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Altruistic and egoistic motivations to engage with contact-tracing apps: Lessons learned from the Covid-19 pandemic

Motivaciones altruistas y egoístas para comprometerse con las apps de rastreo de contactos: Lecciones aprendidas de la pandemia por Covid-19

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ABSTRACT

During the Covid-19 pandemic, contact-tracing apps have offered effective help to bend the contagion curve. Thus, it is of critical importance to understand the factors that influence contact-tracing apps' adoption among citizens. In particular, the successful adoption and usage of contact-tracing apps strongly relies on individual motives. Therefore, this study draws on the theory of altruistic and egoistic motivation for prosocial behaviours to analyse the underlying motives through which citizens engage in voluntary behaviours aimed at using and promoting the use of contact-tracing apps. The study also examines the mediating role of users' trust in the app. Data from 221 users of Ireland's Covid Tracker app was analysed. Structural equation modelling with PLS was used to test the research model. Findings show differences between egoistic and altruistic motivation in promoting app use and sharing. Egoistic motivation significantly promotes voluntary behaviours among citizens and users' trust in the app mediates this influence. Yet, contrary to predictions, in the context of the pandemic, altruistic motivation does not play a significant role in engaging citizens in these voluntary behaviours, either directly or indirectly. The findings of this study are important for policy makers and may inform future policy decisions regarding the implementation of contact-tracing apps in the case of new pandemics or for other contexts requiring cooperative daily check-in.

Keywords: Contact-tracing, Covid-19, Altruistic motivation, Egoistic motivation, Prosocial behaviour.

RESUMEN

Durante la pandemia por Covid-19, las apps de rastreo de contactos han supuesto una ayuda efectiva para doblegar la curva de contagios. Por lo tanto, resulta de gran importancia entender los factores que influyen en la adopción de apps de rastreo de contactos entre los ciudadanos. En concreto, una adopción y uso exitosos de estas apps dependen fuertemente de los motivos individuales. Por ello, este estudio se basa en la teoría de motivaciones altruistas y egoístas para los comportamientos sociales para analizar los motivos por los cuales los ciudadanos llevan a cabo determinados comportamientos voluntarios dirigidos a usar y promocionar el uso de apps de rastreo de contactos. Este estudio también examina el papel mediador de la confianza de los usuarios en la app. Datos de 221 usuarios de la app de rastreo de contactos de Irlanda fueron analizados. El modelo se testó usando modelos de ecuaciones estructurales con PLS. Los resultados muestran diferencias entre las motivaciones egoístas y altruistas a la hora de promover el uso de la app. La motivación egoísta promueve significativamente comportamientos voluntarios entre los ciudadanos y la confianza de los usuarios en la app media esta influencia. Sin embargo, en el contexto de la pandemia, la motivación altruista no juega un papel significativo a la hora de animar a los ciudadanos a llevar a cabo estos comportamientos voluntarios, ni directa ni indirectamente. Los resultados de este estudio pueden ayudar a tomar futuras decisiones sobre la implantación de apps de rastreo de contactos en el caso de nuevas pandemias o de otros contextos que requieran un registro diario cooperativo.

Palabras clave: Rastreo de contactos, Covid-19, Motivación altruista, Motivación egoísta, Comportamiento social.

1. INTRODUCTION

The coronavirus (Covid-19) pandemic has been one of the world's major health crises during the past century. In an attempt to curb coronavirus outbreaks due to contact with asymptomatic patients, governments around the world established limitations on citizen mobility and implemented traditional contact-tracing programs (Trang *et al.*, 2020). However, due to the high risk of contagion and the rapid transmission of Covid-19, controlling the pandemic through traditional contact tracing was not feasible (Ferretti *et al.*, 2020).

One solution to this problem that caused great controversy was the implementation of contact-tracing apps (Trang *et al.*, 2020). These apps use big data and Bluetooth and GPS technologies to automatically register all app users with whom an individual has been in contact. Therefore, when a user is infected by the virus and notifies this to the app, other people who have been in contact receive a warning message on their mobile phones to stay in quarantine, thereby helping to prevent the spread of the virus.

Contact-tracing apps' effectiveness depends on a large percentage of the population downloading and using the app (Riemer *et al.*, 2020). This is why countries such as China made their use mandatory (Farronato *et al.*, 2020). In European countries, by contrast, their use was entirely voluntary. In most European countries, such as the United Kingdom (*NHS COVID-19* app), France (*Stop-COVID* app), Italy (*Immuni* app) and Spain (*Radar COVID* app), contact-tracing apps failed. However, there are some exceptions, such as in Germany and Ireland, where contact-tracing apps experienced unprecedented success; for instance, in Germany, the Corna-Warn-App reached 16 million downloads just in its first month, whereas Ireland's COVID Tracker app's downloads reached the equivalent of a third of smartphone users in the country in just its second week (BBC News, 2020). Apps with this level of adoption success provide a useful context for the study of contact-tracing apps.

As contact-tracing apps offer a possible solution to bend the contagion curve, it is of critical importance to understand the factors that influence contact-tracing apps' adoption among citizens. Recently, numerous studies have examined the effect of different factors on the adoption and use of contact-tracing apps worldwide, namely privacy concerns and cyber security risks (e.g., Altmann *et al.*, 2020; Horvath *et al.*, 2022), government-related factors such as trust on the government (e.g., Abeler *et al.*, 2020; Buder *et al.*, 2020) and individuals' political views (e.g., Lewandowsky *et al.*, 2021; Wnuk *et al.*, 2020), technology-related factors such as individuals' technical abilities (e.g., Albrecht *et al.*, 2021; Kostka & Habich-Sobiegalla, 2020), compatible equipment (e.g, Bachtiger *et al.*, 2020; Horstmann *et al.*, 2021), and app design and specifications (e.g., Wiertz *et al.*, 2020; Zhang *et al.*, 2020), and individuals' characteristics such as socio-demographic variables (e.g., Jansen-Kosterink *et al.*, 2021; Von Wyl *et al.*, 2021), health status (e.g., Blom *et al.*, 2021; O'Callaghan *et al.*, 2021), and personality traits (e.g., Guillon & Kergall, 2020; Walrave *et al.*, 2021).

