Review Paper

An Analysis on the Cultural and Societal Forces Behind COVID Contact Tracing and its Potential Implications

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I.   Introduction

The COVID-19 pandemic has infected over 100 million people and caused more than 2 million deaths worldwide. The impact of this pandemic extends to almost every aspect of daily life, everywhere in the world. With an ongoing pandemic of this scale, countries and organizations are trying to control the outbreak via several different methods. Among them, one promising method of containing the pandemic is contact tracing. People have implemented various ways to track close contacts of COVID cases, ranging from the traditional labor-intensive method to the more technologically advanced app-based methods. Within these different methods, the app-based solutions tend to be the most popular among countries due to their advanced technologies through unified deployment, and relatively high efficiency in usage (low cost and wide audience.) The underlying technologies with these advanced solutions are largely similar, yet people's attitudes towards the usage of such tech vary greatly. Hence, these apps have varying degrees of success across different geographies. This paper gives an overview of the contact tracing methods used in the coronavirus pandemic, helping readers to better understand the mechanisms used in contact tracing; more importantly, this paper tries to answer the question of why similar technologies have varying degrees of success in different places. Through analyzing the differences in several social/societal factors across different countries, including the different cultures, and societal structures in each country, we theorize the reasons behind the success of contact tracing, framed by acceptance, and measured by app installment and media attitudes, of app-based COVID contact tracing solutions. It will also address the public concerns of digital contact tracing so that local governments could better strategize in the deployment of contact tracing technologies, which might lead to more successful pandemic control.

II.   Theoretical Overview

The importance of contact tracing

Contact tracing has historically been done by collecting patients' data through which hired contact tracers identify contacts mainly by interviews. Successful contact tracing is very important in controlling disease outbreaks by identifying and quarantining potential exposure sources, cutting the ways that diseases could spread. In controlling the COVID-19 pandemic, it is even more essential to have adequate contact tracing, because of its highly contagious nature. The success of contact tracing could be measured by the "percentage of contacts traced" (Pueyo, 2020), and this percentage depends on the initial R0 (the effective reproduction number, in other words, the number of infections caused by an infected person) of the virus. (Pueyo, 2020) With the initial R0 of coronavirus between 2.5 and 3.5, people must trace around 70 to 90 percent of contacts (Kucharski et al, 2020) for the spread to be considered "controlled" with its R0 brought down below 1. (i.e. less than 1 additional infection is caused by every new infection.) To bring down the R0 of COVID 19 to below 1, 20 to 30 contacts need to be traced for every infected individual (Kucharski et al, 2020.) These numbers give a general idea of how successful contact tracing needs to be to control the COVID pandemic.

Ways to conduct contact tracing

With the previously mentioned importance and logistics of contact tracing, it is obvious that extensive amounts of resources need to be employed, either by hiring many contact tracers, or by using more technologically advanced methods, to achieve successful contact tracing. Previous research has pointed to a couple of different ways that these resources could be employed:

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1 manual contact tracing
2 automated contact tracing via Bluetooth
3 automated contact tracing via combination of phone number and QR code

There are differences between the ways that each contact tracing method work. Manual contact tracing utilizes human forces. According to an article by Pueyo (2020), manual tracing is usually done in the following procedures. The tracers will interview the infected person about his locomotion and contacts to identity contacts sometimes with the help of GPS and CCTV camera footages. Then the tracers will classify the spotted contacts into high risk or low risk. Then usually the contacts at high risks will be ordered to self-quarantine for 14 days while the contacts at low risks will be notified to pay attention to symptoms.

Automated contact tracing via Bluetooth requires people to download applications/opt in on their phones and the applications send out and receive Bluetooth signals from other devices when two devices are in proximity of each other. When a person tested positive, the person could report the infection through the app and all the other people whose device exchanged Bluetooth signals with the infected person would get notified through the app. (Pueyo, 2020) The technology behind these methods are largely similar across different applications, with the Apple/Google API method being the most dominant. Contact tracing via combination of phone number and QR code is mainly used in China as a compulsory requirement. Most public places in China require people's "green code" to get in. To get the code, a person has to complete a questionnaire mainly about the person's location over the past 14 days and local authorities will verify. Then if the person did not travel to certain places over the past 14 days, the person's code will be green, otherwise it will be red which will cause the person to be rejected at entering public spaces.

