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

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I use a COVID-19 contact-tracing app. Do you? Regulatory focus and the intention to engage with contact-tracing technology

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ABSTRACT

Based on regulatory focus theory, it is proposed that there is a relationship between the intention to use COVID-19 contact-tracing apps and goal-directed motivation. Two studies tested this proposal. Study 1 examined the relationship between participants' chronic regulatory focus and the intention to use contact-tracing apps. Apps usage intention was positively associated with prevention focus. A mediation analysis showed that the relationship between prevention focus and apps usage intention was mediated by privacy and information security concerns. The stronger the prevention focus, the weaker the concerns, thus, the stronger the intention to use contact-tracing apps. Study 2 used priming to have participants adopt either a momentary promotion or prevention focus, after which they were asked about their intention to use contact-tracing apps. A situationally induced regulatory focus influenced the intention to use contact-tracing apps. A moderation analysis showed that age moderated the relationship between regulatory focus and apps usage intention.

1. Introduction

Rapid contact tracing is essential to slowing the spread of COVID-19. By allowing authorities to quickly notify those who may have been exposed to the virus, contact-tracing apps help scaling up the process (Elkhodr et al., 2021). However, despite the understanding that contact-tracing apps may help in the battle against COVID-19, penetration rates of these apps in many countries are low (Kahnbach et al., 2021). This is a problem because contact-tracing apps are only as good as the number of users willing to share information with the network. The greater the number, the more effective the applications are. Therefore, for this approach to succeed, it is essential to find ways to encourage people to use these apps and voluntarily share personal information with public health authorities regarding their COVID-19 status.

Against this backdrop, the goal of this research is twofold: first, to provide insight into the psychological mechanisms underlying the intention to use COVID-19 contact-tracing apps; second, to advance the understanding of how to encourage people to voluntarily share personal information with the authorities in times of public health crisis.

This paper is structured as follows. It starts with literature review on acceptance of, and intention to use, COVID-19 contact-tracing apps. Next, regulatory focus theory, a well-established theory of motivation and goal-directed behavior, is introduced (Scholer, Cornwell & Higgins, 2019). This is followed by the proposal that there is a relationship between the intention to use contact-tracing apps during public health crisis and goal-directed motivation. The rationale behind this proposal is discussed. In the sections that follow, two studies are reported that support this proposal. Based on these studies, a model for the intention to use contact-tracing apps is developed. Finally, practical implications for public health are discussed.

2. Contact-tracing apps: public acceptance

Contact tracing is used by public health authorities to determine the chain of contacts of an infected person. The goal of contact tracing is to identify people who may have been exposed to, and possibly infected with, COVID-19, and get them to self-isolate. Rapid contact tracing is critical to slowing the spread of the virus, and this is where automated contact-tracing apps may be useful and beneficial for individual users and the community. These apps are designed to detect contacts between mobile devices and automatically send a notification telling the users or public health officials whether somebody has potentially been exposed to COVID-19.

Digital contact tracing uses different technologies to detect contacts between mobile devices (Hernández-Orallo, Manzoni, Calafate & Cano, 2020). Some apps use location tracking. This technology is capable of identifying a person's contacts by tracking their mobile phone's movements (by using for example GPS), and looking for other phones that have spent time in the same physical location. Some apps use proximity tracking, in which a mobile phone is able to swap encrypted tokens with other nearby phones over Bluetooth. Using this technology, it is easier to anonymize the users, and is therefore considered better for privacy as

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compared with location tracking. There is also the DP-3T protocol which stands for decentralized privacy-preserving proximity tracing. This is an open-source protocol for Bluetooth-based tracking in which contact logs of an individual phone user are only stored locally, so no central authority is able to know the identity of those who have been exposed to COVID-19. As for the architecture of data collection, there are three approaches: centralized, decentralized, and hybrid. In a centralized design, there is a central server that is capable of performing various functions including storage of personal information, generation of contact records, risk analysis, and exposure notification. In a decentralized design, these functions are transferred to the users' devices, leaving the central server with no, or with minimal, participation in the entire process of contact tracing. In a hybrid design, these functionalities are divided between the users' devices and the central server.

The Exposure Notifications System [ENS] is an example of a global initiative led by tech giants Google and Apple to facilitate digital contact tracing (Michael & Abbas, 2020). The ENS is a platform jointly developed by the two companies with the purpose of letting iOS and Android phones communicate with each other over Bluetooth. Developers around the world can use the platform to build contact-tracing apps that work for both iOS and Android devices. The general idea is that a user who has been diagnosed with COVID-19 has the option to voluntarily upload the information to the system. Other users who may have come in close proximity with this user will receive a notification to their smartphone with further instructions from public health authorities. Of particular importance is that apps using the system cannot track the user's location. Furthermore, the system does not share the user's identity with Google, Apple, or other users. Here is how the technology works. For every smartphone that opts in, the technology disguises the identity of the user by generating a random sequence of numbers that change every few minutes (a privacy-preserving ID). Then, using Bluetooth, anytime a phone detects another phone close by that also opted in, the two devices work in the background to exchange these random IDs. If in the future a user is diagnosed positive for COVID-19, they can report that positive result in their app. Any phone that has exchanged random IDs with this user in the last 14 days will receive a notification that they may have been exposed to COVID-19 without revealing their identity. Public health authorities can then help anyone at risk with guidance. To protect the users' privacy, every user controls whether they receive notifications. The technology only works if the user decides to opt-in, and it can be turned off at any time. The matching process happens on the user's device, and the identity of the user is not shared with other users, Google, or Apple. The system does not collect nor does it use location data from the devices. It uses Bluetooth, a technology designed to detect if two devices are in close proximity without revealing their geographic location. If a user has been exposed to COVID-19, public health authorities may ask them for additional information (e.g., a phone number) to contact them with guidance.

Among the most significant advantages of using mobile applications to perform contact tracing are the rapid collection of reliable data and fast detection of contacts at risk. By allowing authorities to quickly notify those who may have been exposed to COVID-19, contact-tracing apps scale up the process, thus helping in the battle against the disease. However, the success of these apps relies on people's willingness to voluntarily share information with the authorities regarding their COVID-19 status. This is an important issue because despite all the advantages, penetration rates of contact-tracing apps in many countries are low (Kahnbach et al., 2021). And the question is why.

2.1. Privacy concerns

One of the key factors in the acceptance of contact-tracing via smartphone apps is privacy concerns (Li et al., 2021). People generally strive to protect their private life from any attempts at interference. The need and willingness to protect private life are major barriers to the adoption of contact-tracing technology, in particular because these applications are often perceived by the public as an intrusion of privacy. Privacy concerns and mistrust of government, especially concerns over government surveillance, may be a source of tension in the relationship between the government and the citizens. People are worried that their personal information might be used by the government to track and monitor them for purposes other than public health. In addition, there are worries that government surveillance will continue long after COVID-19 is gone. This is important because the combination of privacy concerns and lack of trust in government may hamper the willingness to use contact-tracing apps.

Indeed, an interview study in the United Kingdom that explored public opinions on contact-tracing apps found that privacy and surveillance concerns predominated (Samuel et al., 2021). These concerns were associated with fear of violation of individual liberty and autonomy. A study of the adult population in Luxembourg showed that although Luxembourgers in general had a positive attitude towards contact-tracing apps, privacy concerns could hamper their willingness to adopt one (Riillo, Peroni & Sarracino, 2020).