Although these studies answer the question of *"what"* drives or impedes contact-tracing apps' adoption or use, they have not deepened into *"why"* citizens are willing to engage in prosocial behaviours related to the use and adoption of these apps. In the context of a collective action problem as the pandemic, achieving desirable collective outcomes depends partly on individuals' willingness to engage in actions that can have personal costs but benefit the group as a whole (Fang *et al.*, 2022; Syropoulos and Markowitz, 2021). While extant literature has explored psychological underpinnings of prosociality concerning shopping for others or doing telework to support the COVID response overseas (Politi *et al.*, 2021), it is also important to explore *"why"* citizens perform behaviours that benefit the community and its members, but go beyond requirements and are not directly or formally rewarded, such as using a contact-tracing app, recommending it to other potential users and assisting other users downloading and using the app. Therefore, this study seeks to answer the following question: what motivates citizens to perform these behaviours for themselves and others?

As Roberts *et al.* (2014) stated, *"motivation explains why people behave in certain ways, what energises their behaviour and what directs their subsequent voluntary action(s)"* (p. 150). Indeed, motivational factors have successfully been used to explain why users engage in voluntary behaviours towards information systems and online communities (Kim *et al.*, 2018). Yet despite their importance, scant research has been conducted in the context of contact-tracing apps. To address this gap, this study draws on the theory of altruistic and egoistic motivation for prosocial behaviours (Batson & Shaw, 1991) to analyse the underlying motives through which citizens engage in voluntary behaviours aimed at using and promoting contact-tracing apps among others. The study also examines the mediating role of users' trust in the app.

This research contributes to the literature in several ways. First, this research provides empirical insights into the impact of citizens' motivations —ignored to date in the literature— on contact-tracing apps. Additionally, most existing studies investigating contact-tracing apps' adoption were carried out at the beginning of the pandemic (e.g., Abeler *et al.*, 2020; Altmann *et al.*, 2020; Guillon & Kergall, 2020; Kaspar, 2020; Lewandowsky *et al.*, 2021; Li *et al.*, 2020; Trang *et al.*, 2020; Wnuk *et al.*, 2020; Zhang *et al.*, 2020). At that time, there was a great lack of knowledge and confusion around contact-tracing apps. This study conducted several months after the start of the pandemic, when the app was "up and running", can help us better understand the motivations to use and promote the use of contact-tracing apps. Third, whereas previous research has investigated fictitious apps or the determinants of users' intention to adopt contact-tracing apps (e.g., Buder *et al.*, 2020; Horvath *et al.*, 2022; Li *et al.*, 2020, 2021; Naous *et al.*, 2020; Utz *et al.*, 2021; Wiertz *et al.*, 2020), this study analyses the use of a real application among real users. Finally, given that the Covid-19 pandemic may not be the last pandemic that the world will see, the results of the study may inform future policy decisions regarding the implementation of contact-tracing apps in the case of new pandemics, or in other contexts requiring cooperative daily check-in and/or tracing or in fostering adoption of other prosocial initiatives.

2. PRIOR RESEARCH ON CONTACT-TRACING APPS

Since the beginning of the pandemic, research on Covid-19 has grown exponentially, with a great number of studies investigating the factors that influence the adoption and usage of contact-tracing apps. Most previous research has primarily relied on privacy issues, government-related factors, technology-related aspects and individuals' characteristics to explain contact-tracing apps adoption and usage (Table 1).

Table 1
Prior research on factors influencing contact-tracing apps adoption and use

Factors	Variables	Sample of studies analysing the variables	Main findings
Privacy and security	Privacy concerns	Abuhammad *et al.* (2020), Altmann *et al.* (2020), Bachtiger *et al.* (2020), Chan and Saquib (2021), Cocosila *et al.* (2022), Jansen-Kosterink *et al.* (2021), Kostka and Habich-Sobiegalla (2020), Horstmann *et al.* (2021), Horvath *et al.* (2022), Li *et al.* (2021), Utz *et al.* (2021), Walrave *et al.* (2021), Zimmermann *et al.* (2021)	Overall, privacy concerns as well as security and surveillance perceived risks decrease the acceptance and use of contact tracing
	Security/ surveillance risk	Abeler *et al.* (2020), Albrecht *et al.* (2021), Lewandowsky *et al.* (2021)	
Government	Trust in the government	Abeler *et al.* (2020), Altmann *et al.* (2020), Buder *et al.* (2020), Guillon and Kergall (2020), Kostka and Habich-Sobiegalla (2020), Lewandowsky *et al.* (2021)	Overall, acceptance and use of contact tracing are higher for people who trust governments and support their measures. However, the effect of ideological views on the acceptance of contact tracing is inconclusive.
	Satisfaction with the government	Horvath *et al.* (2022)	
	Ideological views	Lewandowsky *et al.* (2021), Wnuk *et al.* (2020)	
	Supporting government measures	Albrecht *et al.* (2021), Saw *et al.* (2021), Von Wyl *et al.* (2021)	
Technology	Technical abilities	Albrecht *et al.* (2021), Blom *et al.* (2021), Kostka and Habich-Sobiegalla (2020)	Overall, individuals' lack of compatible equipment and technical abilities to install, understand and use apps are barriers to contact-tracing apps. Voluntary use, anonymous data and limited data storage are preferable.
	Attitude towards technology	Jansen-Kosterink *et al.* (2021)	
	Technical equipment	Bachtiger *et al.* (2020), Blom *et al.* (2021), Horstmann *et al.* (2021)	
	App characteristics and specifications	Altmann *et al.* (2020), Buder *et al.* (2020), Horvath *et al.* (2022), Kaspar (2020), Lewandowsky *et al.* (2021), Li *et al.* (2020), Li *et al.* (2021), Trang *et al.* (2020), Wiertz *et al.* (2020), Zhang *et al.* (2020), Zimmermann *et al.* (2021)	
Individual's characteristics	Gender	Bachtiger *et al.* (2020), Guillon and Kergall (2020), Horstmann *et al.* (2021), Kaspar (2020), Kostka and Habich-Sobiegalla (2020), Lewandowsky *et al.* (2021), Wnuk *et al.* (2020)	Overall, acceptance of contact tracing is positively correlated with individuals' youth, monthly income, innovativeness and prosocialness, and negatively correlated with individuals' impulsivity. The effects of gender and health status are inconclusive.
	Age	Bachtiger *et al.* (2020), Buder *et al.* (2020), Guillon and Kergall (2020), Horstmann *et al.* (2021), Jansen-Kosterink *et al.* (2021), Kaspar (2020), Kostka and Habich-Sobiegalla (2020), Lewandowsky *et al.* (2021), Von Wyl *et al.* (2021)	
	Financial situation	Abuhammad *et al.* (2020), Kostka and Habich-Sobiegalla (2020), Von Wyl *et al.* (2021)	
	Area of living	Abuhammad *et al.* (2020), Utz *et al.* (2021)	
	Education	Guillon and Kergall (2020)	
	Health status	Bachtiger *et al.* (2020), Blom *et al.* (2021), Buder *et al.* (2020), Horstmann *et al.* (2021), Kostka and Habich-Sobiegalla (2020), O'Callaghan *et al.* (2021)	
	Personality traits	Cocosila *et al.* (2022), Clark *et al.* (2020), Guillon and Kergall (2020), Li *et al.* (2021), Walrave *et al.* (2021)	

Source: Authors.

