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Contact-tracing apps and alienation in the age of COVID-19

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ABSTRACT

Using a core idea of critical social theory, alienation, we interrogate the failure in the design and adoption of a Stop-COVID app in France. We analyse the political and scientific discourse, to develop an understanding of the conditions giving rise to this failure in this unprecedented moment. We argue that the digital-first solutionist approach taken by the government failed because, as in all Western countries, most stakeholders were alienated from the reality of the COVID-19 pandemic and lacked concrete knowledge of it. Furthermore, the French government and its COVID-19 council excluded relevant scientific experts in favour of quantitative modelling based on abstract partial knowledge. This along with coercion and lack of transparency about the app, reinforced alienation, undermined effectiveness in managing the crisis and resulted in the digital design failure. We suggest that such alienation will prevail in the COVID-19 era characterised by regimes of control, rampant abusive location tracking, and data collection, and where public officials are more concerned with managing effects than seeking causal explanations. The digital-first solutionist approach was adopted, not because digital solutions (to contact tracing) are superior to traditional ones, but by default due to alienation and lack of interdisciplinary cooperation.

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1. Introduction

In the past information systems for contact, tracing have proven beneficial in fighting epidemics. What if we added a smartphone app that could identify the chain of contacts more rapidly and curb pandemics like COVID-19 (Ferretti et al., 2020; Hinch et al., 2020)? Such a smartphone solution raises a number of concerns. Among those that have been addressed are privacy and the ineffectiveness of the app in a catch 22 situation. If the app is imposed, individuals will feel they are being surveilled, which raises immediate ethical concerns and may signal authoritarian regimes. Conversely, if use of the app is voluntary and every step in the tracing process requires explicit consent, it is highly unlikely that the critical threshold of use will be achieved to ensure effectiveness in contact tracing. If use is voluntary, as in Western countries, and if, from a utilitarian (consequentialist) viewpoint, we could argue that it is beneficial if it saves only one life, ethical and political concerns related to privacy and health still remain (Rowe, 2020a). Shifting government responsibility for negotiating the value dilemmas of privacy, freedom of movement and health, onto citizens and representatives in order to lift the lockdown is a mark of neo-liberal regimes (ibid). Some argue that citizens should not be asked to choose between privacy and health; they should enjoy both (Harari, 2020). Moreover, a condition of privacy and

health, is that proposed solutions are discussed and designed for transparency and trustworthiness (Harari, 2020). In this paper, we argue that in pandemic situations, quantitative speculations based on analogies, abstract and partial knowledge hinder effective intervention design and crisis response. Unprecedented crisis situations require that design solutions be based on concrete knowledge derived from inclusive scientific debates and problem understanding grounded in reality. In the following we use the French case, to critically interrogate the effectiveness of the design and the adequacy of smartphone contact-tracing apps and argue that:

- Solutionist approaches (Morozov, 2013) lead to inadequate specifications and *irrelevant* data collection due to partial understanding and recognition of the problem (especially transmission paths of COVID-19).
- The dominant epidemiological approach and inadequate design of the French Stop-COVID app indicate an alienation from nature of disease transmission and from social reality when borders reopen.
- The unfortunate *outcome* (ineffective design), misunderstandings of the transmission paths and pan-European interoperability issues of apps can be partly explained by the government's use of coercive tactics in their urgency to act and

demonstrate action and by the choice of a sovereign solution, all of which reinforce alienation.

- Such alienation will prevail in: a) a digital age where “digital comes first” (Baskerville et al., 2020), i.e., when digital artefacts are created to represent reality before reality is known b) the control age (Beniger, 1986) where abusive location tracking and data collection (Rowe, 2020a) can lead to classification and detection frenzy, and c) the anthropocene age when reality seems too complex to search for causal explanations and where public action focuses on managing effects (Chandler 2019).
- Practically the misunderstandings of the transmission paths and inadequate designs could have been avoided by more inclusive (international and interdisciplinary) collaborations of scientists to marshal relevant knowledge from other specialities such as fluid mechanics and aerosols, or information systems.

In the following sections, we provide some background on the contact-tracing information systems and their effect in fighting epidemics. We then develop a critical stance based on philosophers’ concept of alienation and describe our methodology before examining arguments in the French public debate on the Stop-COVID app. Finally, we discuss these findings in light of an international comparison with 10 countries and highlight our contribution(s).

2. E-GOV apps for crisis management

Increasingly e-government solutions are used to respond to national and global crises and provide digital public services to citizens (Goh & Arenas, 2020). Dedicated mobile apps, social networks, and online communications now support governments in all the stages of crisis management (pre-crisis, crisis, post-crisis). During the crisis stage government responses focus on push communication processes, providing information (through social networks or mobile apps) for coordinating citizen behaviour (Coombs, 2014), while during public health crises, government responses unfold through specific and complex technological, organisational, and social processes. Governments tend to emphasise life-threatening risks during the crisis stage of a public health problem, promoting the urgency of compliance with guidelines. Fear appeals are utilised to coerce compliance by emphasising the threat that will befall citizens if they do not comply with the government’s recommendations (Walton, 2013). Fear appeals are highly recommended and popular in public health communication (Tannenbaum et al., 2015; Walton, 2013). The health crisis communication literature also suggests that fear appeals may be effective in reducing

infectious disease outbreaks by motivating citizen engagement in preventive behaviours (Chon & Park, 2019) and decreasing panic on social media (Xu et al., 2020). The second focus of public health crisis response is recursive communication processes (e.g., Contact tracing) to inform government actions. Indeed, government actions are dependent upon data for: (1) efficient contact tracing for informing infected citizens, and (2) coordinating relevant actions with local health authorities. Contact tracing is a systematic method used as part of a disease surveillance strategy (predict, observe and minimise). The process involves pulling data from diverse sources (airlines and airport records, routine clinical examination, etc.) to map the chain of infection by: (a) identifying persons (contacts) who may have encountered an infected person, and (b) collecting data on their moves (tracing) and subsequent contacts. This strategy has been effective in determining HIV infection chains in the 1980s, tuberculosis outbreaks, and infection spread in the H1N1 pandemic (Swaan et al., 2011).

Smartphone apps for contact tracing were first used in 2014–2016 in West Africa during the Ebola epidemic. West African scientist and IT experts in Sierra Leone and Guinea developed e-government initiatives such as smartphone apps for digital contact tracing (Danquah et al., 2019; Sacks et al., 2015). Smartphone apps provided cheaper, timely, and more accurate contact-tracing data than manual methods (Danquah et al., 2019). However, these apps faced severe operational limitations in security and privacy due to the short timeframe for development, infrastructure complexity, local collaboration and coordination challenges (Danquah et al., 2019; Sacks et al., 2015). In spite of these limitations, epidemiology researchers were optimistic about the efficacy of such digital tools and viewed smartphone apps at the new “silver bullet” for disease contact tracing (Farrahi et al., 2014; Ferretti et al., 2020). When COVID-19 emerged and progressed as a pandemic from January to March 2020, epidemiologists enthusiastically embraced smartphone apps for contact tracing. The tech giant Alibaba in collaboration with the Hangzhou municipality and the blessing of the Chinese government developed and deployed on February 11 2020, Alipay Health Code, the first smartphone app for COVID-19 contact tracing. Numerous countries quickly followed launching other smartphone contact-tracing apps based on GPS or Bluetooth infrastructure, and using centralised or decentralised approaches for processing contact data (Fahey & Hino, 2020).