2.2. Information security concerns

In a related vein, there is evidence that people also have concerns about information security (O'Connell et al., 2021). Security flaws both in the design and implementation of contact-tracing apps may put personal data at risk. In particular, there is a risk that sensitive information may be misused or processed unlawfully. Concerns about data protection and data security are only amplified by worries about the vulnerability of smartphones to malicious attacks and hacking (Reshmi, 2021). Cyber threats include various malwares, such as viruses, ransomware, spyware, Trojan horses, and worms. Among these, ransomware is one of the biggest cyber threats to digital infrastructure. Attackers who launch ransomware attacks use various techniques to bypass an unauthorised access to data assets and collect information. The primary purpose is to hijack data and demand ransom in exchange for the data that were captured. Embedded in ransomware, crypto modules can be used to render the user's data unavailable. Ransomware either locks the devices or encrypts the files and demands the user to pay ransom to retrieve access. Clearly, this can be a major concern to users of contact-tracing apps, in particular in the case that the attack is used to demand ransom in exchange for not publishing the data that was captured.

A study in France, Germany, Italy, the United Kingdom, and the United States found strong support for contact-tracing apps in all countries under different installation regimes (voluntary vs. automatic by mobile phone providers) (Altmann et al., 2020). Cybersecurity and privacy concerns, together with lack of trust in government, were major barriers to uptake. In a Johns Hopkins study of US citizens, it was found that the vast majority of respondents (between 70 and 80%) were willing to install an app that is perfectly private and/or accurate (Kaptchuk, Goldstein, Hargittai, Hofman & Redmiles, 2020). However, only 23% of respondents reported being willing to install an app that might leak their location, while 31% of respondents were willing to install an app that might leak their proximity data (information about who they have been close to). A study of Australian adults and American adults found that the provision of data safety assurances had a positive impact on people's intentions to engage with contact-tracing technology (Bradshaw et al., 2021).

2.3. Is the technology effective?

In addition to privacy and information security concerns, many people have concerns over the effectiveness of contact-tracing technology. A study in Germany found that doubt about the effectiveness of the apps was a strong predictor of not engaging with digital contact-tracing systems (Horstmann, Buecker, Krasko, Kritzler & Terwiel, 2021). Another study comparing the willingness to use contact-tracing apps in China,

Germany, and the United States found that public acceptance of contact-tracing technology was highest among Chinese respondents (Kostka & Habich-Sobiegalla, 2020). The factors influencing acceptance rates were similar in the three countries, and included the perceived effectiveness of contact-tracing apps, privacy concerns, and trust in state officials. One of the concerns with respect to the effectiveness of contact-tracing technology was that the adoption rate of contact-tracing apps in the general population would be low. A study aimed at measuring the actual usage of Germany's official contact-tracing app revealed skepticism about the effectiveness of contact-tracing technology (Munzert, Selb, Gohdes, Stoetzer & Lowe, 2021). A silver lining was that this skepticism was combined with optimism about the prospects of increasing the effectiveness of these apps by expanding the user base through monetary incentives. Indeed, it has been shown that monetary incentive (even small ones) could significantly increase the uptake of digital contact-tracing apps. In a UK-based focus group study, participants were divided as to whether or not they intended to use a COVID-19 contact-tracing app (Williams, Armitage, Tampe & Dienes, 2021). Participants who stated that they would not be using the app expressed concerns over uptake, privacy, and stigma. Concerns over uptake were linked to doubts whether enough people would use the contact-tracing technology in order for it to be an effective means of limiting the spread of COVID-19. For those who stated they would be using the app, contributing to the greater good was the main reason for their choice.

To summarize, privacy and information security concerns, when combined with doubts about the effectiveness of contact-tracing apps, could be a major barrier to the uptake of the technology. This could only be exacerbated by lack of trust in government and public health authorities.

2.4. COVID-19 perceived risk

Another line of research suggests that risk perception of COVID-19 is associated with the adoption of preventive behaviors against the disease (Dryhurst et al., 2020). Particularly relevant in this context is that COVID-19 risk perception correlates positively with the intention to use contact-tracing apps (Li et al., 2021). Risk perception of extreme events like COVID-19 has cognitive, emotional, and social dimensions. Studies focusing on cognitive aspects of risk perception and health behavior show that engagement in preventive behavior is positively associated with the perceived likelihood of harm (subjective probability of being harmed by the disease), perceived susceptibility to harm (subjective vulnerability to the disease), and perceived severity of harm (subjective danger associated with the disease) (Brewer et al., 2007). Studies examining emotional aspects indicate that engagement in virus-mitigating behaviors during COVID-19 is positively associated with fear of the virus (Harper, Satchell, Fido & Latzman, 2020) and level of anxiety (Fragkaki, Maciejewski, Weijman, Feltes & Cima, 2021). Studies exploring social aspects of risk perception and health behavior reveal that COVID-19 perceived risk is positively associated with prosocial values (it is important to do things for the benefit of society even if they come with a cost at the personal level), negatively associated with individualistic worldviews (the government should not interfere with citizens' private lives), and positively associated with social amplification (hearing about the virus from family and friends, news consumption, and information received on social networks) (Dryhurst et al., 2020).

Taken together, these studies suggest that engagement in preventive behaviors, willingness to comply with restrictive measures to counter the spread of COVID-19, and the intention to use contact-tracing apps are all positively associated with COVID-19 perceived risk. People who believe that COVID-19 is a dangerous disease, see themselves as vulnerable, and estimate their probability of being infected as high, will be more willing to use contact-tracing apps than those who do not. Anxiety and fear of COVID-19 may strengthen the effect. Prosocial values may also facilitate the uptake of contact-tracing apps.

2.5. Summary

Based on the literature, worries about privacy and civil liberties, concerns about information security, and doubts about the effectiveness of the technology have been identified as major inhibitors to the uptake of contact-tracing apps. Mistrust of government and concerns about intrusion by state agencies only exacerbate these effects. From a risk perception perspective, complacency about the risk of COVID-19 and lack of awareness about (or poor judgment of) how dangerous the disease can be, have been shown to hinder the adoption of contact-tracing technology. Lack of fear of COVID-19, low level of anxiety about the consequences of the disease, and over-optimism about the likelihood of contracting the virus contribute to these effects. In general, the perceived risk of COVID-19 is expected to drive positive attitudes towards contact-tracing acceptance. The higher the perceived risk, the stronger should be the intention to adopt contact-tracing apps. By contrast, concerns about the technology are expected to do the opposite. The higher the concerns, the weaker should be the intention to engage with contact-tracing technology.

There are many other factors influencing the uptake of contact-tracing apps, some of which are facilitators and some are barriers. Notable facilitators are prosocialness and willingness to contribute to the greater good (Hassandoust, Akhlaghpour & Johnston, 2021; Li et al., 2021; Williams et al., 2021), collective responsibility (Riillo et al., 2020), intrinsic attitudes toward new technologies and readiness to adopt innovative solutions (Li et al., 2021), perceived personal benefit (Hassandoust et al., 2021), perceived public health benefits (Li et al., 2021), adoption willingness of other people (Li et al., 2021), use of other health apps (Kostka & Habich-Sobiegalla, 2020), pre-existing underlying health conditions (Jonker et al., 2020), and the extent to which one has changed one's lifestyle because of COVID-19 (e.g., avoiding public transportation) (Saw, Tan, Liu & Liu, 2021).