First, one of the factors that has received great attention among researchers is related to privacy and security. Despite their potential, the use of contact-tracing apps to fight the pandemic has generated great debate. Rowe (2020) discusses the dilemma that citizens face about choosing between safety and privacy. Indeed, several studies have found that citizens across different

countries expressed concerns about privacy as one of the main reasons for not using contact-tracing apps (Abuhammad *et al.*, 2020; Altmann *et al.*, 2020; Bachtiger *et al.*, 2020; Cocosila *et al.*, 2022; Horstmann *et al.*, 2021; Utz *et al.*, 2021). The risk of surveillance after the pandemic and having their phone hacked were also important reasons against app installation (Abeler *et al.*, 2020).

Early studies focused also on government-related factors. Zimmermann *et al.* (2021) found that participants perceived contact-tracing apps as governmental surveillance tools. This is why one of the most important predictors of app uptake was trust in the government (Buder *et al.*, 2020; Guillon & Kergall, 2020; Kostka & Habich-Sobiegalla, 2020). Additionally, Wnuk *et al.* (2020) found that ideological views of individuals were stronger predictors for supporting surveillance than variables related to the pandemic, such as personal threat. Finally, supporting government measures, such as adherence to mask-wearing, were also correlated to the acceptance of contact-tracing apps (Albrecht *et al.*, 2021).

Another factor that has attracted the interest of researchers is related to technology. Individual's technical abilities (Albrecht *et al.*, 2021; Kostka & Habich-Sobiegalla, 2020) were associated with increased contact-tracing app uptake, whereas lack of technical equipment, such as a compatible smartphone, was identified as one of the frequent reasons against app installation (Bachtiger *et al.*, 2020; Blom *et al.*, 2021; Horstmann *et al.*, 2021). App characteristics and specifications were also influential, such as the kind of data storage (Zhang *et al.*, 2020) and the type of installation (Altmann *et al.*, 2020).

Finally, researchers have also focused on how individuals' characteristics, such as gender (Lewandowsky *et al.*, 2021; Wnuk *et al.*, 2020) or age (Jansen-Kosterink *et al.*, 2021; Kostka & Habich-Sobiegalla, 2020), influence contact-tracing apps' adoption. Individuals' health status and the potential to infect or get infected also played an important role (Horstmann *et al.*, 2021; O'Callaghan *et al.*, 2021). Furthermore, individuals' personality traits (Clark *et al.*, 2020) were found to correlate with app uptake too.

While these aspects answer the question of *"what"* drives or impedes citizens from engaging in voluntary behaviours towards these apps, they do not deep into *"why"* citizens are willing to engage in these citizenship behaviours. To address this gap, previous research must be extended to investigate more intangible aspects, such as individual motives, which have successfully explained engagement in voluntary behaviours towards information systems in previous literature (Kim *et al.*, 2018), and which are discussed further below.

3. RESEARCH MODEL AND HYPOTHESES

Prosocial behaviours (or citizenship behaviours) can be defined as behaviours that benefit any community and its members, but go beyond requirements and are not directly or formally rewarded (Lemmon & Wayne, 2015). About contact-tracing apps, these behaviours refer mainly to downloading and using the app (e.g., sharing location information, informing if getting infected, etc.) to create a base of users so that the app is effective, but also to other voluntary behaviours that have been stated to add value to firms and organisations, such as advocacy and helping (Yi & Gong, 2013). On the one hand, advocacy through positive word-of-mouth refers to recommending the app to other potential users, such as work colleagues, family and friends. This behaviour is valuable as it contributes to enhancing the reputation of the object (e.g., firm, organisation, app, etc.) that is being recommended, as well as to promote it among other potential users and increase the base size (Groth *et al.*, 2004; Yi & Gong, 2013). On the other hand, helping refers to users' behaviour aimed at assisting other users in downloading and using the app (Yi & Gong, 2013). This behaviour has also been observed within firms, where customers direct helping behaviour at other customers because the latter may need help behaving in ways consistent with their expected roles (Groth *et al.*, 2004; Yi & Gong, 2013). So, a question arises: what motivates citizens to perform these behaviours for themselves and others?

Batson and Shaw (1991) proposed two types of motivation depending on the ultimate goal that drives prosocial behaviours: altruistic motivation and egoistic motivation.

Altruistic motivation *"is a motivational state with the ultimate goal of increasing another's welfare"* (Batson & Shaw, 1991, p. 108). The primary form of altruistic motivation is altruism, which has been defined as *"behaviour that promotes the welfare of others without conscious regard for one's own self-interests"* (Hoffman, 1978, p. 326). In other words, altruism involves benefiting others without expecting something in return. Piliavin and Charng (1990) conducted a comprehensive review of altruism research and concluded that altruism is a part of human nature. Although there may be very few instances of absolute altruism, where individuals show an absolute lack of self-concern in the motivation for an act, relative altruism, where self-concern plays a subtle role in motivating an act, is more prevalent (Smith, 1981). According to this, in the context of the pandemic, some citizens might become users of a contact-tracing app to help others without expecting anything in return for their help.

Besides altruism, altruistic forms of motivation also include supporting the service provider (Choi & Lotz, 2016). A close relationship between customers and their service providers can increase customers' empathy towards their service providers and their desire to improve the service provider's welfare, resulting in prosocial behaviours (Bove *et al.*, 2009). As Hennig-Thurau *et al.* (2004) suggested, supporting the service provider is related to altruism and draws on the same psychological background, which is a concern for others. In the pandemic context, the service provider is embodied by the central government and/or the national health system in charge of the contact-tracing app. Thus, some citizens might become users of a contact-tracing app to contribute to their communities' fight against the virus and to help others (e.g., governments, health systems, etc.) manage the pandemic.