Europe, underexposed to the H1N1, Ebola, and SARS health crises, had little or no recent citizen awareness of pandemics, or government experience and knowledge of fighting pandemics. More than a decade ago Mounier-Jack and Coker (2006) argued there was lack readiness for a pan-European

collaboration for crisis management of ordinary influenza pandemics, and these deficits still remain (Droogers et al., 2019). In France, e-government initiatives launched during the COVID crisis, focused on online communication, an online form for administrative control during the lockdown, and the Stop-COVID contact-tracing app. While the European Data Protection Board pleaded in favour of developing a pan-European coordinated action plan for contact-tracing apps, European countries adopted various stances, with some governments in favour of a decentralised, distributed, and privacy-preserving approach and others such as the French government, favouring a partially centralised approach (Rowe, 2020a).

3. Alienation in critical theory

Alienation and emancipation are central ideas of critical social science theory (CST) (Geuss, 1981). While emancipation is well discussed in the IS literature, alienation has been largely ignored. The concept of alienation is concerned with explicating how our intellectual relationship to the natural and social worlds reproduces knowledge contradictions and dysfunctional social practices, while emancipation is concerned with liberating ourselves from various forms of alienation (Dobson, 1995; Honneth, 1991). Frankfurt school CST builds its social critique on Hegelian dialectics (Geuss, 1981). According to G.W.F. Hegel (1977), alienation (estrangement) is a mechanism of false consciousness that reproduces contradictions in our quest for self-knowledge (ourselves and nature). This alienation results in abstract speculative knowledge that does not inform “essential nature”. Building on Heraclitus’s understanding that “being and non-being are one”, G.W.F. Hegel (1977) argues that we are not different from nature, we are nature. Alienation is to think of ourselves as outside of nature, while trying to know nature and ourselves; this is a false consciousness, (a self-deception), the consequence of which is acting against ourselves. For example, if we do not understand the tree as our respirator and nourisher, we cut and sell it for “economic value”, depriving ourselves its life-sustaining products. Hegelian scientific knowledge requires intimacy with that which we inquire into, or seek to transform. Alienation (false consciousness, self-deception) is the path to ignorance and disastrous consequences for humanity. This *theory of alienation* is further developed by various critical social theorists. Marx (1977) illustrates how alienation from the historical material conditions of life results in exploitative social organisation of economic production. Heidegger (1954) argues that our alienation from the essence of technology exposes us to imprisonment by technology. In his critique of social Habermas (1971a, 1971b) illustrates how various forms of alienation from our social world

results in “science as ideology” that impoverishes our self-understanding. Beck (1992, 1996) illustrates how the alienation from nature embedded in our science and technology practices creates a risk to our global survival. More recently, and closer to our Flyvbjerg (2000, 2001) argues that alienation from concrete knowledge about conditions of megaprojects distorts political and administrative rationality, resulting in absurdities in decision-making. We may also argue that the multitude of paradoxes that characterise liquid modernity (Bauman, 2013; Doyle & Conboy, 2020) and the phenomenon we study is a consequence of alienation.

3.1. Alienation, Science and Praxis

Alienation is a taken-for-granted worldview of our relationship to the world that has profound consequences for approaches to knowing (science) and acting (praxis) in the world. In *Science of Logic*, Hegel (1812) argues that alienation from our world leads to abstract knowledge which is incomplete for understanding and acting in it. He explains the process of abstract knowledge generation as follows:

“[T]o abstract means to select from the concrete object ... this or that mark from ... the many other properties and features left out of account; ... they are left yonder, on the other side . the inability of the understanding ... compels it to content itself with the impoverished abstraction ... [that] reveals itself as incomplete (ibid. p. 87)

Alienation from our world (natural and social), and its complexities, begets: (a) alienated abstract knowledge, (b) alienated decision-making, (c) design of alienated technologies, and (b) the reproduction of alienation. Abstract systems and digital e-government applications that routinise social interactions, engender forms of alienation, such as, facelessness, dislocation, and distrust (Feldstein, 2019; Giddens, 1990; Kuldova, 2020). Dislocation means the locus of control is shifted to the system leaving a human actor no possibility to negotiate as in a human-to-human interaction; thus, she or he loses agency, becomes “faceless”, lacking a human identity, which depends on recognition by the other (Giddens, 1990). Digital solutionism is a form of alienation characterised by advocacy of a solution, typical a smartphone app with simple algorithms based on some proxy that is easy to quantify, which if used regularly is supposed to solve a complex problem (e.g., keeping one’s health) (Morozov, 2013). Such solutionism can only nurture false expectations and self-deception. Digital technologies for surveillance of humanity are the most recent in this progression from alienated abstract knowledge to alienating technologies (Engel, 2019; Lyon, 2003). Governments now partner with tech firms to deploy these technologies for surveilling citizens and predicting their

behaviour (Taylor et al., 2008), while public officials appeal to technical rationality and abstract scientific knowledge to legitimatise these decisions (Habermas, 2015). Decades ago Vogel (1988) raised ethical concerns and cautioned the introduction of digital technologies into society:

“Contemporary technology takes place under the sign of alienation (in Marx’s sense): it is a social product but appears like an autonomous force, responding to the imperatives of the market, or the balance of power, in ways we feel incapable of affecting. It is not the social character of our interventions in nature that deserves criticism but rather . . . they have not been sufficiently socialized that there exists no means of exerting over them democratic social control. Only when we find a way to assert that control, and so end our own alienation, will it be possible to begin to work for a technology that truly solves human problems instead of being an alien and autonomous force threatening to destroy us. (pp. 380-381)”

Flyvbjerg (2004) who is concerned with public management argues that we need “a form of reasoning which yields an ‘ethical know-how’ in which the universal and the particular are co-determined” (ibid p. 300). Moreover, critical theorists argue that collaborative and inclusive approaches are essential for building consensus to support contentious public management initiatives (Doberstein, 2016; Siddiki et al., 2017).

4. METHODOLOGY

Our research adopts a CST methodology which entailed the systematic collection and critical analysis of empirical materials on the French debates on the Stop-COVID app (Myers & Klein, 2011). An important issue was defining the relevant framing of the analysis for the particular crisis situation (Street & Ward, 2012). We chose to define it using two themes in the public debate “lockdown vs. un-lockdown” which provided both a sense of temporality and had symbolic meaning for French citizens, organisations, and institutions. From this perspective we followed the advice of Cukier et al. (2009) to identify and select empirical materials from relevant authoritative sources for the period February 1 to June 17 2020, namely: (1) Le Monde, founded in 1944, is the most popular and reputable French afternoon daily newspaper. It is the authoritative source for the institutional debate on values and political action and for scientific positions that inform the government and the public. From Le Monde, we collected 85 articles mentioning Stop-COVID app and contact-tracing systems published between April 5 (the first article) and June 17. From Le Monde, we also searched for and collected 355 articles reporting on debates on other preventive measures such as masks and social distancing. (2) Three government websites (updated weekly)

providing Minutes of Parliament and Senate debates. From these websites, we consulted 40 documents related to the COVID-19 crisis. (3) CNIL, the French directorate responsible for digital privacy and digital risks, from which we collected 10 documents (2 policy recommendations and 8 articles related to the crisis). (4) We monitored the scientific literature on the effect of masks as preventative measures, and transmission paths of SARS-CoV-2. Finally, to contrast the French situation with nine other countries we collected additional information from various sources (see Appendix A).

