Lessons for China: Understanding the Role of Mobile Applications in China's Response to COVID-19

By

Isabelle Claude
Samuel Skinner
William Yang
Xianhan Jia

Lessons from China: Understanding the Role of Mobile Applications in China's Response to COVID-19

An Interactive Qualifying Project
Submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
In partial fulfilment of the requirements for the
Degree of Bachelor of Science

By
Isabelle Claude
Samuel Skinner
William Yang
Xianhan Jia

Date:
July 9th 2020

Advisor: Professor Jianyu Liang
Worcester Polytechnic Institute

Sponsors: Professor Hui Zhang
Tsinghua University

Professor Xianfeng Chen
Wuhan University of Technology

Abstract

In early 2020, COVID-19 swept the world into a global pandemic. We worked with professors and students at Tsinghua University and Wuhan University of Technology to study how mobile apps were used to combat COVID-19 in China. We conducted surveys and expert interviews in order to understand the role of mobile applications in China's COVID-19 response. Our results suggested that the role of mobile applications should be to assist public health officials, inform citizens, protect users private data, and be adaptable to their specific situation.

Acknowledgements

Our team would like to begin by thanking our incredible advisor, Professor Jianyu Liang of the Worcester Polytechnic Institute. Her wise insight informed every part of our project, from the initial proposal to the final presentation. We would not have been able to succeed without her. We would also like to thank our ID 2050 instructor, Professor Laura Roberts of the Worcester Polytechnic Institute. Through her teaching we acquired the skills necessary to collect and analyze our data, without which there would be no project.

We would also like to thank our sponsors: Professor Hui Zhang of Tsinghua University, and Professor Xianfeng Chen of Wuhan University of Technology. Their knowledge was invaluable, as were the resources they provided us as we performed research in China from over seven thousand miles away. We would like to thank the student researchers at Wuhan University of Technology for their invaluable assistance in producing and disseminating our survey. Without their hard work, we would have no survey results. Finally, we would like to thank all of the experts from both sponsoring universities who allowed us to interview them. Their insights and experiences allowed us to draw interesting and useful conclusions.

We would also like to thank the Institutional Review Board of the Worcester Polytechnic Institute, whose approval of our survey and interview guide allowed us to conduct our research. Their dedication to maintaining ethical standards of research ensured that we did not put any of our interviewees or survey respondents at risk.

We would also like to thank our friends and family who helped us stay safe and sane during these incredible times.

Executive Summary

Introduction: Pandemics are an inevitable fact of nature, like tsunamis and earthquakes. While we cannot stop new diseases from appearing among us, we can mitigate the spread of these diseases in several ways. We worked with our sponsors at Tsinghua University's Institute of Public Safety Research, and the School of Public Safety and Emergency Response at Wuhan University of Technology to better understand how mobile applications can be used to help effectively fight disease outbreaks. Our research focused on China, and their use of mobile applications in their response to COVID-19. Since China was the first country to deal with an outbreak of COVID-19, and the first country to widely use mobile technology in their response to the disease, China serves as a useful case study for the role of mobile technology in fighting infectious diseases. Our initial research questions were:

- What mobile applications did China utilize during COVID-19
- How did these mobile applications function?
- What were the strengths and weaknesses of these applications?
- How could these applications be used most effectively?

We began our examination of these research questions by familiarizing ourselves with the history of COVID-19 and mobile technology in healthcare.

Literature Review: Though COVID-19 began in the Chinese city of Wuhan, it quickly became a disease of global proportion, being designated a pandemic by the World Health Organization (WHO) on March 11th (Hauck, 2020). It is unlikely that COVID-19 will be overcome without a vaccine, which is estimated to become available in mid-2021 (Gallagher, 2020).

On January 23rd, the epicenter of China's COVID-19 outbreak, Wuhan, was put under lockdown; a day later the province containing Wuhan, Hubei, was also put under lockdown by the Chinese government (Xie, 2020). During this time, China introduced its "health code"

system, which assigned neighborhoods and citizens a specific health code meant to indicate their risk of having been exposed to COVID-19 (Davidson, 2020). This health code system came to be hosted on the popular apps WeChat and Alipay, which each have billions of users (Kharpal, Roberts, 2020). Some experts have argued that China's use of these mobile applications was essential in the success they have had with combating COVID-19 (Davidson, 2020).

There is a long history of mobile technology being used in healthcare. A 2008 overview found that integrating mobile technology into existing healthcare infrastructure can lower healthcare costs, improve efficiency, and enable new forms of health care such as online consultations (Standing, 2008). Mobile technology has also been used before in the tracking and combating of infectious diseases, such in the case of researchers who used google search analysis to allocate resources towards fighting the spread of HIV (Young, 2015). During the COVID-19 crisis, many countries have launched their own COVID-19 apps in an attempt to assist citizens and public health officials to combat COVID-19, as seen in Appendix A. There is a wide range in how these apps work, ranging from what researchers call a minimal to maximal approach (Khan, 2020). While many have expressed hope that these apps can assist public health officials in the fight against COVID-19, others are worried that these apps violate user privacy (Bond, 2020).

Methodology: Our methodology consisted of three Objectives:

- Objective 1: Design efficient user survey and expert interview guide
- Objective 2: Administer user survey and perform expert interviews
- Objective 3: Analyze data collected from user survey and expert interviews

Objective 1 consisted of creating and revising our survey and interview guide. Objective 2 consisted of using our survey and interview guide to collect survey and expert interview data. Objective 3 consisted of analyzing our data through coding and numerical analysis. The

interview and survey responses were coded using a similar method to open coding described by University of Arizona researchers (Blair, 2015). In addition to these three objectives, continuous literature research was performed throughout the project. A timeline of the execution of our methodology can be found in Table 1.

Week/Objective	1	2	3	4	5	6	7
Objective 1: Design efficient user survey and interview guide							
Objective 2: Administer user survey and perform expert interviews							
Objective 3: Analyze data collected from user survey and expert interviews							
Literature Research							

Table 1: A timeline of which Objective was executed throughout the seven weeks of our IQP.

Findings: Coding the expert interviews revealed six important themes, seen in Figure 1. From these results and the content of the interviews, we believe that striking a balance between collecting and utilizing users' personal information, and in turn protecting this information, is a key concern for COVID-19 mobile applications. In addition, close work between local communities and the national government was essential to keeping people safe in China during COVID-19, especially during the lockdown of Wuhan. Mobile applications functioned to assist these two groups in communicating and coordinating, but did not replace the work of people such as delivery drivers and contact tracers. The interviews also revealed that COVID-19 apps worked differently in different regions of China.

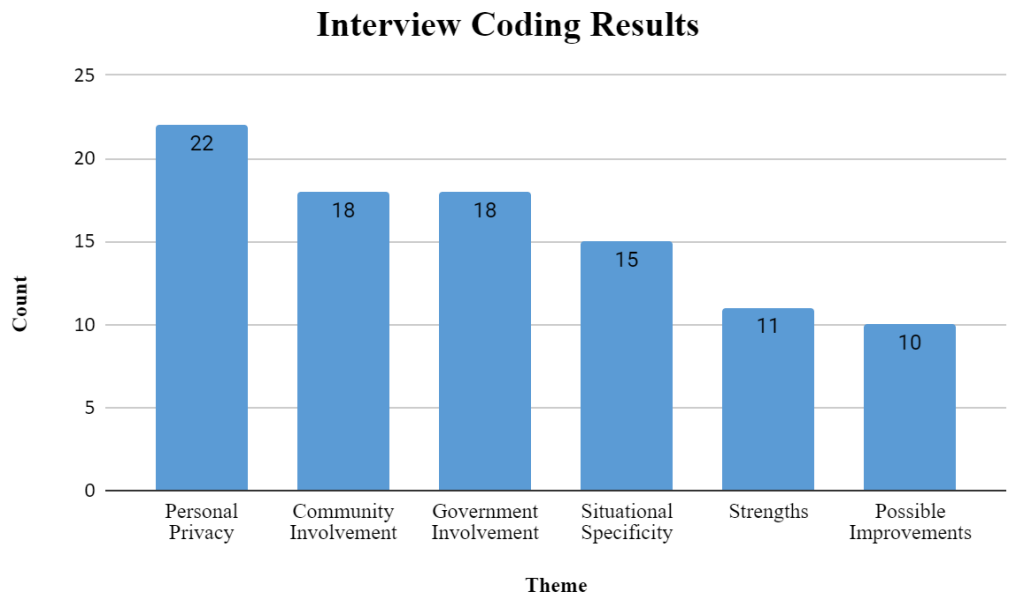

Figure 1: Interview coding revealed six important themes throughout our seven expert interviews.

While these apps worked well in China, our results also showed that there was room for improvement, especially in the area of accessibility to elderly or those unfamiliar with technology.

Similar results were obtained by our survey analysis. When asked what they used COVID-19 apps for, the largest response was for "accessing information on COVID-19" (101 out of 283 responses). In addition, respondents overwhelmingly answered "information" when asked what the most valuable feature of COVID-19 apps was (25 out of 45 responses). As with our interview results, our survey results revealed the importance of providing information as a primary function of COVID-19 apps. The demographics of our survey skewed young, with 82.4 percent of respondents being under 25 years old. This could pose issues in terms of obtaining representative results for all of China, as young people usually have more experience with mobile apps and their usage as opposed to older people.

Recommendations: Based on our findings we believe there are four main lessons to learn from China's use of mobile applications to fight COVID-19: mobile applications should *assist* in existing COVID-19 responses, *inform* users, *protect* user's personal information, and *adapt* to their environment. These lessons are illustrated in Figure 2.

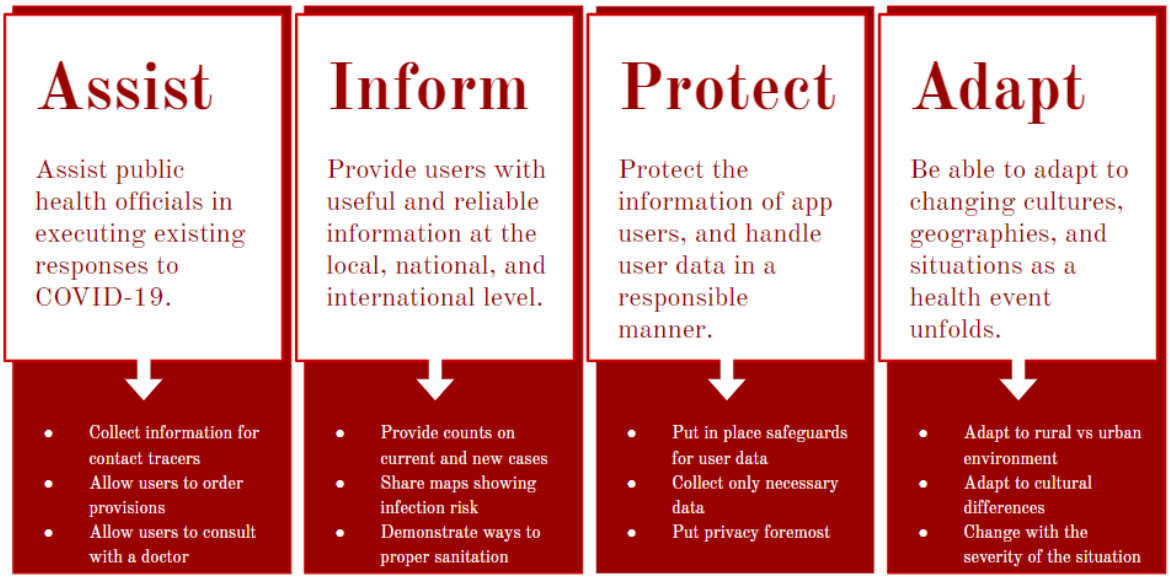

Figure 2: *Assist*, *Inform*, *Protect*, and *Adapt* are the lessons generated by our research.

We recommend that public health officials and app developers take these lessons into consideration when developing COVID-19 related mobile applications. In addition, we encourage future researchers to utilize our report as a jumping off point for further research, by utilizing not only our four lessons, but our extensive literature research as well.

Authorship

Introduction:	Samuel Skinner, Edited by all
Literature Review:	
History of COVID-19	Xianhan Jia, Edited by all
China's Response to COVID-19	Samuel Skinner, Edited by all
Ubiquity of Mobile Technology In China	Isabelle Claude, Edited by all
Mobile Technology in Healthcare	Samuel Skinner, Edited by all
Existing Mobile Applications for COVID-19	Samuel Skinner, Edited by all
Conclusion	Samuel Skinner, Edited by all
Methodology:	
Introduction	William Yang, Edited by all
Objective 1: Designing an Efficient Survey and and Interview Guide	
Survey Draft	Samuel Skinner, Edited by all
Expert Interview Guide	Samuel Skinner, Edited by all
Objective 2: Administering Survey and Performing Expert Interviews	
Expert Interview	Isabelle Claude, Edited by all
Surveys	Isabelle Claude, Edited by all
Objective 3: Analyzing Data Collected from User Surveys and Expert Interviews	
Survey Coding	William Yang, Edited by all
Interview Coding	Samuel Skinner, Edited by all
Literature Research	Samuel Skinner, Edited by all
Challenges	Isabelle Claude, Edited by all
Findings:	
Expert Interview Results	Xianhan Jia, Edited by all
Survey Demographic Results	Isabelle Claude, Edited by all
Survey Open Response Results	William Yang, Edited by all
Conclusions	William Yang, Edited by all
Recommendations	Samuel Skinner, Edited by all
Appendices	All, Edited by all

Table of Contents

Table of Figures

Table of Tables

Introduction

Over the past 100 years, advances in science and technology have enabled humanity to accomplish wonders unimaginable to earlier generations. In 100 years we have completely interconnected the continents through air travel, and people through the internet. We have saved millions of lives with a growing repertoire of antibiotics, landed people on the moon, and looked back into the very beginnings of our universe. However, the forces which shape our lives in 2020 are not completely dissimilar to those which shaped the lives of our ancestors in 1920. 100 years ago the world was in the midst of the global pandemic known as the Spanish Flu, which killed up to 20 million people. While the Spanish Flu took around a year to become a worldwide pandemic, it took COVID-19 only a few months to achieve a similar, if not greater scale. While globalization has certainly improved living standards in many parts of the world, the increased mobility of people and products has also made it easier for events like the COVID-19 outbreak to occur.

Pandemics are an inevitable fact of nature, like tsunamis and earthquakes. While we cannot stop new diseases from appearing among us, we can mitigate the spread of these diseases in several ways. One tool which promises to revolutionize how we respond to pandemics is mobile technology. This broad category of machines range from cell phones to artificial intelligence (AI) to apps, and are the subject of interest for our sponsors at Tsinghua University's Institute of Public Safety Research, and the School of Public Safety and Emergency Response at Wuhan University of Technology. Our sponsors would like to know how best to deploy mobile technologies in future events mirroring COVID-19, including what forms of technology should be used, how should they be used, and who should use them? By answering these questions, we

hope to be able to assist our sponsors in understanding how to best utilize mobile technology in future public health crises.

Though there is an existing body of research around mobile solutions to infectious diseases, the ever advancing nature of mobile technology means that this literature is in need of updating on a regular basis. Crises separated by even five years will face radically different situations when it comes to the technology that public health officials have at their disposal. One fairly new aspect of mobile technology which has been utilized heavily in China during the current crisis is a myriad of mobile applications which assist citizens and authorities in tracking and containing the spread of COVID-19. In order to better understand how these programs function and how they can be made more effective in the future, our group worked hand in hand with our sponsors in China to collect information on how apps were deployed in China to help combat COVID-19, and how these apps function. We utilized expert interviews and surveying techniques to gain a better understanding of how mobile applications were used in China to combat COVID-19. We then used this information to come up with several lessons that we can learn from China's response.

Literature Review

History of COVID-19:

In December, 2019, a new virus began to spread throughout the city of Wuhan, China. Within the same month, the virus had spread throughout the country. On February 11, 2020 the International Committee on Taxonomy of Viruses (ICTV) named the new virus SARS-CoV-2, standing for Severe Acute Respiratory Syndrome Coronavirus 2 (WHO, 2020). On the same day, the World Health Organization (WHO) named the disease caused by the virus as COVID-19, standing for Coronavirus Disease 2019 (WHO, 2020). On March 11th, the WHO declared COVID-19 to be a pandemic after it was found to be in all regions of the world. Figure 3 shows a timeline of critical events during the COVID-19 crisis.

