Exploring young adults' unwillingness to adopt COVID-19 contact tracing apps: a mixed-method study[1]

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Abstract

Frame of the research: The field of research that investigates responses to external threats has recently provided evidence concerning consumer responses to COVID-19-related threats. Drawing on psychological reactance theory, we focus on how young adults respond to government-imposed containment measures that threaten individual freedom.

Purpose of the paper: We investigate how and when young adults' unwillingness to adopt COVID-19 contact tracing apps (CTAs) reflects their focus on government-imposed containment measures and the perceived difficulty in restoring freedom. We also develop empirically based clusters of young adults who differ in terms of their focus on containment measures, the difficulty in restoring freedom, and CTA adoption intentions.

Methodology: We use a mixed-method approach. Through an initial qualitative study featuring in-depth interviews, we explore young adults' perceptions of government-imposed containment measures and their difficulty in restoring freedom to examine how and when these perceptions reflect reduced CTA adoption intentions. Next, through a survey, we conduct a k-means cluster analysis to identify different groups of young adults.

Findings: The perceived restrictive nature of government-imposed measures threatens young adults' freedom and diminishes their CTA adoption intentions. The difficulty in restoring freedom defines when psychological states of reactance (vs. helplessness) occur. Finally, four clusters of young adults emerge: engendered dissidents, apathetic, optimistic adopters, and lost needing guidance.

Research limits: Future research might include consumers of diverse generations to explore age-based differences or use representative samples of diverse countries to account for cultural variations.

Practical implications: The findings contribute to understanding the failure of CTA adoption among young adults during the COVID-19 pandemic. Additionally, they offer relevant knowledge to promote CTA adoption if future pandemics occur.

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[1] This paper is the result of the joint effort of four authors: Camilla Barbarossa, Michela Patrizi, Maria Vernuccio, and Maria Carmen Di Poce. In the manuscript, however, paragraphs §1, §2, §3, §5.2, §5.4, and §6.1 may be attributed to Camilla Barbarossa, paragraphs §4.3, §5.1, and §5.3 may be attributed to Michela Patrizi, paragraphs §4.1 and §4.2, may be attributed to Maria Vernuccio, and paragraph §6.2 and §6.3 may be attributed to Maria Carmen di Poce.

Originality of the paper: In addition to privacy concerns and usability issues as main barriers to CTA adoption, we offer a complementary perspective leveraging psychological reactance.

Key words: Contact tracing apps; COVID-19; psychological reactance; helplessness; consumer behaviour; mixed-method

1. Introduction

During the COVID-19 pandemic, state governments promoted the adoption of contact tracing apps (CTAs) to identify people at risk of infection. Available COVID-19 CTAs rely on Bluetooth technology or geolocation to alert users that they are close to people who have tested positive (Georgieva *et al.*, 2021). Although contact tracing is a "key to reining in the virus", it "has fallen flat in the West" (The New York Times, 2020), with CTA adoption rates at 20% or lower in 2021 in many European countries (EIT Digital, 2021). Despite the pandemic crisis getting ahead, investigating consumers' CTA hesitancy is crucial, as governments are likely to face future pandemics. COVID-19 is not the only pandemic that has had a major impact on the world, as there have been many before, such as the Spanish flu, the SARS epidemic, the Ebola, and the avian flu.

Recent studies in public policy (e.g., Abbaspur-Behbahani *et al.*, 2022), marketing (e.g., Hauff and Nillson, 2021; Jahari *et al.*, 2022; Robin and Dandis, 2022), and information systems and technology (e.g., Akinbi *et al.*, 2021; Chan and Saqib, 2021; Velicia-Martin *et al.*, 2021) reveal that privacy concerns, usability issues, and reduced perceived benefits may prevent consumers from adopting CTAs. Citizens are worried that governments might gain access to their personal data and use it for purposes other than safeguarding public health (Geber and Friemel, 2022). Low perceived effectiveness (i.e., CTAs' limited capacity to manage the spread of the virus) and usability issues (i.e., Bluetooth incompatibility, lack of technical knowledge, and excessive battery consumption) also prevent citizens from using CTAs (Fernandes and Costa, 2021; Trang *et al.*, 2020).

Along with the contributions of these studies, however, two relevant gaps remain unaddressed. First, while existing studies have investigated privacy concerns, usability issues, and reduced perceived benefits as the main inhibitors of CTA adoption intentions, they have neglected to link reduced CTA adoption intentions to aversive psychological states that citizens may have experienced during the COVID-19 pandemic when facing unprecedented threats to their freedom. Individuals have felt their freedom threatened to the extent that they have experienced the 'pains of imprisonment' because of government-imposed containment measures (Dhami *et al.*, 2020). These threats have triggered psychological states of reactance towards the government (Díaz and Cova, 2021; Krpan and Dolan, 2020), which may have led to defiance regarding other government-advocated containment measures, such as CTAs. This research gap is thus unfortunate because it limits a full understanding of the cognitive and emotional factors that may prevent individuals from adopting CTAs beyond privacy concerns and usability issues.

Second, while existing studies have investigated the social acceptability of CTAs among consumers in general (e.g., Georgieva *et al.*, 2021; Trang *et al.*, 2020), they have neglected to investigate young adults in this context. Similarly, no previous studies have profiled young adults regarding their hesitancy towards adopting CTAs. This gap is unfortunate because young adults are more socially active than older generations and contribute more to the spread of the virus (Centers for Disease Control and Prevention, 2020; *The New York Times*, 2020). Furthermore, young adults value freedom, autonomy, and choice more than older generations do and benefit from an active lifestyle (Berger, 2017). Therefore, they are more likely to develop psychological reactance and engage in defiant behaviors if government-imposed containment measures restrict their freedom (Eurotopics, 2020). Finally, young adults are digitally savvy and use mobile apps intensively, more than older generations. Therefore, they can play a crucial role in diffusing COVID-19 CTAs into the mainstream through intergenerational learning (Fernandes and Costa, 2021; UNECE, 2019).