In the analysis phase, with the CST emancipatory knowledge interest in mind, we applied the principles outlined by Myers and Klein (2011). Using the CST core concept of alienation, from Hegel, Marx, Habermas, and Beck (*Principle 1*) we interrogated French government practices regarding a contact-tracing app. From the value position (*Principle 2*), of transparency, transdisciplinary collaboration, and science over government coercion and abuses, we focused on identifying contradictions. We also perform an ethical assessment of the design and adoption of the app using the four criteria proposed by Mingers and Walsham (2010): Efficacy: does the system work and do what it is supposed to? Ethicality: is the system compatible with the values of stakeholders? Equity: is the system fair and just for all affected? Effectiveness: does the system meet the owners’ aspirations in the long term? In challenging the government practices (*Principle 3*), we questioned the relevance of quantitative speculations and their reliance on digital epidemiology and erroneous assumptions of the virus transmission, while ignoring relevant scientific knowledge of aerosol dynamics. We systematically read and analysed the corpus of documents using principles of critical hermeneutic analysis (Ngwenyama & Lee, 1997). In theorising our findings we use qualitative causal loop modelling (see Figure 2) to illustrate the empirically observed interaction dynamics and their implications (Yearworth & White, 2013). To complement our analysis of the empirical materials we (a) followed the situation daily, first as citizens concerned for family safety, (b) engaged in debates on the issues with family members, and specialists on public health preventative measures, and fluid dynamics. The three authors performed extensive triangulation among sources and the narrative of the key events (see Figure 1) was submitted to an expert in fluid dynamics and airborne transmission and to a public health specialist for corroboration of the important events of the scientific discourse and corrected when needed. Finally, in reporting our findings we suggest improvements to

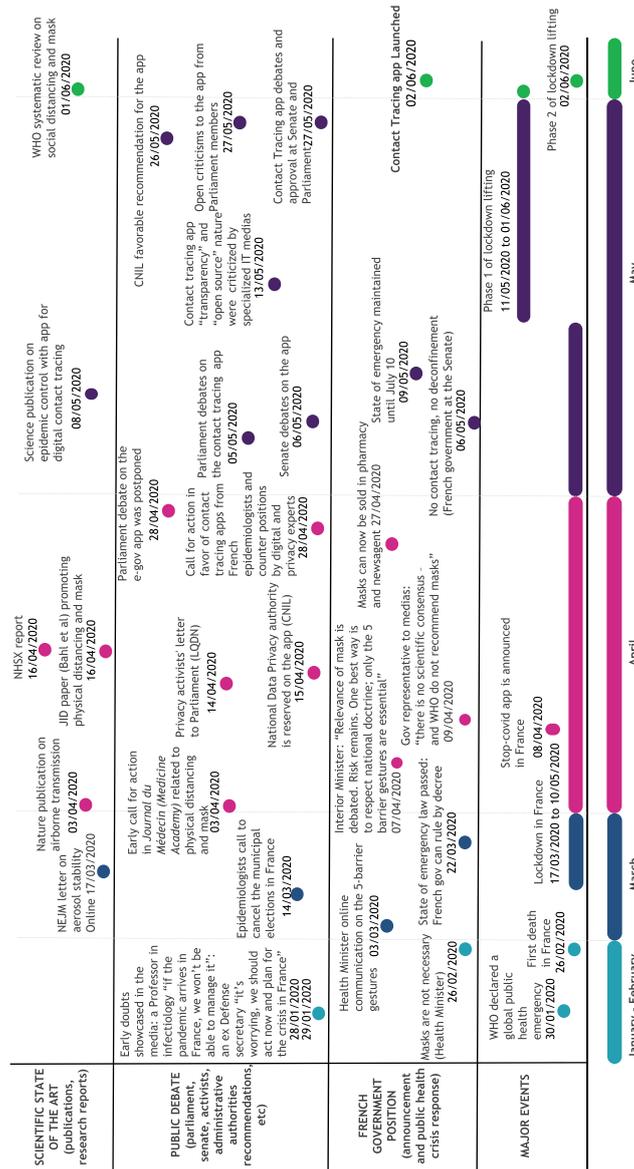


Figure 1. Chronology of events during the COVID-19 crisis in France.

institutions and social practices (*Principle 5*) and some potential areas for future research.

5. Findings

In order to contextualise our findings and key events in the development of the COVID-19 pandemic debate in France, we will first present a critical interpretation of public discourse for three important phases: (1) Pre-COVID-19 crisis, (2) Crisis and Lockdown, and (3) Unlockdown and Post Crisis. We will then discuss some key aspects of alienation from the material and social reality of the COVID-19 pandemic and their consequences of incomplete knowledge and their undermining of the effectiveness of government interventions (digital apps and behaviour prescriptions) to manage the pandemic.

5.1. Pre-COVID-19 crisis Phase

On February 18, Health Minister proclaimed: “*France is ready because we have an extremely solid health system*”. The pre-crisis phase was characterised by this belief that France and Europe were largely protected from pandemics, and there was a false perception that the French health system was a sufficient protection against the pandemic. This was a conflation of a robust health insurance protection system with a robust health crisis management system, that signals a deep alienation from the reality of pandemics and their social consequences. In addition, infrastructure for producing basic requirements for fighting pandemics, personal protective equipment (PPE)’s for healthcare workers and drugs had all relocated to China during the last decade. In the previous 3 years, national hospital funding was drastically cut and just-in-time delivery of hospital supplies was implemented under neo-

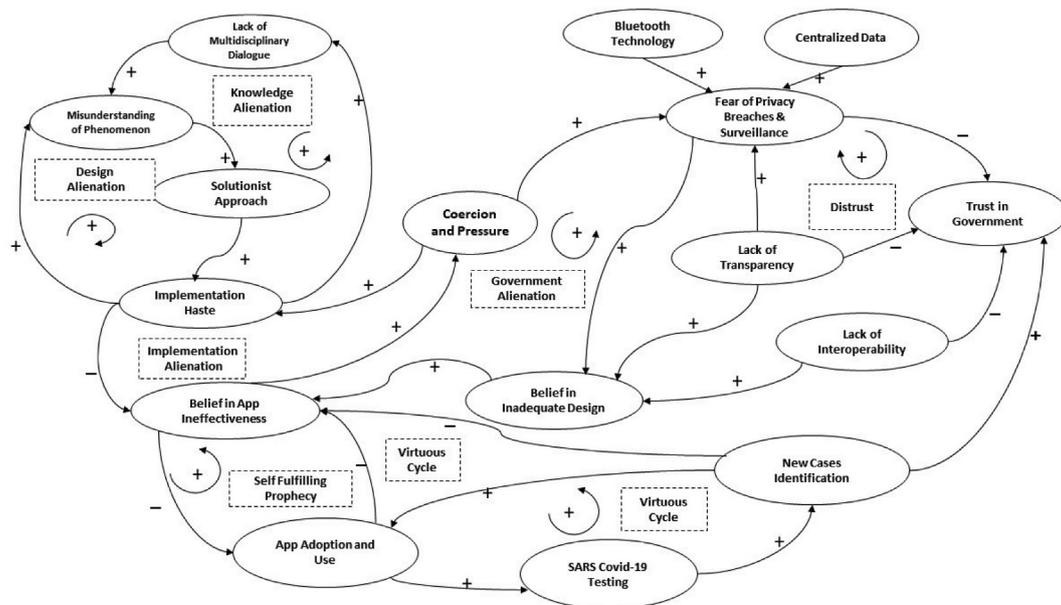


Figure 2. Illustration of interaction dynamics observed from our empirical analysis.

liberal public management policies. These actions which diminished the capabilities of the state to take effective action against the pandemic are yet another manifestation of alienation from the material conditions necessary for the resilience of the state. This pre-COVID-19 crisis phase lasted till early March with basically no action even though since January there was knowledge of a new coronavirus epidemic in China. By February it had spread to neighbouring countries in Europe, leading Italy to declare lockdown on February 21.