This research primarily focuses on technology solutions in contact tracing because it reveals new information that is previously not studied upon. This is the first time that such a large-scale technology solution is applied in an epidemiological setting, essentially turning every mobile device into a data collection point, unavoidably raising privacy concerns. With the recent debate on data privacy, and new regulations such as GDPR limiting data operations from a government perspective, understanding this issue of privacy, in such a unique setting, could reveal underlying dilemmas that are interesting to study. Cultures that are seeing as "democratic", "vowing for human rights", and "freedom" could in this scene, backfire and cause public health issues.

Efficacy in technological approaches to contact tracing

With the previous information on how countries are employing technologies to trace contacts, app-based approach using Bluetooth technologies has been an overwhelming majority chosen by governments around the world. However, the efficacy of such methods could prove to be less than ideal in the real world, especially given the discussion on privacy. With the "opt-in" approach that many countries are taking (recommending installation, but not forced), only 10% of contacts of infected individuals would be sent to officials through this channel. Even with the standard "opt-out" approach, only approximately 60% of close contacts could be traced using this method (Pueyo, 2020), which is less than the 70% minimum for effective contact tracing (Ferretti et al., 2020). Hence only using contact tracing apps would not be enough, implying the need for manual methods. In addition, high installation rates would mean more efficacy of such contact tracing apps. Later discussions would also talk about how the difference acceptance of such apps in different areas could vary the efficacy of these technological approaches.

Privacy Concerns in Contact Tracing

Scholars have previously discussed the legitimacy of privacy in special cases, such as a pandemic. At normal times, privacy of citizens will always be the primary problem governments and companies must solve. However, in a pandemic people have to reevaluate the importance of privacy versus the importance of public health and often public health won out.

With the advances in technology, people are more and more concerned about the infringement on personal information that technology is creating. The better the technology is, the more the company and authorities know about people. Recently, there were many cases of data breaches and misuses, such as the twitter hack of many high-profile US personalities in 2020. (Dutta, 2020) This would in turn create ethical issues that are paradoxical and are challenging to address.

Social Theory and Explanations

Contact tracing is essentially a form of surveillance. In the modern society, surveillance is widely adopted by governments in their political agenda, namely to "make society better" and protect the public. There have been discussions from social scientists, regarding the phenomenon of surveillance. Parenti (2004) argued that surveillance is a form of prison, a "soft cage", that "establishes in the body the constricting link between an increased aptitude and an increased domination." (2004) Foucault (1995) sees surveillance as a form of

"disciplinary power", strengthening the control of the government. The advancement of surveillance made it so omnipresent, that almost everyone is under the watch, and Foucault coins this phenomenon as a "panopticon", where every individual is seen through this device that spans across all areas of the world. On the other hand, Foucault also argues that surveillance is a sign of modernity since it is a docile form of dominance instead of the violent form practiced in ancient times. From the similar imagery of surveillance established by both sociologists, people can infer that surveillance restricted people's freedom while providing a more efficient, and "futuristic" society, where people live in a world ruled by more organic and invisible forces, instead of violent and mechanical ones.

III. Research Methods

To understand how successful contact tracing is in different countries, and to theorize the forces beyond different levels of success of contact tracing in different geographies, we have built out a system to measure the level of success of different contact tracing applications. The system comprises of two raw variables, media attitude and installment numbers of the respective applications. The methods of measuring these two variables are introduced below.

Method of selecting news articles for attitudes:

A prime goal of this research is to understand the differences between contact tracing apps across different nations. One good way of gauging the effectiveness and people's attitude towards these applications is news/media responses. These responses not only tell us people's general attitudes toward the contact tracing applications, but also enlightens the differences in cultures regarding such applications. Here we will assume that these applications use similar technologies, and these news reports will in turn reflect the attitudes towards the applications, not the effectiveness/quality of the applications. It is safe to make this assumption because at the current stage, the applications mostly use Apple/Google's API as the core technology, meaning that they are large similar in the way that they work. Hence any differentiations in media attitudes could be interpreted as more of an emotional/cultural attitude towards these applications.