Extant literature has largely analysed whether altruistic forms of motivation promote prosocial behaviours in a variety of contexts. For instance, individuals motivated by altruism and

the enjoyment of helping others have shown greater willingness to engage in behaviours that would benefit a specific community (Choi & Lotz, 2016), such as using e-participation (Naranjo-Zolotov *et al.*, 2019), tweeting (Lee *et al.*, 2015), using electronic knowledge repositories (Kankanhalli *et al.*, 2005), purchasing local food (Birch *et al.*, 2018), contributing to electronic networks of practice (Wasko & Faraj, 2005) and sharing opinions with others (Reimer & Benkenstein, 2016). Altruistic motivation has also been associated with innovation through co-creation activities (Roberts *et al.*, 2014). Likewise, Lemmon and Wayne (2015) confirmed that altruistic concern for organisations promotes organizational citizenship behaviour toward the organization. Finally, in the context of the Covid-19 pandemic, Apuke and Omar (2021) found that altruistic individuals were more motivated to share information and news about the virus to inform others. Based on the arguments above, the following hypothesis is proposed:

H1: Altruistic motivation has a positive effect on a) intention to continue using the app, b) advocacy, and c) helping.

By contrast, egoistic motivation is *"a motivational state with the ultimate goal of increasing one's own welfare"* (Batson & Shaw, 1991, p. 108). Egoistic forms of motivation include a feeling of duty or felt obligation, reciprocal arrangements which are in the self-interest of all the parties, and pure egoism devoted to increasing one's own good (Schokkaert, 2006). According to this motivation, some citizens might engage with contact-tracing apps due to felt obligation; that is, the inner obligation to care about one's community or organisation's welfare, not to relieve other's suffering, but to receive self-benefits, such as avoiding guilt due to a lack of fulfilment of one's perceived duties (Gebauer *et al.*, 2008). In addition to felt obligation, other citizens might engage with contact-tracing apps due to reciprocity, which involves making contributions for a common goal, based on a perception of supportiveness among the members of a community (Naranjo-Zolotov *et al.*, 2019). Contact-tracing apps' effectiveness depends on a large number of citizens being users; so, although using the app could involve some cost (e.g., battery consumption, concerns about lack of privacy when sharing location information, etc.), citizens might become users with the thought that, if everyone does the same, at the end everyone will benefit from each other. Finally, the ultimate goal of certain citizens to become users of contact-tracing apps might be their own good and benefit, which is inner to human nature, such as receiving valuable information about infections, etc.

Extant literature has also analysed whether egoistic forms of motivation promote prosocial behaviours. For instance, previous research has found that feelings of self-satisfaction, social guilt and perceiving a win-win situation, all of which are egoistic motives, motivate mainstream ethical consumption among individuals (Davies & Gutsche, 2016). Similarly, various studies have found that egoistic forms of motivation promote citizenship behaviours (Choi & Lotz, 2016), such as the purchase of local food (Birch *et al.*, 2018), individuals' contributions to electronic networks of practice (Wasko & Faraj, 2005), innovation through co-creation activities (Roberts *et al.*, 2014) and sharing opinions with others (Reimer and Benkenstein, 2016). Also, Lemmon and Wayne (2015) confirmed that felt obligation towards the supervisor promotes organizational citizenship behaviour toward the supervisor. Based on this, we propose the following hypothesis:

H2: Egoistic motivation has a positive effect on a) intention to continue using the app, b) advocacy, and c) helping.

Previous research has pointed out trust as a critical factor that influences smartphone apps adoption (e.g., Choi *et al.*, 2019; Gu *et al.*, 2017), as trust has largely played a key role in helping users overcome perceptions of risks and uncertainty when using new technology (Gefen *et al.*, 2003; Pavlou & Gefen, 2004). Conceived as *"a glue that holds the relationship together"* (Singh & Sirdeshmukh, 2000, p. 156), trust may be central to the viability of contact-tracing apps because some citizens see these apps as surveillance tools (Zimmermann *et al.*, 2021).

Existing research has demonstrated that, when using a new technology, trust positively predicts behavioural intention (Lee & Song, 2013). For instance, Shiau and Chau (2015) found that trust in online group buying promotes online group buying intention, whereas Chao (2019) demonstrated that trust has a significant influence on students' intention to use m-learning. Similarly, previous studies in a variety of contexts have proven that trust also has a direct effect on the intention to engage in voluntary behaviours (Kim *et al.*, 2018). Indeed, Kim *et al.* (2018) found that feelings of trust predict voluntary behaviours that benefit a community, such as sharing accommodation, even more than altruistic and egoistic forms of motivation; so users who have strong feelings of trust tend to share their rooms, whether or not they enjoy helping others or feel reciprocity towards other members. Additionally, in an organizational context, Lu (2014) found that trust in supervisors promotes organizational citizenship behaviours, whereas Dang *et al.* (2020) found that consumer trust also promotes consumer citizenship behaviours.

Besides promoting voluntary behaviours among individuals, Shiau and Chau (2015) found that trust mediates the relationship between both altruistic and egoistic motivation and prosocial behaviours, such as online group buying intention. In particular, they found that people trust more observable information, so the results of helping others without expecting returns always increase the degree of trust in online group buying activities. Likewise, individuals share information and experiences of online group buying to enhance their image and gain recognition, thus winning the trustworthiness of other members. Based on these studies, we propose that trust in the contact-tracing app mediates the relationship between motivation to use contact-tracing apps and users' voluntary behaviours. Therefore, the following hypotheses are proposed:

H3: Trust mediates the relationship between altruistic motivation and a) intention to continue using the app, b) advocacy, and c) helping.

H4: Trust mediates the relationship between egoistic motivation and a) intention to continue using the app, b) advocacy, and c) helping.

Figure 1 shows the proposed model underlying this research.