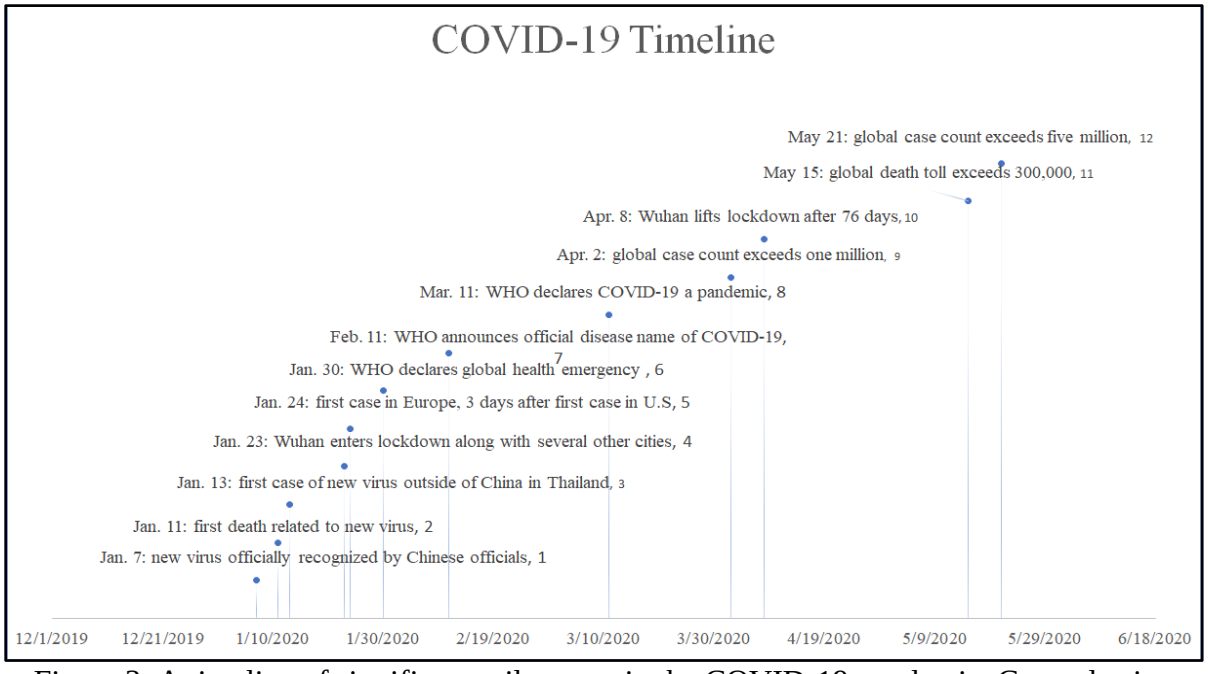

Figure 3: A timeline of significant milestones in the COVID-19 pandemic. Created using information from USA Today's COVID-19 timeline (Hauck, 2020)

SARS-CoV-2 is part of a larger family of viruses collectively known as Coronaviruses. Some past infamous coronaviruses include Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS). The symptoms of COVID-19 include anything from a mild cough to more lethal symptoms that can prove fatal (Q&A on coronaviruses, 2020). Recent research shows that the primary risk of infection from the novel coronavirus is through either inhalation of infected droplets or through contact with the eyes or mouth (Q&A on coronaviruses, 2020). Other investigations suggest the virus can also be spread by contact through the fecal-oral route, but according to WHO, the risk appears to be low (Fei, 2020). As the situation evolves, the WHO is continuing to assist researchers and the public in understanding how COVID-19 is spread (Q&A on coronaviruses, 2020).

After the initial outbreak, many companies, online communities, and event organizers reacted quickly by cancelling and postponing events. This was advised by health organizations such as the CDC in the United States (CDC, 2020). For example, the Tokyo 2020 Olympics was postponed by a year, Adobe decided to "make Summit/Imagine 2020 an online event and cancel the live event in Las Vegas, and E3 2020 was similarly cancelled in New York" (Adobe, ESA, 2020 Olympics, 2020). As the virus got progressively worse, more institutions started to cancel events and important services. For example, most public and private universities across the globe shut down their campuses for the remainder of the 2020 spring semester, opting to hold classes online to protect their students (UNESCO, 2020). While some universities are attempting to open

up again for the fall semester, many will continue to function remotely until at least 2021 (Anderson, 2020). In addition to universities, governments across the world began recommending that public schools and nonessential businesses shut down and conduct their business online (UNESCO, 2020). Due to the sudden closure of so many schools and businesses, unemployment has skyrocketed worldwide, with the UN predicting a total of 195 million jobs lost due to COVID-19 (Reuters, 2020). In the heart of global finance, some economists are predicting that the United States could reach Depression era levels of unemployment, as unemployment insurance claims continue to rise - as seen in Figure 4 - to historically high rates (Rugaber, 2020). As of April 23rd, the United States has lost 26.5 million jobs during the COVID-19 crisis, with unemployment exceeding twenty percent (Lambert, 2020).

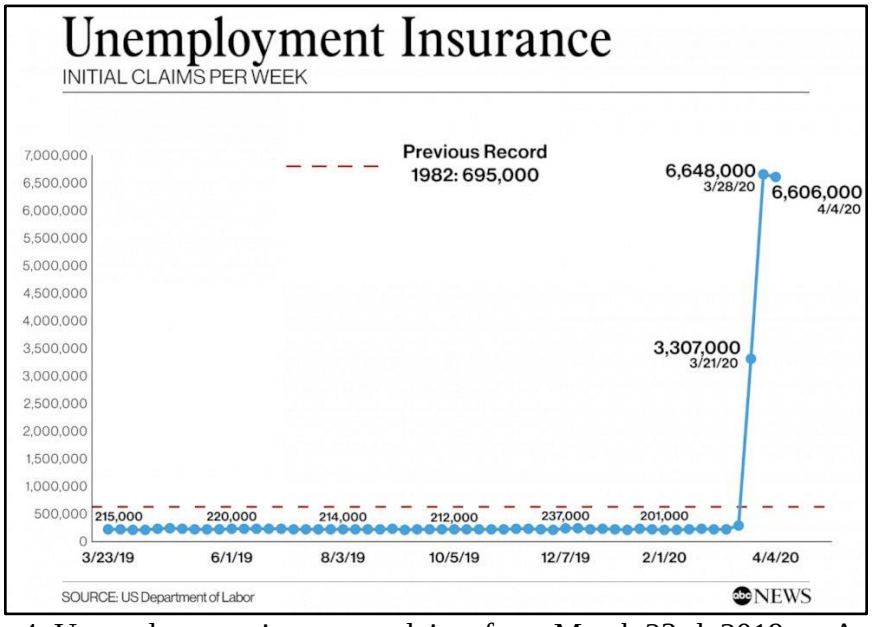

Figure 4: Unemployment insurance claims from March 23rd, 2019, to April 4th, 2020. Catherine Thorbecke. (2020, April 9). 6.6 million more Americans file for unemployment amid COVID-19 financial crisis.

Almost half a year after the first human infection, the situation in some affected regions began to return to normal, such as in Wuhan and Beijing where lockdowns and travel bans were lifted in late-April (Campbell, 2020). However, the crisis was far from over. In Wuhan, several new cases of COVID-19 prompted the city to test nearly seven million people over twelve days in late May to prevent the disease from spreading throughout the city a second time (Che, 2020). China's northeastern province of Jilin temporarily shut down public schools and transportation in mid-May before enforcing a quarantine after a series of new infections in the region raised concerns of a second wave of COVID-19 (Chen, 2020). In mid-June, Beijing experienced a series of cases just after city officials reported that the city was COVID-19 free, plunging the city back into lockdown and aggressive testing measures (Raghav, 2020). Similarly, a recent spike in the number of new COVID-19 cases in the American South - where states reopened earlier than their northern counterparts - has introduced fears of a resurgence in cases throughout the United States (Romano, 2020). The threat of a second wave should not be underestimated, as many experts on the 1918 Spanish Flu point towards the fact that the majority of deaths attributable to the virus came during the second wave of the disease (Brisco, 2020).

Many doctors and health officials believe that the only long-term solution to the COVID-19 crisis is the development of a vaccine for SARS-CoV-2, which experts hope may be available in mid-2021 (Gallagher, 2020). Initial data from human trials in Europe showed that some potential vaccines can produce antibodies for SARS-CoV-2, but it is still unknown how effective

these vaccines will be in preventing an infected person from developing COVID-19 (Gallagher, 2020). Figuring out how to best distribute a vaccine for the novel coronavirus is already posing ethical concerns. Health policy researcher, Lawrence Gostin, has raised concerns over a situation where “countries are likely to compete with one another for scarce vaccines and hoard them for their own citizens” (Rogers, 2020). Until a working vaccine and system to distribute it has been developed, social distancing policies are likely to stay in effect (Courtney-Guy, 2020).

China's Response to COVID-19:

As the epicenter of the COVID-19 pandemic, China had very little time to formulate a response to COVID-19 when it emerged in late December. Reports indicate that local officials in Wuhan withheld or downplayed information on COVID-19 as it began to spread throughout the city - actions which lead to the replacement of the local Secretary of China's ruling party (Gertz, 2020). However, after this initial inaction, the response from the Chinese government was swift and severe. On January 23rd, Wuhan was locked down; a day later the entire province of Hubei - of which Wuhan is the capital - was locked down as well, keeping sixty million people in place (Xie, 2020). Many experts were unconvinced at the time that this lockdown was necessary, and were shocked by what would become the largest quarantine effort in modern history (Graham-Harrison, 2020). A timeline of the events leading up to the quarantine appear in Figure 5.

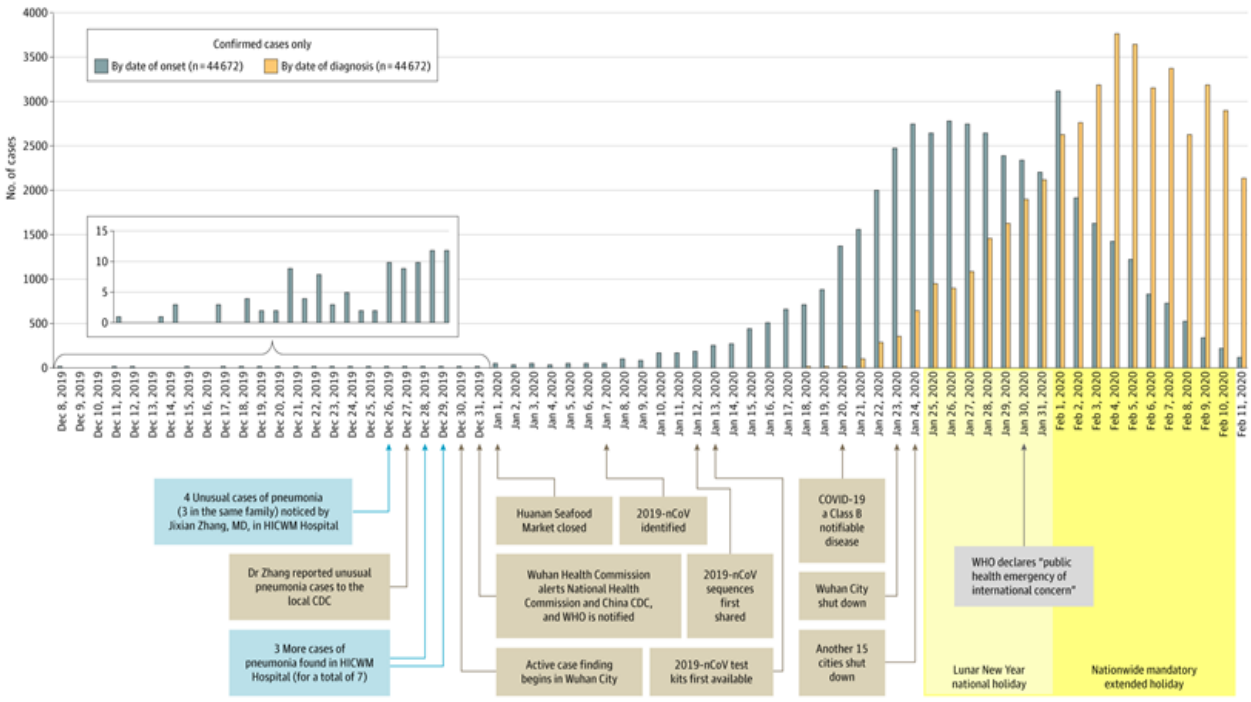

Figure 5: A timeline of the events leading up to and following the lockdown of Wuhan and Hubei Province (Wu, 2020).

The decision to lock down Wuhan and its parent province was reached by a group of disease experts who arrived in Wuhan to investigate an unknown pneumonia-like disease on January 19th, which would later be designated COVID-19 (Xie, 2020). Though studies have confirmed that COVID-19 existed in Wuhan as early as January 2nd, it was not until these medical professionals began getting infected around two weeks later that any action was taken to further investigate the new virus (Huang, 2020). With the Lunar New Year approaching on the 25th of January, experts warned that unless infected areas were isolated before the 24th, the traveling associated with Lunar New Year celebrations would spread the then-unknown virus throughout China (Xie, 2020). This lockdown was the first major step taken by the Chinese government to combat COVID-19, and some estimate it may have prevented up to seven hundred and forty-four thousand infections (Xie, 2020).

The rapid lockdown of Wuhan meant that all air and train travel out of the city was stopped, along with a blocking of the city's highways to prevent people from leaving by car (Gan, 2020). By January 30th, private motor vehicle traffic had also been banned in an attempt to dissuade residents from leaving their homes (Gan, 2020). In the early days of the lockdown there was some confusion around which stores - like restaurants and pharmacies - would be open, and when they would be opened; as time progressed many began to adjust into a new routine and life

under lockdown (CGTN, 2020). One man live streamed himself running a full marathon in his apartment to entertain himself, while others danced together over video calls (Hilotin, 2020).

In order to prevent the spread of COVID-19, many neighborhoods prevented their residents from leaving their homes, instead relying on food deliveries to feed their residents (Graham-Harrison, 2020). There was some difficulty initially setting up systems of distributing food to citizens as they isolated at home; in one neighborhood, officials reportedly distributed meat to residents using garbage trucks, raising concerns among residents about the safety of this meat (Zuo, 2020). In response, the two responsible officials were fired, and community workers went door to door delivering apologies for the event (Zuo, 2020). This event, among others, illustrates the trial and error approach that community and government officials were forced to take to deal with the Wuhan lockdown.

The WHO referred to the Wuhan lockdown as "unprecedented," adding that it served as "a very important indication of [China's] commitment to contain the epidemic in the place where it is most concentrated" (Crossley, 2020). Experts estimate that the lockdown may have prevented the spread of COVID-19 throughout the country by up to three days, buying officials and health care workers valuable time to prepare (Kreamer, 2020). Though effective, some experts argue that if information has not been withheld from the public and central government initially, COVID-19 could have been dealt with using less serious measures (Graham-Harrison, 2020).

In addition to the lockdown, officials in Wuhan worked to improve diagnostic capabilities and contact tracing measures within Wuhan in order to combat the disease. An entirely new hospital was even constructed in Wuhan, with construction lasting only ten days (McDonald, 2020). In order to staff this new hospital and assist health care workers at existing facilities, the central government sent an additional 1,230 medical professionals to Wuhan (Web Desk, 2020). Even with all the efforts undertaken to prevent the spread of COVID-19 out of Wuhan, every region in China had reported cases of COVID-19 by January 30th, a mere six days after the lockdown of Hubei (Chappell, 2020).

For the next two months, Wuhan's remained in lock down. Health and community officials did all they could to isolate potentially infected individuals, and care for those whose condition became critical. A CGTN report from inside Wuhan - titled *The Lockdown: One Month in Wuhan* - spoke to community officials whose job it was to go door to door in one apartment building everyday to check residents' health status, and make sure they were getting the necessary resources they needed to quarantine (CGTN Youtube, 2020). One of these officials said she and her partner check on around one thousand residents a day. This report also followed a man who tested positive for COVID-19, who was then transported by the government to a local hospital, where he was required to quarantine. Though he agreed to go, the man wished he could have quarantined at home. Though many in the report are supportive of the lockdown, it is clear that not everyone was happy with the severity of their forced isolation; one business owner

yelled at health officials when they came to check up on her, lamenting how the quarantine prevented her from operating her business. It is clear from the report that the months of lockdown in Wuhan were extremely difficult for the residents of Wuhan on both a material and emotional level. After two months of extensive testing, food deliveries, and isolation, Wuhan officially opened back up on April 8th (Campbell, 2020). Around five million residents who had left Wuhan before the lockdown to celebrate the Lunar New Year were finally able to return, and business was able to resume in the city (Campbell, 2020).