Notable barriers are low general trust in others (Horstmann et al., 2021), misconceptions surrounding the apps, for example, that contact tracing would involve some form of 'mapping' that would be visible to others (Williams et al., 2021), and belief in COVID-19 conspiracy theories (Banai, Banai & Mikloušić, 2021; Corbu, Negrea-Busuioc, Udrea & Radu, 2021). To this are added fear of stigmatization (Williams et al., 2021) and individualistic worldviews (Dryhurst et al., 2020), as well as low technical skills, problems with downloading or installing apps, and lack of technical equipment or not having appropriate devices (Horstmann et al., 2021).

As can be seen, studies on acceptance of contact-tracing technology cover numerous factors all of which likely have some level of influence over the intention to adopt contact-tracing apps. Nevertheless, I would argue that to better understand why so many people resist tracking technologies, it is essential to find a link between the subjective circumstances of the individual and the objective circumstances of COVID-19. And this is where the current research comes in. Drawing on regulatory focus theory (Scholer et al., 2019), a leading theory of motivation and goal-directed behavior, this research offers a new theoretical perspective on the acceptance of contact-tracing apps. Special emphasis is put on the role of achievement motivation in the voluntary adoption of tracking technologies. When actively engaged in goal pursuit, people can use different strategies and tactics to achieve their goals. The choice of strategies and tactics depends on the motivation that drives the individual, and has implications for goal-directed behavior. From this perspective, it is likely that goal-directed motivation will have an influence on the willingness to adopt contact-tracing apps. In the next section, the theory of regulatory focus is introduced and the rationale behind this idea is discussed.

3. Regulatory focus

According to regulatory focus theory (Scholer et al., 2019), there are two substantially different ways to pursue goals. There is the

promotion-focused way and there is the prevention-focused way. The two ways differ in what motivates goal pursuit and also in which strategies are preferred in goal pursuit. People with a promotion focus are motivated by growth and advancement, and prefer to use eager strategies in goal pursuit. People with a prevention focus are motivated by security and safety, and prefer to use vigilant strategies. Growth and security are two basic human needs, and all people are concerned about both, maintaining safety and pursuing progress. Nevertheless, in any given moment, concerns of one type may predominate over the other due to either chronic or situational differences in accessibility, which can then influence behavior.

Individuals with a strong promotion focus are motivated by growth-related goals such as progress and advancement. They think big, dream big, getting ready for the next big thing. Given these goals, promotion-focused individuals are primarily sensitive to gains and nongains (Idson, Liberman & Higgins, 2000). Gains reflect success whereas nongains (an unsatisfactory status quo) reflect failure. The motivation is to move from 0 to +1. In terms of approach and avoidance, the motivation is to approach gains and avoid nongains. These individuals have a strategic preference for eagerness means of goal attainment – enthusiastically striving to achieve personal goals (Crowe & Higgins, 1997). Promotion-focused eagerness has been shown to be associated with various types of behaviors, such as considering multiple alternatives (Liberman, Molden, Idson & Higgins, 2001), readiness to take risks (Zou, Scholer & Higgins, 2014), creative thinking (Friedman & Förster, 2001), openness to new experiences (Vaughn, Baumann & Klemann, 2008), a preference for change over stability (Liberman, Idson, Camacho & Higgins, 1999), and in tasks involving speed-accuracy trade-off, speed is more important than accuracy (Förster, Higgins & Bianco, 2003).

Individuals with a strong prevention focus are motivated by security-related goals. They are concerned with maintaining safety and upholding obligations and duties. Given these goals, prevention-focused individuals are primarily sensitive to nonlosses and losses (Idson et al., 2000). Nonlosses (a satisfactory status quo) reflect success whereas losses reflect failure. The motivation is to not move from 0 to −1. In terms of approach and avoidance, the motivation is to approach nonlosses and avoid losses. These individuals have a strategic preference for vigilant means of goal attainment – careful deliberation before taking action (Crowe & Higgins, 1997). Prevention-focused vigilance has been shown to be related to different types of behaviors, such as considering fewer options and thoroughly vetting the options before making a decision (Liberman et al., 2001), a preference for stability over change (Liberman et al., 1999), avoiding unnecessary risk (Hamstra, Bolderdijk & Veldstra, 2011), favoring the status-quo over reform (Boldero & Higgins, 2011), and in speed-accuracy tasks, accuracy is more important than speed (Förster et al., 2003).

According to regulatory focus theory, all people are motivated by both promotion and prevention concerns. However, there are differences between individuals in chronic accessibility to these two types of concerns (personality-related variation), and there are also differences in temporary accessibility (variation due to momentary situational influences). Individual differences in the chronic strength of the two systems can be a result of different styles of caretaker-child interactions. For example, interactions that contribute to the development of a promotion focus emphasize aspirations, and communicate to the child that what matters in life is making progress, and that people, in general, should be concerned with the advancement from the status quo to a better state, that is, continuously pursuing a better position rather than maintaining a satisfactory state. By contrast, interactions that contribute to the development of a prevention focus emphasize obligations, responsibilities, and duties, and communicate to the child that what matters is preserving safety and security, and that people, in general, should be concerned with the maintenance of the status quo against falling to a worse state. Bolstering and supporting parenting styles (giving the children lots of encouragement, attention, and praise) are associated with a strong promotion focus, whereas punitive and controlling parenting styles (children are instructed to follow strict rules of obedience) are associated with a strong prevention focus.

Situational differences in accessibility may emerge from a broad range of sources. Organizations can reward employees on a performance basis with focus on eagerness to excel versus vigilance not to fail. Incentive systems can be structured to emphasize gains and nongains versus nonlosses and losses. Leaders can urge their followers to focus on aspirations versus responsibilities. Tasks may encourage eagerness to be the best (the best performer will be promoted) versus vigilance not to be the worst (the worst performer will be fired).

The promotion and prevention systems are orthogonal, that is, they operate independently from one another. Thus, at the chronic level, a strong promotion focus does not mean a weak prevention focus, and vice versa. Individuals can simultaneously have a strong promotion motivation and a strong prevention motivation. Nevertheless, in any given moment, concerns of one system are likely to predominate due to either chronic or situational factors, and guide behavior.

Among the things distinguishing promotion-focused individuals from prevention-focused ones there is one additional feature of human nature which is particularly relevant to the present research. The promotion motivation has been shown to be associated with a dominant independent self-construal whereas the prevention motivation has been shown to be associated with a dominant interdependent self-construal (Aaker & Lee, 2001; Lee, Aaker & Gardner, 2000). The concept of self-construal refers to how people define and make meaning of the self (Markus & Kitayama, 1991). People who are independently-oriented view themselves as individual entities whereas those who are interdependently-oriented view themselves and define their identity in relation to others. Different construals of the self may have an impact on cognition, emotion, and motivation, and thus, on behavior. Individuals with a dominant independent self-construal seek to preserve their independence from others by attending to the self and by expressing their unique inner qualities. They value autonomy, privacy, and freedom, are less likely to cooperate with others, and are less sensitive to others' needs (Cross, Hardin & Gercek-Swing, 2011). By contrast, individuals with a dominant interdependent self-construal focus on attending to others, fitting in, and harmonious interdependence with others is more important than discovering their unique attributes. They value mutuality, relational responsibilities, and social norms, are open and responsive to the needs of others, and are more likely to take into account the wishes of others when making decisions (Cross, Bacon & Morris, 2000).