We designed a "media attitude score" (referred to as "score" in this article) to capture the attitude towards contact tracing applications. This variable will in turn become a proxy in understanding the societal/cultural difference in the issue of privacy in contact tracing. The media's attitude towards a particular contact tracing application was measured by selecting 10 news articles and then giving a "score" based on these 10 articles. The news articles are selected based on the following method: we will pull the first 10 valid results on Google's result page selecting "news" as the type, results are then "sorted by relevance, and "recent", with the search input being the application's name. We only select "valid" articles as sometimes an article could still be not relevant even with these restriction filters, requiring a manual screening process. A "positive" article will receive a score of 1, a "neutral" article will receive a score of 0, and a negative article will receive a score of -1. Here "positive" is defined as where the news article mainly discusses the advantages of the specific contact tracing application; "negative" is defined as where the news article mainly discusses the disadvantages of the specific contact tracing application; "neutral" in this case could be an article that either discusses more technical details with no attitude, or an article that discusses a balance of both the advantages and disadvantages of the contact tracing application. The scores of each individual article are then aggregated to generate a "total score" for each country/region. This score would then be the final metric that we use. A total score larger than zero would then signify a positive overall attitude; a total score of zero would signify a neutral overall attitude; and a score smaller than zero would signify a negative overall attitude.

Ways to count installation/usage rates:

We collect installation numbers because it captures another aspect of people's attitude towards the contact tracing apps. We could calculate a usage rate based on the installation numbers, and this usage rate captures the willingness to participate in/governments' push of contact tracing in a specific country/region; both of these aspects reflect a societal attitude towards using technology for contact tracing and having quantifiable knowledge could prove helpful in understanding societal differences that might be attributable to the differentiations of contact tracing solutions. The installation number of a specific contact tracing application is extracted from the Google Play Store application page, and this method is overall the most accurate. We select Google Play Store for installation numbers over other sources for a couple of reasons: first, almost all contact tracing applications around the world are deployed on the Google Play Store, offering the ability for universal comparison; second, Google Play Store is a application platform on Android, which is the most widely used mobile platform in the world, hence Google Play Store also tends to have one of the largest user bases in terms of application downloads (arguably, the App Store on iOS also has a very big user base, but the App Store does not offer publicly available installation numbers per app.)

The exact installation numbers are estimated as the median between the stated scale and the scale above. (For example, Indonesia has 1000000+ installations, and we know that the next level up is 5000000+, so we take the middle value between the two and say that the exact numbers of installation for Indonesia is (1000000+5000000)/2 = 3000000. Hence the installment rate is calculated by 3000000/Indonesia's population of 267.7 million ≈ 1.12%

Data

Table 1. Contact Tracing App Success Measures for a Selection of Applications:

Country	App Name	Release date (2020)	Installment	News	Population(mil)	Installment rate
Italy	diAry "Digital Arianna"	April 10th	500+	5	60.3	0.001%
Indonesia	PeduliLindungi	April 14th	1000000+	1	267	1.12%
Denmark	Smitte/Stop	April 16th	100000+	3	5.81	5.17%
Iceland	Rakning C-19	April 1st	100000+	2	0.364	22.17%
India	Aarogya Setu	April 2nd	100000000+	-3	1,352	22.19%
Brazil	Tô de Olho	April 4th	10000+	Not enough data	210	0.014%
USA	Novid	April 7th	10000+	8	328	0.009%
Finland	Koronavilkku	August 31st	1000000+	0	5.52	54.35%
Canada	COVID Alert	July 31th	1000000+	2	38.0	7.89%
Saudi Arabia	تباعد	June 14th	1000000+	Not enough data	34.2	8.77%
Japan	新型コロナウイルス接触確認アプリ(COVID-19 Contact-Confirming Application)	June 19th	5000000+	0	125	6%
Italy	Immuni	June 1st	5000000+	3	60.3	12.44%
Morocco	وقايتنا ("Our prevention")	June 1st	1000000+	2	37.0	8.11%
Switzerland	SwissCovid	June 25th	500000+	1	8.57	8.75%
Austria	Stopp Corona	March 25th	100000+	7	8.90	3.37%
UK	NHS COVID-19	September 24th	5000000+	2	67.8	11.06%
South Africa	COVID Alert South Africa	September 2nd	100000+	4	59.6	0.503%

Some rudimentary look at the data reveals some interesting information. Many European countries use Google and Apple API to create their own contact tracing applications. Whilst being a relatively good solution at this moment, these applications still got complaints from users/media. Some of the most common inconveniences of these applications include sending out confusing notifications, not supported on older devices and most importantly, there is still risk of leak of personal information despite the advanced privacy measures of the Apple/Google API (Tracing ID of people exposed is available in background codes, which could be accessed by authorities and malign hackers, causing data misuse and breach). These countries all only have one official application approved by the government. Surprisingly, the three newest applications currently receive the lowest media attitude scores, despite having the opportunity to improve upon previous experiences from application deployment in other countries. This suggest that the user experiences have not improved over the past months in contact tracing applications.