Though they have faced much valid criticism, China's response to COVID-19 has been lauded by much of the international community. The head of the WHO went as far as to say, "the Chinese government is to be congratulated for the extraordinary measures it has taken to contain the outbreak, despite the severe social and economic impact those measures are having on the Chinese people" (Anderson, 2020). One poll suggests that up to sixty percent of global citizens approve of China's response to COVID-19 (Strauss, 2020). Internally, seventy-five percent of Chinese citizens were happy with their government's dissemination of COVID-19 related information, and 67 percent were happy with their government's delivery of necessities and PPE (Anderson, 2020). Though the Chinese government can certainly improve its response to COVID-19 in several ways, its actions thus far have undoubtedly helped both its own citizens, and the world.

One aspect of China's response to COVID-19 which generated much interest abroad was their "health code" system. Seen by some as a draconian control-measure, others have argued that the health code system - which works through mobile applications on citizens phones - has been integral to China's success during the COVID-19 crisis (Davidson, 2020). Though the health code system was originally hosted on its own app, it is now being held as a mini-program on the popular Chinese apps WeChat and Alipay (Jao, 2020). Aside from how useful or useless these apps may be, their existence would not be possible without the widespread usage of smartphones throughout China and the rest of the world.

The Ubiquity of Mobile Technology in China:

Over the past ten years, the usage of mobile technology - typified by devices such as smartphones, tablets, and laptops - has spread rapidly around the globe. According to Pew Research, it is estimated that over five billion people - over 60 percent of the world population - have mobile devices (Silver, 2019). Of these five billion people, approximately fifty-five percent of China's population of about 1.4 billion people are smartphone users (Statista, 2020). As seen in Figure 6, Statista also anticipates that the number of smartphone users will increase by two percent by 2021, and will continue to rise each year by two percent. (Statista, 2020). This rise in smartphone use is part of a longstanding trend. An additional 12 percent of the Chinese population have access to smartphones today as opposed to five years ago. Younger people are especially more likely to be digitally connected. One survey found that over 90 percent of respondents in advanced economies under the age of 35 owned a smartphone (Silver, 2019). It is also important to note that, although a great deal of China uses mobile technology, its usage is not equal across the nation. Laura Silver of Pew Research found that people in advanced economies or people with higher levels of education are more likely to have smartphones than people in emerging economies (Silver, 2019).

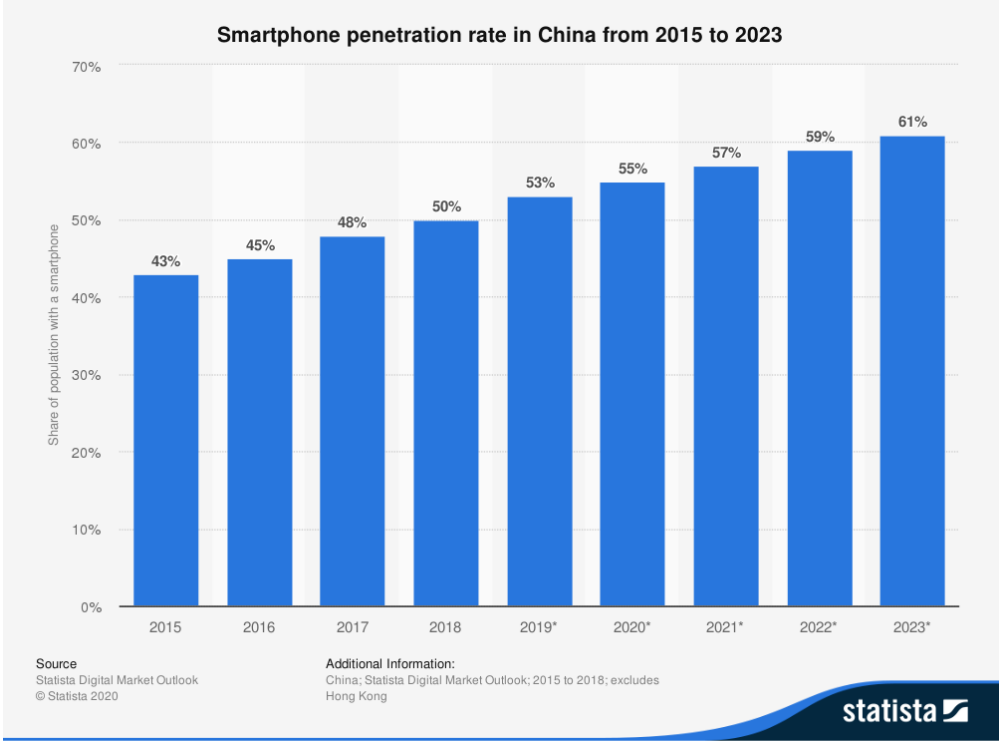

Figure 6*:* Smartphone penetration rate in China from 2015 to 2019. Reprinted from Statista.com (Wong, 2020).

The COVID-19 crisis has only hastened China's move towards a cashless society, as people look for ways to safely purchase things without physically exchanging money (Warner, 2020). For the past few years China has been attempting to build a cashless society, with apps like WeChat and Alipay serving as mediums through which transactions can flow (Utopia, 2020). Both of these apps were widely used by people in China even before COVID-19, with both Alipay and WeChat having over a billion users in 2019 (Kharpal, Roberts, 2020). The widespread usage of these apps likely meant that when the Chinese government began moving their health code system to function as mini-programs on Alipay and Wechat, many users were able to access the health code system without downloading any new applications.

Smartphones and other forms of mobile technology have become a key component in communication throughout the world, making the online space an essential platform for disseminating critical instructions and information during worldwide crises such as the current pandemic. It is anticipated that within the next century, mobile technology will enable the entire world to be interconnected, regardless of socio-economic status. Because mobile technology is one of the easiest and most effective forms of communication, it has been used to spread information during worldwide catastrophes, such as the COVID-19 pandemic.

Mobile Technology in Healthcare:

Over the past few decades, mobile phones and tablets have increasingly been integrated into healthcare systems around the world. These relatively new innovations promise to boost the efficiency of healthcare systems across the world while also improving healthcare outcomes. Despite the benefits that smartphones and other mobile devices would bring to the healthcare industry, their implementation has been slowed by systemic barriers which warrant consideration. Though mobile technology promises to improve all areas of healthcare, recent developments alongside the ease of modern big data analysis have led many to believe that a combination of the two could allow healthcare institutions to better respond to infectious diseases such as COVID-19.

Hospitals have been utilizing various forms of mobile technology for over a decade to improve the efficiency of their healthcare workers and to lessen costs. These benefits were

detailed in a 2008 overview by Susan and Craig Standing entitled *Mobile Technology and Healthcare: The Adoption Issues and Systematic Problems*. The Standings point towards the ability for healthcare workers to now update patient records at the point of care, which has decreased the amount of clerical errors made. These patient records can in turn be accessed by healthcare workers directly from personalized bar codes assigned to each patient upon their arrival at the hospital. The increased availability of smartphones and other smart devices has allowed healthcare workers to consult with one another and with their patients almost instantly, which has resulted in a reduced patient load due to healthcare providers' abilities to treat patients at home via smartphones or similar devices. The Standings analysis shows that the cost benefits of these technology integrations are quite stark. In one case, the Standings found that the integration of voice activated hands-free communications systems at a Sydney hospital freed up to 20 hours of staff time per day, or a cost savings of seven million dollars per year. This system included computers on wheeled platforms, hand held computers, and hands-free communication badges which connected doctors to this system. Another benefit they found was that much of this technology is designed to function wirelessly, cutting down on expenses associated with installing the hard wiring which machines such as PC's need to run. In addition to hardwiring being quite expensive initially, the Standings showed that it also required somewhat frequent repair, further making mobile technology the cheaper option.

Though many benefits of mobile technology assume the presence of an existing and expensive healthcare infrastructure, it is also being used to improve healthcare outcomes in historically wealth deprived regions, such as many parts of Africa and South Asia (Braun, 2013). In these regions healthcare workers are often required to take responsibility for more patients than they can reasonably attend to, all while working with significantly less resources than healthcare workers in wealthier countries (Braun, 2013). Additionally, many of these healthcare workers must go to their patients, as opposed to their patients coming to one centralized location such as a hospital or clinic; further strain is put on these healthcare workers when one considers that many of the locations they are expected to service are often distant from one another (Braun, 2013). For healthcare workers such as these, mobile technology functions as a critical way for healthcare workers to communicate, receive training, and be deployed by healthcare managers. According to one pilot study in Mawali, the use of mobile phones allowed healthcare workers to double the number of clients they were able to service over a six month period (Mahmud, 2010). Another study found that midwives and associated healthcare workers in Indonesia self-reported that mobile phones made it easier for them to meet their patients' needs on a timely basis (Chib, 2008).

Despite the general scholarly consensus that mobile technology can greatly improve healthcare systems in the developing and developed world alike, there are still major barriers to its full integration and use (Standing, 2008). The Standings' study associated these barriers with

the following rationales. They found that the current speed of innovation ensures that the cutting edge technology of today could soon become obsolete, raising the risk of further investing in the related infrastructure. They also found a large amount of resistance towards utilizing mobile technology came from the culture of healthcare workers. Due to the high stakes associated with healthcare, the Standings found that healthcare professionals tend to have a conservative 'if it isn't broke, don't fix it,' mentality, making doctors and nurses less likely to adopt technology they are not comfortable with, or which they perceive to have flaws. The failure of healthcare professionals to fully embrace new innovations can result in subpar results for these new systems, as the synergistic nature of mobile technology requires all aspects of a system to be utilized for maximum efficiency. Though these results from the Standings seem bleak, others studies have found that as healthcare workers have begun to utilize phones and tablets in their personal lives more often, they have increasingly brought them into the workplace, increasing the prevalence of mobile technology in healthcare in a more organic way (Burley, 2005). As attitudes continue to change and mobile technology is refined, the barriers to its use in the healthcare industry seem to be lowering.

The potential benefits of mobile solutions in healthcare have not been lost on officials worldwide, who have been attempting to utilize these tools to control and combat pandemics in various ways. Smartphones and similar devices allow public health officials to quickly share and record occurrences of infectious diseases in an area, which then allows public health officials to

decide what steps to take to mitigate the spread of said disease, as well as allowing researchers to develop models of how the disease may continue to spread (Li, 2010). For example, researchers found that the data generated by mobile technology can be used to accurately predict the prevalence of HIV in a certain geographic area, enabling healthcare workers to focus their resources on those areas (Young, 2015). Similar methods of data analysis - which comb through Google searches and social media posts for keywords in relation to geography - have also been used successfully to track the spread of influenza (Aramaki, 2011). The combination of these two technologies has proven much more effective than earlier attempts due to recent technological developments. Mass phone surveys were utilized to track the spread of the H1N1 virus in Mexico during the 2009 outbreak to limited success, illustrating how in under a decade mobile methods have gone from a somewhat effective method of disease management to an extremely effective method (Astley, 2010). Further advances in big data suggest that the usefulness of these technologies in the fight against pandemics will only increase with time. Therefore, it is critical to study past and current applications of mobile technology to learn how best to utilize limited resources during future pandemic scenarios.

Existing Mobile Applications For COVID-19:

Though mobile technologies like phones and laptops are not new to healthcare, the wealth of mobile applications that have been deployed to fight COVID-19 is unprecedented. As mentioned in the previous section, collecting data from phone surveys during the H1N1 outbreak in Mexico proved to have mixed results, as the quality of data collected was hampered by the nature of collecting data over the phone (Astley, 2010). Collecting data using apps promises to make it easier than ever for healthcare professionals to collect large amounts of location and health data at a rapid pace, allowing researchers to keep up with a disease outbreak as it spreads. Throughout the COVID-19 crisis, mobile apps have been deployed in countries including China, Switzerland, and the United States in order to assist in the fight against COVID-19 (Barrionuevo, 2020). Appendix A shows some of the apps being utilized in 11 regions as of July, 2020. The deployment and use of these applications have varied both between different countries and within them, existing on a spectrum of what researchers have called a maximal and minimal approach (Khan, 2020). While a more in-depth exploration of these apps will be included further on in this section, the context in which researchers look at these apps is important to understand.

On May 21st, roughly five months after the first reported cases of COVID-19, John Hopkins released a report on the findings from a focus group of experts in mobile responses to pandemics, entitled *Digital Contact Tracing for Pandemic Response*, which attempts to set guidelines for the use and deployment of mobile applications in pandemics, with a special

interest in the ongoing crisis (Khan, 2020). While the focus group agreed that mobile apps have the potential to greatly assist public health officials, they made sure to emphasize that the good derived from the use of these apps must greatly outweigh the harm they pose, especially when it comes to the issue of privacy. Privacy concerns have already been raised over the mobile applications being used in the Hangzhou province of China, with some experts worrying that the usage of these apps will become normalized even after the pandemic is over (Holmes, 2020). In the United States, NPR reporter Sharon Bond raised the issue that having a company like Google or Apple collecting and reporting users' movements to the government might be "...really creepy to a lot of people" (Bond, 2020). Though these apps may prove extremely effective at combating COVID-19, the right to privacy of the individuals using these apps arguably supersedes these benefits.

The issue of privacy intersects with the different ways in which these mobile apps have been utilized, corresponding to the previously mentioned maximal and minimal responses. The maximal response is typified by South Korea, where the location information of infected citizens is posted on government websites, blogs, and social media accounts after the citizens data is anonymized (Kim, 2020). This maximal response contrasts with "...the United States, which has so far erred on the side of individual privacy, and from neighboring Japan, where testing has been deliberately limited." (Kim, 2020). The United States has undertaken a minimal response, with contact tracing mostly being outsourced to private companies like the aforementioned

Google and Apple, who collect location data, anonymize it, and then report it to participating state and federal governments (Khan, 2020). For example, North Dakota's state government has partnered with the company ProudCrowd to adapt their sports fan tracking app to be used for contact tracing during COVID-19 (Office of the Governor, 2020). The Governor's office has a goal of getting 50,000 people - approximately seven percent of the state's population - to agree to download the app, which tracks anonymized user locations in 10 minute increments, and allows users to send their own data to the state government if they become infected with COVID-19 (Office of the Governor, 2020). Undoubtedly, more contact tracing apps and strategies will emerge as the COVID-19 crisis continues; developing an understanding of how these apps function, and how they manage the conflict between efficiency and privacy is important to creating better apps to assist public health officials while respecting the rights of individuals.

What should be clear from this brief discussion is that the character of COVID-19 apps often depends on the governmental structure and culture of the society in which they are deployed. Because of this fact, it is likely not possible to create a one-size-fits-all application for the whole world; however, understanding the victories and failures of contact tracing apps in one country can be useful in improving apps in another part of the world. For example, the Chinese model of contact tracing app would likely not work in the United States due to differing cultural

attitudes on personal privacy, but an examination of the Chinese model could still be very useful in improving and critiquing the American model (Tam, 2018).

Conclusion:

As history and current events have shown, there is no single way to deal with a pandemic. Different countries took different measures to prevent the spread of the Coronavirus, with some being more effective than others. While there is an existing body of literature on the applications of mobile technology to past pandemics, there is as of now little analysis of how this fast evolving technology was and is being used to mitigate the spread of COVID-19. Our group aimed to help fill this gap. The process we undertook to achieve this goal can be broken down into three objectives. First, we constructed a user survey and expert interview guide through a process of ongoing literature research and discussion with our advisor and sponsor. Next, we administered this survey to people in China, and conducted expert interviews with seven experts from our sponsoring universities. Finally, we utilized coding and numerical analysis to draw conclusions on the role of mobile applications in China's response to COVID-19, and draw out useful lessons for future disease outbreak scenarios.