Differences in self-construal may be associated with the readiness to accept contact-tracing mobile applications. Here is why. Studies show that mortality salience (reminders of death) is likely to increase in-group investment, and the effect is particularly strong for individuals with a dominant interdependent self-construal (Routledge, Juhl, Vess, Cathey & Liao, 2013). In-group investment is reflected in one's identification with, positivity toward, and willingness to self-sacrifice for, one's group. A potential explanation for this behavior is that increased investment in social groups is utilized by individual group members to manage their awareness of death and maintain healthy psychological functioning in the face of highly disruptive negative events (Juhl & Routledge, 2015). COVID-19 is a life-threating event. As such, it may drive individuals with a dominant interdependent self-construal to comply with government restrictions, especially if they believe that restrictions are a useful tool to combat the threat, and especially if they believe that restrictions offer a solution to COVID-19 at the collective level. Accepting tracking technologies is a social responsibility for them, and they are willing to sacrifice their own privacy and civil liberties for the greater good. This behavior should be particularly pronounced among prevention-focused individuals because they tend to have a dominant interdependent self-construal. Following this rationale, individuals in a prevention focus should be motivated to accept contact-tracing technologies as a means to cope with COVID-19. Individuals in a promotion focus tend to have a

dominant independent self-construal. They value privacy, freedom, and autonomy. They are less likely to cooperate with others, are less sensitive to others' needs, and are less responsive to the concerns of others. Therefore, it is expected that as compared with individuals with a prevention focus, those with a promotion focus would be less willing to engage in digital contact tracing.

Based on this, it is suggested that the adoption of contact-tracing mobile applications should be associated with regulatory focus. Based on the literature review, it is further suggested that COVID-19 perceived risk and privacy concerns should play a role in this association. Four hypotheses have been formulated in accordance with these suggestions.

4. Research hypotheses

4.1. Hypothesis 1

The intention to adopt contact-tracing apps should be positively associated with the strength of prevention focus, but not associated with the strength of promotion focus. Here is the rationale. Individuals with a strong prevention focus tend to have an interdependent self-construal. For them, engaging in contact-tracing is a social responsibility, and they are ready to some extent to sacrifice their own privacy for the greater good. Moreover, prevention-focused individuals are primarily concerned with safety and security. Thus, despite privacy concerns, they are expected to accept contact-tracing technologies for their safety and the safety of their community. Finally, these individuals try to avoid risk. Digital contact-tracing may be perceived as a precautionary measure and a means to reduce the risk of being infected with COVID-19 which is good enough a reason to use these apps.

Individuals with a promotion focus are driven by two competing forces: on one hand, they are willing to take action to tackle challenges (to beat the virus). This, together with openness to new technologies may encourage the uptake of contact-tracing apps. On the other hand, promotion-focused individuals tend to have an independent self-construal. They value individualism, autonomy, and freedom, are less likely to cooperate with others, and are less sensitive to the needs of others. As a result, they seek solutions at the individual level, for example, getting vaccinated. To this is added the fact that people in a promotion focus tend to take risks. They are less willing to use contact-tracing apps, and they are ready to accept the danger of getting infected with COVID-19. The reward is a greater sense of freedom. Moreover, as opposed to individuals with a prevention focus, those with a promotion focus tend to consider multiple alternatives when making decisions, in which case, they would try to find other ways to cope with COVID-19.

These two opposing forces simultaneously encourage and discourage the uptake of contact-tracing apps, thus canceling each other out. Therefore, promotion focus is not expected to influence the use of contact-tracing apps.

4.2. Hypothesis 2

The intention to use contact-tracing apps should be positively associated with COVID-19 perceived risk. By allowing public health authorities to quickly notify those who may have been exposed to COVID-19, contact-tracing apps help in the battle against the disease. Therefore, the higher the perceived risk of COVID-19, the higher should be the willingness to engage with contact-tracing technology.

4.3. Hypothesis 3

The intention to use contact-tracing apps should be negatively associated with privacy concerns. Individuals want to protect their private lives from any attempts at interference. This could be a barrier to the adoption of contact-tracing apps, in particular because these apps collect personal information on users which may be perceived as an intrusion on privacy rights. Therefore, the higher the concerns about privacy and civil liberties, the weaker should be the intention to engage with contact-tracing apps.

4.4. Hypothesis 4

The intention to adopt contact-tracing apps should be negatively associated with age. Age has been shown to be negatively related to acceptance of government monitoring (van den Broek, Ooms, Friedewald, van Lieshout & Rung, 2017), negatively related to support for tracking technologies (Wnuk, Oleksy & Maison, 2020), and positively related to resistance to selling personal data (van den Broek et al., 2017). These findings suggest that age is positively related to privacy concerns, and thus should be negatively related to the adoption of contact-tracing apps. Indeed, in a study exploring the adoption of the 'Corona-Warn-App' in Germany, it was found that non-users were on average older than users (Horstmann et al., 2021). Notable among the reasons for not using the app was concern over privacy. Based on this, it is proposed that the intention to adopt contact-tracing apps should be negatively associated with age. The rationale is that privacy concerns have a negative effect on the intention to use contact-tracing apps, an effect that increases with age (Kaptchuk et al., 2020). But there is another reason. In general, as compared with the younger generation, people of older age are less tech-savvy, and are less inclined to install and use new applications on their smartphones (Walrave, Waeterloos & Ponnet, 2020). In line with this, it is expected that the higher the age, the weaker would be the intention to adopt contact-tracing apps.

In the next sections, two studies are described that were conducted to test these hypotheses. In Study 1, regulatory focus was measured using a self-report questionnaire. In Study 2, regulatory focus was experimentally manipulated through priming.

5. Study 1

The aim of Study 1 was twofold: first, to explore the relationship between regulatory focus and the intention to voluntarily use contact-tracing apps; and second, to examine the role of perceived risk of COVID-19, concerns about privacy and information security, and age in this relationship.

5.1. Material and methods

5.1.1. Participants

Three hundred and ninety seven people participated in the study (217 females, 180 males), mean age 30.85 years, age range 18–60. Recruitment of participants was done with the help of undergraduate students as part of a course requirement. The course focused on how technology could help in the fight against COVID-19. Students were given a link to an online questionnaire which they sent to people they knew. Participation was on a voluntary basis, and no payment was offered. All data were confidential and respondents' anonymity was ensured. The study was conducted in Israel during a three-month period from March to May 2021.

5.1.2. Procedure

Participants filled out an online questionnaire consisting of two parts (Appendix). The first part (Q1-Q11) comprised items taken from the regulatory focus questionnaire (RFQ) (Higgins et al., 2001), a tool designed and implemented to measure regulatory focus as a chronic disposition. The rationale behind the RFQ is that a new achievement task stimulates a sense of pride in individuals with a subjective history of success in dealing with similar tasks in the past. This achievement pride has an effect on how one regulates oneself toward the new task.