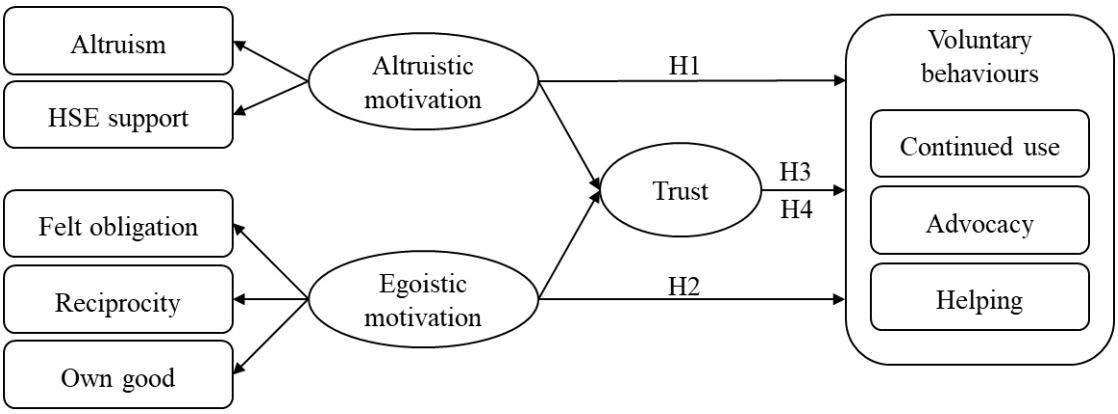

Figure 1
Proposed model
Source: Authors.

4. METHODOLOGY

4.1. Data collection and participants

To test the proposed hypotheses, a study was developed in the context of Ireland's contact-tracing app, called Covid Tracker Ireland. The app was released by the Irish Government and the Health Service Executive, which is the publicly funded healthcare system in Ireland, on 7th July 2020. The app was provided to the public for free for downloading to mobile phones.

Table 2
Sample characteristics

Variable	Category	%
Age	18-25	47.6
	26-45	15.8
	46-65	17.6
	66-80	5.0
	Prefer not to say	14.0
Gender	Male	31.2
	Female	67.8
	Other	0.5
	Prefer not to say	0.5
Education	Primary	0.5
	Secondary	16.7
	Tertiary/University	82.8
Working status	Working full-time	36.2
	Working part-time	11.8
	Studying	44.8
	Unemployed/ Receiving Pandemic Unemployment Payment	2.2
	Stay-at-home Mum/Dad	0.5
	Prefer not to say	4.5

Source: Authors.

Following approval from the University's Research Ethics Committee, an online survey designed using Qualtrics was circulated to students and staff of one of the largest Universities in Ireland. This country commenced a strict lockdown in March 2020, and University education was mainly provided online during the academic year 2020-21. Therefore, data collection took place during the first term of the academic year 2021-22, coinciding with Ireland's plans for a safe return to University campuses. As a screening question, participants were required to have already downloaded the Covid Tracker app. After removing incomplete and non-valid questionnaires, a final sample of 221 respondents was obtained. Table 2 provides an overview of sample characteristics.

The appropriateness of the sample was assessed through the software G*Power v3.1.9.7. Using the effect size at 0.15, the alpha error probability at 0.05, and the statistical power of 95%, a total sample size of 119 would be required. The number of valid responses in this study is 221, which exceeds the minimum requirement, confirming the appropriateness of the sample size.

4.2. Measurement instrument

To measure all the constructs included in the online survey, well-established scales taken from previous literature were adapted to ensure that the items fit the context (Table 3). In all cases, 7-point Likert-type scale items were used, ranging from 1 (strongly disagree) to 7 (strongly agree).

4.3. Common method bias assessment

As the data were based on self-reported measures and collected through a one-time survey, common method bias was evaluated by both procedural and statistical methods (Podsakoff *et al*., 2003). First, participation in the study was voluntary and the responses were anonymous. Furthermore, the dependent and independent variables were included on different pages of the online survey, thus preventing the respondents from identifying cause-effect relationships among the constructs. In addition, the variance inflation factor (VIF) values were assessed. The results suggest there is no common method bias in the study, as all values were between 1.510 and 3.167, lower than the 3.3 threshold (Kock, 2015). Additionally, Harman's single-factor test (Podsakoff *et al.*, 2003) was applied. The first factor explained 45.1% of the covariance among the constructs. As this value is less than the recommended 50% threshold, it can be concluded that common-method bias did not affect the data.

Table 3
Scales, descriptive statistics and measurement model results

Constructs, items and sources	Mean	SD	FL	CR	AVE
Altruistic motivations				0.952	0.768
Altruism (*Reimer & Benkenstein, 2016*)					
ALT1. I want to help others with this	5.43	1.70	0.961		
ALT2. I care about benefiting others	5.48	1.64	0.977		
ALT3. It is important to me to do good for others	5.39	1.71	0.966		
HSE support (*Choi & Lotz, 2016*)					
HSE1. It helps the HSE to manage the pandemic if I use the app	5.10	1.74	0.944		
HSE2. It makes HSE task easier if I use it	5.09	1.68	0.960		
HSE3. It provides HSE with opportunities for improving the current situation if I use it	5.10	1.68	0.964		
Egoistic motivations				0.914	0.545
Felt obligation (*Eisenberger et al., 2001*)					
OBL1. I feel a personal obligation to do whatever I can do to fight the pandemic	5.73	1.57	0.813		
OBL2. I feel a personal obligation to use the app	4.79	1.90	0.916		
OBL3. I would feel guilty if I did not use the app	3.46	2.02	0.798		
Reciprocity (*Wasko & Faraj, 2005*; *Hsu & Lin, 2008*)					
REC1. Other people are helping me by using it, so it's only fair to help them by using it	4.07	2.02	0.861		
REC2. It is advantageous to me and other people to use the app	5.00	1.82	0.926		
REC3. It is mutually beneficial when I use the app	4.81	1.88	0.925		
Own good (*Reimer & Benkenstein, 2016*)					
OWN1. The information in the app is advantageous for me	4.60	1.71	0.813		
OWN2. It is for my own good	4.89	1.76	0.897		
OWN3. I expect to receive something in return (e.g., information about contacts who tested positive)	4.76	1.96	0.701		
Trust *(Slade et al., 2015)*				0.970	0.914
TRU1. I trust the app to be reliable	5.43	1.80	0.938		
TRU2. I trust the app to be secure	5.46	1.82	0.965		
TRU3. I believe the app is trustworthy	5.48	1.80	0.964		
Behavioural intention *(Venkatesh et al., 2012)*				0.941	0.842
INT1. I intend to continue using the app	5.63	1.60	0.916		
INT2. I plan to continue using the app for the duration of the pandemic	5.79	1.54	0.941		
INT3. I will continue using the app even if a covid-19 vaccine becomes widely available	5.31	1.85	0.896		
Advocacy *(Yi & Gong, 2013)*				0.968	0.910
ADV1. I say positive things about the app to others	4.67	1.90	0.952		
ADV2. I recommend the use of the app to others	4.71	1.96	0.967		
ADV3. I encourage friends/relatives/work colleagues to use the app	4.58	2.02	0.943		
Helping *(Yi & Gong, 2013)*				0.961	0.892
HEL1. I help people (e.g., friends, family) when they seem to have problems with the app	3.99	2.20	0.942		
HEL2. I teach other people to use the app correctly	3.67	2.21	0.955		
HEL3. I give advice to other people about the app	3.81	2.19	0.936		

Note: SD: standard deviation; FL: factor loading; CR: composite reliability; AVE: average variance extracted. HSE = Health Service Executive.
Source: Authors.