Methodology

Introduction:

Our goal was to research the role that mobile applications played in China's response to COVID-19, in order to draw relevant lessons from this information. This goal was achieved through accomplishing three sequential objectives. Our first objective was to design and workshop an app user survey, and expert interview guide. Our second objective was to administer our survey, and conduct our expert interviews. Our third objective was to qualitatively and quantitatively review the data we collected during our second objective. Additionally, literature research which was begun in March, 2020 continued up until the publication of our project, in order to ensure that our members were up to date on the reality of the COVID-19 situation. Throughout the execution of our methodology, we faced a myriad of challenges, which we were able to overcome through determination and alterations to our methodology. A timeline of the execution of our methodology is shown in Table 1.

Objective 1: Designing an Effective User Survey and Interview Guide

Survey Draft:

Beginning in March, 2020 , we began developing a survey of multiple choice and free response questions to administer to people within China on their experiences with COVID-19 related apps. The purpose of this survey was to collect valuable information on a specific group, for the purpose of data analysis (Mckee, 2015). Specifically we hoped to collect information on user demographics, user experience, and user perception of COVID-19 related apps. Our survey was developed by consulting the survey design guidelines produced by Quinn Evaluation Consulting (Quinn, n.d.). While developing our survey, we went through four distinct periods of revision. These periods of revision can be seen in Figure 9, and involved feedback from our advisors, fellow students, and sponsors. A copy of our final survey can be found in Appendix B.

Expert Interview Guide:

Similar to our survey, our expert interview guide went through several revisions before our first expert interview, and several additional edits afterwards. Though it can sometimes be difficult to define who is an expert, interviewing knowledgeable individuals with relevant experience in a given topic can be extremely useful for researchers, especially when conducting preliminary research such as our own (Bogner, 2009). Leading up to our first expert interview, our advisors assisted us in revising our expert interview guide. A copy of this interview guide can be found in Appendix C. As we began to conduct interviews, we used these initial experiences to alter and adapt our interview guide in order to collect the most relevant and useful information possible. A copy of this final interview guide can be found in Appendix D. Figure 7 shows the general process of revisions which our interview guides underwent.

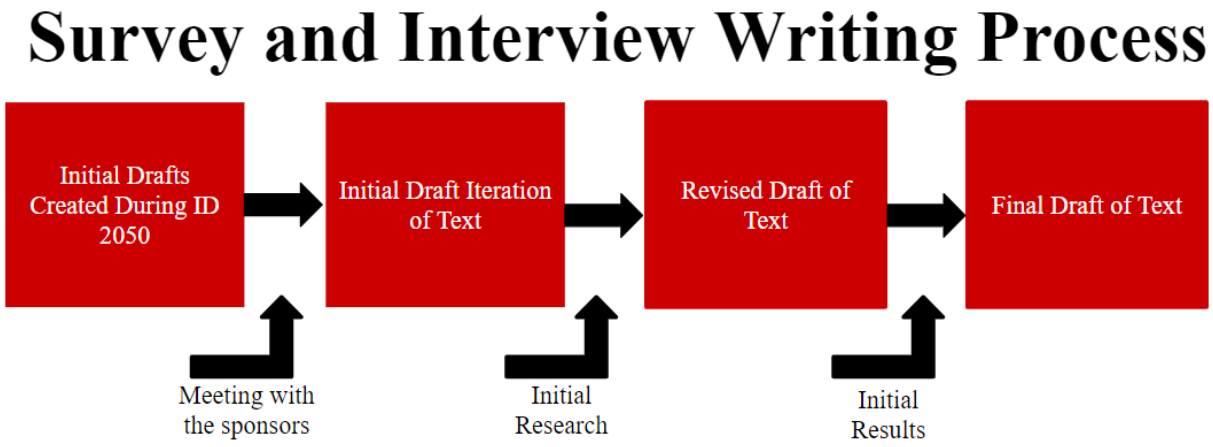

Figure 7: As our project progressed, we updated and revised our survey and interview guide to facilitate the collection of relevant and useful information.

Objective 2: Administering our Survey and Performing Expert Interviews

Expert Interviews:

Experts in the field of public health were contacted after being recommended to us by our sponsors. We sent these potential interviewees a list of possible interview questions in English and Chinese, so that they would have a chance to familiarize themselves with the topic of the interview. Giving interviewees questions in advance allows them to provide more accurate and thought out answers during the actual interview, increasing the usefulness of the data collected from these interactions (Adler, 2015). Specifically in our case, this also allowed interviewees who did not speak English as a native language to prepare responses in English, allowing them to take the time to create a response which may not have been possible in a fast paced live interview. Interviews were conducted primarily in English, but a Chinese speaker was on hand to receive and ask clarifying questions in Chinese when needed. All interviews were recorded, and a transcript of the interview was constructed afterwards. These transcripts were numbered and anonymized to protect the identities of our experts. These interviews can be found in APPENDIX E-K.

Surveys:

We worked with our collaborating members in China to develop a method that allowed us to survey people who had first hand experience using COVID-19 related apps. We adapted our survey questions to an online surveying format, before distributing these surveys to people in China using WenJuanXing ("Survey Star" in English). We collected data on age, gender, and the population density of the respondents' location of residence. We also collected data on user satisfaction and perception of COVID-19 related apps, as well as users' favorite and least favorite app features. Our survey was only administered to people in China over the age of 18. Once the group of individuals that volunteered to take part in the surveys completed them, the responses were aggregated to draw conclusions, elaborated on in Objective 3.

Objective 3: Analyzing Data Collected from User Surveys and Expert Interviews

Survey Coding:

After receiving the survey results from our Chinese teammates we went through the provided answers and translated them into English. We utilized Google Translate to translate shorter answers, and had a team member, fluent in Chinese, translate longer answers that Google Translate would potentially struggle with. We then began to code the responses by reading them all, analyzing the similarities and differences between responses, and then creating preliminary categories that each response and their similarities fit under. This coding scheme was adapted from open coding described by researchers at the University of Arizona (Blair, 2015). After this was done, bar graphs were made in Google Sheets to visualize the difference in responses.

The online platform that our Chinese teammates utilized, known as Survey Star, automatically converted the multiple choice responses into percentages. In receiving these percentages, we were able to make pie and bar graphs, which were used to visualize the

difference in opinions and responses. By being able to visualize the differing percentages in terms of length and size of each category, we were able to develop insights.

Interview Coding:

Interviews were coded for common themes in a multi-step process. The coding technique utilized was adapted from the open coding technique as described by researchers at the University of Arizona (Blair, 2015). An initial read-through was performed, where approximately twenty themes were identified, such as *Trust in Government* and *Contact Tracing*. After successive read-throughs these twenty themes were refined into ten more concise themes, where themes like *Community Food Delivery* and *Community Check-ins* were consolidated into *Community Involvement*. This process was continued until six themes were generated which best represented the interview data. These themes were:

- *Personal Privacy*
- *Community Involvement*
- *Government Involvement*
- *Situational Specificity*
- *Strengths*
- *Possible Improvements*

By comparing the frequency of these themes, we were able to gather and analyze our interviews in a more systematic way.

Each of these themes coded for a unique type of information. *Personal Privacy* pertains to concerns and information on the collection of personal and private data on COVID-19 apps. *Community Involvement* and *Government Involvement* pertains to the differing and unique roles that the local community and Government took during the COVID-19 crisis. *Situational Specificity* pertains to information about regional concerns and temporal concerns regarding

COVID-19 apps. *Strengths* and *Possible Improvements* pertains to comments praising or criticizing certain aspects of China's COVID-19 response and its use of mobile applications.

Literature Research:

Throughout the entire project, continual literature research was conducted to make sure our project and project members were up to date on the COVID-19 crisis. This included reading news articles, consulting COVID-19 related journal articles as they were published, and continually updating our literature review section. Literature research was carried on up until the publication of our project.

Challenges:

We faced various challenges while executing our methodology. The most prominent of these came from the online nature of our project. Remote work was complicated by poor internet connections, time-zone differences, and an unfamiliarity with apps such as zoom when it came to conducting interviews. While working on the survey with our Chinese collaborators, we would often have to wait over twelve hours to get a response on a question, which slowed us down substantially. Despite these issues, by remaining flexible and open to change, we were able to work with and around these issues.

One possible shortcoming of our methodology is the range of our survey and interviews. Our survey was distributed and filled out overwhelmingly by young people (under 25 years of age), which is not a representative sample of COVID-19 app users in China. This could cause a multitude of issues. For example, young people today have spent most of their lives with access to mobile devices and the internet; an app which is easy for a younger person to use may be much harder for an older, less tech-savvy app user. This along with other issues, means that further surveying is necessary to confirm and validate the results of our survey analysis. A

similar issue arises from the expert interviews. All seven of the experts who we interviewed were professors at one of our sponsoring universities. There are almost three thousand universities in China, meaning that our interviews do not necessarily reflect the academic consensus across China in regards to COVID-19 applications. (Top Universities, 2019). This issue is connected to the above issue of remote learning. As we were not physically in China to spread the range of our survey and interview, we were unable to reach a more representative sample. In addition, the difficulty of travel and communication brought on by COVID-19 also could have affected our Chinese collaborators ability to disseminate our survey.

Findings

Expert Interview Results:

We interviewed 7 experts in China who specialize in the field of public health. These experts were all recommended to us by our sponsors at Tsinghua University and Wuhan University of Technology. It is important to note that there may be some inconsistencies in the information provided by the interviews due to the language barrier. The identities of the interviews have been anonymized. The results of our interview coding can be seen in Figure 8.

Many of our interviewees mentioned how important apps like Alipay and WeChat were to China's response to COVID-19. Alipay is an online payment system similar to PayPal. WeChat also runs its own online payment service nearly identical to Alipay, but also functions as a popular instant messaging app in mainland China. Both apps store an abundance of personal information such as names, addresses, bank accounts, and user identity, which is required by Chinese laws. Both apps provide platforms for in-app programs called "mini-programs." Many COVID-19 related apps in China are on one of these two platforms.

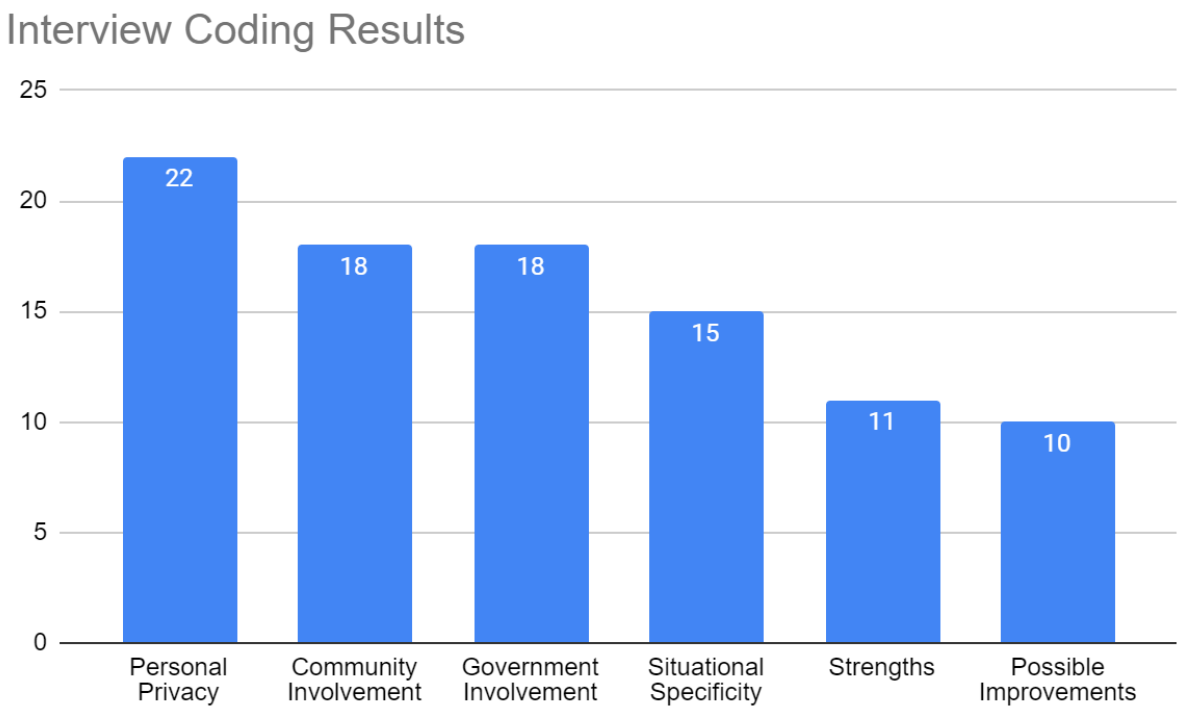

Figure 8: The results of coding the interview transcripts revealed six major themes.

From the interview coding results we can see that the most common theme was Personal Privacy. Interviewees generally showed a lack of knowledge on how long their personal information would be held by COVID-19 apps, and found this lack of knowledge concerning. One way this concern could possibly be addressed is by having users' personal data automatically deleted after a certain amount of time. According to one of the interviewees, "...there is a time limit on this data…each city has a different limit on how long they will keep this data." (Appendix H). Some interviewees also expressed concerns about their privacy, although many also thought that some amount of discomfort was necessary to supply these apps with important information. One interviewee said, "we're worrisome but it is acceptable because health and life are our top priority at this moment, but after the COVID-19, I don't want to connect to the health code app and other apps due to the personal information." (Appendix J).

Other experts did not see any problems with the amount of information being collected by these COVID-19 apps. One expert spoke in favor of these apps, saying "there's no personal information leak in this app, since you can only know you have contact or not. …, I want to know if I have contact history, that requires me to provide some personal information, (because) others also want to know if I'm sick or not, I think it's reasonable." (Appendix E)

The second largest categories resulting from our coding were Government Involvement and Community Involvement. The fact that these two categories were tied for second place suggests action on the national and local level are equally important when it comes to fighting COVID-19. While the local and national government used COVID-19 apps to designate areas based on risk levels and allocate resources to different areas, community workers and volunteers within each community used COVID-19 apps to assist them while distributing food, ensuring residents quarantined properly, and taking care of the elderly.

During the initial outbreak of COVID-19, food prices rose dramatically in several regions of China, due to a lack of preparedness on the part of the national and local governments. China's lack of preparedness for COVID-19 extended to their use of mobile applications, which had to be rapidly developed after the outbreak of COVID-19. The precursor to China's health code system was a railroad query system released at the beginning of the COVID-19 outbreak, which allowed railroad passengers to check if they had come into contact with any potentially infected persons. According to one interviewee, "at the beginning of the epidemic, people were frightened. As an example, I took a train during that time, so I'm not sure whether I have contacted any patient, so during that stage of time, railway system released a query system" (Appendix E). This query system helped China slow down the spread of COVID-19, and laid the groundwork for the health code system. After the health code system began to be used, data from

the railway query system was integrated into the health code system. Every province, city, office building, and school campus used their own health code system, which caused much confusion. These apps did not share information with one another, meaning that citizens who needed to travel also needed to download and update several applications. Although this situation has gradually improved, it has not been solved, as there are still many different health code applications throughout mainland China (China Daily, 2020) (Legal Daily, 2020). Several interviewees also expressed their concerns on the usability of these COVID-19 apps. For instance, elderly people who are not familiar with smartphones are easily confused by the need to show different health codes at different locations such as the grocery store, the gym, and their places of work.

Despite the initially chaotic situation, China's quick response to COVID-19 effectively "flattened the curve." Initially government agencies and communities relied on quickly constructed and premature applications. As time progressed, governments collaborated with third-party companies, who worked to improve the apps by updating the user interface, and adding additional features.

The major takeaways from our interview analysis are as follows:

1. Applications should be open about how user's private data will be stored and utilized.
2. Various COVID-19 apps should be consolidated, in order to cut down on the number of necessary apps which users have to download.
3. Apps should be developed before, and not after disease outbreaks occur.
4. Apps should take into account regional differences. Applications servicing rural areas may need to work differently than applications servicing urban areas.

5. While relatively well received, COVID-19 related apps still have room for improvement, as many people think they are annoying. Steps should be taken to minimize the number of times users have to interact with these applications on a daily basis.
6. Apps should be made easy to use and accessible to people who do not have prior experience using mobile applications. Government agencies and community committees should allocate resources towards teaching citizens how to effectively use these apps.

Survey Demographic Results:

The survey questions were displayed through multiple choice and open response questions, inquiring about demographic information as well as phone/app specific questions. The surveys inquired sixteen questions in total, but due to the fact that the last two questions were ambiguous and optional, the vast majority of the respondents left these two questions blank. This made for an impossible accurate analysis, so the team chose to neglect these two questions from our results. We received one hundred and twenty-seven responses in total, but because every question was optional, some questions were left blank. The demographic information analyzed included age, gender, location, travel history during COVID-19, and rurality. In analyzing this information, we were able to assess whether or not the results from the survey were representative of all of China or just select groups.