5.2. Crisis and Lockdown Phase

In early March the perception of a crisis was still unclear. On March 6, President Macron, exhibiting his alienation from the reality of the emerging global pandemic, went to the theatre and invited “*French citizens to go out in spite of COVID-19 [...] show must go on, there is no need to modify our habits*”. The crisis continued to accelerate and the number of infection cases continued to increase. On March 14, the number of infections doubled in less than 72 hours. On March 16, there were 6633 confirmed infection cases and 148 deaths, then panic ensued. Only 10 days after inviting citizens not to modify their habits, President Macron announced the lockdown of France on national TV. He ordered the closing of France’s borders and declared “*we are at war*” with the virus and will take whatever measures are needed at “*whatever the cost*”. On April 28 both unlockdown and the Stop-COVID app were supposed to be discussed in parliament, but the prime Minister decided against having the debate because the app was not ready. Discussion convened on May 5 in parliament and May 6 in Senate. This debate was notably

informed by Le Monde, which included a call from epidemiologist to support the app (April 28).

5.3. Unlockdown and post-crisis phase

This phase began on May 11 when the first step of unlockdown took place. However, effective management of the unlockdown required planning for crisis containment and for a second outbreak. The Stop-COVID app was announced as an essential measure to “*limit the virus diffusion and identify future chains of infections*” (Health Minister, May 13). Key for the Stop-COVID app approval in this period were the debates in Parliament and Senate on May 27, encouraged the day before by a favourable recommendation of the Stop-COVID app by CNIL (Administrative Authority for Data Protection and Privacy) revising their April 15 findings concerning data privacy risks. The new CNIL finding stated that the design of the app would not lead to discrimination, privacy, or security leaks. After only a day of Senate and Parliament debates on the app, it was approved. While senators strongly resisted on May 5, they largely approved it on May 27, pressured by coercive government tactics (see section below). On June 2 the app was launched, and on July 17 the government announced that only 2.3 million people downloaded the app (out of 67 million French citizens) but no information was given on the number of active users.

5.4. Lack of state of the art on SARS-CoV-2 transmission

On March 11, the government announced the creation of a COVID-19 scientific council, comprising 11

health experts selected by the government. These include social scientists, family physicians, intensive care physicians, epidemiologists, and virologists, a digital strategy advisor, and a representative of an anti-poverty NGO. The epidemiologists were more influential on the council for their capabilities in quantifying and predicting death rates, an important statistic for the government and media. Notable exclusions from the council were scientists who studied fluid mechanics and airborne aerosol dynamics. The COVID-19 council focused on the issues of lockdown-unlockdown and the Stop-COVID app, and ignored important scientific knowledge concerning SARS-CoV-2 transmission. As early as March 17 experiments reported virus suspension in aerosols for 30 minutes and possibly hours (Van Doremalen et al., 2020). As early as April 3 there were media and scientific reports of aerosol transmission of SARS-CoV-2 (Borsellino et al., 2020). In the *journal du Médecin* several scientists from disciplines other than epidemiology synthesised their arguments for masks, insisting that their effectiveness and relative importance depended on the socio-technical and environmental conditions (Borsellino et al., 2020). International virologists argued that there was airborne transmission of SARS-CoV-2 (Asadi et al., 2020; Bahl et al., 2020), but French epidemiologists and the council ignored them. On April 3 stronger evidence of aerosol transmission and the efficacy of masks for prevention appeared in a publication (Leung et al., 2020) in *Nature*. Most importantly, Bahl et al. 2020 (April 16) highlighted government prescription on physical distancing was “not based on current scientific evidence”. They argued physical distancing needed to be 6 or 8 metres depending on the environmental conditions and other factors, “viscoelasticity of the expiration fluid, type of ventilation, velocity of expiration, rate of evaporation, and the dynamics of turbulent cloud generated during exhalations, sneezing, or coughing” (Bahl et al., 2020). In France, Bertrand Rowe, a Fluid Mechanics and Astrochemistry researcher, had written several short notes explaining the risks of indoor infections due to typical practices of internal air recycling (Morawska & Cao, 2020), and noted the importance of wearing masks in workplaces and crowded buildings for collective protection (Rowe, 2020bb).

A WHO funded review of physical distancing and masks, published on June 1, also confirmed these findings. A seminal study on digital contact-tracing apps published May 8 by Ferretti et al. (2020) mentioned airborne transmission. However, neither spatio-temporal implications of transmission paths nor socio-technical conditions were explicitly considered in their modelling of the design efficacy. This limitation and ignorance of the mentioned above scientific reports and the use of NHS executive summaries meant the COVID council and the French

government designed their interventions based on incomplete knowledge. Furthermore, the French print media and TV did not report or debate airborne transmission paths until after a signed petition of 239 scientists from diverse disciplines appeared in the *New York Times* on July 4, and a scientific paper (Morawska & Milton, 2020) appeared in the *Journal of Infectious Diseases* on the 6 of July. On July 15 mechanistic transmission modelling of the infection on the Diamond Princess demonstrated the relative importance of aerosol transmission (Azimi et al., 2020).

5.5. Strategy by default and design specification errors

Besides misunderstanding transmission paths, the French government’s position appeared as a strategy “by default” of reacting to events *and managing effects* rather than anticipating based on causal explanations (Chandler, 2019). On March 03 in online communication, the government outlined its doctrine, *the 5 barrier gestures* (cough in your elbow or a tissue; single use of tissues; no handshake greetings; avoid kissing; wash your hands frequently). However, little was communicated on prevention measures successful in countries, such as South Korea, Taiwan, and China (i.e., rapid testing, wearing masks). With a lack of understanding of the situation, the government communications remained focused on its doctrine of *the five barrier gestures* and respect for the lockdown to defeat the COVID-19 pandemic. On March 25, a government spokesperson argued on National TV: “we have to respect the 5 barrier gestures and the lockdown [...] there is no need for masks if we respect social distancing measures”, and, following WHO, the prescribed distancing was 1 metre. On April 7 and 9, the Interior Minister stated the best way to fight the pandemic was to “respect the national doctrine; only the 5 barrier gestures are essential”.¹

Paradoxically at the same time, on April 8, the government announced the development of the Stop-COVID app. The app is designed to identify infected and uninfected persons (carrying the app) encountering each other within one metre for at least 15 minutes. These rules were abstracted based on an incomplete understanding of the phenomenon, from a limited scope of the academic literature and were far too restrictive and optimistic. They were also taken on the belief that broader specifications would lead to an excess of false positives and possible panic risk. A preprint of the NHSX report (Hinch et al., 2020), published on April 16, contained the central argument used in the Parliament by Government in favour of the Stop-COVID app: “we only need 56% of the population using the app” (May 27). But the French government failed to mention later academic publications

nuancing this first finding such as Ferretti et al. (2020) and ignored studies that did not fit their narrative. Similarly, Information Systems research findings were not considered in designing the app or planning its deployment. Government officials did not explain in plain language the security, privacy, data collection, processing, storage, and reuse (i.e., criteria that influence citizens' adoption and use of e-government apps). Rather, they emphasised the number of deaths and the need for collective protection (fear appeals) to legitimate the app. The lack of proactive government strategy for managing pandemics came to light early April with the shortage of PPE for health professionals. Commenting on the shortage on April 24, the State Secretary stated: *"the current pandemic scenario was not envisioned by French public health agencies"*. This lack of readiness from the pre-crisis and towards the end of the crisis was influenced by epidemiological projections of the pandemic from statistical models based on analogies to other viruses without recognising the specificity of transmission of SARS-CoV-2 or how it could affect the design specifications for the app.

