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Digital Contact Tracing:

The Medium is the Message

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Abstract: This essay investigates digital media devices and networks for addressing the spread and control of the novel coronavirus/COVID-19 infection. But unlike many of the other essays in this special issue, it will not focus on the message — the information and misinformation, the accurate reportageand the rumors, or the news and the fake-news— that is conveyed onthese digital platforms. Instead, I will focus on the use of digital mobile devices and networks to monitor and control the social aspectsof the virus and the vectors of infection. Toward this end, we will considerthe different ways that mobile technology can be employed to address and respond to a global pandemic like COVID-19; and we will examine the opportunities and challenges of DCTT in an effort not just to understand how these technologies work but to extract from this analysis a clear formulation of their possible benefits and attendant costs.
Keywords: coronavirus; mobile technology; ethics

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Rastreamento digital de contatos: o meio é a mensagem

Resumo: Este ensaio investiga dispositivos e redes de mídia digital para abordar a disseminação e o controle da nova infecção por coronavírus / COVID-19. Mas, ao contrário de muitos dos outros ensaios nesta edição especial, ele não se concentrará na mensagem - a informação e a desinformação, a reportagem precisa e os rumores, ou as notícias e as notícias falsas - que é transmitida nessas plataformas digitais. Em vez disso, vou me concentrar no uso de dispositivos e redes móveis digitais para monitorar e controlar os aspectos sociais do vírus e os vetores de infecção. Para esse fim, consideraremos as diferentes maneiras como a tecnologia móvel pode ser empregada para abordar e responder a uma pandemia global como o COVID-19; e examinaremos as oportunidades e desafios do DCTT em um esforço não apenas para entender como essas tecnologias funcionam, mas para extrair dessa análise uma formulação clara de seus possíveis benefícios e custos associados.
Palavras-Chave: Coronavírus; tecnologia móvel; Ética.

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Rastreo digital de contactos: el medio es el mensaje

Resumen: Este ensayo investiga dispositivos y redes de medios digitales para abordar la propagación y el control de la nueva infección por coronavirus / COVID-19. Pero, a diferencia de muchos de los otros ensayos de esta edición especial, no se centrará en el mensaje - la información y la desinformación, los informes precisos y los rumores, o las noticias y noticias falsas - que se transmiten en estas plataformas digitales. En cambio, me centraré en el uso de redes y dispositivos móviles digitales para monitorear y controlar los aspectos sociales del virus y los vectores de infección. Para eso, consideraremos las diferentes formas en que se puede emplear la tecnología móvil para abordar y responder a una pandemia global como del COVID-19; y examinaremos las oportunidades y desafíos de DCTT en un esfuerzo no solo por comprender cómo funcionan estas tecnologías, sino por extraer de este análisis una formulación clara de sus posibles beneficios y costos asociados.
Palabras clave: Coronavirus; tecnología móvil; Principio moral.

1 Introduction

Mobile devices and the data networks that support them provide unprecedented opportunities for the distribution of information—both accurate reports and rumor—during the time of pandemic (Merchant and Lurie 2020, Ali and Kurasawa 2020). Responding to this challenge has required careful attention to the content that is distributed by digital platforms and the effect these messages have had on individual users and communities. This is standard operating procedure in media and communication studies. The focus of analysis is predominantly on the content of the message, its geographical reach, and its social impact and effects. But this is only one part of the total picture. As Canadian media theorist Marshall McLuhan (1995) had argued over five decades ago, an exclusive focus on the content of the media can have the effect of distracting us from perceiving how the exigencies of the medium may itself be the message.

This essay investigates digital media devices and networks for addressing the spread and control of the novel coronavirus/COVID-19 infection. But unlike many of the other essays in this special issue, it will not focus on the message—the information and misinformation, the accurate reportage and the rumors, or the news and the fake-news—that is conveyed on these digital platforms. Instead, I will focus on the use of digital mobile devices and networks to monitor and control the social aspects of the virus and the vectors of infection. The essays will therefore pivot from an almost exclusive concern with the messages that have been developed for and disseminated by digital media and focus attention on the medium of digital technology and its cost/benefits for controlling the COVID-19 pandemic.