According to regulatory focus theory, individuals have promotion achievement pride or prevention achievement pride (or both). Those with a subjective history of success in achieving promotion-focused goals have promotion pride, whereas those with a subjective history of

success in achieving prevention-focused goals have prevention pride. Promotion pride and prevention pride elicit different orientations to new tasks, and this impacts the way people engage with the task. Promotion pride involves pride from a subjective history of past success with promotion-focused eagerness. This promotion pride encourages the use of eagerness means to achieve new task goals. By contrast, prevention pride involves pride from a subjective history of past success with prevention-focused vigilance. This prevention pride drives the use of vigilance means. Thus, promotion pride and prevention pride are orientations to new tasks that stem from a subjective history of past success in promotion and prevention goal-pursuit, respectively. As achievement pride involves a subjective history of success, what matters is one's personal sense of one's history of promotion or prevention success in goal-pursuit. The RFQ was developed to measure exactly that.

The questionnaire incorporates a 6-item promotion subscale and a 5-item prevention subscale measuring individuals' subjective history of success in promotion-focused regulation and prevention-focused regulation, respectively. Items in the RFQ ask participants how frequently specific events have occurred in their lives, with the rationale that individual differences in accessible past histories should reflect differences in chronic regulatory focus. Promotion-focused items ask, for example, 'Do you often do well at different things that you try?' (1-never or seldom to 5-very often). Prevention-focused items ask, for example, 'How often did you obey rules and regulations that were established by your parents?' (1-never or seldom to 5-always). The second part (Q12-Q28) included items assessing the participants' perception of the risk of COVID-19, concerns about privacy and information security, and the intention to use contact-tracing apps. Age and gender data were also collected.

5.2. Results and discussion

Analysis of the data was based on logistic regression models. The independent variables were promotion scores, prevention scores, and age (continuous measured variables), gender (0-female, 1-male), as well as perceived disease risk and privacy concerns. The perceived risk of COVID-19 was assessed with three items (Q12-Q14) asking the respondents whether COVID-19 was a dangerous disease (0-no, 1-yes), what the chances were that they would contract COVID-19 (0-low, 1-high), and whether they were worried about contracting COVID-19 (0-no, 1-yes). A measure of perceived disease risk was calculated using the average of the three items. The rationale is that the perceived risk of COVID-19 is associated with the perceived severity of the disease, perceived likelihood of infection, and disease-related worry. Therefore, by implication, if one perceives COVID-19 as a risk to one's health, one has to believe that COVID-19 is a dangerous disease, and that one's likelihood of contracting the disease is high, and in addition, one should be worried about contracting the disease. Privacy concerns were assessed with eleven items (Q15-Q25) asking the respondents questions regarding privacy and information security issues and potential violations of civil liberties. The following is an example of one such item: 'Contact-tracing apps should only be used voluntarily, and should provide the users with opt-in/opt-out functionality.' (0-do not agree, 1-agree). A measure of privacy concerns was calculated using the average of the eleven items. The dependent variable was evaluated with one item (Q26) asking the respondents whether they would be willing to install and use contact-tracing apps on their smartphones (0-no, 1-yes).

According to Hypothesis 1, the intention to adopt contact-tracing apps should be positively associated with prevention scores, but not with promotion scores. To test this hypothesis, the participants' reported intention to use contact-tracing apps was logistically regressed on promotion scores, prevention scores, age, and gender. As expected, prevention scores (controlling for promotion scores, age, and gender) were positively related to the intention to use contact-tracing apps ($b = 0.305$, $p < 0.05$). There was no relationship between promotion scores (controlling for prevention scores, age, and gender) and the intention to use contact-tracing apps ($b = 0.274$, $p > 0.05$). See Table 1.

According to Hypothesis 2, the intention to use contact-tracing apps should be positively associated with COVID-19 perceived risk. To test this hypothesis, participants' reported intention to adopt contact-tracing apps was logistically regressed on the measure of perceived disease risk, promotion scores, prevention scores, age, and gender. As expected, perceived disease risk (controlling for promotion scores, prevention scores, age, and gender) was positively related to the intention to use contact-tracing apps ($b = 0.742$, $p = 0.05$). See Table 2.

According to Hypothesis 3, the intention to adopt contact-tracing apps should be negatively associated with privacy concerns. To test this hypothesis, participants' reported intention to use contact-tracing apps was logistically regressed on the measure of privacy concerns, promotion scores, prevention scores, age, and gender. As expected, privacy concerns (controlling for promotion scores, prevention scores, age, and gender) were negatively related to the intention to use contact-tracing apps ($b = -1.997$, $p < 0.05$). See Table 3.

According to Hypothesis 4, the intention to engage in contact tracing should be negatively associated with age. To test this hypothesis, participants' reported intention to use contact-tracing apps was logistically regressed on age, promotion scores, prevention scores, and gender. As expected, age (controlling for promotion scores, prevention scores, and gender) was negatively related to the intention to use contact-tracing apps ($b = -0.025$, $p < 0.05$). See Table 4.

The results indicate that all hypotheses were supported. At this point, a deeper analysis was necessary to better understand the role of COVID-19 perceived risk and privacy concerns in the relationship between prevention focus and the intention to adopt contact-tracing apps. Specifically, a mediation analysis was performed to determine whether there was an indirect path from prevention focus through privacy concerns to the intention to use contact-tracing apps. The rationale is that prevention focus is expected to be negatively associated with privacy concerns, and privacy concerns are expected to be negatively associated with the uptake of contact-tracing apps. Thus, the stronger the prevention focus, the lower the concern for privacy, and the lower the concern for privacy the stronger the intention to use contact-tracing apps. This makes sense given that individuals with a strong prevention focus are primarily motivated by the need for safety and security. Perceiving COVID-19 to be a threat to their health (and health of others), these individuals are willing to set aside (at least temporarily) their concern over privacy, and use contact-tracing apps.

Analysis of the data was based on regression models and statistical techniques designed to test mediation effects. In Step 1, privacy concern (mediator) was linearly regressed on prevention scores, promotion

Table 1
The intention to use COVID-19 contact-tracing apps and prevention focus.

Logistic Regression:Model 24 for CORONA_APP_0_NO_1_YES (4 variables, $n = 397$)								
Variable	Coefficient	Std.Err.	z-statistic	P-value	Lower95%	Upper95%	VIF	Std. coeff.
Constant	0.002	0.139	0.014	0.989	−0.271	0.275		
Promotion	0.274	0.172	1.589	0.112	−0.064	0.612	1.039	0.092
Prevention	0.305	0.124	2.465	0.014	0.063	0.548	1.078	0.146
Age	−0.025	0.010	−2.585	0.010	−0.044	−0.006	1.049	−0.153
Gender	0.074	0.208	0.356	0.722	−0.334	0.483	1.026	0.020

Table 2
The intention to use contact-tracing apps and COVID-19 perceived risk.

Logistic Regression:Model 31 for CORONA_APP_0_NO_1_YES(5 variables, n = 397)								
Variable	Coefficient	Std.Err.	z-statistic	P-value	Lower95%	Upper95%	VIF	Std. coeff.
Constant	−0.023	0.140	−0.167	0.867	−0.299	0.252		
Promotion	0.293	0.173	1.691	0.091	−0.047	0.633	1.042	0.098
Prevention	0.294	0.125	2.360	0.018	0.050	0.539	1.082	0.141
Perceived disease risk	0.742	0.378	1.961	0.050	0.000	1.484	1.033	0.114
Age	−0.023	0.010	−2.381	0.017	−0.043	−0.004	1.062	−0.141
Gender	0.132	0.211	0.622	0.534	−0.283	0.546	1.045	0.036

Table 3
The intention to use COVID-19 contact-tracing apps and privacy concerns.