5. ANALYSES AND RESULTS

The research model was tested using Partial Least Squares (PLS) Structural Equation Modelling (SEM), with the software Smart PLS 3.0. This methodology is the most appropriate method to follow in this study for three reasons: the purpose of the PLS approach is prediction, suitable for the proposed model; the PLS technique does not require a normal distribution; and PLS is indicated for the analysis of models when the sample size is lower than 250, as in our case (Hair *et al.*, 2017; Reinartz *et al.*, 2009). PLS simultaneously assesses the reliability and validity of the measurement model and the estimation of the structural model. These two steps are described next.

5.1. Measurement model

First, the reliability and validity of the research constructs were assessed (Table 3). Altruistic motivation to use the Covid Tracker app was conceptualised as a second-order construct composed by a sense of altruism and the wish to support the Health Service Executive (HSE). Similarly, egoistic motivation to use the Covid Tracker app was operationalised as a second-order construct composed by a sense of felt obligation, feelings of reciprocity, and looking for one's own good. The results showed that all standardised factor loadings were above 0.7 and statistically significant at 0.01 (Carmines & Zeller, 1979), which suggests that the individual item reliability was adequate. In addition, all the constructs were internally consistent, as their composite reliabilities were greater than 0.7 (Nunnally & Bernstein, 1994). The constructs also met the convergent validity criteria, as the average variance extracted (AVE) values were above 0.5 (Fornell & Larcker, 1981). Finally, the discriminant validity was also supported (Table 4) as the square root of the AVE for any two constructs was greater than the correlation estimate among the constructs (Fornell & Larcker, 1981).

Table 4
Discriminant validity

	1	2	3	4	5	6
1. Altruistic motivation	0.876					
2. Egoistic motivation	0.814	0.738				
3. Trust	0.540	0.564	0.956			
4. Continued use	0.319	0.386	0.368	0.918		
5. Advocacy	0.568	0.599	0.543	0.432	0.954	
6. Helping	0.398	0.465	0.287	0.326	0.679	0.945

Note: Values on the diagonal are the square roots of the AVEs. Values below the diagonal are construct correlations.

Source: Authors.

5.2. Structural model

To test hypotheses, a bootstrapping procedure with 5,000 iterations of resampling was used (Chin, 1998). The model accounted for 17.1% of the variation in the intention to continue using the app, 42.2% of the variation in advocacy, and 20.7% of the variation in helping behaviours. The Stone–Geisser test criterion (Q^2) exceeded the threshold of 0 for all dependent variables, thereby supporting the predictive relevance of the model. Finally, as the SRMR (standardised root mean square residual) showed a value of 0.07, lower than the threshold of 0.08 (Hu and Bentler, 1998), it can be concluded that the model has a good fit.

The results (Table 5) indicated that, among the two types of motivation, egoistic motivation is the only one showing significant effects on users' voluntary behaviours. In particular, users' egoistic motivation to use the app is positively associated with their intention to continue using the app (β = 0.291; *p-value* = 0.016), advocacy (β = 0.300; *p-value* = 0.002), and helping behaviours (β = 0.406; *p-value* = 0.000), which supports H2. On the contrary, altruistic motivation to use the app has no significant effect on users' intention to continue using the app (β = -0.040; *p-value* = 0.718), advocacy (β = 0.172; *p-value* = 0.107), or helping (β = 0.050; *p-value* = 0.653), which leads H1 to be rejected. Regarding the mediating role of users' trust in the app on the relationship between motivations and prosocial behaviours, the findings show that trust partially mediates the role of egoistic motivation on intention to continue using the app (β = 0.083; *p-value* = 0.025) and advocacy (β = 0.103; *p-value* = 0.007), which supports H4a and H4b respectively. However, no mediating role has been found for trust neither among the influence of egoistic motivation on helping (β = 0.011; *p-value* = 0.687), nor among the influence of altruistic motivation on intention to continue using the app (β = 0.054; *p-value* = 0.108), advocacy (β = 0.068; *p-value* = 0.060), or helping (β = 0.007; *p-value* = 0.711), leading H3 and H4c to be rejected.

Table 5
Structural model results

Hypotheses	β	*t*	*p*-value	Supported
H1a: Altruistic motivation → Behavioural intention	–0.040	0.362	0.718	No
H1b: Altruistic motivation → Advocacy	0.172	1.614	0.107	No
H1c: Altruistic motivation → Helping	0.050	0.450	0.653	No
H2a: Egoistic motivation → Behavioural intention	0.291	2.410	0.016	Yes
H2b: Egoistic motivation → Advocacy	0.300	3.130	0.002	Yes
H2c: Egoistic motivation → Helping	0.406	3.786	0.000	Yes
H3a: Altruistic motivation → Trust → Behavioural intention	0.054	1.607	0.108	No
H3b: Altruistic motivation → Trust → Advocacy	0.068	1.885	0.060	No
H3c: Altruistic motivation → Trust → Helping	0.007	0.370	0.711	No
H4a: Egoistic motivation → Trust → Behavioural intention	0.083	2.242	0.025	Yes
H4b: Egoistic motivation → Trust → Advocacy	0.103	2.702	0.007	Yes
H4c: Egoistic motivation → Trust → Helping	0.011	0.403	0.687	No

Source: Authors.