Leveraging psychological reactance theory (Brehm, 1966) and focusing on young adults, we aim to investigate how and when young adults' adoption intentions towards COVID-19 CTAs reflect their focus on government-imposed containment measures and the perceived difficulty in restoring freedom. Furthermore, we aim to provide an empirically based typology of young adults based on their intentions to adopt CTAs and the underlying motivations (i.e., focus on government-imposed containment measures and the perceived difficulty in restoring freedom).

The findings from our study offer relevant theoretical contributions. First, previous studies focused on usability issues and privacy concerns as the main barriers to CTA adoption (e.g., Chan and Saqib, 2021; Velicia-Martin *et al.*, 2021). With a complementary perspective, we conceive psychological reactance as another key CTA adoption inhibitor. Furthermore, we investigate young adults' CTA adoption intentions rather than those of consumers in general (e.g., Hauff and Nilsson, 2021; Fox *et al.*, 2021). We explore the CTA-related factors that motivate young adults' CTA hesitancy and present a new typology with practical and theoretical significance. Gaining comprehensive knowledge of these groups is essential to understand their behavior and providing policymakers with insights into how to develop tailored communications that will more effectively persuade these crucial segments.

2. Theoretical background and objectives of the study

The field of consumer research that investigates responses to external threats (Campbell *et al.*, 2020) has recently provided evidence concerning consumer responses to COVID-19-related threats (Kirk and Rifkin, 2020; Panarese and Azzarita, 2021). In this work, we focus on the threats to individual freedom that arise from government-imposed containment measures and the response of consumers-specifically young adults. We are interested in understanding how and when government-imposed containment measures may threaten young adults' freedom and motivate

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their resistance towards other government-advocated containment measures, such as CTAs. Previous studies have shown that although government measures have the laudable goal of promoting public health and safety, they may have unintended results, such as citizens' defiant behaviors (e.g., Grandpre *et al.*, 2003; Hornik *et al.*, 2008). For example, LaVoie *et al.* (2017) showed that individuals' exposure to graphic labels in anti-smoking campaigns caused an increase in perceived threat to freedom, resulting in more smoking behaviors. Similarly, Irmak *et al.* (2020) highlighted how government laws restricting cell phone use while driving restricted citizens' perceived freedom, which made them more likely to use the phone. In sum, policymakers' attempts to regulate individual behavior to ensure the public interest can be met with resistance if individuals focus on the restrictive nature of the recommendations and perceive these recommendations as threats to their freedom (Irmak *et al.*, 2020). We address this issue in the context of COVID-19 CTA hesitancy by adopting the psychological reactance theory (Brehm, 1966). Psychological reactance theory (Brehm, 1966) predicts that when people perceive that their freedom is threatened, they enter an aversive motivational state of reactance (Rosenberg and Siegel, 2018). Psychological reactance is described as a mix of negative emotions (e.g., anger) and negative cognitions (e.g., counterarguments) that contribute equally to regaining threatened freedom (Dillard and Shen, 2005). The government's efforts to contain the virus by imposing measures on their populations during the COVID-19 pandemic have frequently resulted in psychological reactance (Krpan and Dolan, 2020; Sprengholz *et al.*, 2021; Taylor and Asmundson, 2021). Such threats could be particularly salient for contemporary young adults (Panarese and Azzarita, 2021), who are confident, independent, and goal-oriented and value freedom, autonomy, and choice (Eisner, 2005). In contrast to older generations, young adults may not adhere to formalities when communicating with authoritative figures and may challenge the legitimacy of institutional authority (Berger, 2017). Along these lines, we contend that the focus on the restrictive nature of COVID-19 government-imposed containment measures may influence young adults' perceptions about their freedom being threatened. Increased perceived threats to freedom, in turn, may hamper young adults' alignment with government-advocated recommendations, such as CTA adoption. To our knowledge, no prior studies have investigated how young adults focus on the restrictive nature of government-imposed containment measures during the COVID-19 pandemic may hamper their CTA adoption intentions through increased psychological reactance.

Psychological reactance may result from perceived threatened freedom, but to date, no previous studies concerning CTAs have investigated the conditions under which this reaction may prevail. The perceived difficulty in restoring freedom may play a key role in this regard (Brehm and Brehm, 2013). Previous research has shown that reactance may vanish when freedom is lost (vs. threatened) (Brehm and Brehm, 2013). This proposition is in line with the energization model of motivation (Brehm and Self, 1989), which suggests that the intensity of an individual's aversive reaction depends on the difficulty in restoring their freedom. That is, individuals may exhibit

higher psychological reactance when they feel they can regain threatened freedom. Conversely, when the individual realizes that it is impossible to restore threatened freedom, the motivation for reactance should diminish or even disappear (Mikulincer, 1988). In this case, a state of passive discomfort, known as "helplessness", may arise. Font and Hindley (2017), for example, tested the psychological consequences of threatening tourists' freedom of travel. They found that when tourists are informed that visiting a disappearing destination is still possible, albeit difficult, they experience psychological reactance; psychological reactance in turn enhances tourists' desire to travel. Conversely, when tourists are informed that they cannot further visit the destination (i.e., restoring freedom is impossible), they feel psychological helplessness and devalue the unavailable location. Along these lines, we argue that the perceived difficulty in restoring freedom plays a relevant role in regulating the adoption of COVID-19 CTAs. When young adults perceive that they can still restore the freedom that the government-imposed containment measures have threatened, they experience reactance. Conversely, when young adults believe that it is impossible to restore their freedom, they feel helpless. To our knowledge, no contribution has examined perceived difficulty in restoring freedom as a boundary condition under which one of these two psychological reactions prevails over the other. Specifically, this is the first study to investigate how the perceived difficulty in restoring freedom during the COVID-19 pandemic influences the occurrence of psychological states of reactance and helplessness and how these psychological states affect young adults' CTA adoption intentions. Consequently, this study aims to investigate how and when young adults' adoption intentions toward COVID-19 CTAs reflect their focus on government-imposed containment measures and the perceived difficulty in restoring freedom.

Furthermore, in the context of COVID-19, no study has proposed a segmentation of young adults to define the psychological processes they undergo and the importance they attribute to managerially relevant CTA-related variables. This research gap limits our knowledge of this crucial target and prevents policymakers from effectively persuading young adults to adopt CTAs. Therefore, we also aim to identify relevant clusters of young adults who differ in their focus on government-imposed COVID-19 containment measures, perceived difficulty in restoring freedom, and willingness to adopt CTAs.