Logistic Regression:Model 32 for CORONA_APP_0_NO_1_YES(5 variables, n = 397)								
Variable	Coefficient	Std.Err.	z-statistic	P-value	Lower95%	Upper95%	VIF	Std. coeff.
Constant	−0.044	0.144	−0.307	0.759	−0.327	0.239		
Promotion	0.267	0.179	1.493	0.135	−0.083	0.617	1.040	0.089
Prevention	0.254	0.129	1.969	0.049	0.001	0.506	1.094	0.121
Privacy concerns	−1.997	0.419	−4.768	0.000	−2.818	−1.176	1.028	−0.293
Age	−0.025	0.010	−2.445	0.014	−0.044	−0.005	1.052	−0.149
Gender	0.185	0.216	0.858	0.391	−0.238	0.609	1.035	0.051

Table 4
The intention to use COVID-19 contact-tracing apps and age.

Logistic Regression:Model 24 for CORONA_APP_0_NO_1_YES(4 variables, n = 397)								
Variable	Coefficient	Std.Err.	z-statistic	P-value	Lower95%	Upper95%	VIF	Std. coeff.
Constant	0.002	0.139	0.014	0.989	−0.271	0.275		
Promotion	0.274	0.172	1.589	0.112	−0.064	0.612	1.039	0.092
Prevention	0.305	0.124	2.465	0.014	0.063	0.548	1.078	0.146
Age	−0.025	0.010	−2.585	0.010	−0.044	−0.006	1.049	−0.153
Gender	0.074	0.208	0.356	0.722	−0.334	0.483	1.026	0.020

scores, age, gender, and perceived disease risk (independent variables). In Step 2, the intention to use contact-tracing apps (dependent variable) was logistically regressed on the independent variables. In Step 3, the dependent variable was logistically regressed on the independent variables and on the mediator. The results are summarized in Tables 5-7.

In Step 1, prevention scores were negatively related to privacy concerns ($b = -0.035$, $p < 0.05$). In Step 2, prevention scores were positively related to the intention to adopt contact-tracing apps ($b = 0.294$, $p < 0.05$). In Step 3, privacy concerns were negatively related to the intention to use contact-tracing apps ($b = -1.937$, $p < 0.05$). All the effects were in the expected direction. In addition, the effect of prevention scores (the independent variable) on the intention to use contact-tracing apps (the dependent variable) was not significant in Step 3 when the mediator (privacy concerns) was controlled ($b = 0.249$, $p > 0.05$), but was significant in Step 2 when the mediator was uncontrolled ($b = 0.294$, $p < 0.05$). According to this analysis, privacy concerns mediated the relationship between prevention scores and the intention to use contact-tracing apps.

A second mediation analysis was performed to examine whether there was an indirect path from COVID-19 perceived risk through privacy concerns to the intention to use contact-tracing apps. The rationale in this case is that the perceived risk of COVID-19 is expected to be negatively associated with privacy concerns, and privacy concerns are expected to be negatively associated with the uptake of contact-tracing apps. Thus, the higher the perceived risk of COVID-19, the lower the concern over privacy, and the lower the concern over privacy the stronger should be the intention to use contact-tracing apps.

A three-step statistical procedure (similar to the previous one) was applied to test this path. In Step 1, privacy concerns (the mediator) were linearly regressed on perceived disease risk, promotion scores, prevention scores, age, and gender, (the independent variables). In Step 2, the intention to use contact-tracing apps (the dependent variable) was logistically regressed on the independent variables. In Step 3, the dependent variable was logistically regressed on the independent variables and on the mediator. The results are shown in Tables 5-7.

In Step 1, COVID-19 perceived risk was negatively related to privacy concerns ($b = -0.121$, $p < 0.05$). In Step 2, COVID-19 perceived risk was positively related to the intention to adopt contact-tracing apps ($b = 0.742$, $p = 0.05$). In Step 3, privacy concerns were negatively related to the intention to use contact-tracing apps ($b = -1.937$, $p < 0.05$). All the effects were in the predicted direction. Moreover, the effect of COVID-19 perceived risk (the independent variable) on the intention to

Table 5
Mediation Step 1.

Multiple Regression:Model 9 for PRIVACY_ CONCERNS(5 variables, n = 397)								
Variable	Coefficient	Std.Err.	t-statistic	P-value	Lower95%	Upper95%	VIF	Std. Coeff.
Constant	−0.019	0.018	−1.045	0.297	−0.054	0.017	0.000	0.000
Promotion	−0.016	0.022	−0.702	0.483	−0.059	0.028	1.042	−0.035
Prevention	−0.035	0.016	−2.213	0.027	−0.066	−0.004	1.082	−0.114
Perceived disease risk	−0.121	0.048	−2.523	0.012	−0.216	−0.027	1.033	−0.127
Age	0.001	0.001	0.684	0.494	−0.002	0.003	1.062	0.035
Gender	0.041	0.027	1.534	0.126	−0.012	0.095	1.045	0.078

Table 6
Mediation Step 2.

Logistic Regression:Model 11 for CORONA_APP_0_NO_1_YES(5 variables, n = 397)								
Variable	Coefficient	Std.Err.	z-statistic	P-value	Lower95%	Upper95%	VIF	Std. coeff.
Constant	−0.023	0.140	−0.167	0.867	−0.299	0.252		
Promotion	0.293	0.173	1.691	0.091	−0.047	0.633	1.042	0.098
Prevention	0.294	0.125	2.360	0.018	0.050	0.539	1.082	0.141
Perceived disease risk	0.742	0.378	1.961	0.050	0.000	1.484	1.033	0.114
Age	−0.023	0.010	−2.381	0.017	−0.043	−0.004	1.062	−0.141
Gender	0.132	0.211	0.622	0.534	−0.283	0.546	1.045	0.036

Table 7
Mediation Step 3.

Logistic Regression:Model 13 for CORONA_APP_0_NO_1_YES(6 variables, n = 397)								
Variable	Coefficient	Std.Err.	z-statistic	P-value	Lower95%	Upper95%	VIF	Std. coeff.
Constant	−0.064	0.145	−0.440	0.660	−0.349	0.221		
Promotion	0.279	0.179	1.558	0.119	−0.072	0.630	1.043	0.093
Prevention	0.249	0.129	1.921	0.055	−0.005	0.502	1.096	0.119
Perceived disease risk	0.556	0.393	1.417	0.157	−0.213	1.326	1.050	0.085
Privacy concerns	−1.937	0.422	−4.593	0.000	−2.763	−1.110	1.044	−0.284
Age	−0.023	0.010	−2.310	0.021	−0.043	−0.004	1.063	−0.141
Gender	0.226	0.219	1.033	0.302	−0.203	0.654	1.051	0.062

use contact-tracing apps (the dependent variable) was not significant in Step 3 when the mediator (privacy concerns) was controlled ($b = 0.556$, $p > 0.05$), but was significant in Step 2 when the mediator was uncontrolled ($b = 0.742$, $p = 0.05$). According to this analysis, privacy concerns mediated the relationship between COVID-19 perceived risk and the intention to engage with contact-tracing technology. A sensitivity power analysis with an anticipated effect size (f^2) of 0.15, desired statistical power level 0.8, number of predictors 6, and significance level 0.05 indicated that the minimum required sample size was 97, less than a quarter of actual sample size.