Figure 9 represents the age demographics. Out of 125 responses, 103 of the respondents are between the ages of 18 to 25. 6 of the respondents are between the ages of 26 and 35, eleven are between the ages of 36 and 45, and 5 are between the ages of 46 and 60. None of the respondents reported above the age of 60. The bar graph exemplifies the fact that we received an abundance of responses from individuals in China between the ages of 18 to 25 in comparison to

the other age groups. This information concludes the information discussed in the “Ubiquity of Mobile Technology” section of the background, where younger individuals are more inclined and used to using mobile technology. The displacement of the age demographics may also explain the fact that very few respondents thought that the apps were confusing and lead to fewer complaints and more praise about the apps. Figure 10 showcases the gender demographics. Out of 124 responses, 48.4 percent of the respondents reported to be a man while 51.6 percent reported to be a woman. The pie chart represents a roughly equal amount of responses from each gender, which in turn proposes no underlying questions of whether or not gender potentially could have played a role in swaying responses in one direction rather another.

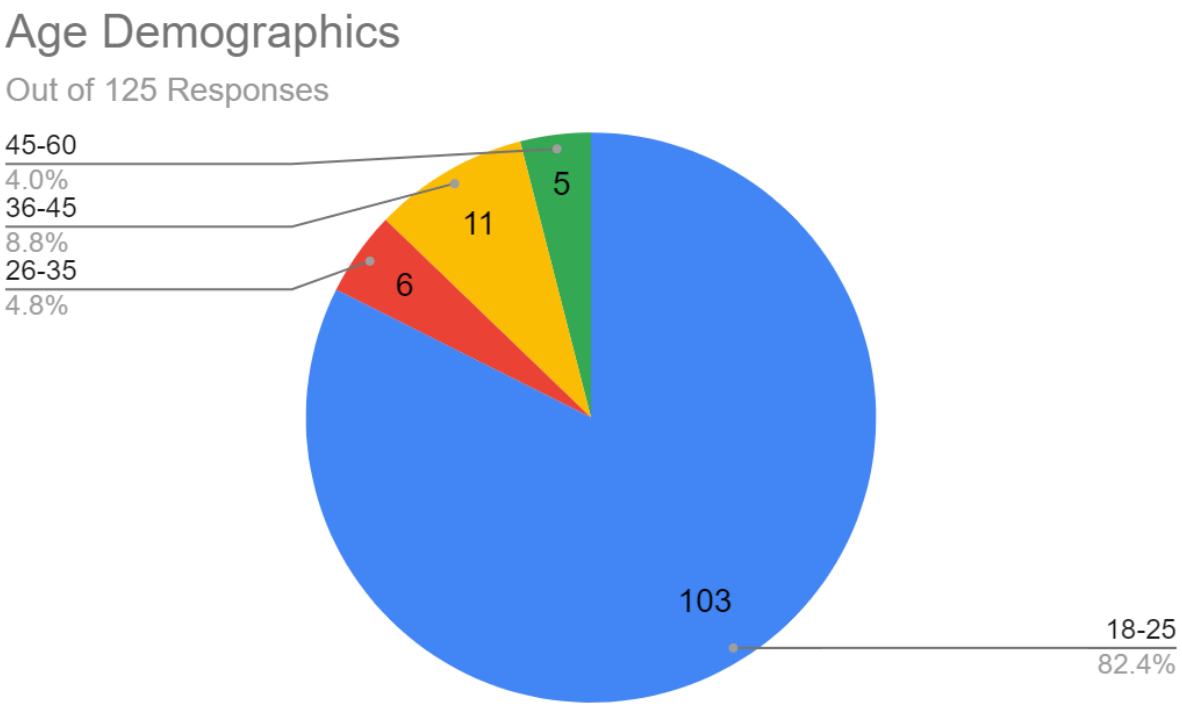

Figure 9: Survey respondents were asked to report their age range.

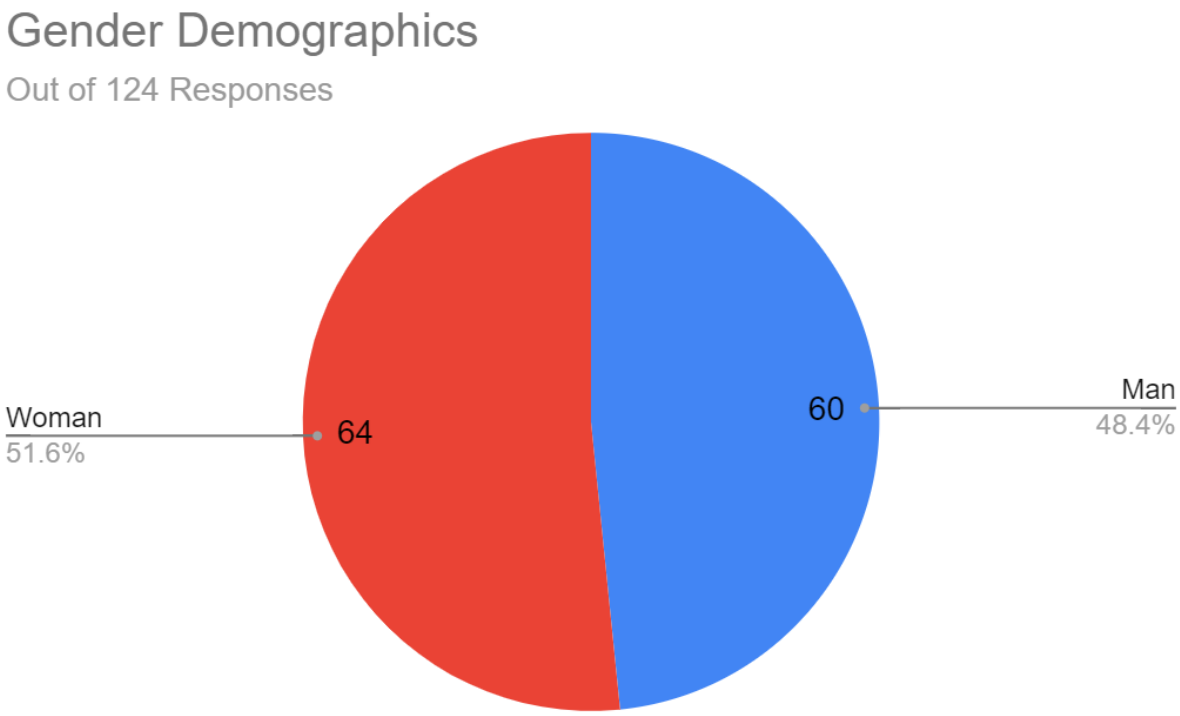

Figure 10: Survey respondents were asked for their gender identity - man, woman, or other.

Figure 11 displays the location demographics. We received several responses from individuals throughout China. The donut chart, displays the percentages of respondents from thirteen different provinces. According to Briney of ThoughtCo.com, China is divided into 23 provinces, 22 of which are controlled by the People's Republic of China (Briney 2020). As seen on the chart, out of 94 responses 30.5 percent of the respondents reported being located in the Hubei province which is also the province in which Wuhan, where the first case of coronavirus was reported, is located. Figure 12 displays which provinces in China we received responses from.

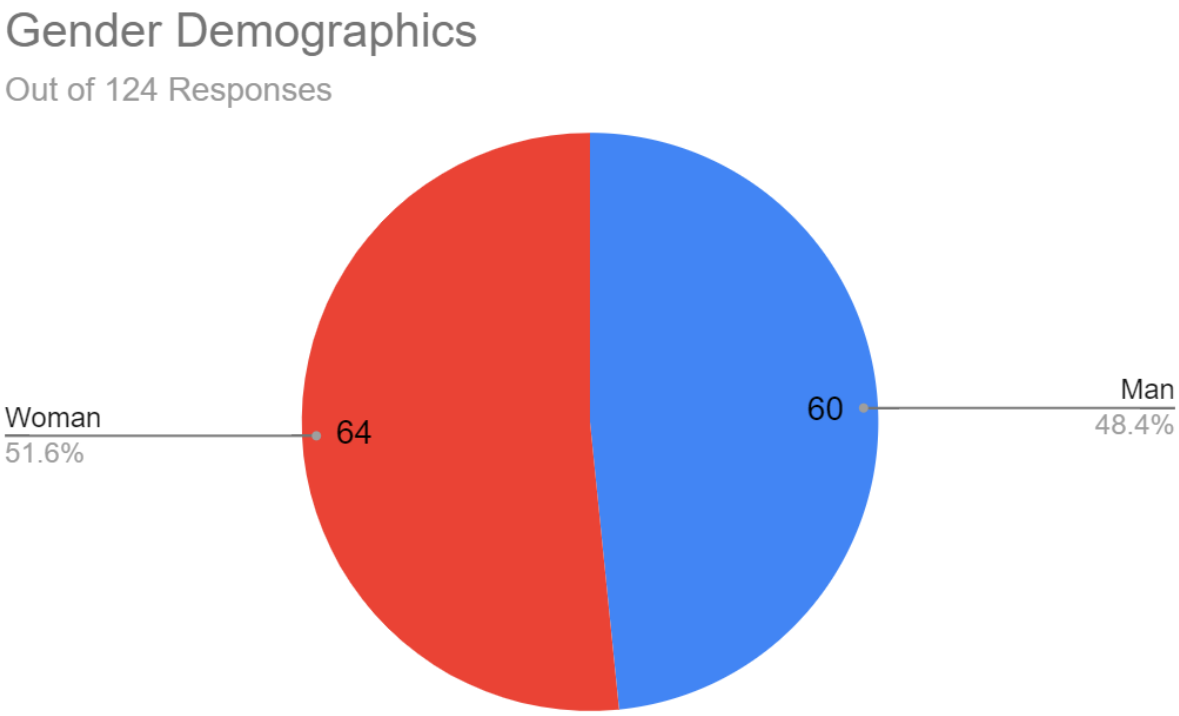

Figure 11: Survey respondents were asked to report the province in which they reside.

Figure 12: Map of China with circled provinces in which our respondents reported located. (Travel China Guide, 2020).

Figure 13 represents the travel history during the COVID-19 crisis. The survey question was asked to highlight the amount of respondents that had to download another app due to travelling outside of their city or province. 122 respondents answered this question revealing that 104 of respondents reported not travelling to outside of their province, 18 of respondents reported travelling outside of their province. This pie chart exemplifies the fact that travel decreases during crises. Natalie B. Compton of the Washington Post interviewed special pathogens expert Syra Madad, who featured in Netflix docuseries "Pandemic: How to Prevent an Outbreak" on her opinion on travelling during a pandemic. '"We're still in the middle of the pandemic, and, unfortunately, this is something that's going to be with us for the foreseeable future… I think no one should be traveling. All nonessential travel shouldn't take place. If this is not something that you need to go do for your own safety, then maybe it's something you could do at another time."' (Compton, 2020). Individuals in China recognize the severity of remaining in place during a pandemic and thus didn't travel often outside of their city or province and didn't have to download other apps.

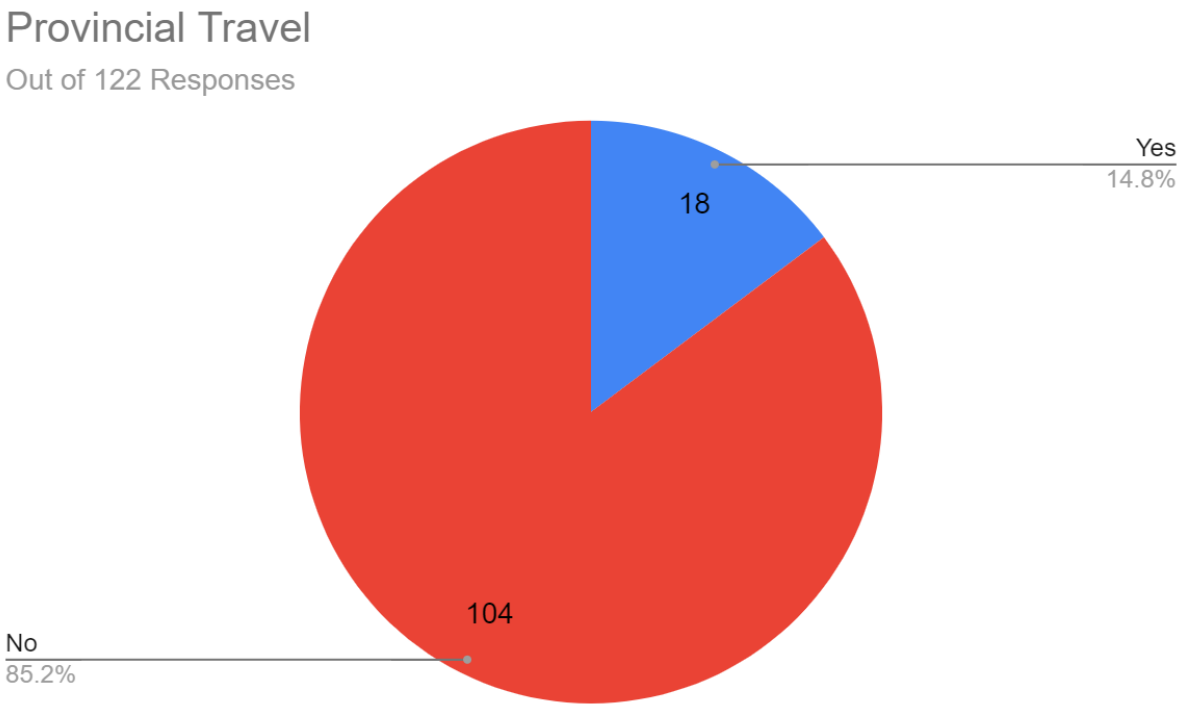

Figure 13: Pie chart representing the data the travel history during COVID-19 of the survey responses

As shown in Appendix B, where the survey questions are present, question four inquires the ruruality of each respondents corresponding city or province. The majority of respondents, 99, replied that they felt as if their city or province was ⅗ or less in population, while 26 respondents replied ⅘ or above. 2 respondents didn't reply. This concludes that many respondents did not feel that their city was too crowded, but no other valid conclusions could have been made from this question without making assumptions.

Survey Open Response Results:

The survey also contained a considerable amount of questions aimed at gauging what type of phones and what apps every respondent used. While these questions did not provide any information directly related to our topic, we believed that they would give us some context to some of the other questions asked. As can be seen in Figure 14, when asked what type of phone they used, 84 percent of respondents to the question answered that they used an Android phone as opposed to an iPhone or other device. Additionally, Figure 15 shows that while established apps like WeChat and Alipay were used the most, a large number of respondents also used standalone apps for things related to COVID-19. These two questions gave us some background information on the technical context behind the responses that we obtained throughout the rest of the survey. After some discussion we also deduced from the information provided that it would be more efficient to either alter or add onto an existing widely-used app platform like Facebook or other forms of social media in order to increase the availability of a COVID-19 related tool.