3. Methodology overview

To generate reliable conclusions and provide a more comprehensive depiction of the phenomenon under study, we employed a mixed-method approach (Davis *et al.* 2011).

Considering the paucity of studies adopting a psychological reactance approach to investigate resistance towards CTAs, in Study 1, we first relied on a qualitative approach. Through conducting in-depth interviews (N = 35), we explored how and when young adults' adoption intentions towards COVID-19 CTAs reflect their focus on government-imposed containment

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measures and the perceived difficulty in restoring freedom.

Next, in Study 2, we conducted a survey (N = 821) and a cluster analysis to enhance the generalizability of our findings and identify groups of young adults who differ in their intentions to adopt COVID-19 CTAs and motivations to do so (i.e., focus on government-imposed containment measures and perceived difficulty in restoring freedom). In addition, we profiled these segments based on the predominant psychological processes (as emerged in Study 1) and managerially relevant CTA-related variables.

4. Study 1 – Exploring young adults' unwillingness to adopt CTAs

4.1 Overview and sample

Given that CTAs are new technology-based containment measures with limited existing empirical knowledge on young adults' CTA adoption in a pandemic context, we first conducted exploratory qualitative research aiming at understanding how young adults perceive government containment measures, whether they experience difficulty in restoring their freedom, and how these factors may contribute to developing their CTA adoption intentions. We reached theoretical saturation (Glaser and Strauss, 2017) after 35 in-depth interviews with Italian young adults (28 nonusers, 7 users) aged between 18 and 41 years old (Whang and Im, 2021) who owned a smartphone and who were aware of Immuni, the Italian CTA (see the sample characteristics in Appendix, Table 1). We identified Italy as the geography of interest because this country has been hit dramatically by the pandemic and still exhibits one of the highest rates of coronavirus deaths among its population in the European Economic Area (Statista, 2023). Immuni sends users notifications on possible infections and recommendations on the best behaviors to be implemented; it works with Bluetooth Low Energy Technology, and it does not involve any identification or geolocation of the user. In addition, the Italian government has widely recognized the crucial role of young adults in promoting the diffusion of Immuni among the national population. In particular, the Italian government has developed public communication to encourage young adults to be Immuni ambassadors (Italian Ministry of Health, 2020). However, the Italian Ministry of Health himself defined the adoption of Immuni among younger citizens as a total failure (Open, 2020). Understanding why individuals who are highly familiar with mobile apps may conversely refuse to adopt CTAs (e.g., Immuni) is thus crucial.

4.2 Procedure and analysis

To elicit respondents' accounts of their spontaneous thoughts and experiences, we developed a brief interview guide based on open-ended questions (in addition to the fixed data) that covered three key points: 1) perceptions about the government containment measures and the difficulty in restoring one's freedom amid the COVID-19 pandemic; 2) psychological reactions, opinions, and experiences related to government-

imposed containment measures; and 3) the adoption of Immuni. The interviews were carried out through video conferencing systems between November 2020 and March 2021 and had an average duration of 45 minutes. At the time of our study, the government's restrictive measures included mandatory green pass exhibition, mask usage, isolation, quarantine, and a 10 p.m. curfew.

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The interviews were transcribed, resulting in 335 pages of 1.5 line-spaced content in 12-pt font, and then analyzed through a multiphase coding process that included thematic analysis. The "corpus" was sorted into content segments (one or more sentences) assigned to thematic categories (King and Horrocks, 2010). We proceeded with a line-by-line analysis of the text and first outlined "descriptive codes" (i.e., concise codes delineating specific text portions). Based on this codification, we adopted a process of progressive abstraction and merging, which led us to first identify the "integrative themes" (i.e., the key concepts) and, next, the "overarching themes". This procedure led to defining the key themes that characterize the thinking of the respondents.

Two research team members conducted the coding process independently and compared the results after each coding step. Moreover, to enhance the reliability of our findings, we followed the code-confirming approach (King and Horrocks, 2010), in which two independent coders who were experienced in marketing and received methodological training validated the associations. The interjudge reliability (i.e., agreement ratio) was satisfactory (89%).

4.3 Study 1 - Findings

Based on the multistage analysis process, we identified two overarching themes: the "focus on the beneficial effects of government-imposed containment measures" and the *"focus on the restrictive nature of government-imposed containment measures"*. Related to the latter, the content analysis revealed four key concepts (i.e., "integrative themes"), that is, "freedom deprivation", "psychological reactance", "helplessness", and "perceived difficulty of restoring freedom". Our analyses focus on informants who mainly perceived the government-imposed containment measures as highly restrictive. In what follows, we provide a detailed description of the themes identified.

The thematic content analysis revealed that the majority of interviewees focused on the restrictive nature of government-imposed containment measures. Particularly, these informants referred to how these governmental measures restricted their self-actualization and intimacy needs, in that they limited mobility, the chance to receive proper higher education or work, the pursuit of personal and professional goals, and the freedom of intimate relationships and social contacts.

"*Thinking about the measures enacted by the government to contain the COVID-19 pandemic, the first word that comes to mind is restriction. Restriction because I can't travel or even walk freely in the street, I can't attend courses at the university... I had so many personal and professional plans that I won't realize because now we cannot do anything! I'm limited in*

my contact with my nearest and dearest, I cannot go out with my friends and have dinner with them. Even the Christmas vacations, for example, I won't be able to spend them with my relatives" (Interviewee 8).

On the other hand, some other interviewees focused on the beneficial effects of government-imposed containment measures, as they recognized several positive outcomes of these measures for personal and public safety.

"*I think that the measures enacted by the government are essential, only in this way can we contain the spread of the virus and get out of the pandemic. They are essential because they support the safety of the individual citizen and the entire community*" (Interviewee 17).

Consistent with the goal of this study (i.e., explaining CTA adoption hesitancy), we focused our analysis on informants who mainly perceived the government-imposed containment measures as highly restrictive, as all of them were Immuni nonusers and stated that they were unwilling to adopt them.