5.6. Coercive tactics to promote the solution

Facing significant opposition from Deputies and Senators, the government employed numerous coercive tactics to obtain agreement on its solutionist approach to the Stop-COVID app. On April 20, Senator Philippe Bas argued: *"the Korean app was efficient, but 20.000 people were employed by the Korean government to run the contact tracing process [...] we do not have the same resources [...] we do not want to be monitored by a big computerised and centralised Big Brother"*. During the vote at Parliament, Deputy Philippe Gosselin called for caution about *"solutionism, this too high trust in technology"* (May 27). He argued that the two files "SI-DEP" and "Contact Covid" related to the traditional method of contact tracing already available (see Rowe, 2020a) were sufficient. Deputy Patrick Hetzel (May 29) stated: *"the app was approved but there are still numerous legal, ethical and societal questions to be answered, in addition to usefulness and efficiency issues. While unlockdown is taking place, the app is still not ready, with blurred boundaries [...] objectives, technologies and uses of the app are too risky, we are gambling our freedom over unknown results"*. The most iconic example of coercion was on May 6 at the Senate when the Health Minister pressed senators to adopt the Stop-COVID app, stating: *"No contact tracing, no unlockdown"*. Deputies reported off the record that they faced pressures from members of the government. On April 14 Deputy Aurélien Taché claimed: *"State Secretary visited our Deputy Group and said that each of us will have to encourage the use of the Stop-COVID*

app. But if this is moral pressure of deputies and ministers [...] I am worried". On May 27, the State Secretary in charge of the digital, Cédric O, made a fear appeal to the Parliament: *"the alternative to the Stop-COVID app is simple [...] you can accept the app and contribute to contain the pandemic, reduce the number of future death, reduce the risk of a new lockdown [...] or you could choose, for political reasons [...] to deprive our citizens from this protection [...] in that case you will accept all the related risks; to say it clearly, you will be accountable for new contaminations, additional death, and the greater risk of a new lockdown."* Ironically, he admitted his coercive tactics, stating: *"this sentence is threatening, but it is true. This is what science and statistics told us [...] if you refuse the tools, you will have to face it with open eyes"*. In response, Deputy Aurélien Pradié was remarkable ironic, stating: *"We would believe in a bad dream if Hannah Arendt had not prevented us against the greatest dangers for free men: the passive abandonment of fundamental liberties. Voluntariness does not exist when it's about alienating part of one's liberty. How to thank you for such benevolence? This world that is prepared for us will be clean, hygienic; it will be safe, over-controlled: clean but anesthetised, hygienic but alienated"*.

Similar tactics were used by the media to target citizens and justify the app as a solution to COVID-19. During all the lockdown phase (17/03/2020 to 10/05/2020), government officials made daily announcements of the number of deaths and new infections. On March 16, the Prime Minister, Édouard Philippe repeated 6 times President Macron's metaphor, *"We are at war"*, in a public discourse. Later, on national TV, on May 28, he employed a mixture of authority arguments and war metaphors to present Stop-COVID app to the citizens, stating: *"epidemiologists believe it is a necessary tool to fight against the pandemic [...] it is a new tool [...] a powerful tool, vital in our war against the pandemic"*. On June 3 government officials emphasised: *"epidemiologic studies show us that, from the first download, the app enables us to avoid infections and even death"*. The effectiveness of this communication strategy remains to be seen, but as of July 17, only 3,43% of French citizens downloaded the app.

5.7. Assessment of Stop-COVID App

On assessing the app from the perspective of Mingers and Walsham (2010) four criteria we found the following. *Efficacy*: From a pragmatic perspective the Stop-COVID app is only half efficacious. The system works, but does more than what it is supposed to do even with too narrow specifications for contact (1 metre distance and >15 min); it collects more data than originally claimed by the government and goes

beyond the expectations of stakeholders. *Ethicality*: In the French context, the app and the way it is publicly debated, fuel dilemmas and the privacy paradox (Rowe, 2020a). Consistent with the ranking comparing other smartphone warning apps on data privacy (see Appendix A), the French app does not meet good standards and cannot be considered ethical due to lack of transparency of its code and the way its characteristics are communicated to the public. *Equitability*: How can a system be equitable if it is based on alienation and coercive tactics? A centralised system does not allow an end to end anonymisation which may open the path to discrimination. *Effectiveness*: From the government perspective, a higher rate of infection detection and control of disease spread due to download and use? As of June, 23, there were only 2.3 M downloads of the Stop-COVID app, 68 people registered their infection status on it, but only 14 were alerted of infection contact risk (Medical Express, 2020). Given the alienation from nature in the general case, and other design choices that can influence download and app usage (Figure 2), we understand why effectiveness is very low in the French case. We can say its low adoption is a failure for the government and a success for opponents. Perceived health policy rigour cannot explain the low rate of adoption, as in the case of Italy where very rigid policy supersedes the need for additional protection of a contact-tracing app (see Appendix A). Given our improved understanding of the transmission paths, we see the limitations of digital solutions; they can help, but cannot curb the disease. Even if in other countries design features and implementation characteristics lead to higher effectiveness, the ethics of such apps remains problematic. Moreover, apps with capabilities for intense tracking of citizens based on some combination of geolocation and AI, will only advance the surveillance society. Alternatively, we could arrive at the same outcome through coercive measures (mandatory use) that are incompatible with democratic values. We are not against the cautious use of invasive digital technologies, if careful attention is given to social and material conditions and we can control their impacts by ensuring proportional use and effectiveness. These conditions were not met in France, and even if government officials argue that the pandemic crisis makes the approach acceptable, it contradicts French values of *liberté, égalité, and fraternité*, and should be rejected. If the debacle of our public management of the COVID-19 pandemic and app design makes clear the dangers of alienation on such societal projects, it will have done a great service to society.

6. Discussion

The COVID-19 pandemic, considered the worst global crisis since WWII, is wreaking havoc on social and

economic systems globally. Facing unprecedented challenges of the pandemic, France imposed in a country-wide lockdown to slow the transmission of COVID-19 and manage the consequences. Such extreme measures were never taken during the 1720 plague, the 1831 cholera epidemic, nor WWII. However, even though the public health responses to crisis were strict in France, other countries such as Italy took even stricter actions (see Appendix A). Our empirical observations from the critical analysis of the French public debates on COVID-19 and from our assessment of the design effectiveness of the contact-tracing app, and additional evidence at international level (see Appendix A) require theoretical elaboration. In the following we distil our findings into three theoretical propositions and present supporting argumentation for each proposition, illustrate the interaction dynamics in a causal loop model (see Figure 2), then outline practical implications for public management practice.

6.1. Theoretical propositions

Proposition 1: The empirical evidence from our study illustrates that solutionist approaches are highly likely to result in inadequate design specifications and *irrelevant* data collection due to lack of state of the art on key dimensions of the problem (e.g., transmission paths of the disease). According to Rowe (2020a) the three conditions for an effective classification-based smartphone contact tracing app are: a) correct data collection and b) correct classification and c) triangulation with other apps, all raise ethical issues. In this paper we argue that data collection becomes irrelevant if not based on clear understanding of individuals' behaviour (e.g., international travel) and knowledge of the disease transmission dynamics. While there was scientific knowledge on transmission paths, including airborne, available from international experts at the very beginning of the French lockdown, the COVID council ignored it, and it was never transparently discussed in French society. Another paradox in the French case is that, while data collection is irrelevant and alienating with current specifications,² a better knowledge of aerosol transmission dynamics and distance parameters (≤ 8 metres) should have led to wider data collection.³ Ironically such broader collection is exactly what happened. On June 15th French media revealed that data collection was broader than officially announced by the Government. Naturally this should – and it does now – raise concerns about privacy and surveillance. If we really want to consider airborne transmission in the app design to enable detection of as many new cases as possible, the only design choice is using geolocation and intrusive digital surveillance that violates freedom and liberty, as in

China and Norway (see footnote 3 and [Appendix A](#)). A more ethical alternative is to be clear that the app is limited to certain spatio-temporal conditions and give up the pretence that it will curb the pandemic.