Toward this end, the investigation will proceed in three steps. First, we will consider the different ways that mobile technology can be employed to address and respond to a global pandemic like COVID-19. Since will we not have the time or space to consider all the available strategies and methods, this overview is provided in order to get a big picture perspective from which we can then drill down into one particular application that has attracted a good amount of attention, digital contact tracing technology (DCTT). Second, we will examine the opportunities and challenges of DCTT in an effort not just to understand how these technologies work but to extract from this analysis a clear formulation of their possible benefits and attendant costs. Finally, we will conclude with consideration of the most notable issues for using DCTT to address the COVID-19 crisis. Like all technological solutions, DCTT has promise. But those promises are not without complications and potential hazards.

2 COVID-19 Pandemic and Mobile Tech

Mobile devices, service providers, and the existing cellular network—an ensemble of different technologies that can be lumped together under the umbrella term "mobile technology"—are not just convenient tools for communication and information dissemination, they are a system of mobile sensors that can be employed by users, governments, and public health officials to help track and hopefully control the spread of infection. During the COVID-19 crisis, mobile technology has already been used in three distinct ways: documentation, modeling, and contact tracing.

1) *Documentation* – Documentation efforts involve using mobile technology to track where people are situated for the purposes of managing self-isolation and quarantine. This is accomplished by collecting data on user location. During previous global pandemics, like the 1918 Spanish flu, this was mainly achieved by manual processes aided by the technology of telephone and mail. We can now do the same by using the technology of mobile smartphones and cellular data services. In Taiwan, for instance, the government has developed an App to track and help ensure that quarantined individuals remain within the boundaries of their quarantine. If a user strays outside the predefined borders, the App can alert the user and/or public health officials. These Apps work by using geolocation data, either by way of triangulation from cellphone towers or GPS signals. Although useful

for managing quarantine, these documentation solutions do have significant privacy concerns. As reported by Access Now (2020, 11), the Taiwanese App "assumes that there is a documented link between each individual's identity, their phone number, and their residential address, which includes information on co-habitants."

2) *Modeling* – Modeling provides for a less invasive form of management. By using anonymized data provided by service providers, it is possible to track population densities and identify potential "hot spots" for the spread of disease. Internet companies and platforms (i.e. Bytedance, Facebook, Google, Tencent, AT&T, etc.) already gather data about what their billions of users are doing and where. This data, which is typically utilized for providing users with location-specific data concerning weather, road congestion, or other conveniences, can also be used to track alterations in user location and demographic density in specific geophysical locations. Like documentation efforts, modeling employs geo-location data, which is something service providers already collect and process, and this information can be easily obtained either from triangulation between cellphone towers or GPS. But unlike documentation, modeling typically does not require a dedicated App (since it is using a feature that is already part of the standard operating procedures of the data network) and do not typically employ user-identifying information.

For this reason, modeling has better privacy protections for users and is therefore less invasive. But what modeling gains in privacy protections, it sacrifice to accuracy. Modeling solutions can help public health officials track changes in location and population density over time and this information may aid public health officials in mapping potential hot spots for the spread of infection. But that is all. Modeling, therefore, can produce impressive-looking "heat maps" to help visualize how well quarantine is working (or not), but this information is often considered to be too coarse or general for the actual management of the spread of infection.

3) *Digital Contact Tracing* – Digital contract tracing technology endeavors to split the difference. It seeks to provide the kind of direct and positive control over the spread of the virus that comes from documentation efforts along with the privacy preserving features that are available with modeling. Contact tracing is not new. Public health officials have, during the time of previous viral outbreaks, like AIDS and SARS, used contract tracing to control the spread of the disease. This was typically accomplished by manual data collection and processing procedures. When someone showed signs of being ill, they were interviewed to figure out where they had been and with whom they had contact. Then the individuals exposed to risk of infection ("contacts") could be notified by public health officials and provided instructions on how to protect themselves and others. This

work is time and labor intensive, requiring an army of human contact tracers typically utilizing either in person interviews, telephone, or text messaging. Similar efforts are already in place and have been deployed in response to the COVID-19 crisis.