Respondents who perceived government-imposed containment measures as restrictive suffered freedom deprivation, which they expressed in terms of limitation of choice, imposition of individual decisions, manipulation, and pressure. As noted by Interviewee 30:

"*The restrictive measures limit my freedom of choice because they are choosing what I can and cannot do! In other words, they are [government members] manipulating and pressuring my freedom. In this sense, I feel a lack of freedom*" (Interviewee 30).

As a result of freedom deprivation, most interviewees expressed two different psychological states, i.e., *psychological reactance and helplessness.* Regarding psychological reactance, some informants revealed that they felt anger and that this emotional state was directed towards the source of the restraint, i.e., the government. Additionally, they exhibited negative attitudes towards the government and its containment measures: they ascribed greater failure to solve the aversive situation to the incompetence of the state government, which they claimed to be inexpert and unqualified.

"*I always feel angry! My anger is toward those [government members] who tried and failed to manage the pandemic situation. I am angry with them because although they deprived me of freedom, nothing changes, the situation is still the same! All the containment measures have not brought the results they hoped for; this is a clear sign that the measures have been ineffective! Therefore, the government is inexpert and incompetent to manage the situation. […] The Immuni app, as well as all the other measures, is yet another clumsy attempt by the government. Therefore, I'm not going to adopt it*" (Interviewee 2).

Regarding helplessness, other interviewees disclosed being profoundly hopeless, defenseless, and demoralized. These retreat emotions emerged as crucial because these respondents, who felt at the mercy of events, were unable to achieve personal and professional goals, which were salient for their self-identification and status affirmation. As Interviewees 5 and 27 stated,

"*I feel strongly defenseless and demoralized because I find myself catapulted into this situation of freedom deprivation, and there is nothing I can do to get out of it. […] What would be the point of using Immuni?*

Nothing because the situation would not change. Therefore, I'm not going to adopt it soon" (Interviewee 5).

"*I am helplessly at the mercy of events. I cannot achieve the personal and professional goals I set for myself. At this point in my life, I should be showing everyone what I'm worth, but I cannot. Because of this, I am deeply discouraged*" (Interviewee 27).

Therefore, the words of the interviewees revealed how both reactance and helplessness negatively correlated with the willingness to adopt Immuni, since informants who experienced these psychological states expressed their disinterest in using this CTA.

Furthermore, the content analysis allowed us to identify the theme of the *perceived difficulty in restoring freedom*, which respondents expressed as the impossibility of returning to and restoring the pre-COVID-19 situation because of endless waves of contagion. Respondents believed that government containment measures would have lasted for many months or years.

"*I think it's hard to regain a situation of full freedom in the sense that you cannot go back, and you cannot restore the pre-COVID-19 situation since, despite all the measures, the reported cases are increasing day by day. Therefore, I think that the restrictions will last for a long time, for months, for years…*" (Interviewee 24).

Finally, the interviews revealed that the different levels of perceived difficulty in restoring freedom could trigger either reactance or helplessness. Specifically, we found that the majority of individuals who exhibited very high levels of difficulty in restoring freedom were highly discouraged and demoralized and exhibited states of helplessness. Conversely, those who exhibited less intense difficulty in restoring freedom were also more likely to show psychological reactance in the form of anger and negative cognitions towards the government. As Interviewees 32 and 11 said,

"*What do I think of the government? Inadequate and incompetent, that is all I have to say because I'm angry! [...] It will be difficult to return to the pre-COVID-19 situation, but not impossible*" (Interviewee 32).

"*I am deeply discouraged… which is why I think we will never return to pre-COVID-19 normalcy*" (Interviewee 11).

5. Study 2 - Identifying young adult clusters

The second objective of this study was to identify an empirically based typology of young adults who differed in their focus on government-imposed containment measures, perceived difficulty in restoring freedom, and willingness to adopt CTAs. We thus adopted a quantitative approach, surveyed Italian young adults, and conducted a cluster analysis. We also profiled the identified segments of young adults according to sociodemographic data, the predominant psychological processes they undergo, and the importance they attribute to managerially relevant CTA-related variables.

5.1 Data collection

We recruited Italian young adults (aged 18-41 years) who were aware of the existence of Immuni, through Prolific, a participant recruitment company. Using a purposive sampling strategy, we obtained 900 responses. Seventy-nine respondents were disqualified because they provided incomplete answers or failed attention checks, resulting in a final sample of 821 valid responses (gender: women = 42.2%, nonbinary = 1%; educational level: 2.1% = primary school education, 33.1% = high school diploma, 60.4% = bachelor's or master's degree, 4.1% = Ph.D.). Respondents were highly familiar with mobile app usage (M = 6.54, SD = 1.02), but the vast majority of them (78.1%) did not use Immuni.

5.2 Procedure and measures

The questionnaire included close-ended questions divided into three sections. The first section included the measurement scales for the clustering variables: the focus on government-imposed containment measures, the perceived difficulty in restoring freedom, and the willingness to adopt CTAs. The second section presented the measurement scales used as qualitative descriptors in the cluster analysis, e.g., perceived freedom deprivation, psychological reactance, helplessness, resilience, trust towards the government, attitudes towards containment measures, and CTA privacy concerns (see Appendix, Table 4 for more details). Finally, in the last section, we collected sociodemographic data (i.e., age, gender, and educational level).

Concerning the clustering variables, we relied on the insights gathered from the qualitative Study 1 to develop a six-item, 7-point Likert scale to measure participants' focus on the restrictive nature of government-imposed containment measures (e.g., "The containment measures mandated by the government strongly limit my freedom of choice"), which also echoes input from White *et al.* (2008); and the four-item, 7-point Likert scale pertaining to the perceived difficulty in restoring freedom, which also reflects input from Dillard and Shen (2005) (e.g., "There is no chance to return to a pre COVID-19 normality"). Finally, we measured the willingness to adopt (WTA) Immuni by adapting Chan and Saqib's (2021) three-item, 7-point semantic scale (e.g., "Not at all interested/Very interested to use Immuni in the near future").