IV. Results

A closer look at the data would conclude the following discoveries:

The more installment an app has, not only in pure installment number basis, but also installment rate, would have lower news media attitudes.

An app with a bigger user population (as a percentage of the country's population) tends to have more critical media responses. We notice that applications with especially small installment bases (e.g. Novid from the US, Stopp Corona from Austria, and COVID Alert from South Africa) have exceptionally high reviews. This

could be due to the app being the most advanced, and not being pushed by the local government as heavily. We note that in the case of the US, Novid is a niche product, and is not offered by government officials, hence it might have higher acceptance. We also notice that applications with high installment rates (India, Finland, Iceland etc.) have lower news media attitudes. We argue that this might be the case because more users would mean higher chances of things going wrong, but also we need to address a user bias in such scenarios. Apps with high installment bases (especially the ones above 20%) have some sort of government promotion, and even enforcements in place for the mass surveillance, which might lead to negative emotions surrounding such applications. Less installed apps also mean that people are most likely willingly installing such apps, which would lead to better feedback. The difference here is that apps with particularly low installment tend to be ones where users are willingly adopting, and apps with especially high installment are likely ones where many users are "forced", or "nudged" by governments and official entities to install, leading to more negative responses.

Installment base is not a direct indicator of "acceptance". This means purely pushing for more installment numbers are not enough to get people's full trust and participation in contact tracing through technological approaches.

Most countries have a mediocre attitude towards contact tracing apps. Meaning that our hypothesis of a mixed emotion towards contact tracing is valid. There are benefits to these contact tracing apps, but there are potential personal privacy concerns.

A couple of apps have particularly positive responses, both in terms of media attitudes, and the installment rate (e.g. Italy's Immuni.) This could be partially attributed to the good design of the applications, but also the societal attitudes towards contact tracing. Such countries and apps have populations that are more conscious of the group and societal efforts that can work together to resolve the pandemic, and this would be something that Foucault would call "modernity". They are more open to surveillance when there is a larger societal good, and this would in turn mean that the country is more "modern". This is certainly a good example, albeit very rare when surveillance could work in society's citizens' benefit, much to Foucault's wishes.

We tried to be as equally representative of continents in selecting the list apps that we collect data on as possible, but a overview of the contact tracing applications available shows overwhelmingly that European countries, especially western and northern European countries, together with countries in Asia, have more successfully deployed applications. Here "successful" means that more proportion of the population have installed the application. This could be explained using the surveillance/modern society theory from Foucault before. We argue that these countries are more "modern" because they have a higher adoption rate of surveillance, and we see several countries in Europe and Asian being extremely successful at this (Finland, Iceland, and India.) The general higher surveillance state in Europe and Asia means that these areas have more acceptance and adoption of surveillance, and governments would have an easier time "controlling" their citizens, making them more "docile". This is also in line with the particularly lenient criminal justice systems in some of these countries (e.g. Nordic countries such as Finland and Norway do not have the death penalty, and they also tend to be very lenient in prosecuting suspects and have especially great prison systems.) On the other hand, countries in the Americas and elsewhere in the world have applications few and far between and have particularly low adoption rates, evident from our survey. The less accepting attitude towards surveillance in countries such as the US means that the society is in a more "violent power" and "brute force" stage. This is not to say that the societies in countries such as the US are not "developed", but to say that the way that power is exerted in such countries are in a more mechanical and rudimentary form. This might lead to more criminal prosecution, and arguably more crime, which is in line with the high incarceration rates in the US (where it houses the largest prison population in any country in the world. And over 1/3 of the Black population in the US will be or has been in prison at some point in their lives.)

Surveillance is good: it makes it easier for citizens to behave better, and hence it will make a place safer. In the sense of controlling the pandemic, this higher level of surveillance would make it easier to control the pandemic and save lives.

AND Surveillance is bad: IF governments abuse this power of surveillance, then it is harmful to the freedom and human rights of the citizens, which is inherently bad, and it might hamper societies' development.