There are, however, legitimate concerns that manual contact tracing may be too slow and inefficient to respond to the unprecedented scope and rapid proliferation of this particular viral outbreak. Digital contact tracing technology (DCTT) has been introduced and promoted as a solution to this problem (Ferretti et al. 2020). In Singapore, Israel and India there is already an App for that. In Europe there is debate between two competing frameworks, which have names that sound like Star Wars' droids: PEPP-PT and DT-3T (Pan-European Privacy-Preserving Proximity Tracing and Decentralized Privacy-Preserving Proximity Tracing). And in the US, Apple and Google recently announced collaboration on an exposure notification API (application program interface) that was publically released in mid-May 2020.[2]

2 On 10 April 2020, Apple and Google announce an unprecedented collaboration with two phases: "First, in May, both companies will release APIs that enable interoperability between Android and iOS devices using apps from public health authorities. These official apps will be available for users to download via their respective app stores. Second, in the coming months, Apple and Google will work to enable a broader Bluetooth-based contact tracing platform by building this functionality into the underlying platforms" (Apple 2020). As anticipated, phase one was completed on 20 May 2020 with beta release of an exposure notification API. The second phase of the effort, however, may be under revision insofar as the two tech giants have indicated they will continue conversations with public health authorities concerning the exigencies of an OS-based contact and/or exposure notification system.

3 Digital Contact Tracing Technologies

DCTT is not one technology but identifies a spectrum of different technological solutions and implementation strategies. On one end of the spectrum there are what can be called the "maximal approach." These efforts employ centralized collection and processing of data and therefore require implementation and management by a trusted third party, which is, more often than not, a national government. Maximal DCTT solutions have already been deployed in South Korea and have helped contribute to that country's rapid and successful response to the COVID-19 crisis. As reported by Access Now, "the information published online includes a wealth of information, such as details about when people left for work, whether they wore masks in the subway, the name of the stations where they changed trains, the massage parlors and karaoke bars they frequented, and the names of the clinics where they were tested." But having this information centralized and then published online has had significant privacy costs and the data has been (mis)used to identify and harass infected individuals (Kim 2020).

On the other end of the spectrum are the privacy preserving efforts like the two frameworks being debated in the EU and the Apple/Google partnership (Google 2020). In these decentralized approaches, data is stored and processed locally on the user's device and individual identity is preserved. These minimal DCTT solutions use Bluetooth "handshakes" to identify and record contact between users and then store and process this proximity data without registering the identity of the individual contact. As explained by a published report from the Johns Hopkins University Project on Ethics and Governance of Digital Contact Tracing Technologies:

In most architectures, these proximity data are stored in the users' phones as anonymized "beacons" that cannot be used to re-identify the users directly. If a user with a PPPT [privacy-preserving proximity tracking] app installed on their phone tests positive and enters test results into their app, those who have been in contact with them can be notified by the app. This "exposure notification" can be automatic or at the discretion of the COV+ person [i.e. an individual who has tested positive for COVID-19 infection], depending on the app design. If notified, a user who has been in contact with a COV+ individual would receive a push notification alerting them to possible exposure (which may be timestamped), but with no other identifying information (Kahn et al. 2020, 4).

The advantages of this approach to contact tracing is that it does not require centralization of personal data or a trusted third party. It is therefore insulated from (although maybe not entirely immune to) many of the privacy concerns that accrue to the maximal approaches. The one disadvantage to the minimal approach is that it is less effective from a public health perspective, since individual infected persons are not able to be identified, tracked, and directly contacted.

In between these two extremes are a range of middle-ground solutions that try to strike a balance by capitalizing on the best both sides have to offer. These middle-ground solutions involve "the collection and storage of personal data—including identifying information and location data—on the user's phone. These decentralized but personally identifiable data can then be voluntarily shared with public health officials if the user tests positive for SARS-CoV-2" (Kahn et al. 2020, 4). Iceland's Rakning C-19, which launched in early April, is a good example of a middle ground solution. It keeps tracks users' GPS data to compile a record of where they have been, allowing investigators—with permission—to look at whether those with a positive diagnosis are potentially spreading the disease. Another middle-ground solution has been proposed by a team at MIT under the moniker Safe Paths. As described on the project's website, this solution consists of two components: a user-facing smartphone application called "PrivateKit" and a web application for public health officials called "Safe Places."