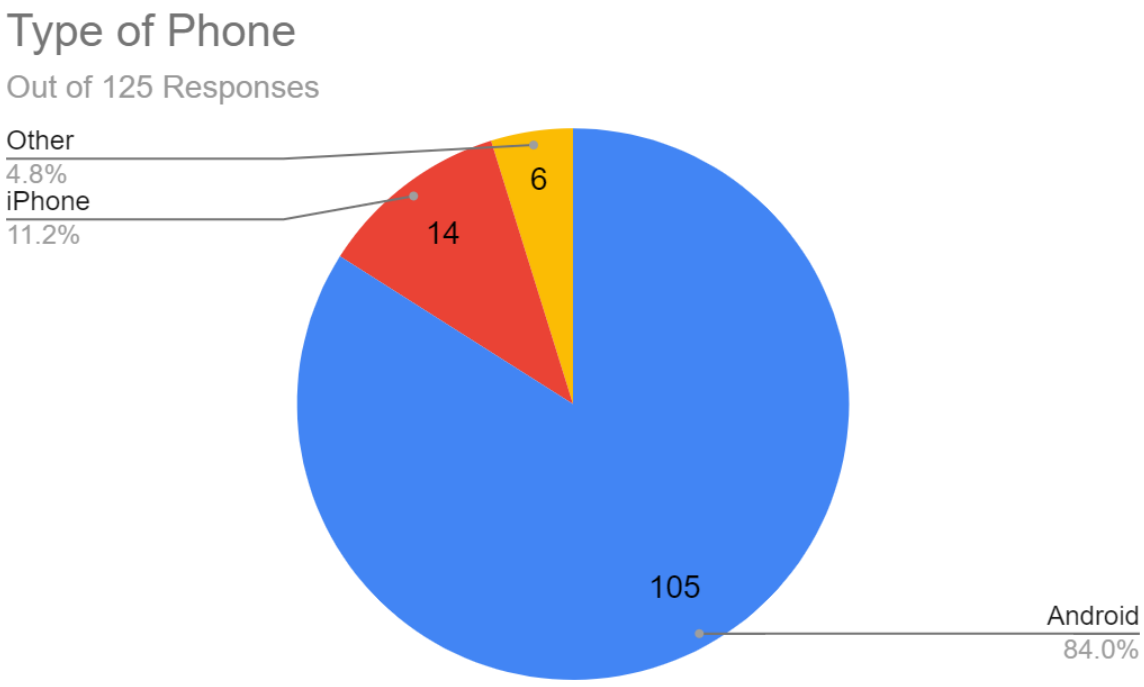

Figure 14: Donut chart representing the types of phone survey respondents used.

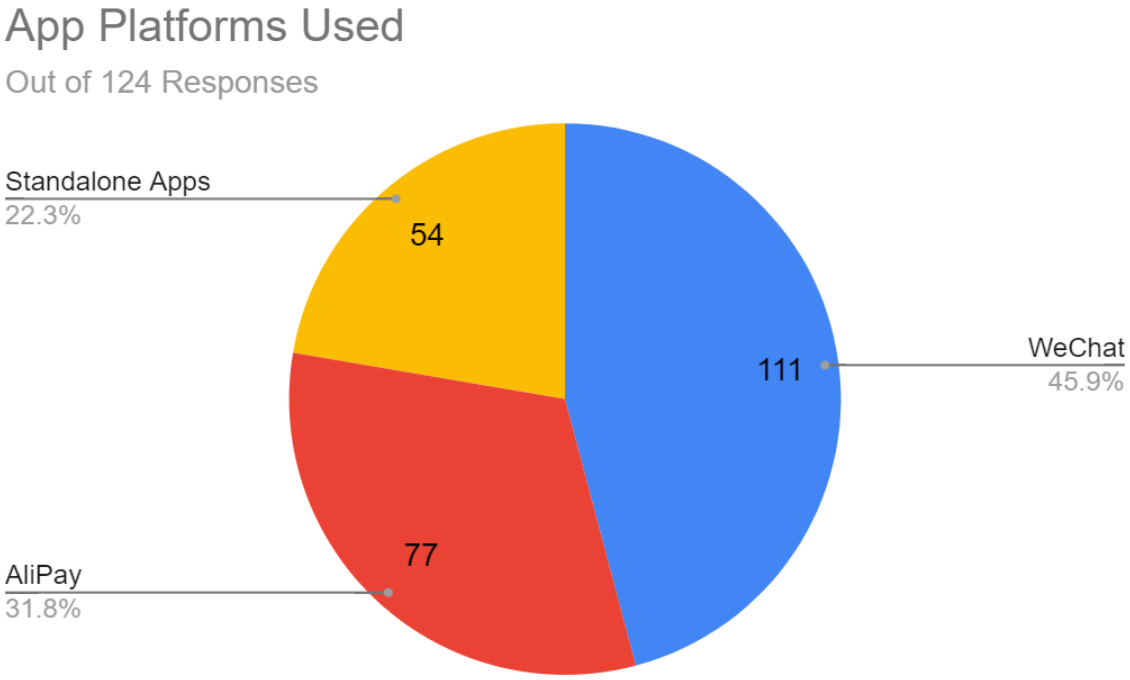

Figure 15: Bar chart representing the apps that respondents are primarily using (respondents could select multiple answers)

The team also gained an unexpected tidbit of information. Due to a bias that likely stemmed from the difference between Chinese and American culture, we had expected for the apps' most important Coronavirus feature to be related to contact tracing. However, answers to many of the survey questions suggested that most of the respondents actually valued the information and news that the apps provided over any features related to contact tracing. Figure 16 shows that when asked what each respondent used the apps for, 81% of them selected "Receiving health alerts" and 66 percent selected "Assessing information on COVID-19" (Surveyees were allowed to select multiple options). Additionally, when asked what they thought was the most valuable feature 56 percent of responses mentioned how the information provided by the app was the best part of the COVID-19 app of their choice (Figure 17).

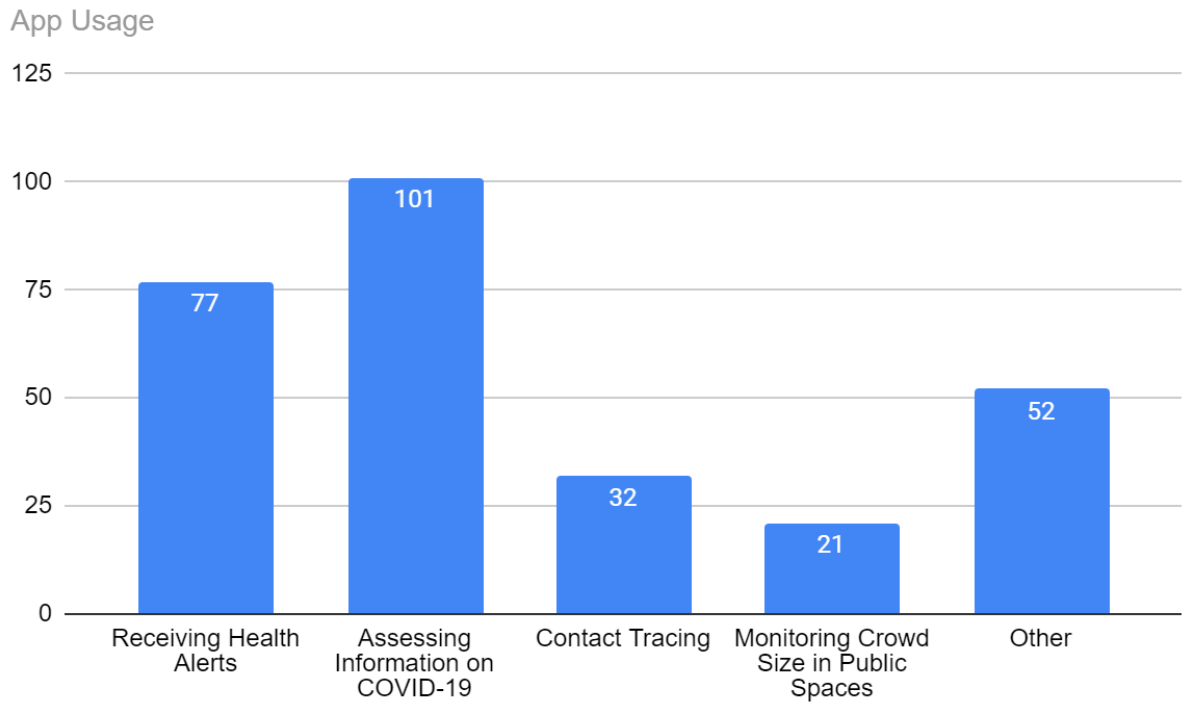

Figure 16: Bar chart showing what respondents used their COVID-19 related apps for (total of 125 responses)

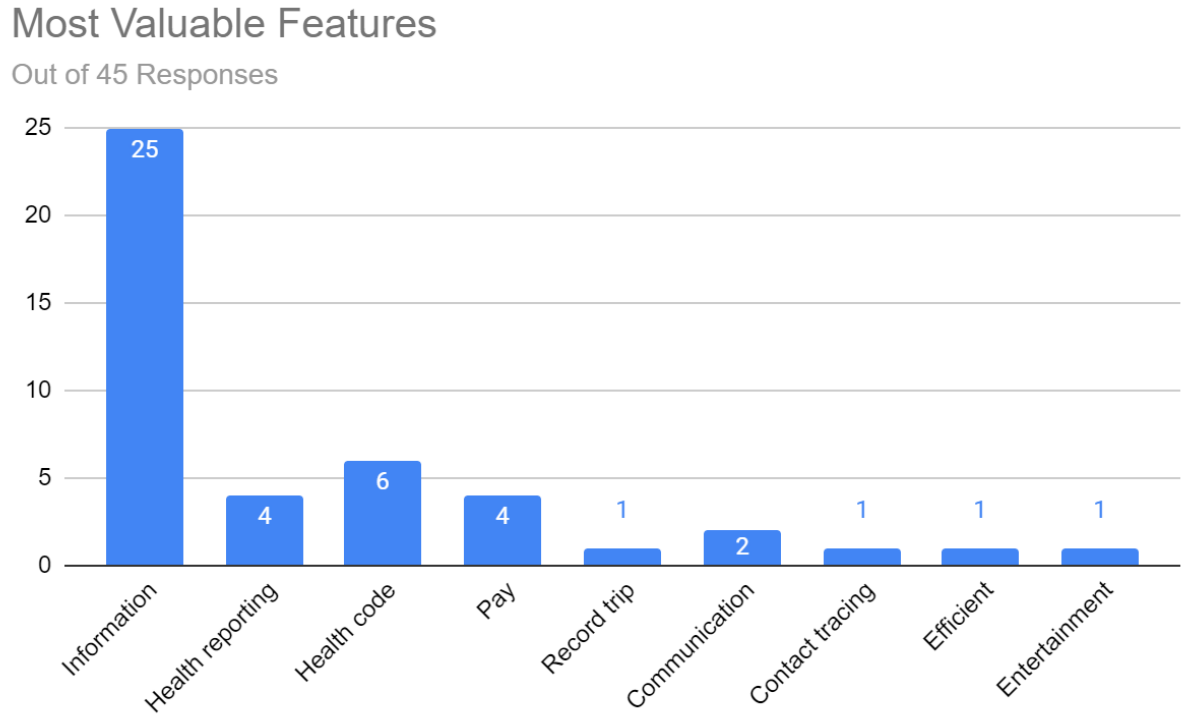

Figure 17: Bar chart showing what respondents thought the most valuable feature of their app of choice was

We also gauged the least valuable and most desired missing features in addition to the most valuable ones. However, when asked for their opinion on the least valuable feature present in the apps that they used, 67 percent of respondents replied that there were no useless features present in the app, as can be seen in Figure 18. Additionally, Figure 19 shows a similar response to a question about any features that our respondents would like added, with 65 percent stating that they didn't think any extra features were necessary. This information in addition to the fact that survey respondents largely favored using the apps to collect information clearly shows that the majority of respondents thought that the most important part of the app was the ability to gain trustworthy information about the virus instead of contact tracing like the team originally theorized.

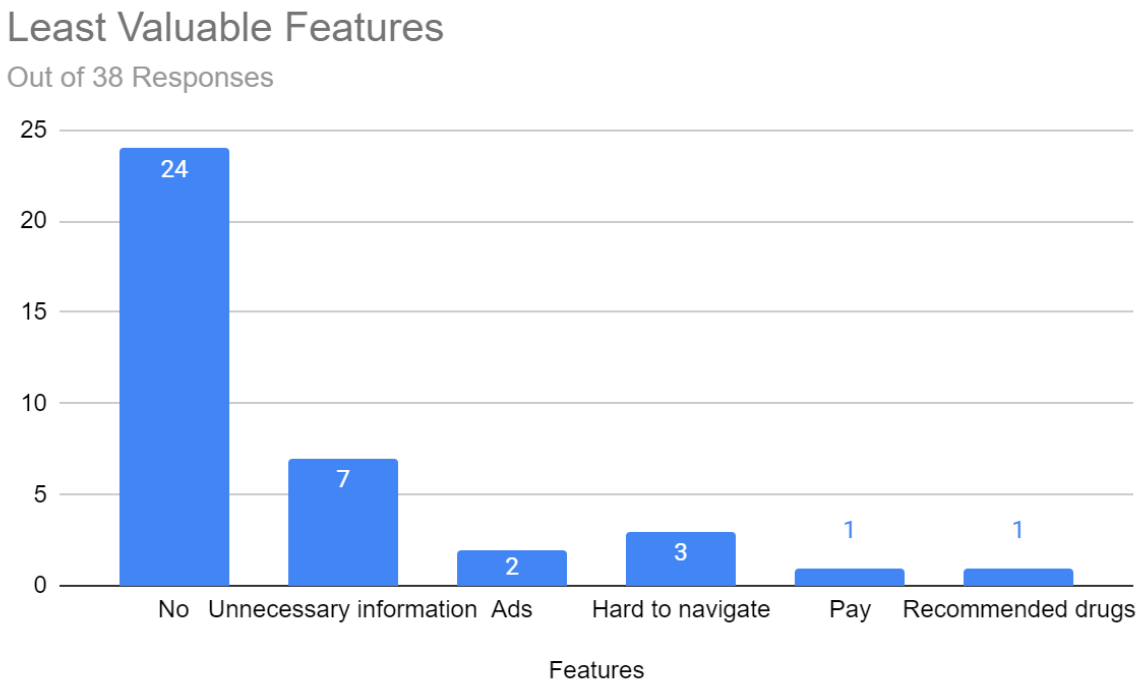

Figure 18: Bar chart showing what the respondents thought the least valuable feature of their app of choice was

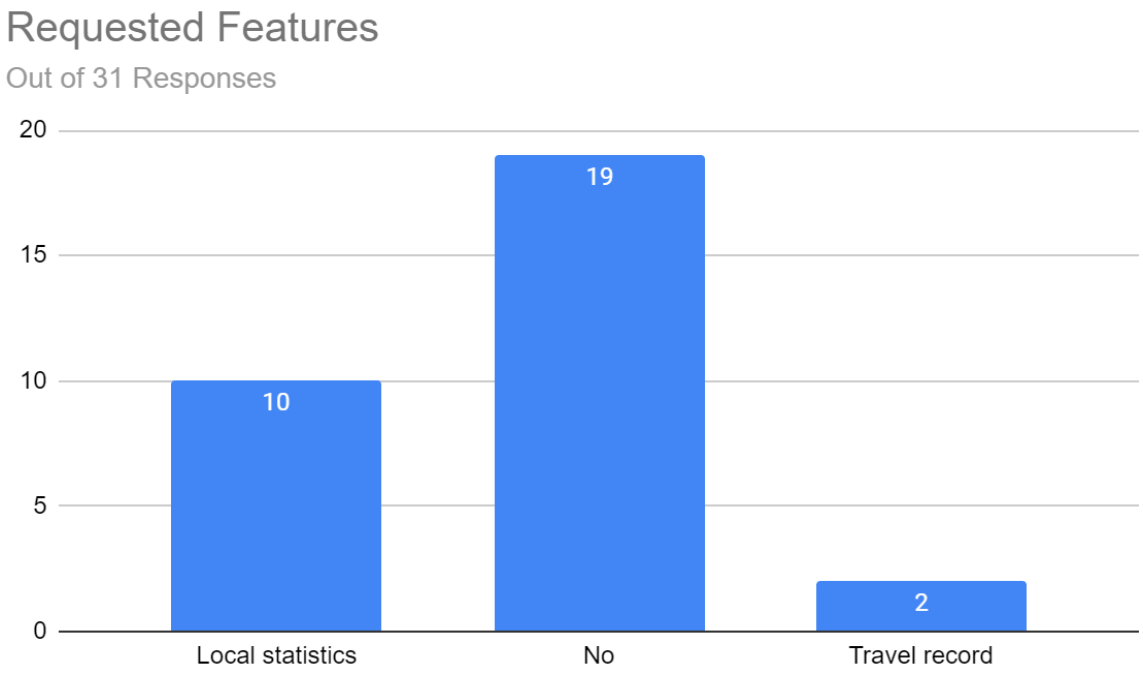

Figure 19: Bar chart showing what features the respondents wished to be added to their app of choice

There were also questions designed to find the opinions of the survey respondents towards the apps that they use. It is important to gauge the respondents' sentiment in order to provide both some context for other answers as well as a general measure of how survey respondents perceived COVID-19 related apps in China. When asked to rate their experience with their app from 1-5 (1 being the worst, 5 being the best), 86 percent of answers indicated that the answerer had either a good or neutral experience with the app, as can be seen in Figure 20. Additionally, Figure 20 shows the general reasons provided by users as to why they selected the number that they did. Notably, 89 percent of respondents also answered that they did not feel uncomfortable while using the COVID-19 app of their choice (Figure 21). This information explains why previous responses were so overwhelmingly positive. However, we must keep in mind that the vast majority of respondents to the survey are younger and thus more likely to be

familiar with apps, making it more likely for them to have a positive user experience with their chosen software. However, older people and those who are less familiar with technology may have a more difficult time with the app and thus could have a more negative experience with it (Smith, 2020).