V.   Discussions

This research is a unique look at how sociology and ways to understand surveillance could help explain patterns we see in the adoption in contact tracing. Contact tracing is unique because it is not the normal form of surveillance. Yet normal form of surveillance would share similar patterns because governments would always say that surveillance help enhance public safety, help protect the public when talking about it. However, surveillance, in most scenarios is not like this as governments tend to use data collected for other purposes as well.

We draw on views from academics such as Foucault, who sees surveillance as to produce docile bodies, and to produce "good citizens," to understand how such surveillance would affect the governing structures of the

society. Surveillance would be beneficial to the government because it saves them money in the criminal justice system, and it helps governments better control their citizens for themselves to stay in power as well.

In the real life, especially in the example of analysis today – contact tracing, things are not as dystopian yet: contact tracing might not make people behave better (because people tend to stay further away from others when using contact tracing), nor does it help governments control citizens now (because all the information is kept private at private parties.) But in the future, this technology opens a channel for governments to over-power its citizens, and there is no guarantee that governments would not use the pandemic as an excuse to further the agenda of general surveillance outside of contact tracing.

Countries that have more positive attitudes have higher acceptance to contact tracing apps, and have an easier time dealing with the pandemic. This acceptance could be attributed to a couple reasons: first, they might have surveillance before, and are more used to surveillance in general. The acceptance of surveillance is a sign of advancement, theorized by Foucault's theory of docility. (Asian countries/smaller countries exhibit these signs.) These countries are the "more modern" ones in Foucault's theory. Second, in the countries with low level of democracy, where people are directly or indirectly forced to install contact tracing apps, news media may be censored to give the public a positive impression of the apps. It will be easier to promote/mandate the use of such applications in these countries, which tend to lead to a positive outcome in controlling the pandemic. A more negative attitude towards digital contact tracing signifies that the country is more "democratic" and have more different voices. Such a country might have more difficulties pushing surveillance programs. The country has a less "docile" society and is less "modern" in terms of advancement in power. It would be more difficult to enforce and conduct contact tracing in these countries, which would tend to lead to a poorer outcome in controlling the pandemic.

There are certain limitations to the way we conduct the data analysis. We choose Google Play installation numbers because of its wide availability and it is the most detailed and comprehensive source that is publicly available to our knowledge. However, this is not to say that Google Play data is perfectly accurate. The numerical installation numbers it provides are not exact. (e.g 100,000+) which would cause problems differentiating installation between countries that have similar population numbers. Different countries also have different cell-phone system structures. For example, countries like India have an almost entirely android-based ecosystem, hence would have a lot more installation on Google Play, and countries such as Japan have more people using iPhones, hence would have less Google Play users. Some other countries, such as China, blocks Google services hence would not have Google Play installation numbers available.

The way we evaluate news/media attitudes towards contact tracing apps are the most efficient and scientific way that we can conduct with limited time and resources, however, there are imperfections associated with such evaluation methods. First, only collecting 10 opinions for each app is limiting, potentially opening possibility for outliers. Second, our random selection methods could also be skewed by Google's search algorithms and their alleged political preference, if any. We also do not use a quantitative way to evaluate news articles, and new technologies such as NLP(natural language processing) and content analysis could certainly be employed. But due to the limited knowledge on these subject areas, we choose to manually evaluate these news articles using a qualitative way.

The timeframe and scope of this research also means that we are limited in terms of the number of countries we could collect data on, and the way that we evaluate contact tracing applications from these governments. We could use a more complete image with more comprehensive data collection (getting information on more countries, getting a more exact installment number, using more scientific news collection methods etc.)

This research opens the discussion to view contact tracing from a sociological framework. Contact tracing is a form of surveillance that have potential impact on the free will of people's actions. Governments can advertise the benefits of contact tracing via propaganda or enforce more laws that promotes surveillance of citizen and thus allow the citizens to be more accustomed to surveillance in the long term. Citizens must be aware of the misuse of contact tracing by authorities which might damage their legal rights. However, this research also sheds light on the counterintuitive benefits of surveillance, which is normally viewed as a negative thing. The acceptance of surveillance leads to higher efficiency in certain aspects of society, which is a seldom-mentioned benefit. Using the sociological lens allows the systemic analysis of surveillance, which could be useful in future studies.

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