*P1: In unprecedented crisis situations, digital interventions should be designed from concrete knowledge that considers scientific debates and understandings of the problem grounded in socio-technical reality **instead of** quantitative speculations based on analogies, abstract and partial knowledge. Failure to do so reinforces alienation and undermines the effectiveness of interventions in the crisis situation.*

P2: Interoperability challenges related to the choice of a sovereign solution abstracted from reality of international travel (inside and outside EU) lead to the perception of an inadequate solution to a global problem.

P3: Coercive communication tactics and pressure from government officials to hasten the launch of the app contributed to the design failure, the low adoption rate (downloads and use) and ineffectiveness of the solution.

P3a: Designers will capitulate to coercion because they cannot go against the government's will, and the capitulation will undermine their decision making on the app design.

P3b: Capitulating to government coercion and pressures to speed up the launch undermines correctness of requirements specification as designers can only go as fast as the understanding of the complexity of the problem will allow.

P3c: Coercion leads to distrust, and when combined with design options that are perceived as unethical, fuels the beliefs of inadequate design and ineffectiveness of the app which results in low adoption rates.

The inadequate design indicates an alienation from nature and social needs when borders reopen. Alienation from (a) the natural reality of the coronavirus, its aerosol transmission dynamics, and the effects of distance and mask-wearing; (b) the reality that open borders and mobility of European (and other) citizens, both contributed to false consciousness and incomplete knowledge for designing and deploying an adequate digital solution. This alienated knowledge undermined the smartphone app's legitimacy and trustworthiness on account of (a) ineffective contact-tracing due to inappropriate design parameters for distancing; (b) interoperability challenges across smartphone platforms (and service providers); and (c) escalating digital risks to privacy breaches and surveillance of users due both to Bluetooth technology (Hassan et al., 2018) and to the choice of a centralised solution (Fahey & Hino, 2020). We contend that a lack of understanding and false consciousness yields to solutionism. In the French case the technology is not even effective for significant detection of cases.

Proposition 2: The app may only increase the knowledge of events which is unnecessary when we don't have correct knowledge of disease transmission paths and social behaviour (mobility of European citizens and international travel). In fact, it has been argued that when borders reopen pandemic control will require interoperability among contact tracing apps and global collaborations. Indeed, experience of past health crisis (H1N1, SARS, Ebola, etc) lead Asian and African governments to collaborate on aligning national and regional crisis response plans to ensure a greater resilience (Droogers et al., 2019). However, the French app currently lacks any form of interoperability with neighbouring countries as of July 2020. Such a limitation is a consequence of national solutionism when governments and their experts are under the influence of Big Tech and both benefit from the argument of regaining national sovereignty over technology.

Proposition 3: We theorise that, and probably specific to France (see [Figure 2](#)), the inadequate design from incomplete knowledge of the disease transmission path and behaviour, the low adoption rate and the ineffectiveness of the solution can be partly explained by the coercive attitude of government in their urgency to act and demonstrate action. We recognise that coming from a background in systems design, one could argue that design is always imperfect, always partial, and never complete as eliciting user requirements are often unknown even to the user, and are always changing radically anyway. However here the project is an infrastructure project. Only a minimal interface will allow the user to give consent at different stages in the process. We never criticised it – in the French case the design of the interface seems satisfactory to us. Our criticism bear on the communication (lack of transparency and coercion) and on the opportunity to launch such an app given that the problem the app is supposed to respond – the co-presence with an infected individual – is only a part of the overall problem (two other paths: touch and airborne are not addressed with the app); and it cannot even fill this part because with such strict/narrow conditions and problems with Bluetooth technology an extremely low portion of the population will be potentially tested. However, haste to design it in a short time contributes to ineffective design because designers cannot go against Government's will. French national pride was at stake, Singapore and other Asian countries had already succeeded in deploying effective contact tracing apps (Fahey & Hino, 2020; and [Appendix A](#)) and the prominent Oxford team had developed an app for the UK. The problem needed to be solved urgently, and these symbolic pressures also contributed to the digital first solutionist approach that undermined the effectiveness of the app.

In addition, coercive tactics used in communications about the app fuelled distrust leading to low adoption rates. However, scholars have long argued that coercive tactics can prove counterproductive and increase the digital divide (Chan & Pan, 2008). Military approaches to implementing e-government apps in times of crisis, with “*command-and-control [...] “targets and terror”*” can backfire (Wastell et al., 2009, p. 270). Moreover, Irani et al. (2007) cautioned that many e-government apps are too rigidly imposed on citizens and are dehumanising social interactions. In spite of these admonishments, industry best practices still highlight “digital by default” government policy, authoritarian approaches, digital determinism, and coercive crisis communication (Corydon et al., 2016). In health crisis communication, coercive tactics are the standard course of action (Chon & Park, 2019; Tannenbaum et al., 2015). But, recent studies suggest that measured, adequate, and relevant fear appeals instead of pressure and unnecessary exaggeration of risks, are more successful at mediating citizens scepticism and resistance (Jin et al., 2019; Lunn et al., 2020). Presently, public trust in science and medicine is particularly important issues in France, as vaccination rates continue to fall due to anti-vax movements (Peretti-Watel et al., 2014). More research is needed to understand the influences on public trust and adoption of e-government initiatives in times of crisis. In particular, the complex challenge of minimising influences of irrational fears and fake news while raising citizens awareness of risks.

6.2. Theorising the interaction dynamics

In Figure 2, we illustrate the interaction dynamics using a causal loop model that reflects our theoretical propositions. The model builds from the idea that beliefs can be causal and as a consequence reality is constituted through multiple feedback loops (Markus & Rowe, 2018). The upper left part of Figure 2 reflects P1 and illustrates the dynamics of two forms of alienation: knowledge alienation and design and implementation alienation. Design and implementation alienation arise from digital solutionism and haste which ignores the issue of partial understanding of the phenomenon or problem. Haste can be viewed as good because it diminishes the belief that the app will be ineffective. However, the need to take action can also reinforce the idea that coercion is a good thing and finally coercion is interpreted by designers that speed if not haste in design and implementation is necessary. We argue that such dynamics occur in the general case (at least in western democracies). However, it would not be so dramatic if design choices and governmental discourse did not alienate trust in the app and trust in government as it obviously happened in France. The lack of transparency, both

perceived and objective, the fear of data privacy issues and of habituation to surveillance in the long term were reinforced by government coercion despite the voluntary adoption strategy. These factors reinforced distrust in government and led to the belief that the app was inadequately designed. This belief, highlighted by the public debate, in turn, reinforced the belief that the app would be ineffective. The rest of the model is self-explanatory. It appears that those countries that did not make the same errors as France were more successful in their app design and adoption. For example, Germany followed an open collaborative approach instead of coercion and developed design options that enabled interoperability among apps (cf. Appendix A). The result was almost six times the adoption rate than France. In addition, while France overlooked testing, Germany invested significantly in COVID testing capacities. Germany’s contact-tracing app benefitted from network externalities (higher rates of COVID test self-reported on the app), which lead to further app adoption and use in a virtuous loop (bottom of Figure 2). Two recent studies (Pietz et al., 2020; Ferretti et al., 2020), also found that testing and contact tracing by smartphone apps are important for relaxing lockdown measures. While we agree that testing is essential, the privacy issues of smartphone contact tracing apps will need resolution to ensure high levels of adoption.

