived value of the CTA more after the introduction of restrictive measures, it appears this was not a determining concern before these measures were enacted. This result suggests the target population should be informed and consulted prior to the design of the app and to the onset of restrictive measures. Overlooking social risks could decrease actual and active post-adoption use of the app (e.g., not declaring oneself positive, uninstalling the app, not activating Bluetooth) or further fuel distrust towards the government and thus reduce late adoption.

As hypothesized in Fox et al. (2021), the social privacy calculus seems to lean more on the benefits than on the risks side. A few avenues could explain this tendency. First, in a crisis context, individuals may focus their attention on the possible benefits of the proposed solution. Second, risks may be underestimated due to known factors such as overconfidence in privacy assessments, lack of information, bounded rationality, or hyperbolic discounting (Acquisti & Grossklags, 2006). In particular, we hypothesize that the latter is worth exploring since possible benefits in the short and long terms were publicly emphasized more than the uncertain and distant social risks.

Social Influence of Peers, Distrust Towards Government, and Personal Innovativeness

Even when social factors are accounted for, the adoption of CTAs and the intention to integrate the health pass do not depend exclusively on a rational, albeit subjective, calculation. Social influence from peers, distrust towards the government, and personal innovativeness also influence this decision.

Social influence from peers affects perceived value almost as much as perceived individual or social benefits, and more than perceived social risks of discrimination and threats to freedom. This result is consistent with prior studies (Duan & Deng, 2021; Fox et al., 2021; Hassandoust et al., 2021) and indicates that, faced with the complexity of assessing the value that can be derived from app use, individuals rely on trusted peers to make their decision.

Individuals' personal innovativeness also influences their decision to adopt a CTA, and their intention to integrate the health pass even more. Although some of this difference may be attributed to a gap between intentions and behaviors, this result could also suggest that the more sensitive nature of vaccination status data does not change highly innovative individuals' intentions attitude towards the app. Alternatively, this result could suggest that individuals with a high personal innovativeness may discount social risks they are not concerned about. Decision-makers should thus be aware of the risks of relying on individuals with a high personal innovativeness for the design of the app and related public policies since they may discount social risks that are a concern for other types of users, especially in times of crisis when possible benefits are strongly emphasized.

Giving a broader role to ethical committees in app design and policy decisions could help to prevent fueling distrust in the government.

Our results also highlight a significant negative influence of distrust towards the government in its management of the epidemic, while prior studies found no significant influence of trust in institutions or the government (Hassandoust et al., 2021; Kurtaliqi et al., 2022; Reith et al., 2021; Thiée et al., 2021). This finding is all the more important when considering that the distrust that was present in the early phases of the pandemic in France (Rowe, 2020) may have been reinforced by restrictive measures that were enacted after our survey. We believe this result supports the notion that distrust is not a mere opposite of trust but rather “the active expectation that the behaviors of other actors jeopardize personal security” (Chang & Fang, 2013, p. 150). Future privacy calculus and CTA adoption research should thus consider measuring distrust in the government in its management of the pandemic. Governments should also mind the risk of further increasing distrust by enacting coercive measures that may decrease actual adoption and only lead to compliance or avoidance strategies.

Another interesting result is that the negative influence of distrust in the government is stronger on the intention to integrate the health pass. We see three possible explanations to this result. First, we cannot exclude a gap between intentions and actual behaviors similar to a privacy paradox, whereby respondents claim to distrust the government more than their behavior shows. Another possibility would be that this difference reflects the more sensitive and risky nature of the disclosed data in the case of the integration of the health pass. Lastly, it could reflect the more uncertain nature of the risks of integrating the health pass into the app, leading individuals to use their distrust towards the government ability to manage the app as a proxy for risks.

LIMITS AND FURTHER RESEARCH

We believe our research lends credence to a social approach to the privacy calculus when technologies bear collective risks and benefits. It also shows distrust may be more relevant than trust in institutions when risks and benefits are difficult to assess. Lastly, data collection just days before restrictive measures were announced and enacted provides an original comparison point for future studies. However, limits should be acknowledged before attempting to generalize from our findings.

First, our measures reflect perceptions and behaviors at one point, just before health pass-related restrictive measures were announced and enacted. While this helps us to report attitudes and behaviors at a rarely investigated moment of the pandemic, threat perceptions, trust, and behavioral adaptations may change along the timeline (Jennings et al., 2021). Two opposite though not exclusive hypotheses can be drawn and explored: (1) perceived social risks and distrust towards the government may have increased since restrictive measures materialized in citizens’ daily lives, and some would argue, (2) perceived risks and distrust may have been reduced by a form of habituation to technological surveillance and the disclosure of sensitive data this requires (Rowe et al., 2020). Further studies on the evolution of these perceptions and behaviors could help to assess if and how they changed over time. The growing body of research on CTA adoption offers an opportunity for comparing results at different moments of the pandemic, although differences in governments’ responses and national cultures can represent a significant bias. Other indicators may also reflect changes in perceived risks and distrust towards governments’ management of the situation. Usage data released by governments, social media posts, newspapers articles, protests, and parliamentary debates could reveal interesting insights on the evolution of perceived risks.