6. DISCUSSION

Based on the theory of altruistic and egoistic motivation for prosocial behaviours (Batson & Shaw, 1991), one could expect that users of a contact-tracing app might engage with it to help others (namely altruistic motivation) and to receive self-benefits (namely egoistic motivation). However, contrary to our predictions, this research has shown that, in the context of contact-tracing apps, altruistic motivation does not predict users' voluntary behaviours either directly (rejecting H1) or indirectly (rejecting H3), and that continuance use intention, advocacy and helping are only motivated by individuals' egoistic motivation (supporting H2). These findings are novel and contradict previous literature somewhat. While it is true that the positive effect of egoistic motivation on prosocial behaviours has been well documented in previous research in other contexts (e.g., Birch *et al.*, 2018; Choi & Lotz, 2016; Davies & Gutsche, 2016; Lemmon & Wayne, 2015; Reimer & Benkenstein, 2016; Roberts *et al.*, 2014; Wasko & Faraj, 2005), most existing knowledge has usually supported the predominance of altruistic motivation over egoistic motivation. For instance, Kankanhalli *et al.* (2005) found that enjoyment in helping others (altruistic motivation) promotes electronic knowledge repository usage, while reputation and reciprocity (egoistic motivation) don't. Similarly, Lee *et al.* (2015) found that altruistic motivation promotes intention to tweet, while egoistic motivation doesn't. Likewise, Naranjo-Zolotov *et al.* (2019) showed that altruism promotes the intention to use e-participation, while reputation and reciprocity (egoistic motivation) don't. A possible explanation for the predominance of egoistic motivation in the specific context of contact-tracing apps can be found in Schechter and Yuskavage (2012), who determined that relationships that are not directly reciprocated might not be based on altruism. This idea is also in line with the work of Maner and Gailliot (2007), who stated that motivations for prosocial behaviours depend on the relationship context, with altruistic motivation being more prominent in the context of close relationships than among strangers. Similarly, Piatak and Holt (2020) stated that in formal contexts, motivations related to public service might be more consistent predictors of prosocial behaviours than altruism. Considering these arguments, as in the Covid-19 pandemic context there is a common benefit but an individual threat, and there is no direct reciprocation between well-known individuals, it is plausible that receiving self-benefits is more important to individuals than helping other strangers when considering the use of contact-tracing apps.

Finally, in the specific context of contact-tracing apps, the findings have confirmed the importance of trust in the success of the app. In line with previous research in varied contexts which predicted the effect of trust on voluntary behaviours (e.g., Chao, 2019; Dang *et al.*, 2020; Kim *et al.*, 2018; Lee & Song, 2013; Lu, 2014; Shiau & Chau, 2015), the findings of this study have demonstrated that trusting the contact-tracing app plays a mediating role between egoistic motivation to use the app and users' intention to continue using the app and to be advocates of the app (supporting H4a and H4b). As trusting the app involves perceiving it as reliable and secure, it somehow also translates into whether users trust the organisation that controls the app, such as the government, the healthcare system, or the app developer. Therefore, these findings are in line with other studies who found that acceptance and use of contact-tracing apps are higher for individuals who trust the organisation in charge of it, which is usually the government (e.g., Abeler *et al.*, 2020; Altmann *et al.*, 2020; Buder *et al.*, 2020; Guillon & Kergall, 2020; Kostka & Habich-Sobiegalla, 2020; Lewandowsky *et al.*, 2021).

6.1. Theoretical implications

This study makes several theoretical contributions. First, as stated before, most existing research analysing the adoption and use of contact-tracing apps worldwide has limited the scope of those studies to variables related mainly to privacy and security concerns and cyber security risks, government-related factors, individuals' characteristics, and technology-related factors. From a theoretical point of view, prior research has drawn on theoretical paradigms such as the technology acceptance model, the theory of goal-directed behaviour, the theory of privacy (Shahidi *et al.*, 2022), the unified theory of acceptance and use of technology (van der Waal *et al.*, 2022) or the theory of planned behaviour (e.g., Kwarteng *et al.*, 2023), to analyse the determinants of contact-tracing apps adoption and the acceptance or resistance to use them. These studies have found that factors such as a positive attitude towards these apps (Kwarteng *et al.*, 2023) or social norms regarding the use (van der Waal *et al.*, 2022) are stronger predictors of adoption and use. However, scant research has focused on individuals' motivations, leaving the question of *"why"* citizens are willing to engage in prosocial behaviours related to the adoption and use of contact-tracing apps unanswered. Drawing on the theory of altruistic and egoistic motivation for prosocial behaviours (Batson & Shaw, 1991), this study contributes to the existing body of knowledge by showing that the motives through which citizens engage in voluntary behaviours aimed at using and promoting the use of contact-tracing apps are mainly egoistic. As noted by Maner and Gailliot (2007), motivations for prosocial behaviours depend on the relationship context. Therefore, this study provides the first empirical evidence of the predominance of egoism over altruism in the context of contact-tracing apps, which has not received attention previously.

This study also contributes to bridging existing knowledge gaps in terms of the methodology and research context. First, most data collection of empirical studies analysing contact-tracing apps during the Covid-19 pandemic were carried out during the first six months after the launch of the first contact-tracing app worldwide (e.g., Abeler *et al.*, 2020; Altmann *et al.*, 2020; Guillon & Kergall, 2020; Kaspar, 2020; Li *et al.*, 2020; Trang *et al.*, 2020; Wnuk *et al.*, 2020; Zhang *et al.*, 2020). During these first months, many countries were experiencing lockdowns or other public-health interventions related to minimising contacts, and therefore citizens' perceptions of risk from interacting with or near others may have been lowered. Consequently, apps may have been perceived as a less necessary intervention until a return to "normality" and greater socialising was imminent. Secondly, as during those first months of the pandemic in which most studies were carried out, many countries had not even launched their own contact-tracing apps, most empirical studies did not survey real users of any app but analysed situations with

hypothetical apps or just focused on analysing citizens' general opinions about contact-tracing (e.g., Buder *et al.*, 2020; Li *et al.*, 2020, 2021; Naous *et al.*, 2020; Utz *et al.*, 2021; Wiertz *et al.*, 2020) as well as their intention to use these apps in the future (see Von Wyl *et al.* (2021) and Joo and Shin (2020) as exceptions). Therefore, this study contributes to the existing literature by analysing contact-tracing apps' use among citizens at a critical time of the pandemic, when the country was returning to "normal" opening, and by providing empirical evidence on the use of contact-tracing apps based on a sample of real users of a real and in-use app. Finally, previous studies on this phenomenon have focused on a limited number of European countries, mainly Germany (e.g., Blom *et al.*, 2020; Buder *et al.*, 2020; Kaspar, 2020), the United Kingdom (e.g., Abeler *et al.* 2020; Bachtiger *et al.*, 2020; Lewandowsky *et al.*, 2020) and France (e.g., Guillon & Kergall, 2020). Therefore, this study contributes to the current literature by analysing Ireland's contact-tracing app, Covid Tracker, which is worthy of study, as it represents a case of success in terms of downloads, compared to other European countries.