In Study 1, regulatory focus was measured using a self-report questionnaire. This is a limitation because it leaves room for alternative interpretations of the results. In order to provide more direct evidence for the role of regulatory focus in the decision to use contact-tracing apps, it is essential to experimentally manipulate the regulatory focus, and show that this influences the intention to use these apps. This was the purpose of Study 2.

6. Study 2

Promotion and prevention pride are orientations to new task goals that originate from a personal sense of history of past success in promotion and prevention goal-pursuit, respectively (Higgins et al., 2001). Since the sense of history is subjective and the pride is an orientation to new task goals, it is possible to manipulate both the sense of history and the orientation. This was the guiding principle in the design of Study 2. The study used the same paradigm as Study 1, except that promotion and prevention were experimentally manipulated through priming rather than being measured with a questionnaire. Priming is a technique to temporarily increase the accessibility of specific past histories. This enables to generate temporary differences between individuals in the sense of history that would normally reflect chronic differences in accessible past histories.

6.1. Material and methods

6.1.1. Participants

Ninety six people were enrolled in the study (44 females, 52 males), mean age 34.16 years, age range 18–60. Participants' recruitment was done by undergraduate students (other than those who helped in Study 1) as part of a course assignment on the role of technological progress in the fight against global pandemics like COVID-19. Students were given a link to an online questionnaire which they sent to friends, family, and acquaintances. Participation was voluntary and no payment was provided. Confidentiality and anonymity were guaranteed to all participants. The study was carried out in Israel during a three-month period from March to May 2021.

6.1.2. Procedure

Participants were randomly assigned to one of two experimental priming conditions: promotion and prevention (Higgins et al., 2001). Participants were blind to which condition they were in. Within both conditions, participants were asked to complete a three-part online questionnaire. The first part was identical for both conditions, and included items related to COVID-19 perceived risk, and in addition, items related to privacy and information security concerns (similar to Study 1). The second part included the experimental manipulation. Participants in the promotion condition were instructed to write about a time in the past when (1) they felt they made progress toward being successful in life; (2) compared to most people they were able to get what they wanted out of life; and (3) when trying to achieve something important to them, they performed as well as they ideally would have liked to. Participants in the prevention condition were instructed to write about a time in the past when (1) being careful enough avoided getting them into trouble; (2) they stopped themselves from acting in a way that their parents would have considered objectionable; and (3) they were careful not to get on their parents' nerves. The priming made participants momentarily engage in either a promotion-focused state of mind or a prevention-focused state of mind. After being primed, participants completed the third part of the questionnaire (identical for both conditions) in which they were asked about their intention to use contact-tracing apps (an item similar to Study 1). Gender and age were also collected.

6.2. Results and discussion

Study 2 experimentally primed past histories of either promotion success or prevention success. It was expected that using priming to make participants momentarily experience either a subjective history of prevention success or a subjective history of promotion success would have the same effect on the intention to use contact-tracing apps as did high prevention scores and high promotion scores. Study 1 showed that the intention to use contact-tracing apps was positively associated with prevention scores, but not associated with promotion scores. These findings suggest that high (relative to low) prevention scores predict a

Table 8
Moderation.

Logistic Regression:Model 9 for CORONA_APP_0_NO_1_YES(6 variables, n = 96)								
Variable	Coefficient	Std.Err.	z-statistic	P-value	Lower95%	Upper95%	VIF	Std. coeff.
Constant	−0.283	0.516	−0.548	0.584	−1.294	0.728		
Regulatory focus	0.166	0.587	0.283	0.777	−0.985	1.317	1.033	0.043
Perceived disease risk	−1.549	1.025	−1.512	0.131	−3.557	0.459	1.129	−0.251
Privacy concerns	−6.187	1.324	−4.674	0.000	−8.781	−3.592	1.127	−0.988
Age	−0.046	0.031	−1.501	0.133	−0.107	0.014	2.338	−0.339
Gender	−1.252	0.598	−2.094	0.036	−2.424	−0.080	1.141	−0.346
Interaction: regulatory focusXage	0.089	0.045	2.003	0.045	0.002	0.177	2.359	0.486

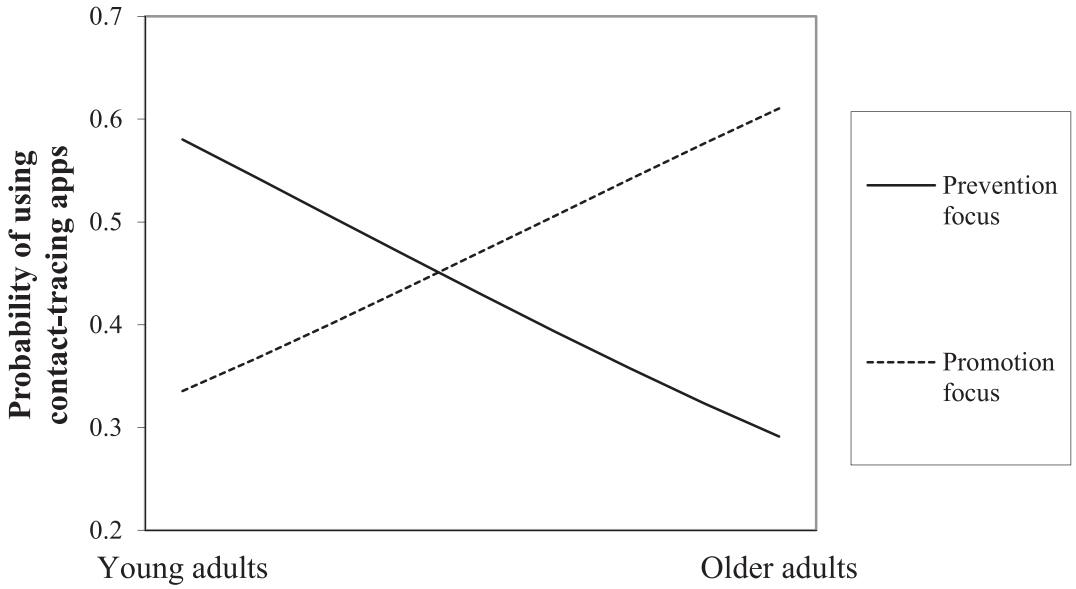

Fig. 1. Regulatory focus had a significant impact on the participants' self-reported intention to use contact-tracing apps, and the effect was moderated by age.

stronger intention to adopt contact-tracing apps, whereas high (relative to low) promotion scores do not. Based on this, it was hypothesized in Study 2 that the intention to adopt contact-tracing apps would be stronger in the prevention success condition relative to the promotion success condition.

Logistic regression was applied to test the hypothesis of the study. Participants' self-reported intention to use contact-tracing apps (0-no, 1-yes) was the dependent variable. The independent variable of interest was regulatory focus (0-prevntion, 1-promotion). Four additional independent variables were included in the analysis: perceived disease risk, privacy concerns, age, and gender (all measured as in Study 1). The dependent variable was logistically regressed on all five independent variables. None of the main effects reached statistical significance.

When analyzing relationships between variables, it is possible that despite there being no significant main effects, significant interactions between the variables would occur. A significant interaction indicates moderation. Therefore, the next step was to test for moderation effects. Four models were run, each of which included five independent variables (regulatory focus, perceived disease risk, privacy concerns, age, and gender) and a single interaction between regulatory focus and one of the other independent variables (either regulatory focus X perceived disease risk, regulatory focus X privacy concerns, regulatory focus X age, regulatory focus X gender). The analysis revealed a significant interaction between regulatory focus and age ($b = 0.089$, $p < 0.05$), suggesting that regulatory focus influenced the intention to use contact-tracing apps, and the effect was moderated by age. See Table 8, Fig. 1.