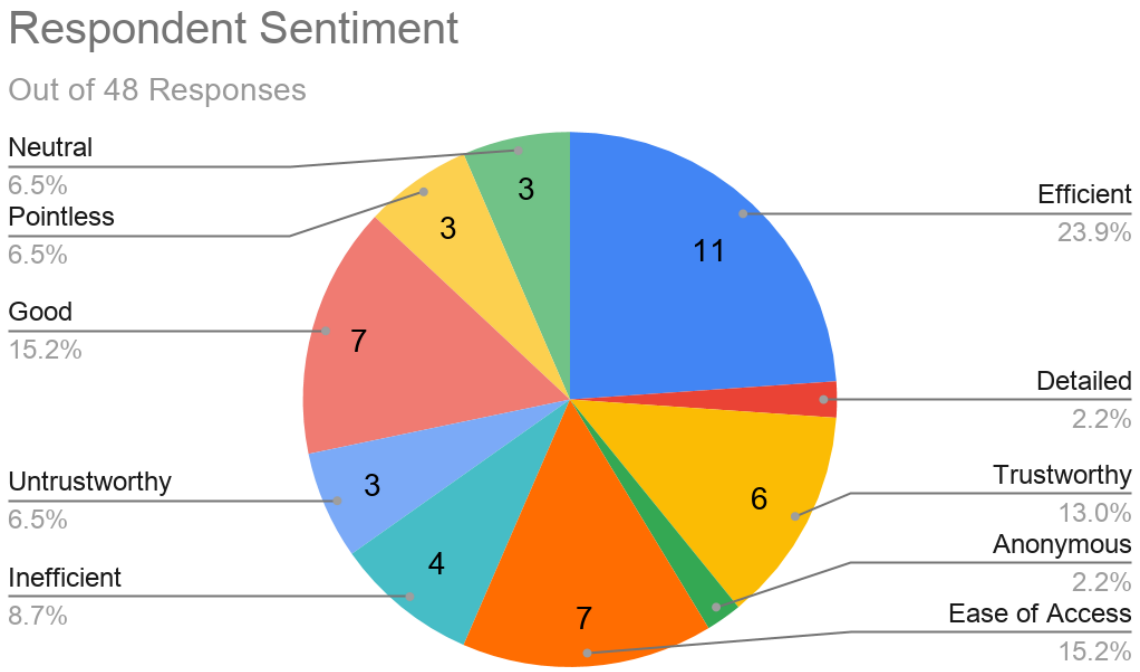

Figure 20: Donut chart depicting the reason why respondents felt the way they did about the app of their choice

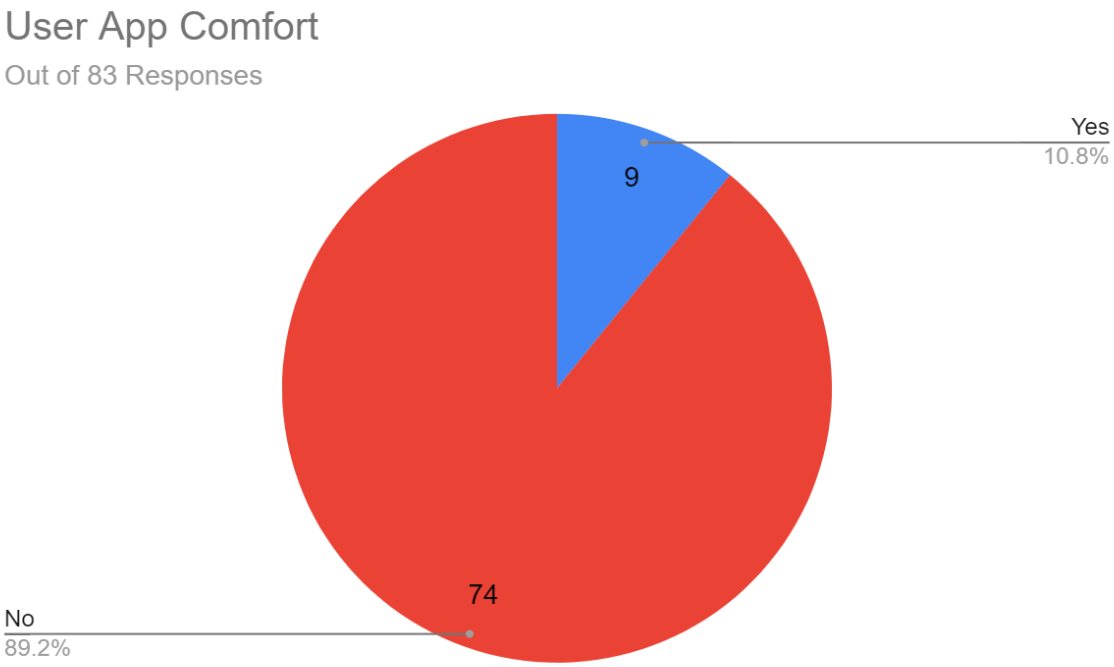

Figure 21: Donut chart depicting whether or not the respondents' were uncomfortable with their apps or not

Conclusion:

After analyzing and discussing our results and findings, we realized that there were several takeaways that we needed to consider when making our final conclusions. Many of the interviews we conducted emphasized that personal privacy is a concern, and apps should be streamlined to be as efficient and unobtrusive as possible in order to make them easily usable for users of all skill levels. Our surveys may have a potential age, location, and population size bias present in our data due to the demographics of the survey respondents. Additionally, our findings suggested that if a developer wishes for wide dissemination of an app, they could target the largest phone type user base first if they have limited resources or potentially add onto an existing popular app like Facebook. We also found from the surveys that the majority of respondents stated that they mainly used their apps for getting information. Additionally, they were generally happy with the app of their choice and didn't think there were any missing or unnecessary features.

Recommendations

Our group faced an ever growing array of challenges over the three months it took us to complete this project. Despite the unprecedented challenges we faced, we were able to successfully gather and analyze information on the role of mobile applications in China during the COVID-19 crisis. These results suggest interesting conclusions, many of which challenge some initial assumptions we had at the beginning of this project. We hope that the recommendations we draw from these results will be helpful in assisting our sponsors and other public health experts conceptualize and combat COVID-19 in the coming months and years. Our recommendations for the use of mobile application to combat COVID-19 are summarized in the following bullet points:

- Mobile applications should *assist* existing responses to COVID-19, not replace them.
- Mobile applications should function to *inform* users with useful and relevant information.
- Mobile applications must *protect* users' personal information and data.
- Mobile applications must *adapt* to the location and situation of the region in which they are utilized.

These four lessons are described in detail below.

Assist: When we began this project, we assumed that the most useful aspect of mobile applications in the fight against COVID-19 would be contact tracing features. However, our research uncovered that app users actually found the information that the apps provided much more useful than the contact tracing features, with 55 percent picking the former over 4 percent picking the latter. Though mobile apps can certainly assist contact tracers by providing information on citizens symptoms, locations, and travel history, most contact tracing around the world continues to be done by trained health care workers. For example, contact tracers in

Wuhan checked in on up to 1000 citizens per day during the city-wide lock down, meaning that while mobile applications could have assisted these workers, it hardly replaced them (CGTN Youtube, 2020). Therefore, we recommend that mobile applications be designed to assist existing COVID-19 responses, like contact tracing, rather than replacing them. If an organization had to choose between utilizing resources to enable app contact tracing, or hire more real-life contact tracers, we would emphatically recommend that more real-life contact tractors be hired.

Inform: As previously mentioned, we initially underestimated the role that mobile applications played in providing users with relevant and useful information. In addition to information being rated the most useful feature provided by these applications, the most requested additional feature was local statistics and information. These results suggest that one of primary roles of mobile applications during the current crisis should be as a platform to share accurate information on topics such as local and national infection counts, infection risks in various areas, and local and national news. This information not only helps citizens stay safe, but also helps citizens cope with the stress that comes along with health crises such as COVID-19 (Hilotin, 2020). In addition to adding more relevant information, these apps should be streamlined in order to make it easier for users to access critical information, and to improve user experience. Through our expert interviews, we found that one way this was done in China was by using the already existing apps of WeChat and Alipay as platforms to host COVID-19 mini-programs. We recommend that health organizations focus on refining COVID-19 apps into sources of reliable information, to improve public safety and wellbeing.

Protect: Since China announced it's COVID-19 app and health code system, concerns have been raised over violations of privacy, and information safety (Bond, 2020). Similar concerns were raised during our expert interviews, in which several experts expressed concern

over a potential leak of personal information which could pose a threat to users safety or finances. Personal information was the most common theme to come out of our expert interview analysis, showing how critical this issue is to the use of mobile applications during COVID-19. While it is essential that public health officials have access to large pools of data to effectively coordinate responses to public health crises such as COVID-19, a balance must be struck between collecting useful data, and protecting users' privacy. Therefore, we recommend that systems be put into place in order to actively protect users' data, such as increased cyber-security measures taken with this data, and a policy of destroying personal data after a certain time period, such as after thirty days.

Adapt: Since the inception of this project, we have been aware that there is likely no 'one size fits all' applications which could be used all over the world to help combat COVID-19. Due to differences of culture, geography, and situational specificity, COVID-19 apps will need to be able to adapt to their environments. This need is reflected in the previously noted request for more local statistics, but was also a common theme throughout our expert interviews. One expert noted that as the COVID-19 situation improved in Wuhan, the app-based health code system should also have become less strict with giving citizens yellow or red codes, in order to reflect the changing situation. Additionally, apps must be able to adapt to cultural differences. While our expert interview revealed that wearing a mask and self quarantining are uncontroversial in much of China, protests in the United States over the use of these simple measures means that the use of these apps would have to change if it was taken from the former country to the latter (Ecrama, 2020). Therefore, we recommend that COVID-19 apps be designed in a way which allows these apps to be changed with the situations they exist in. We also recommend that public

health officials keep the communities they are serving in mind as they create these apps, and as they utilize them.

Overall, we found that the most effective response to COVID-19 is not a fancy app, but a coordinated effort among local communities and larger governmental agencies. In Wuhan, local community organizations coordinated food deliveries and quarantines, while the national government facilitated the building of hospitals and the gathering of medical professionals in highly affected areas. Together, these two groups were able to work together to ensure that Wuhan and China at large dealt with COVID-19 in a praiseworthy manner (AAP, 2020). While mobile applications do have a role to play in combating COVID-19, we urge the public to be careful of viewing these apps as a panacea to a problem that is largely rooted in world politics and socio economics. For example, it would be foolish to suggest that a mobile application could solve the current crisis the United States is facing in regards to COVID-19. Technological innovation can improve many things, but a country that opens too early and hides medical care behind a paywall will suffer regardless.

Though our project generated useful information and insights, there are many further directions of research which are suggested by our results. While we have been able to distill the lessons of *assist*, *inform*, *protect*, and *adapt* down from our research, there is still much to be learned about how exactly to carry through these recommendations. Some aspects of these recommendations cannot be generalized, and will have to be answered by each local or national government when the time comes. *Protect* and *adapt* for example could themselves be the subject of a much more in-depth study on the exact mechanisms by which mobile applications could be made easily rearrangeable and safe. In general, our research focused on user experience, and a socio-historical analysis of mobile apps as they have existed over the COVID-19 crisis. In

another world we might have focused on one specific COVID-19 app, and dissected its features and inner workings. This is still a fruitful path for further research; though our project suggests *what* should be done, the question of *how* remains outside of the scope of our research. In that way, our project can be thought of as a starting off point for future, more detailed research on the use of mobile apps to combat COVID-19.

The scope of our research was at once limited by the nature of COVID-19 in an academic sense, and in an immediate material sense. Though relatively new, the amount of information already existing on COVID-19 is vast, and whole projects could be conducted on the COVID-19 applications that exist within one province of a specific country alone. On an immediate level, we had to conduct our project while living through the ongoing COVID-19 crisis. The topic of our project meant that we were constantly focused on COVID-19, which for many can be a quite difficult subject. Phycologists have weighed in on the effects of the current global pandemic on peoples' mental health, concluding that it has caused many to feel unmotivated, be less productive, and suffer from stress (Haas M.D, 2020). Our project not only had to be conducted entirely remotely under COVID-19, but it also had to take into account the 12 hour time difference between ourselves and our sponsors/collaborators which posed its own logistical challenges. This report was written in the midst of several once-in-a-generation historical events; this undoubtedly affected us as we conducted our project.

Despite all of this, we believe that we have contributed to the global fight against COVID-19 in our own way. We hope future researchers will be able to use our report as a jumping off point to develop more mobile solutions to assist citizens and public health officials around the world in the fight against COVID-19. In addition we hope that through our close collaboration with our sponsors in China and our project as a whole may serve as a symbol of

unity in the global fight against COVID-19. In a world which increasingly seeks to pit the people of the United States and China against one another, it is important to remember that we have much more to gain from working together than we have to gain from competing with one another. The only way to combat a global disease is with a global response, and while mobile applications have a role to play, it is much more important that this response be grounded in empathy, kindness, and respect.

References

2020 Olympics - Next Summer Olympic Games | Tokyo 2020 (n.d.). Olympics.org. Retrieved on April 26, 2020, from: https://www.olympic.org/tokyo-2020

AAP. (2020). 'Openness': WHO renews praise for China's coronavirus openness. *The Sydney Morning Herald*. Retrieved from https://www.smh.com.au/world/asia/openness-who-renews-praise-for-china-s-coronavirus-20200526-p54wdo.html

Adler, L (2015). Give Candidates Interview Questions in Advance to Increase Accuracy. *Linkedin Talent Blog*. Retrieved from https://business.linkedin.com/talent-solutions/blog/2015/02/give-candidates-interview-questions-in-advance-to-increase-accuracy

Adobe (2020). The Digital Experience Conference. Retrieved on April 16th, 2020, from https://www.adobe.com/summit/faq.html

Anderson, L. (2020). How Chinese Citizens View Their Government's Coronavirus Response. The Conversation. Retrieved from https://theconversation.com/how-chinese-citizens-view-their-governments-coronavirus-response-139176

Anderson, N. (2020). College Students Want Answers About Fall, but Schools May Not Have Them For Months. The Washington Post. Retrieved from https://www.washingtonpost.com/local/education/will-colleges-reopen-in-the-fall-coronavirus-crisis-offers-only-hazy-scenarios/2020/04/22/a124edae-83d3-11ea-ae26-989cfce1c7c7_story.html

Aramaki, E. Maskawa, S. Morita, M. (2011). Twitter catches the flu: detecting influenza epidemics using Twitter. In Proceedings of the Conference on Empirical Methods in Natural Language Processing (EMNLP '11). Association for Computational Linguistics

Astley, C. M., Danon, L., Dowell, S. F., Lajous, M., O'Hagan, J. J. (2010). Mobile Messaging as Surveillance Tool During Pandemic (H1N1) 2009, Mexico. Emerging Infectious Diseases, 16, 9.

Barrionuevo, A. (2020). Coronavirus Tracking Apps Are Being Tested Around the World, But Will Concerts Get Onboard? Billboard. Retrieved from https://www.billboard.com/articles/news/international/9391534/coronavirus-tracing-apps-concerts-tech-privacy-concerns

Blair, E. (2015). A reflexive exploration of two qualitative data coding techniques. *Journal of Methods and Measurement in the Social Sciences*, *6*(1), 14-29. doi:https://doi.org/10.2458/v6i1.18772

Bogner A., Littig B., Menz W. (2009) Introduction: Expert Interviews — An Introduction to a New Methodological Debate. In: Bogner A., Littig B., Menz W. (eds) Interviewing Experts. Research Methods Series. Palgrave Macmillan, London

Bond, S. (2020). Apple, Google In Conflict With States Over Contact-Tracing Tech. NPR. Retrieved from https://www.npr.org/2020/05/13/855096163/apple-and-googles-contact-tracing-technology-raises-privacy-concerns

Braun, R., Catalani, C., Wimbush, J., Israelski. D. (2013). Community Health Workers and Mobile Technology: A Systematic Review of the Literature. *PLoS ONE 8(6): e65772*.