Concerning the descriptive variables, we measured perceived freedom deprivation by adapting White *et al.*'s (2008) four-item, 7-point Likert scale (e.g., "The government containment measures manipulate me"). Moreover, we treated psychological reactance as a multidimensional construct composed of two dimensions: anger and negative cognitions. We used Xie *et al.*'s (2015) three-item scale to measure felt anger and Ball and Goodboy's (2014) four-item, 7-point semantic scale to measure negative cognitions about the government. We measured helplessness by adapting Gelbrich's (2010) three-item, 7-point Likert scale, resilience by adapting Smith *et al.*'s (2008) three-item, 7-point Likert scale, and trust towards the government by adapting Chan and Saqib's (2021) one-item, 7-point

semantic scale. Finally, we measured the negative attitude towards wearing masks, social distancing, lockdowns, and vaccines by adapting Taylor *et al.*'s (2020) scales, whereas we measured CTA privacy concerns by adapting Chan and Saqib's (2021) measurement scale.

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5.3 Measurement model assessment

We first conducted a confirmatory factor analysis (CFA) to assess the reliability and validity of the measurement model running LISREL software (Jöreskog and Sörbom, 2006). Specifically, we assessed the measurement model related to the three variables used to identify the clusters (i.e., focus on the restrictive nature of government-imposed containment measures, perceived difficulty in restoring freedom, and willingness to adopt CTAs). The results showed an acceptable model fit: $\chi 2(62)$ = 884.851, root mean square error of approximation (RMSEA) =.07, square root mean residual (SRMR) =.07, confirmatory fit index (CFI) =.91, and nonnormed fit index (NNFI) =.90. The standardized factor loadings were all greater than .70, and all standardized item loadings significantly loaded onto their indented constructs (p <.01). The average variance extracted (AVE) for each variable was greater than .50 (.57 ≤ AVE ≤.89), and the composite reliability (CR) was greater than .70 (.87 ≤ CR ≤.96). Moreover, the Cronbach's alpha values were all greater than .70 (.86 ≤ α ≤.96) (Appendix, Table 2). Additionally, the shared variance between pairs of factors was always less than the corresponding AVE, thus showing discriminant validity (Fornell and Larcker, 1981). The means, standard deviations, and bivariate correlations among the three constructs are reported in Appendix, Table 3. "Overall, these findings confirmed that the hypothesized measurement model was reliable and valid". (Bagozzi and Yi, 1988)

To identify distinct groups of young adults, we conducted a nonhierarchical k-means clustering procedure (Ward's method), which was based on the respondents' standardized mean scores related to (1) their focus on the restrictive nature of government-imposed COVID-19 containment measures, (2) the perceived difficulty in restoring freedom, and (3) their willingness to adopt CTA (Immuni). The clustering procedure yielded a four-cluster solution, the generalizability of which to the entire population was confirmed by an adequate Rand index (.76) (Rand, 1971).

5.4 Study 2 - Findings

We labeled the four clusters according to three clustering variables: *Endangered dissidents, Apathetic, Optimistic adopters, and Lost needing guidance* (Appendix, Table 4).

Endangered dissidents (24%): Young adults in this segment expressed the strongest focus on the restrictive nature of government-imposed COVID-19 containment measures (1.07). Additionally, they scored higher than the average on the perceived difficulty in restoring freedom (.56). They exhibited the lowest willingness to adopt CTAs of all clusters (-.96).

Apathetic (24%): Young adults in this segment seemed indifferent to the restrictive nature of government-imposed containment measures (-.46).

Similarly, they did not exhibit high concerns about the impossibility of restoring the threatened freedom (-.35), scoring below the average on both factors. Additionally, they seemed not interested in adopting CTAs, as their willingness to adopt CTAs was below average (-.78).

Optimistic adopters (26%): This segment included young adults who did not focus at all on the restraining aspects of government containment measures. They exhibited the lowest scores of all clusters in terms of focus on the restrictive nature of government-imposed containment measures (-.73) and the perceived difficulty in restoring freedom (-.91). Additionally, they exhibited the highest willingness to adopt CTAs (.82).

Lost needing guidance (26%): Finally, this segment of young adults felt lost and pessimistic about the possibility of restoring their freedom in the near future. They focused more than the average on the restrictive nature of government-imposed containment measures (.19) and, importantly, showed the highest score on the perceived difficulty in restoring freedom among all clusters (.78). Interestingly, they also showed rather high scores on the willingness to adopt CTAs (.79), such that they appeared to seek guidance from governmental authorities in times of uncertainty.

The four clusters differed significantly in terms of age ($F(3, 817) = 6.48$, p <.01) and gender ($\chi^2(6, 821) = 39.97$, p <.01), even if the differences were rather small, while no difference regarding educational levels emerged ($\chi^2(9, 821) = 3.69$, p =.93) (Appendix, Table 4). In addition to the sociodemographic variables, we used descriptive qualitative characteristics to profile the segments, such as freedom deprivation, reactance, helplessness, and resilience. Furthermore, we profiled the segments with individual measures that refer to trust towards the government and negative attitudes towards government containment measures, such as lockdowns, masks, social distancing, and vaccines. Finally, we included measures of consumers' perceptions of CTAs (Immuni) in terms of their awareness, perceived usefulness, privacy concerns, and current usage.

An analysis of variance with Fisher's LSD post hoc comparisons revealed significant differences across clusters (Appendix, Table 4). Endangered dissidents scored highest on freedom deprivation and reactance and above average on helplessness. Their lack of trust in the government was manifested in their negative attitudes towards containment measures (i.e., masks, social distancing, lockdowns, and vaccines). Concerning Immuni usage, these endangered dissidents scored quite low on Immuni awareness, strongly disregarded its effectiveness, and expressed the highest privacy concerns among all clusters. The percentages of Immuni users, which differed significantly among the four clusters ($\chi^2(3, 821) = 147.89$, p <.01), were the lowest among engendered dissidents. Overall, these findings confirmed that the perceived technical liabilities and privacy concerns linked to using CTAs could be related to a deeper state of psychological reactance felt by young adults.

The *apathetic* expressed no specific concerns in terms of freedom deprivation, nor did they exhibit higher scores of reactance or helplessness. However, despite their lack of strong aversion to government containment measures, they perceived Immuni as ineffective and were unwilling to use

it. In turn, they accounted for the second-lowest percentage of Immuni users among all clusters.