6.3. Practical implications

Our analysis and theorising were not aimed at prediction, but understanding and explanation. Thus, we can offer some practical implications to help avoid the reproduction of alienation. If our analysis is correct, beyond taking a value stance on privacy, it suggests that we can improve society by seeking broader participation from relevant actors to mitigate misunderstandings and incomplete knowledge of the natural and social situation. In the context of e-government initiatives in turbulent environments, careful and comprehensive IS planning practices are more efficient than incremental IS planning (Salmela & Spil, 2002). The Stop-COVID case suggests that in an unprecedented crisis situation adaptive governance, planning, collaboration, and cooperation are required for agile and effective interventions (Janssen & Van der Voort, 2020). More open dialogue among international scientists from relevant disciplines, such as fluid mechanics and aerosols, could have enabled the French public officials to marshal the relevant scientific knowledge about the virus and its transmission dynamics. Furthermore, open dialogue with socio-technical design specialists, epidemiologists, and IS experts on adoption behaviour, use, and effects of smartphone apps, could have yielded appropriate knowledge and a less alienating design. A collaborative

team of relevant scientists and socio-technical experts could have mitigated the design failure and poor outcomes: (a) ineffective contact tracing, (b) escalating risks to privacy and surveillance, (c) citizen rejection, and (d) the cost of designing a new more effective one.

The consequences of alienated digital design for social use have been long highlighted (Klein, 1981; Kling & Lundegaard, 1980), but the forces of digital determinism (data capitalism, digital first), and the velocity and ubiquity of digital colonisation of social life have overshadowed the importance of researching the effects of alienation in digitalisation. As we move to colonise more of our natural and social world with digital technologies, the alienation gap will widen as the situational complexities increase, and designers use reductionist strategies to abstract from the complexities and manage their cognitive overload. Ultimately, alienation from nature and social reality will produce an all-digital society acceleration effect (Rosa, 2003) and finally alienation from ourselves. Alienated digital artefacts resulting from inaccurate representations of reality and poor decision-making processes, only increase risks of negative outcomes when we are faced with dangerous unprecedented situations. Questions such as: “Have I been exposed to the virus?” (or “am I exposed or am I going to be exposed?”) cannot be addressed in a digital-first mode. The key point of the digital is identifying and warning about potential exposure to infections so that the effectiveness of preventative actions are credible. A digital contact-tracing app can help create a better world only if we remember that it cannot change what happened. While it can explain how contact happened and influence the ways we talk about or qualify past situations; however, it is dangerous if these situations are misrepresented. In this regard, it is self-deception to believe that “digital first” can give us real-time control of our behaviours by sending wrong signals. From this perspective, digital-first (creating digital representations of reality, before reality is known) is a false consciousness, rooted in alienation from natural and social reality. By creating digital representations of reality without knowledge of reality it creates the potential for behaviours and actions that are dangerous to users of digital artefacts. The promise of a control society (Beniger, 1986) fuels itself serving the interests of a few digital capitalists, captains of digital industries, and public officials who seek to maintain power by showing that they are taking actions to solve problems, even if those actions are inadequate. Such a state of affairs produces more alienation in society (open prison effect; distrust; anxiety about digital surveillance and privacy risks (Rowe, 2020a)) instead of emancipation from a better understanding of our world.

7. Conclusion, limitations and future research

In this paper, we utilised the concept of *alienation* to develop an understanding of the dynamics that led to the failure of the Stop-COVID contact-tracing app in France. This research contributes to a new theoretical explanation of how *alienation* from the socio-material conditions of the situation can result in e-government solutions that bring greater risks, fuelling the digital risk society and the acceleration effect. Firstly, a key insight of this research is that *alienation* from the natural and social reality of the situation of interest results in the illusion of control or false consciousness which undermines our capabilities for effective action. This insight enabled us to critically interrogate and theoretical explanation the failure of the public management interventions (Stop-COVID app, policy, and communication measures) in the pandemic crisis. Alienation from the knowledge of the SARS-CoV-2 virus and the social conditions of life in the EU resulted in the misplaced reliance on the Stop-COVID app which has neither the power to stop the virus nor the pandemic. Moreover, alienation from the social and material reality of the pandemic resulted in flawed institutional processes, scientific dialogue, and cooperation, and a flawed app. Flawed because its specification was based on partial understanding of a highly complex problem – multiple transmission paths including airborne, which is highly dependent on physical and socio-technical conditions. Second, this research provides insights into how alienation manifests in scientific and concrete knowledge-gathering, solution design, and implementation, and government (dis)trust, and how society can partially emancipate itself from alienated situations, as Germany appears to have done. It also provides an empirical contribution to the influence of transparency and trustworthiness in successful e-government initiatives (e.g., Chan & Pan, 2008; Wastell et al., 2009) and confirms their importance in the context of life-threatening crises where health data are at stake. The French case also challenges our current knowledge in health crisis communication processes which tend to overemphasise the effectiveness of fear appeals (e.g., Chon & Park, 2019; Xu et al., 2020). Fourth, this research enables us to characterise the case as “digital-first solutionism” in e-government when (a) digital capabilities are uncritically advocated to solve a complex problem in the absence of adequate knowledge, (b) in the context of the rise of the surveillance and control society via deliberate government action or ignorance of digital technologies, and (c) of reactive tactics resulting from insufficient crisis readiness. This work thus contributes to the literature on ethics of public management and e-government for crisis management (e.g., Fahey & Hino, 2020; Rowe, 2020a).

7.1. Limitations

While this research revealed some interesting insights upon which we develop the above theoretical explanation, it is important to point out some limitations and possible boundary conditions that should be interrogated. First, our theorising is limited to a single case and partial investigations of data from other countries. However, more in-depth comparative analysis of cases in specific countries could uncover evidence for further theorising of the dynamics of alienation. Second, the forms of alienation observed in our case study are more likely to prevail in Western countries that lack experience with coronaviruses and relevant preventative measures. Early in the pandemic, spiralling fear fuelled by dramatic forecasts of infections and deaths motivated urgent action, and hence solutionist approaches. Third, the forms of alienation we observed are also more likely to prevail as societies experience the digital and anthropocene ages where: (a) “digital comes first” (Baskerville et al., 2020), (b) digital surveillance (Rowe, 2020a) and control (Beniger, 1986) is rampant, and (c) reality seems too complex thus public officials focus on managing effects instead of seeking causal explanations (Chandler 2019). Fourth, we know that regardless of how well a system is implemented, if the design requirements are based on poor understanding of the problem situation it is doomed to fail (Klein, 1981). And such design failures are more likely to occur when we think that the digital solutions (e.g., contact tracing) are superior to traditional ones just because they are digital and can accelerate processes, even if at higher risk (e.g., false positives and negatives). Fifth, motivated by profit, tech firms, and digital service providers will support any form digitalisation that contributes to the expansion of location tracking and ubiquitous digital control of our everyday lives even when digitalisation raises huge ethical questions (Rowe, 2020a).

7.2. Future research

While this research advanced our understanding of how alienation can lead to dysfunctional institutional processes that result in IS design failure, it can potentially offer more substantive contributions to advancing research on the “Dark side of IT”. Unlike *emancipation*, its opposite concept in critical social theory, *alienation* has not received attention in IS research. But as we illustrate above it has the potential to advance IS emancipatory knowledge by facilitating dialectic inquiry. Specifically, it can help us to systematically interrogate: (a) worldviews and assumptions that underpin our methods for the design of IS and inquiry into IS phenomena to reveal their limitations, contradictions, and social implications; (b) our false

consciousness about the potential of digital technologies for solving our societal problems and the values dilemmas they generate. For too long the dominant knowledge interest of IS research has been utilitarian, focused on the rapid digitalisation of society; however, there is increasing realisation that utilitarianism cannot address the value dilemmas of digitalisation (Ngwenyama & Klein, 2018; Rowe, 2018). For example, Schultze (2017) argues that we urgently need to critically examine the impacts of IS theories on the digital society we are making. Second, Rowe (2018) calls for more critical inquiry into the value dilemmas that we are facing from the digital transformation of society. The value dilemmas of societal digitalisation that we now face suggest that these are central problems of IS research that deserve considerable attention. Beyond characterising digital-first solutionism, the processes by which digital solutionism pervades the political and social spheres and contributes to societal alienation must be researched. While we must address the critical need for a learning-oriented approach to multidisciplinary scientific knowledge integration, we should also interrogate the processes by which the solutionist camp persistently opposes this and how these processes influence research programmes. Presently, our discipline lacks relevant concepts to help us unpack these problems at all levels of analysis (individual to society) and for generating relevant emancipatory knowledge. The CST concept of alienation has the potential to overcome this knowledge deficit by guiding systematic critically reflexive IS research programmes to help identify and overcome potential negative consequences of rapid digitalisation that is accelerating the digital risk society.