6.2. Practical implications

The Covid-19 pandemic has not been the only viral health crisis in recent decades (Pamplona da Costa *et al.*, 2021); for instance, the Ebola virus in Western Africa, the Zika virus in Latin America, or the Influenza A (H1N1) virus in the USA, had already assaulted health systems before. Furthermore, it does not seem that Covid-19 is going to be the last viral pandemic. Indeed, Microsoft co-founder Bill Gates, who predicted the Covid-19 outbreak in 2015, has warned about the emergence of more pandemics in the future. Having learnt from the Covid-19 pandemic, the use of contact-tracing apps might be a powerful tool to fight future viral pandemics. However, as it happened with the Covid-19 pandemic, for the success of these apps, it is vital to gain a significant base of users. In this sense, the findings derived from this study might help to understand the factors that influence contact-tracing apps' voluntary adoption among the population, to develop future apps and campaigns that would be persuasive for citizens in the event of emerging pandemics.

As this study has demonstrated, instead of emphasizing altruistic benefits derived from using these apps, governments, national health systems, and other responsible third parties are recommended to emphasize the benefits for the individual. To do that efficiently, the first step to follow would be to identify, through research, the form of egoistic motivation (i.e., sense of felt obligation, reciprocity, or own good) that is most salient among citizens of a city or country.

The second step would be to design and deliver powerful communication campaigns in line with the most salient forms of egoistic motivations identified in the previous step. As Laor and Lissitsa (2022) suggested, mainstream media has been the primary source of pandemic information, and thus, should also be the primary source of contact-tracing apps' promotion.

For those places with a high sense of felt obligation or duty, policy makers should use powerful messages to encourage individuals to use contact-tracing apps by appealing to citizens' pride and shame, following the example of the British government, who launched the campaign *"Can you look them in the eyes?"* to encourage the public to follow restrictions. This campaign consisted of pictures showing close-up facial shots of Covid-19 patients and NHS workers wearing oxygen masks and asked people whether they could look them in the eyes and tell them they were doing everything they could to stop the spread of the virus.

For places ranking high on reciprocity, policy makers should create communication campaigns that promote feelings of community and reciprocal effort among users, following the example of Germany, which launched the campaign *"Ich schütze Dich!" (I protect you!)* to express the idea that if other citizens are following the rules to protect you, it is only fair that you do the same to protect them. Similarly, the Irish government launched the campaign *"#InThisTogether"* for people to stay connected, active and mentally well. In this campaign, they promoted the idea of unity in the country and group effort. It included statements such as *"Some of us are anxious"*, *"Some of us are learning to video call our grandchildren for the first time"*, and *"Some of us are working on the front line"*, among others, ending up with *"We'll make it through, together"*. Other countries have also emphasized the idea of unity in their campaigns during the Covid-19 pandemic. For instance, the Northern Ireland Executive released a campaign with the slogan *"We all must do it to get through it"*. Similarly, the Spanish Government used the message *"Este virus lo paramos unidos" (We will stop this virus together)* to reinforce the idea of common effort.

For places where people are motivated mainly by the benefits that contact-tracing apps can have for themselves, policy makers should create campaigns that increase one's perception of self-benefits by showing people how using these apps can considerably improve their lives (e.g., meeting socially with others, travelling, etc.), countering concerns over adverse side-effects, such as battery consuming or surveillance. This would follow the example of the French Government, which also appealed to this egoistic form of motivation and launched the campaign *"Oui, le vaccine peut avoir des effecs désirables" (Yes, the vaccine can have desirable effects)* to persuade young people to have the Covid-19 vaccine, focusing on the desirable effects of getting vaccinated, such as kissing, hugging, or travelling.

Finally, once the campaign is launched, the last step would be to measure its effectiveness in promoting the acceptance and use of contact-tracing apps by identifying key performance indicators (KPIs). Some of these contact-tracing app KPIs are based on mobile app KPIs proposed by Kurzweg (2023), while others correspond to metrics followed during the Covid-19 pandemic (Resolve To Save Lives, 2021). The indicators include: *(1) App Downloads:* the number of times the contact-tracing app gets downloaded to a smartphone device; *(2) App Installs*: actual installations completed on the devices, as not all app downloads might complete the setup process; *(3) App Uninstalls:* when uninstallations occur, to see if it corresponds to any change in the app (e.g., an update) or to changes in other policies and/or restrictions regarding the pandemic; *(4) Registrations*: if users are failing to register after downloading the contact-tracing app, the onboarding flow should be reviewed; *(5) Permissions Granted*: the number of permissions (e.g., location, agenda, alerts) that users allow the contact-tracing app; *(6) Daily Active users*: the number of active users who check in on the contact-tracing app daily; *(7) New Cases Reported per day*: the number of positive cases reported to the app daily; *(8) Contacts Notified*

per day: the number of close contacts of a positive case identified and notified to stay in quarantine through the contact-tracing app. *(9) User Growth Rate*: since contact-tracing apps rely on a consistent base of users to work effectively, it is important to ensure that the user base is growing and to understand how it grows. This can be obtained with the following formula: ((Present User Amount – Past User Amount)/ Past User Amount) * 100; *(10) Social Shares*: the number of times the contact-tracing app is recommended or shared on social media.

6.3. Limitations and future research lines

As with any research, this study has limitations, which offer avenues for future research. First, due to privacy restrictions during data collection (i.e., we could not ask participants for contact. details to contact them in the future), the data were collected using a one-time, self-administered questionnaire; therefore, we cannot analyse the continuance of voluntary behaviours over time. Future studies could use longitudinal data to analyse behaviours related to contact-tracing apps in the long term. Second, the sample is limited to one segment of citizens: students and staff from an Irish University. It would be interesting to include other citizens segments, such as primary and secondary schools, families, employees, etc. Third, the sampling procedure has limitations, such as self-selection bias and the lack of information about non-respondents who use the app. Therefore, future research should use random sampling procedures. Additionally, the data were collected based on one specific contact-tracing app from one specific country: Covid Tracker Ireland. While this app has been successful, which provides great learnings for other apps, future research should replicate this model using other apps in different countries, and in other contexts. Finally, future research should also consider the perspective of the government and/or public institution in charge of the contact-tracing app to provide a wider view of the acceptance and use of these apps.

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