Conversely, the *optimistic adopters* did not perceive freedom deprivation, did not show reactance or helplessness, and exhibited the highest resilience scores of all clusters. Additionally, they showed the highest trust in the government and acceptance of government containment measures. They were highly aware of Immuni, perceived it to be useful, and were not particularly concerned about privacy. The percentage of Immuni users in this cluster was the highest among all clusters.

Finally, the *lost needing guidance* scored above average on freedom deprivation and reactance and exhibited the highest helplessness scores. Despite being deeply hopeless and highly demoralized, these consumers trusted the government and exhibited rather positive attitudes towards government-imposed containment measures. They knew Immuni and perceived it to be useful (as much as the optimistic adopters did) and exhibited low privacy concerns. Finally, the percentage of Immuni users in this segment was the second highest among all clusters. These findings showed an unexpected role of helplessness being positively correlated with the willingness to adopt CTAs. When young adults experienced helplessness, they appeared to seek guidance and welcome government containment measures, CTAs included.

6. Conclusion

6.1 Discussion and theoretical implications

Governments have strongly promoted CTAs as a tool to limit the propagation of the COVID-19 virus (Georgieva *et al.*, 2021). Despite such expensive and dedicated promotional efforts, CTAs have failed to leave much of a mark, even among digitally savvy young adults (Open, 2020). Drawing on psychological reactance theory, we conducted a mixed-method study to determine how and when young adults' reduced adoption intentions towards CTAs reflected their focus on government-imposed containment measures and their perceived difficulty in restoring freedom. Second, we provided an empirically based typology of young adults according to their focus on the restrictive nature of government-imposed containment measures, the perceived difficulty in restoring freedom, and the willingness to adopt CTAs. Finally, we profiled the identified clusters in terms of (a) sociodemographic data, (b) the psychological processes they experienced, and (c) the importance they attributed to managerially relevant and CTA-related variables.

The findings from this mixed-method approach establish two notable theoretical contributions related to the adoption and social acceptability of CTAs. First, in addition to technical features and privacy concerns as the main barriers to COVID-19 CTA adoption (e.g., Chan and Saqib, 2021; Hauff and Nillson, 2021; Trang *et al.*, 2020; Velicia-Martin *et al.*, 2021), we offer a complementary perspective in which both the focus on government-imposed containment measures and the perceived difficulty in restoring

freedom explain how and when young adults are unwilling to adopt CTAs. Specifically, young people's focus on the restrictive nature of containment measures triggers their perceptions of freedom deprivation. As freedom deprivation is experienced, two different psychological states arise, i.e., *psychological reactance* and *helplessness*, with reactance predominating over helplessness when young adults perceive that they still have some chances to restore threatened freedom. Existing studies have mainly focused on anger as a relevant emotion (e.g., Dillard and Shen, 2005); we also identify helplessness as influential. Detangling between reactance and helplessness is crucial. Indeed, the results of the cluster analysis show that the two psychological states have asymmetric relationships with CTA adoption intentions; while reactance negatively correlates with CTA adoption intentions, helplessness positively correlates with them. To our knowledge, this study is the first to apply psychological reactance theory to assess how and when young adults' focus on the restrictive nature of COVID-19 containment measures and their perceived difficulty in restoring freedom might explain CTA adoption failure.

Second, our choice of investigating young adults informs the field of studies that examine CTA adoption among individuals in general (e.g., Hauff and Nilsson, 2021; Fox *et al.*, 2021). Deepening the perspective of young adults is essential, as their adoption intentions and underlying psychological mechanisms may differ from those of older generations. Young adults tend to value freedom, autonomy, and choice more than older generations and benefit from an active lifestyle (Berger, 2017). As such, understanding how and when they might oppose CTAs for reasons that go beyond privacy concerns (Fernandes and Costa, 2021) is a critical step toward achieving mainstream diffusion of CTAs. We identified novel typologies of young adults (*engendered dissidents, apathetic, optimistic adopters,* and *lost needing guidance*) who differ in terms of theoretically and managerially relevant CTA factors. Our findings provide a more fine-grained picture of young adults' attitudes and behavioral intentions towards CTAs that are needed to communicate more effectively with these targets.

6.2 Managerial implications

Our findings have relevant implications for practice. Continued discussions about the failure of the adoption of CTAs should not only consider privacy and usability issues (e.g., Akinbi *et al.*, 2021; He *et al.*, 2021). Conversely, policies promoting CTA social acceptability should also consider the deeper psychological states that young individuals may experience. The results of the cluster analysis indicate four segments of young adults, which questions the effectiveness of any "one-size-fits-all" communication strategy. Practitioners can use our findings to develop more effective communication messages tailored to each segment.

Endangered dissidents and *apathetic* people show low usage intentions and adoption behavior. Endangered dissidents seem more difficult to convince, however, as they express the strongest perceptions of freedom deprivation and reactance, along with strong counterarguments against

CTA effectiveness. When targeting this group, policymakers could develop retrospective explanations (Gelbrich, 2010) that include information about why a containment measure was necessary to ensure public safety. Such messages could reduce reactance by increasing young adults' understanding of government constraints (Davidow, 2003). Another option might be focusing on the benefits of CTAs, such as by using terms associated with enhanced freedom of movement and traveling. The *apathetic* feel less endangered by government containment measures, but they are rather unwilling to adopt CTAs. As young adults, they might be convinced by campaigns that feature influencers (The Conversation, 2020); as apathetic people, behavioral nudges that increase their feelings of ownership and perceived effectiveness could be effective.

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Optimistic adopters and those *who lost the need for guidance* indicate high usage intentions and adoption behaviors. Optimistic adopters do not feel endangered by government-imposed containment measures. They experience low reactance and helplessness and high resilience. Considering this target's belief that CTAs are useful for themselves and society in general, policymakers might offer these committed citizens a moral reward that motivates them to be CTA ambassadors, such that they could feel proud of spreading CTA adoption to the mainstream. Those who *lost the need for guidance* exhibit high usage intentions and adoption behavior; however, they are driven by different motivations and need aid and guidance to reduce their helplessness. Policymakers could target this segment by developing prospective explanations that emphasize how CTAs will give citizens control and power now and in the future. For example, interactive communications with these users through CTAs could encourage resilience and wishful thinking to motivate them to become optimistic adopters.