The positive sign of the interaction term indicates that among young adults, those with a prevention focus are more likely to use contact-tracing apps than those with a promotion focus. The effect is reversed with age such that among older adults those with a promotion focus are more likely to use contact-tracing apps than those with a prevention focus. In addition to the interaction between regulatory focus and age, two main effects reached statistical significance. The intention to use contact-tracing apps was negatively related to both privacy concerns ($b = -6.187$, $p < 0.05$) and gender ($b = -1.252$, $p < 0.05$). The former effect indicates that the higher the concern over privacy, the weaker the intention to use contact-tracing apps. The latter indicates that men (relative to women) are less likely to use these apps.

The most important finding in Study 2 is the interaction between regulatory focus and age. This finding suggests that regulatory focus affects the intention to use contact-tracing apps, a causal relationship rather than a mere association, and the effect is moderated by age. Unlike Study 1, this effect cannot be reinterpreted in terms of an alternative causal direction because regulatory focus was experimentally manipulated.

A sensitivity power analysis with an effect size (f^2) of 0.15, statistical power 0.8, number of predictors 5, and significance level 0.05 showed that the minimum requirement for sample size was 91. Actual sample size was 96.

7. General discussion

The two studies reported in this paper support the proposal that regulatory focus is related to, and has an impact on, the intention to adopt contact-tracing apps. Study 1 tested this proposal using a self-report questionnaire (RFQ), a tool designed to measure chronic regulatory fo-

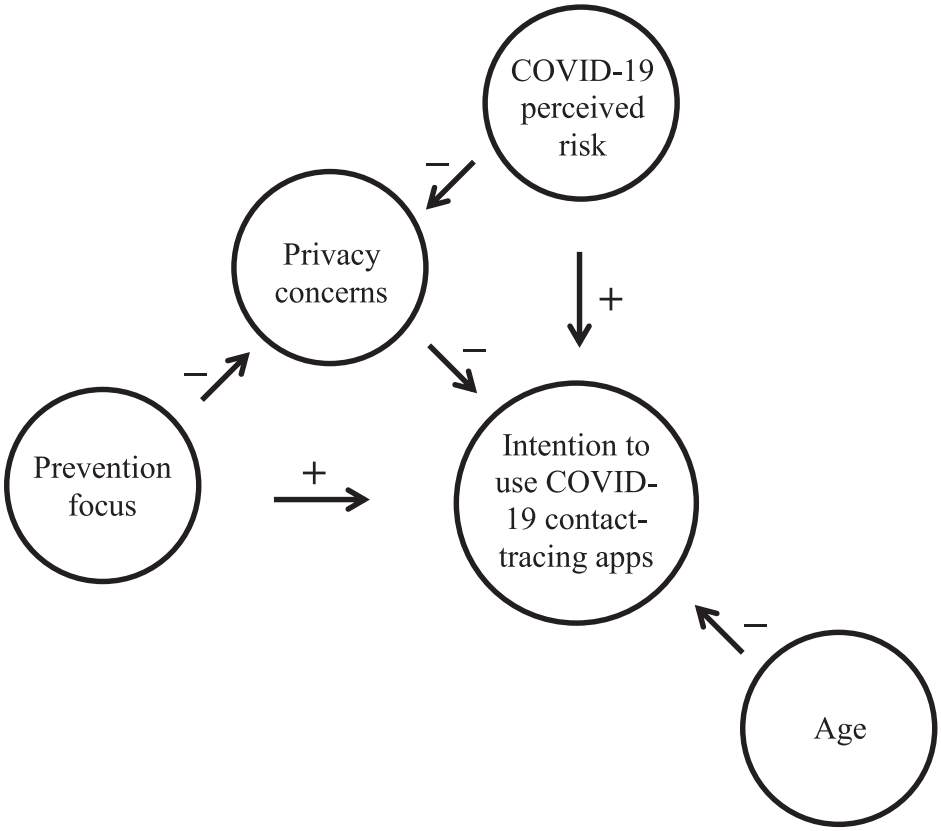

Fig. 2. The intention to engage with contact-tracing technology is positively related to prevention focus and COVID-19 perceived risk. Both relationships are mediated by privacy concerns. Age is negatively related to the intention to use contact-tracing apps.

cus. In Study 2, regulatory focus was experimentally manipulated. The manipulation directly tested the predicted causal direction between regulatory focus and the intention to use contact-tracing apps. The findings are summarized in a model (Fig. 2).

7.1. Practical implications

The studies reported here have implications for public health. In particular, the findings offer insight into the psychological processes affecting the willingness of the public to use contact-tracing apps to counter the COVID-19 threat. The main findings are that prevention focus and COVID-19 perceived risk are positively associated with the intention to use contact-tracing apps, with both relationships being mediated by privacy concerns. Thus, to increase the motivation of the public to engage with contact-tracing apps, there is a need to do three things: first and most important, to send prevention-focused messages calling for the adoption of contact-tracing technology. Second, reduce privacy concerns. Third, explain to the public how dangerous COVID-19 is. Prevention-focused messages should communicate the benefits of contact-tracing apps not only to the individual, but more importantly to society as a whole. And if a well-known and trusted person sends the message, then, the effect is expected to be even stronger. Here are a few examples for prevention-focused messages:

- I use a contact-tracing app on my smartphone. Do you? These apps protect US from COVID-19
- It's on US – ALL OF US – to do all that WE can to fight against COVID-19: Adoption of contact-tracing apps is an important step in the right direction
- WE take RESPONSIBILITY. WE use contact-tracing apps
- There is an OBLIGATION on US, ALL OF US, to do everything WE can: Using contact-tracing apps is a big step towards beating the virus.
- It is on US, ALL OF US who consider ourselves PATRIOTS, to use contact-tracing apps on our phones
- The future depends on US, ALL OF US. And it depends on what WE are doing today. Do not wait. Download the app and start using it today. Not tomorrow, today!

7.2. Limitations and future research

A limitation of the research is that the analysis was based on stated intentions. Participants were asked whether they would be willing to use contact-tracing apps on their smartphone. The reliance on self-report measures may raise questions about the validity of the methodology. In particular, it may raise concerns about the accuracy of the participants' perceptions and their honesty in responding to the questions. Moreover, as people tend to exaggerate their own virtues, this methodology may raise doubts as to whether or not findings could have been distorted by self-serving biases such as self-enhancement. Finally, it should be taken into account that intentions not always translate into practice. With that being said, it is important to note that the use of the method relies on the assumptions that people often know how they would behave in actual situations, and that people have no real reason to mask or camouflage their true intentions. Another limitation stems from the nature of the recruitment process. Students were given a link to an online questionnaire which they sent to friends, family, and other acquaintances. Recruiting participants in this way may yield a sample that is not representative of the general population. Future research will need to address these two limitations.

7.3. Concluding remarks

This research is important because it deepens the understanding of human behavior in the face of global health crises such as the COVID-19. Most importantly, this research is the first to draw on regulatory focus theory to explore the interaction between humans and technology under

crisis situations, thus introducing a new framework for future research in the field.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jjimei.2021.100045.

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