Notes

1. The doctrine was finally amended on April 27, with a decree authorising the sale of masks in pharmacy and newsagent stores. This event relates points to the lack of reassessment processes, and the failure to include diverse and international findings on the scientific state of the art.
2. Government and their big tech allies alienate us by designing contact-tracing apps with criteria (<1 metre; and > 15 minutes contact) insufficient for controlling danger and yet generate numerous false positives. And when they justify their criteria based on public health testing capacity limitations, instead of setting design criteria based correct knowledge of the virus transmission dynamics (≤ 8 metres; and ≤ 30 minutes contact).
3. The Norwegian contact-tracing app had a particularly intrusive centralised design. It captured real-time location data of individuals by GPS in a central database. Machine learning was used to analyse the data for 30 days intervals to account for socio-technical and environmental conditions and map the paths of individuals. The app would have enabled the

government to identify potential contacts via airborne transmission from the recorded paths of infected persons. However, outcry over the digital surveillance from citizens led to its withdrawal.

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Appendix A: International comparison of contact-tracing apps

Country	App Name	Developer or project manager	Tracking Technology	Launch date (2020)	Downloads as of July 2020 (millions)	Population (millions)	Penetration rate	Design (Centralized or Decentralized)	App Diffusion (mandatory, voluntary)	Privacy Rank (0-4) 4= Most respectful of privacy.	Strictness of public health responses (0-1) 1= Strictest.
Australia	COVIDSafe (old app: Coronavirus Australia)	Australian national government	Bluetooth	26/04	6,5	25	26,00%	Centralized	Voluntary	3	0,541
China	Alipay Health Code	Alipay, Hangzhou's Communist Party, Chinese national government	GPS (cell tower data)	16/02	Current: unknown. 700M in February 26.	1393	50,25%	Centralized	Mandatory	0	0,5
France	StopCovid	INRIA (French national institute for research on Computer Science)	Bluetooth	02/06	2,3	67	3,43%	Centralized	Voluntary	2	0,625
Germany	Corona-Warn-App	Deutsche Telekom and SAP	Bluetooth	16/06	14,4	83	17,35%	Decentralized	Voluntary	4	0,541
Iceland	Rakning C-19	Iceland government Civil Protection & Emergency Dept	GPS (cell tower data)	01/04	0,14	0,36	38,89%	Decentralized	Voluntary	4	0,454
India	Aarogya Setu (old app: Corona Kavach)	Indian national government	Bluetooth, and GPS (cell tower data)	02/04	Current: unknown. 100M in May 12.	1353	7,39%	Centralized	Mandatory	2	0,625
Italy	Immuni	Bending Spoons (a tech startup)	Bluetooth	08/06	4,5	60,4	7,45%	Decentralized	Voluntary	4	0,791
Norway	Smittestopp	Norwegian Institute of Public Health	Bluetooth and GPS (cell tower data)	16/04	1,5	5,4	27,78%	Centralized	Voluntary	2	0,545
Singapore	TraceTogether	Government Technology Agency	Bluetooth	20/03	2,10	5,64	37,23%	Centralized	Voluntary	3	0,636
United Kingdom	Kingdom	NHS COVID-19, to be replaced by a new app (unknown as of July 10)	NHSX	Bluetooth	06/05 abandoned on June 18	4,3 (old app)	66,65	6% (old app)	Centralized, then Decentralized	Voluntary	2 (old app)

0,625

Appendix A Legend

- (1) **Country selection:** Ten countries (Italy, UK, Germany, France, Norway, Iceland, India, Singapore, China, Australia), based on two criteria: a) Discussed in French media: as countries with best/worst practices for contact tracing apps; or cited for contact tracing benefits, challenges and issues. b) The countries adopted a variety of strategies and approaches, with different outcomes: Germany, high respect for privacy, voluntary app use, high adoption rate. China and India mandatory app use; Norway adopted a 360° approach to contact tracing app, with integrated location-based tracking and Bluetooth solution, etc.
- (2) **Contact tracing app selected:** Only official and government funded collaboration projects.
- (3) **Launch date, technology, etc);** gathered from official websites
- (4) **Design characteristics and Developers** were assessed through a check of each government website, github/ source code repositories (when available), and supporting documents from English-speaking medias describing the solution.
- (5) **App diffusion Approach:** Is the app deployed on a voluntary basis (opt-in), or is it mandatory (citizens are compelled to use it)? For each app deployment, we checked whether it was possible for citizens to decide to not download the app, to refuse the app permissions, to choose to not use the app, with no risks of administrative sanctions.
- (6) **Measure of download and Penetration rate:** Based on official government statistics on downloads. To establish the penetration rate, we used latest census (**population**) data (2018-2019) for each country. **Limitations:** (a) Download counts do not equal unique users. 1M downloads could mean 500,000 people downloaded and reinstalled the app. (b) People can also download the app but not activate it, or download and later uninstall it. (c) Numbers of downloads may be outdated. It was difficult to find recent data on China and India for instance.
- (7) **Privacy ranking of contact tracing apps (0-4).** 4= Most respectful of privacy (limited AND minimized data

collection, clear policies for data destruction, and end to end anonymity). The [MIT Technology Review ranking of contact tracing app](#) developed and established on May 06, a portal for ranking national contact tracing app based criteria below. Users of apps can rank the app by answering the questions for each indicator listed below:

- a) **Limited data collection and use:** Are there strong use limitations against using data for purposes other than public health? E.g. Law enforcement or intelligence agencies, advertising entities. b) **Clear policies for data destruction:** Are policies in place to ensure tracking does not outlive the effort against COVID-19? c) **Minimized data collection:** Does the technology and policies ensure data is deleted when it's no longer needed for public health purposes? d) **End to end anonymization:** Is the identity of the users masked or anonymized?
- (1) **Strictness of public health responses to Covid-19 crisis** is based upon Porcher (2020)'s dataset. It captures the strictness of governments' responses to the pandemic from January 1, 2020 to April 28, 2020 on a country-daily basis. The dataset comprises 14,590 country-day observations of 228 countries.

Strictness of public health responses is based on the tracking of 12 public health measures: (1) bans on mass gatherings, (2) bans on sporting and recreational events, (3) restaurant and bar closures, (4) domestic lockdowns, (5) international travel restrictions, (6) domestic travel restrictions, (7) curfews, (8) declarations of states of emergency, (9) public testing, (10) enhanced surveillance, (11) school closures and (12) the postponement of elections.

Pietz et al. (2020) studied 17 similar measures of early stringency, and demonstrated that preventative social distancing measures such as cancelling public events, restrictions on gatherings and international travel control were particularly critical in reducing the spread of Covid-19.

Additional References:

Porcher, S. (2020) "A novel dataset of governments' responses to COVID-19 all around the world", Chaire EPPP 2020-03 discussion paper, 2020.