Our findings also have implications for society at large. Global pandemics such as COVID-19 have disruptive effects on businesses, consumers, and society. Healthcare authorities, policymakers, and governments can limit such disruptive effects by reducing the spread of the virus. Persuading young adults is a crucial step toward reaching this goal. Young adults are socially active and contribute more to the spread of the virus. The adoption of CTAs is crucial to limit and track the spread of the virus. Additionally, young adults use mobile apps more than older generations, and might promote CTA adoption diffusion into the mainstream. Our study proposes communication strategies that are tailored for different segments of young adults, which help CTA adoption among this younger population and, in turn, the population at large. The findings of our study will also help policymakers deal with new global crises that may occur in the future for which Italy is still unprepared (Global Health Security, 2021).

6.3 Limitations and future research

This study has some limitations that provide avenues for future research. First, this study investigates young adults' CTA adoption intentions in the context of COVID-19. Future research may consider investigating different generations of consumers to determine differences between younger and older generations through age-based multigroup analyses.

Second, our empirical study is conducted in Italy. Country populations differ in terms of cultural dimensions and levels of trust towards the government, which may all influence CTA adoption intentions. To enhance the robustness of our findings, future research might conduct cross-cultural studies with representative samples of national populations and assess how relevant cultural dimensions (e.g., individualism/collectivism, uncertainty avoidance, power distance) may affect CTA adoption intentions.

Third, we use a mixed-method approach, including qualitative interviews and cluster analysis, albeit our findings cannot fully demonstrate causality, as our study is correlational in nature. Future research can consider adopting an experimental approach to reveal the causality between freedom deprivation caused by government-imposed containment measures, perceived difficulty in restoring freedom, and CTA adoption.

Finally, this research provides a limited number of profiling variables. To better understand the characteristics of the identified segments, additional descriptive variables might be used. On a related note, we identified four clusters of young adults and suggested specific communication strategies that may enhance each segment's CTA adoption. Although we speculate about some communication strategies that seem likely to be effective for each segment, we call for additional experimental research that tests the effectiveness of the proposed communication strategies across diverse consumer segments.

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study

Tab. 1: Overview of interview participants

Interviewee ID	Age	Gender	Educational qualification	Profession	Status
1	28	F	Master's degree	Student	Non-user
2	20	M	High school graduate	Musician	Non-user
3	25	M	Master's degree	Unemployed	User
4	30	F	High school graduate	Shop assistant	Non-user
5	32	F	PhD	Teacher	Non-user
6	24	M	Bachelor's degree	Student	Non-user
7	21	M	High school graduate	Singer	Non-user
8	23	F	Bachelor's degree	Student	Non-user
9	29	M	High school graduate	Clerk	User
10	30	M	High school graduate	Unemployed	Non-user
11	18	F	Secondary school graduate	Student	Non-user
12	20	F	High school graduate	Student	User
13	32	M	High school graduate	Freelancer	Non-user
14	36	M	Master's degree	Software developer	User
15	25	M	Master's degree	Student	Non-user
16	26	F	High school graduate	Shop assistant	Non-user
17	39	M	Bachelor's degree	Clerk	User
18	18	M	Secondary school graduate	Musician	Non-user
19	31	F	High school graduate	Entertainer	Non-user
20	25	F	Master's degree	Clerk	Non-user
21	23	F	High school graduate	Shop assistant	Non-user
22	18	F	High school graduate	Swimmer	Non-user
23	26	M	Bachelor's degree	Freelancer	Non-user
24	37	F	Bachelor's degree	Kindergarten teacher	Non-user
25	18	F	Secondary school graduate	Student	Non-user
26	27	M	Master's degree	Data scientist	Non-user
27	22	M	Bachelor's degree	Student	Non-user
28	29	M	Master's degree	Clerk	Non-user
29	24	F	Master's degree	Unemployed	Non-user
30	29	M	Master's degree	Business consultant	Non-user
31	28	F	Bachelor's degree	Student	User
32	21	F	Secondary school graduate	Student	User
33	26	M	Master's degree	Consultant	Non-user
34	29	M	Bachelor's degree	Dancer	Non-user
35	41	F	High school graduate	Shop assistant	Non-user

Source: our elaboration

Tab. 2: Measurement models assessment

Constructs	Measurement items	λ	α	CR	AVE
Focus on the restrictive nature of government-imposed COVID-19 containment measures (7-point Likert scale, 1=strongly agree, 7=strongly disagree)	The government containment measures		.89	.89	.57
	1. impose too many restrictions on my freedom of movement.	.71			
	2. limit my freedom of choice excessively.	.76			
	3. take me away from my loved ones.	.72			
	4. constrain my social contacts.	.72			
	5. prevent me from achieving my goals.	.83			
	6. prevent citizens from achieving their goals.	.79			
Perceived difficulty of restoring freedom (7-point Likert scale, 1=strongly agree, 7=strongly disagree)	1. It is impossible to return to pre-COVID-19 normality.	.88	.86	.87	.63
	2. There is no chance of restoring pre-COVID-19 normality.	.85			
	3. It is very hard to return to what we called normality.	.80			
	4. I doubt that things will return to normality, as there will be government restrictions for many months, if not years, to come.	.61			
Willingness to adopt Immuni (7-point semantic scale)	How likely/willing/interested are you to adopt Immuni in the near future?		.96	.96	.86
	1. Not at all likely/Very likely	.94			
	2. Not at all willing/Very willing	.94			
	3. Not at all interested/Very interested	.95			

Source: our elaboration

Tab. 3: Mean scores, standard deviations, and bivariate correlations among constructs

	FOCUS REST M=4.24 SD=1.48	DIFFIC RESTOR M=4.04 SD=1.65	WTA M=4.03 SD=2.09
FOCUS REST	1		
DIFF REST	.28**	1	
WTA	−.25**	−.10**	1