Second, cultural variables could limit the generalizability of some of the results. Although the French population shares many cultural traits with other European or North American countries, research has shown that cultural privacy attitudes and behaviors can vary across countries (Gurău & Ranchhod, 2009; Krasnova et al., 2012; Miltgen & Peyrat-Guillard, 2014). The growing body of research on the adoption of CTAs in different countries offers a first insight on how generalizable to other countries our findings are. For instance, social benefits were shown to influence the intention

or decision to adopt a CTA in Germany (Trang et al., 2020), in the United States (Hassandoust et al., 2021), in Sweden (Hauff & Nilsson, 2021), in Ireland (Fox et al., 2021), and in Slovenia (Trkman et al., 2021). Conversely, studies in France (Kurtaligi et al., 2022), the U.S. (Hassandoust et al., 2021) or Germany (Reith et al., 2021 ; Thiée et al., 2021) could not show a significant influence of institutional trust on the adoption of CTAs. The literature draws no clear picture with regard to other variables due to differences in models and measures, and most studies on CTA adoption were carried out in the U.S., Western and Central Europe, and Australia. Cross-country analyses and research in other groups of countries would thus help to better delineate the potential role of culture in the adoption of CTAs.

Despite these limits, we also believe this study offers opportunities for theoretical generalization to other systems and other contexts. If individuals consider social benefits and risks and rely on distrust as a proxy to assess some of the distant risks in their adoption decisions, one could expect them to proceed the same way with similar applications in the context of other pandemics, with other government systems and perhaps corporate systems. An interesting avenue for research would be to extend this reasoning to other contexts where technologies come with collective risks and benefits, whether for society as a whole or for an organization and its members. Investigating the importance of these social factors in the context of other government systems would remove the crisis dimension that may influence perceived risks and benefits. And studying their presence in the context of corporate systems adoption could help us to improve our understanding of their adoption by revealing the possible role of prosocial attitudes in the assessment of both risks and benefits. Likewise, measuring distrust towards management rather than trust may prove useful in explaining reluctance to adopt and use new corporate systems.

CONFLICT OF INTEREST STATEMENT

The authors of this publication declare there is no conflict of interest.

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ENDNOTES

¹ A more fundamental debate is whether such a tracing app is needed (Rowe et al., 2020). This rush towards CTA solutions may reflect a deep misunderstanding of contamination paths that vary depending on variant contagiousness (Rowe et al., 2022).

² However, only 38 million devices connected to it in January 2022.

³ Covid vaccinated, negative test less than 72 hours old, or Covid recovery certificate.

⁴ Fox et al. (2021) used a pre- and post-launch design where respondents were first asked about their intention to use the application, then at a later stage about their intention to adopt/continue usage after the application's launch.

APPENDIX

Variables and items used in the questionnaire

Variables	Source	Items	
Individual Benefits	Xu et al. (2011) Hassandoust et al. (2021)	IB1	Using this application will allow me to protect myself against Covid-19
		IB2	By using this application, I will be more effective in protecting myself against Covid-19
		IB3	By using this application, it will be easier for me to protect myself against Covid-19
		IB4	By using this application, I will save time and effort to protect myself from Covid-19
Social Benefits	Hassandoust et al. (2021) Trkman et al. (2021)	SB1	By using the TOUSANTICOVID application, I will help protect the health system and help healthcare workers
		SB2	By using the TOUSANTICOVID application, I will help to avoid further restrictions
		SB3	It is important that the use of the TOUSANTICOVID application increases to save lives
Individual Risks	Malhotra et al. (2004) Xu et al. (2011) Hassandoust et al. (2021)	IR1	Activating the TOUSANTICOVID application presents risks related to the identification of my smartphone when I activate Bluetooth
		IR2	Using the TOUSANTICOVID application presents risks related to the analysis of my activity on the application
		IR3	Downloading the TOUSANTICOVID application and activating Bluetooth may lead to unexpected problems
Social Risks	Scale developed for this research	SR1	By asking me to install and use this application the Government threatens my freedom of choice
		SR2	I think that the TOUSANTICOVID application can lead to discrimination
Perceived Value	Xu et al. (2011)	PV1	I think that the benefits of using the TOUSANTICOVID application can outweigh the risks
		PV2	The value that I derive from using the TOUSANTICOVID application is more important than the information that is collected about me
Social Influence	Venkatesh et al. (2003) Warkentin et al. (2017) Hassandoust et al. (2021)	SI1	People who are important to me think I should install and use this app
		SI2	People in my entourage advise me to install and use this application
Distrust of Government	Maillard-Wilhelm (2014), Chang & Fang (2013)	DG1	I am skeptical whether the Government will take our interests into account when making decisions
		DG2	I think the way the Government will manage the app is unreliable
		DG3	I think the Government will not be trustworthy in its management of this application
Personal Innovativeness	Agarwal & Prasad (1998)	PI1	When I hear about a new smartphone application, I look for ways in which I could use it
		PI2	Among my acquaintances, I am the first to test new applications
		PI3	I like to experiment with new applications
Intention to Integrate the Pass	Malhotra et al. (2004)	II	I am willing to integrate my vaccination certificate into the TOUSANTICOVID application

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