The PrivateKit app will enable users to match the personal diary of location data on their smartphones with anonymized, redacted, and blurred location history of infected patients. The digital contact tracing uses overlapped GPS and Bluetooth trails that allow an individual to check if they have crossed paths with someone who was later diagnosed positive for the virus. Through Safe Places, public health officials are equipped to redact location trails of diagnosed carriers and thus broadcast location information with privacy protection for both diagnosed patients and for local businesses (Raskar, Pentland and Esvelt 2020).

4 Challenges and Potential Problems

DCTT has promise. It provides individuals, communities, and public health officials with a set of tools that may be effective for responding to the COVID-19 pandemic. Despite these opportunities, however, there are a number of significant challenges.

1) *Adoption Rates* – Many, if not most of the minimal DCTT solutions are opt-in and voluntary, meaning that users will need to actively download, install, and utilize the contract tracing App. And the effectiveness of any DCTT solution is directly dependent on the number of opt-ins. An Oxford University study indicates that there needs to be at least a 56% adoption rate to be effective in stopping the spread of the virus (Hinch et al 2020, 3). No one has come close to this figure. Singapore's TraceTogether App achieved only 20% adoption, and, for this reason, has not really been sufficient to make a significant impact. Iceland's Rakning C-19 has achieved 38%, which is, to date, the highest adoption rate worldwide. At this rate of adoption, the Rakning C-19 has been credited as being a useful piece of the contract tracing puzzle, but it is not in and of itself a game changer. Although the US has yet to implement DCTT on a national scale, studies of potential user acceptance indicate similar problems. In a national study of 2,000 US citizens, conducted between 30 April and 1 May 2020, just over 30 percent of users indicated they would download and use a mobile contact-tracing app.

The best designed technological solutions could fail miserably, if the technology is not widely adopted, trusted by users, and actually employed. For this reason, there is need for a) clear and transparent communication from trusted authorities so that users know what DCTT is and how and why it is being used and b) on-going "boots on the ground" intelligence efforts concerning the efficacy of these technological solutions and how they come to be implemented, adopted, and (in some cases) even rejected by users.

2) *Technological Limitations* – Bluetooth's low energy radio signals have always had reliability issues. Generally this is not a problem, mainly because Bluetooth is used for mundane tasks, like pairing a speaker, a set of wireless earbuds, or a smart watch to a mobile device. But when the same technology is used for contract tracing, which could be a matter of life and death, these reliability

issues can produce significant and crucial errors in the form of both false positives and false negatives. A false positive happens, when a healthy person is unduly treated as infected or exposed. This can happen for a number of reasons. But one way it can occur with Bluetooth is due to the fact that radio signals do not recognize physical barriers and can register contact through walls and other kinds of partitions. Conversely a false negative occurs when a person who might have been in close vicinity to an infected person does not register the contact because the Bluetooth handshake momentarily fails or encounters environmental disturbances that degrade the radio signal.

3) *Digital Divide* - Digital technology is not evenly distributed. There still is a rather significant digital divide, and the individuals less likely to have and use the most up-to-date mobile devices and services are precisely those who are at risk during this pandemic. The best designed DCTT solution means little or nothing for those individuals and communities who do not have access to mobile devices and/or the data services necessary for their operation. This not only affects those on the "have-nots" side of the divide, but will have a wider social impact. If we rely too heavily on DCTT and do not do something proactive to account for individuals who cannot or choose not to use the technology, we risk exposures that cannot be tracked and managed by these technologically enabled solutions. As one possible solution to this problem, the John Hopkins University report recommends providing users with access to equipment and supporting data services: "States, localities, and institutions that recommend widespread use of DCTT should provide technology (e.g., mobile phones, Bluetooth devices) and free data packages to those who desire but lack access to these devices" (Kahn et al. 2020, 11).

If we follow the direction of McLuhan's famous adage (e.g. "the medium is the message"), then we might summarize the message of DCTT in the following way: DCTT provides public health officials with some new tools to track and potentially control the spread of the COVID-19 infection. But these tools are not a silver bullet and will only be effective, when integrated with a more comprehensive public health plan that includes a diversity of approaches—some "old fashioned" or manual and some technological. DCTT may be a necessary piece of the puzzle, but it should not and cannot be considered sufficient in and by itself.

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