Notes: FOCUS REST = focus on the restrictive nature of government-imposed COVID-19 containment measures; DIFFIC REST = perceived difficulty of restoring freedom; WTA = willingness to adopt Immuni. M=mean, SD=standard deviation. **Correlation is significant at p=.01, *Correlation is significant at p=.05, (ns)=Correlation is not significant. The matrix is diagonal

Source: our elaboration

Tab. 4: Cluster descriptions

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	Cluster a		Cluster b		Cluster c		Cluster d		Test statistic	
	Endangered dissidents		Apathetic		Lost needing guidance		Optimistic adopters		F(3,817)	Significance
N (%)	196 (24%)		197 (24%)		213 (26%)		215 (26%)			
Clustering variables	M z score		M z score		M z score		M z score			
FOCUS REST	1.07		−.46		.19		−.73		244.05	<.01
DIFFIC REST	.56		−.34		.73		−.91		262.84	<.01
WTA	−.96		−.78		.79		.82		665.83	<.01
Sociodemographic variables	M	SD	M	SD	M	SD	M	SD		
Age (years)	27.47 $_d$	7.42	28.35 $_c$	6.57	26.57 $_{b,d}$	6.06	29.30 $_{a,c}$	6.79	6.48	<.01
Gender (within cluster)										
Men	75 (38.3%)		92 (46.7%)		62 (29.1%)		117 (54.4%)			
Women	120 (61.2%)		103 (52.3%)		150 (70.4%)		92 (42.8%)			
X	1 (0.5%)		2 (1.4%)		1 (0.5%)		6 (2.8%)			
Education (within cluster)										
Junior high school or lower	6 (3.1%)		6 (3.0%)		4 (1.9%)		3 (1.4%)			
High School	66 (33.7%)		67 (34.0%)		66 (31.0%)		73 (34%)			
Bachelor's or master's degree	118 (60.2%)		114 (57.9%)		134 (62.9%)		130 (60.5%)			
Higher education	6 (3.1%)		10 (5.1%)		9 (4.2%)		9 (4.2%)			
Descriptive qualitative variables	M	SD	M	SD	M	SD	M	SD		
Perceived threatened freedom	5.25 $_{b,c,d}$	1.35	3.09 $_{a,c,d}$	1.39	3.63 $_{a,b,d}$	1.43	2.30 $_{a,b,c}$	1.86	173.41	<.01
Reactance	5.13 $_{b,c,d}$	1.09	4.07 $_{a,c,d}$	1.18	4.53 $_{a,b,d}$	.99	3.44 $_{a,b,c}$	1.06	89.06	<.01
Helplessness	4.64 $_{b,d}$	1.66	3.63 $_{a,c,d}$	1.57	4.87 $_{b,d}$	1.36	3.12 $_{a,b,c}$	1.47	62.10	<.01
Resilience	4.42 $_d$	1.20	4.54 $_d$	1.21	4.44 $_d$	1.13	5.00 $_{a,b,c}$	1.14	11.31	<.01
Trust toward the government	3.13 $_{b,c,d}$	1.42	3.58 $_{a,c,d}$	1.42	3.90 $_{a,b,d}$	1.21	4.42 $_{a,b,c}$	1.29	33.81	<.01
Negative attitude toward wearing masks	2.31 $_{c,d}$	1.61	1.74 $_{a,d}$	1.08	1.53 $_{a,d}$	.90	1.39 $_{a,b}$	.85	25.17	<.01
Negative attitude toward social distancing	2.47 $_{b,c,d}$	1.62	1.68 $_{a,d}$	1.01	1.65 $_{a,d}$	.98	1.36 $_{a,b,c}$	.74	35.60	<.01
Negative attitude toward lockdowns	3.70 $_{b,c,d}$	1.90	2.13 $_{a,d}$	1.26	2.08 $_{a,d}$	1.38	1.65 $_{a,b,c}$	1.01	79.53	<.01
Negative attitude toward vaccines	2.49 $_{b,c,d}$	1.62	1.94 $_{a,c,d}$	1.40	1.65 $_{a,b,d}$	1.02	1.34 $_{a,b,c}$	.81	31.13	<.01
CTA awareness	5.28 $_{c,d}$	1.57	5.31 $_{c,d}$	1.56	6.06 $_{a,b}$	1.10	6.16 $_{a,b}$	1.20	24.60	<.01
CTA effectiveness	2.54 $_{c,d}$	1.55	2.73 $_{c,d}$	1.26	4.79 $_{a,b}$	1.47	4.63 $_{a,b}$	1.48	140.73	<.01
CTA privacy concerns	4.18 $_{b,c,d}$	1.98	3.22 $_{a,c,d}$	1.79	2.31 $_{a,b,d}$	1.47	1.97 $_{a,b,c}$	1.24	83.25	<.01
Number (percentage) of CTA users	4 (0.49%)		11 (1.34%)		75 (9.14%)		90 (10.96%)			

Notes: M z score = standardized mean score, where average = 0, standard deviation = 1; M = mean, SD = standard deviation. Subscript letters indicate significant differences between the cluster of reference and the other clusters at the .05 significance level (Fisher's LSD post hoc test). FOCUS REST = focus on the restrictive nature of government-imposed COVID-19 containment measures; DIFFIC REST = perceived difficulty of restoring freedom; WTA = Willingness to adopt. We measured trust toward the government by one item on a 7-point Likert scale ("How much do you trust your state government?", Chan and Saqib, 2021); negative attitudes toward (e.g., "I am against…") wearing masks, social distancing, lockdown, and vaccines were measured via two-item, 7-point Likert scales; Taylor and Asmundso, 2021; Taylor *et al.,* 2020); CTA awareness was measured on a three-item, 7-point Likert scale (e.g., "I am aware of the possibility of using CTA"); CTA perceived usefulness was measured via a three-item, 7-point Likert scale (e.g., "CTA is useful"; Chan and Saqib, 2021); privacy concerns when using CTA was measured on a three-item, 7-point Likert scale (e.g., "I am concerned that CTA collects too much personal information about me", Smith *et al.,* 1996). Current CTA usage is a dichotomous variable: "Are you currently using CTA?" 1 = yes, 2 = no.

Source: our elaboration