Briney, A. (2020, February 11). Discover the 23 Provinces of China. Retrieved from https://www.thoughtco.com/china-provinces-4158617

Briscoe, B. Wittenberg, J. (2020). History's Warning About a Second Wave of Coronavirus. WFMY News 2. Retrieved from https://www.wfmynews2.com/article/news/local/2-

wants-to-know/history-spanish-flu-second-wave-coronavirus-warning/83-bd1dd578-9214-44d3-a575-ac4cfd5c1314

Burley, Liz & Scheepers, Helana & Fisher, Julie. (2005). Diffusion of Mobile Technology in Healthcare. Proceedings of the Euro MGOV 2005 First European Mobile Government Conference.

Campbell, C. (2020). Wuhan Has Reopened After a Brutal Coronavirus Lockdown. But Is China Ready? Time Magazine. Retrieved from https://time.com/5817251/wuhan-coronavirus-lockdown-reopens/

Catherine T. (2020, April 9). 6.6 million more Americans file for unemployment amid COVID-19 financial crisis. Retrieved April 26th, 2020 from: https://abcnews.go.com/Business/66-million-americans-file-unemployment/story?id=70061717

CDC. (2020) Resources for Large Community Events and Mass Gatherings. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/community/large-events/index.html

CGTN. (2020). Meet Delivery Man Satisfying Wuhan's Late-Night Food Craving. CGTN. Retrieved from https://news.cgtn.com/news/2020-01-29/Meet-deliveryman-satisfying-Wuhan-s-late-night-food-cravings-NEJR7K6DII/index.html

CGTN Youtube. (2020). The Lockdown: One Month in Wuhan. CGTN. Retrieved from https://www.youtube.com/watch?time_continue=98&v=XU9FVqwO4TM&feature=emb_logo

Chappell, B. (2020). Coronavirus Has Now Spread To All Regions Of Mainland China. NPR. Retrieved from https://www.npr.org/sections/goatsandsoda/2020/01/30/801142924/coronavirus-has-now-spread-to-all-regions-of-mainland-china

Che, C. (2020). Wuhan Tests Millions in 12 Days as China Fears Second Virus Wave. Bloomberg. Retrieved from https://www.bloomberg.com/news/articles/2020-05-26/wuhan-tests-millions-in-12-days-as-china-fears-second-virus-wave

Chen, S. Che, C. Shen, F. (2020). Over 100 Million in China's Northeast Face Renewed Lockdown. Bloomberg. Retrieved from https://www.bloomberg.com/news/articles/2020-05-18/over-100-million-in-china-s-northeast-thrown-back-under-lockdown

Chib A, Lwin MO, Ang J, Lin H, Santoso F (2008) Midwives and mobiles: using ICTs to improve healthcare in Aceh Besar, Indonesia. Asian J Commun 18:4, 348–364.

China Daily (2020). One code for all! all provinces are working on make the apps into one [Chinese]. Cyberspace Administration of China. Retrieved from: http://www.cac.gov.cn/2020-04/14/c_1588409502738547.htm

Compton, N. (2020). Here's what experts want you to know before taking a road trip during the pandemic. Retrieved from https://www.washingtonpost.com/travel/tips/heres-what-experts-want-you-know-before-taking-road-trip-during-pandemic/

Courtney-Guy, S. (2020). Social Distancing Will Carry On Until Vaccine Is Found, Government Advisor Says. Metro. Retrieved from https://metro.co.uk/2020/04/16/social-distancing-will-carry-vaccine-found-government-adviser-says-12564012/

Crossley, G. (2020). Wuhan Lockdown 'Unprecedented,' Shows Commitment to Contain Virus: WHO Representative in China. Reuters. Retrieved from https://www.reuters.com/article/us-china-health-who-idUSKBN1ZM1G9

Davidson, H. (2020). China's Coronavirus Health Code App Raises Concerns Over Privacy. The Guardian. Retrieved from https://www.theguardian.com/world/2020/apr/01/chinas-coronavirus-health code-apps-raise-concerns-over-privacy

Ecarma, C. (2020). Trump Supporters Are Staging Armed Protests to Stick It to Coronavirus. *Vanity Fair*. Retrieved from https://www.vanityfair.com/news/2020/04/trump-supporters-protest-coronavirus-orders

Entertainment Software Association (ESA) (2020). News: E3 2020 cancelled due to growing concerns over COVID-19 virus. Retrieved on April 16th, 2020, from: https://e3expo.com/

Fei, X., Meiwen, T., Xiaobin, Z., Ye, Liu.,l Xiaofeng, L., Hong, S. (2020). Evidence for Gastrointestinal Infection of SARS-CoV-2 Retrieved from: https://www.gastrojournal.org/article/S0016-5085(20)30282-1/pdf

Gallagher, J. (2020). Coronavirus Vaccine: When Will We Have One? BBC News. Retrieved from https://www.bbc.com/news/health-51665497

Gan, N. (2020). How Wuhan Residents Are Trying to Make the Best of the Coronavirus Lockdown. CNN. Retrieved from https://www.cnn.com/2020/01/29/asia/coronavirus-wuhan-life-intl-hnk/index.html

Gertz, B. (2020). China Silent Amid Growing Doubts Over Coronavirus Origins. The Washington Post. Retrieved from https://www.washingtontimes.com/news/2020/jan/27/china-silent-coronavirus-origins-amid-wuhan-seafoo/

Graham-Harrison, E. Kuo, L. (2020). China's Coronavirus Lockdown Strategy: Brutal but Effective. The Guardian. Retrieved from https://www.theguardian.com/world/2020/mar/19/chinas-coronavirus-lockdown-strategy-brutal-but-effective

Haas, S.B. (2020). COVID-19: It's OK to Feel Overwhelmed and Be Unproductive. *Psychology Today*. Retrieved from https://www.psychologytoday.com/us/blog/prescriptions-life/202003/covid-19-it-s-ok-feel-overwhelmed-and-be-unproductive

Hauck, G. Gelles, K. Bravo, V. Thorson, M. (2020). Five Months in: A Timeline of How COVID-19 has Unfolded in the US. USA Today. Retrieved from https://www.usatoday.com/in-depth/news/nation/2020/04/21/coronavirus-updates-how-covid-19-unfolded-u-s-timeline/2990956001/

Hilotn, J. (2020). Life Under Lockdown in Wuhan: They Dance, Sing, Run, Chant as Hope Springs Eternal Under Coronavirus Watch. Gulf News. Retrieved from https://gulfnews.com/world/asia/life-under-lockdown-in-wuhan-they-dance-sing-run-chant-as-hope-springs-eternal-under-coronavirus-watch-1.1581930123869

Holmes, O. McCurry, J. Safi, M. (2020). Coronavirus Mass Surveillance Could be Here to Stay, Experts Say. The Guardian. Retrieved from https://www.theguardian.com/world/2020/jun/18/coronavirus-mass-surveillance-could-be-here-to-stay-tracking

Huang, C. Wang, Y. Li, X. Ren, L. Zhao, J. Hu, Y. (2020). Clinical Features of Patients Infected with 2019 Novel Coronavirus in Wuhan, China. The Lancet, Volume 395, Issue 10223, Page 497-506. Retrieved from https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30183-5/fulltext#articleInformation

Jao, N. (2020). Alipay Developed China's National Health Code Rating System. Technode. Retrieved from https://technode.com/2020/02/17/alipay-developed-chinas-national-health code-rating-system/

Khan, J. (2020). Digital Contact Tracing for Pandemic Response. Baltimore, Maryland. Johns Hopkins University Press.

Kharpal, A. (2020). Everything You Need to Know About WeChat - China's Billion-User Messaging App. CNBC. Retrieved from https://www.cnbc.com/2019/02/04/what-is-wechat-china-biggest-messaging-app.html#:~:text=WeChat%20is%20China%27s%20most%20popular%20messaging%20app%20with,have%20used%20it%20if%20you%20live%20outside%20China.

Kim, M. (2020). Seoul's Radical Experiment In Digital Contact Tracing. The New Yorker. Retrieved from https://www.newyorker.com/news/news-desk/seouls-radical-experiment-in-digital-contact-tracing

Kraemer, M. Yang, C. Gutierrez, B. Wu, C. (2020). The Effect of Human Mobility and Control Measures on the COVID-19 Epidemic in China. Science, Volume 368, Issue 6490, Pages 493-497. Retrieved from https://science.sciencemag.org/content/368/6490/493.full

Lambert, L. (2020). Real Unemployment Rate Soars Past 20% - and the U.S. Has Now Lost 26.5 Million Jobs. Fortune Magazine. Retrieved from https://fortune.com/2020/04/23/us-unemployment-rate-numbers-claims-this-week-total-job-losses-april-23-2020-benefits-claims/

Legal Daily (2020). Many provinces achieved code cross reference. Professionals warned: keep your information safe [Chinese]. Xinhua News Agency. Retrieved from http://www.xinhuanet.com/politics/2020-03/18/c_1125727318.htm

Li, J., R.P. (2010). Applications of E-Health for Pandemic Management. 12th IEEE International Conference on e-Health Networking, Application, and Services.

Mahmud N, R.J, N.J (2010) A text message-based intervention to bridge the healthcare communication gap in the rural developing world. Technol Health Care 18(2): 137–44.

McDonald, J. (2020). Built in 10 Days, China's Virus Hospital Takes 1st Patients. Associated Press. Retrieved from https://apnews.com/8e978ecbb3b1dd125221b627d35e8edc

Office of the Governor. (2020). North Dakota Launches Care19 App to Combat COVID-19. North Dakota Office of the Governor. Retrieved from https://www.governor.nd.gov/news/north-dakota-launches-care19-app-combat-covid-19

Q&A on coronaviruses (COVID-19) (2020) World Health Organization. Retrieved from: https://www.who.int/news-room/q-a-detail/q-a-coronaviruses

Raghav, K. (2020). In Beijing it Looked Like Coronavirus Was Gone. Now We're Living With a Second Wave. The Guardian. Retrieved from https://www.theguardian.com/commentisfree/2020/jun/21/beijing-coronavirus-second-wave-virus-china

Reuters. (2020). COVID-19 to Wipe Out Equivalent of 195 Million Jobs, Says UN Agency. The Guardian. Retrieved from https://www.theguardian.com/world/2020/apr/07/covid-19-expected-to-to-wipe-out-67-of-worlds-working-hours

Roberts, D. (2020). Alibaba Spinoff Alipay Surged Past 1 Billion Users in 2019.Yahoo Finance. Retrieved from https://finance.yahoo.com/news/alibaba-spinoff-alipay-surged-past-1-billion-accounts-in-2019-150728030.html

Roger, A. (2020). Let's Say There's a COVID-19 Vaccine - Who Gets It First? Wired. Retrieved from https://www.wired.com/story/lets-say-theres-a-covid-19-vaccine-who-gets-it-first/

Romano, A. (2020). Coronavirus Infections are Rising as States Reopen, Potentially Signaling a Second Wave. Yahoo News. Retrieved from https://news.yahoo.com/coronavirus-

infections-are-rising-as-states-reopen-potentially-signaling-a-second-wave-154847924.html

Rugaber, C. (2020) A Record 10 Million Sought US Jobless Aid in Past Week. Associated Press. Retrieved from https://www.koin.com/news/national/a-record-6-6-million-seek-us-jobless-aid-as-layoffs-mount/

Silver, L. (2019, December 30). Smartphone Ownership Is Growing Rapidly Around the World, but Not Always Equally. Retrieved from https://www.pewresearch.org/global/2019/02/05/smartphone-ownership-is-growing-rapidly-around-the-world-but-not-always-equally/

Smith, A. "Older Adults and Technology Use." *Pew Research Center: Internet, Science & Tech*, Pew Research Center, 30 May 2020, www.pewresearch.org/internet/2014/04/03/older-adults-and-technology-use/.

Standing, S. Standing, C. (2008) Mobile Technology and Healthcare: The Adoption Issues and Systematic Problems. Int. J. Electronic Healthcare, 4, ¾.

Strauss, M. (2020). China's Response to COVID-19 Better Than U.S.'s, Global Poll Finds. Reuters. Retrieved from https://sports.yahoo.com/chinas-response-covid-19-better-115924057.html?src=rss

Tam, L. (2018). Why Privacy is an Alien Concept in Chinese Culture. South China Morning Post. Retrieved from https://www.scmp.com/news/hong-kong/article/2139946/why-privacy-alien-concept-chinese-culture

Top Universities. (2020). Destination Guides: Study in China. *Quacquarelli Symonds Limited*. Retrieved from https://www.topuniversities.com/where-to-study/asia/china/guide

Travel China Guide. (2020). Map of China Provinces and Cities. *Travel China Guide*. Retrieved from https://www.travelchinaguide.com/map/china_map.htm

UNESCO. (2020). COVID-19 Educational Disruption and Response. UNESCO. Retrieved from https://en.unesco.org/covid19/educationresponse

Utopia. (2020). Alipay & WeChat Pay: All You Need to Know About Smart Payment in China. Utopia. Retrieved from https://utopiame.com/en/2020/01/30/wechat-pay-alipay-all-you-need-to-know-about-smart-payment-in-china/

Warner, K. (2020). China Takes Steps to Become First Cashless Society After Covid-19. The National. Retrieved from https://www.thenational.ae/china-takes-steps-to-become-first-cashless-society-after-covid-19-1.1011042.

Web Desk. (2020). 1,230 Doctors Sent to Help Wuhan Hospitals Fight Coronavirus Outbreak. MM News. Retrieved from https://mmnews.tv/more-1230-doctors-sent-to-help-wuhan-hospitals-fight-coronavirus-outbreak/

WHO (2020). Naming the coronavirus disease (COVID-19) and the virus that causes it.WHO. Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it

Wong, S. (2019). Smartphone penetration as Share of Population in China 2015-2023. *Statistica*. Retrieved from https://www.statista.com/statistics/321482/smartphone-user-penetration-in-china/

Wu Z, McGoogan JM. (2020) Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases

From the Chinese Center for Disease Control and Prevention. JAMA. 2020;323(13):1239–1242. doi:10.1001/jama.2020.2648

Xie, E. (2020). Build-Up to Coronavirus Lockdown: Inside China's Decision to Close Wuhan. South China Morning Post. Retrieved from https://sg.news.yahoo.com/build-coronavirus-lockdown-inside-china-145139273.html

Young, S.D. (2014). A "Big Data" Approach to HIV Epidemiology and Prevention. Preventative Medicine, 70, 17-18.

Zuo, M. (2020). Wuhan Sacks Officials After Pork Deliveries are Tipped Into Street from Back of Rubbish Truck. South China Morning Post. Retrieved from https://www.scmp.com/news/china/society/article/3074896/wuhan-sacks-officials-after-pork-deliveries-are-tipped-street

APPENDIX A: TABLE OF CATALOGUED APPS

Country/Region	Name
China	Alipay/ Wechat
India	Aarogya Setu
United States/ North and South Dakota	Care19
United States/ Utah	Healthy Together
Czech Republic	eRouška (eFacemask)
Hungary	Virus Radar
Latvia	Apturi Covid
Switzerland	DP-3T
Norway	Smittestopp
Russia	Social Monitoring

APPENDIX B: FINAL SURVEY

1. **Please list all of the different platforms that use for COVID-19, since the beginning of the outbreak.**
    a. Alipay
    b. WeChat
    c. Standalone apps
2. **What Province or City are you primarily located in? Please insert below.**
    a. [Insert Providence]
3. **Have you used other COVID-19 related apps, specific to other Provinces or cities? i.e have you travelled outside of your Providence recently?**
    a. [Insert location(s)]
4. **What did you use the apps for? Select all which apply.**
    a. Receiving health alerts
    b. Accessing information on COVID-19
    c. Contact tracing
    d. Monitoring crowd size in public places
    e. Other [input other uses]
5. **How would you rate your experience with these apps from 1-5, 5 being a perfect experience?**
    a. **[Insert number]**
6. ***OPTIONAL* Please explain your rating from above**
    a. [Insert reasoning]
7. **Please list any or all the features that were the most valuable to you.**
    a. Feature 1:_____
    b. Feature 2:_____
    c. Feature 3:_____
    d. Feature 4:_____
8. **Please list any or all the features that were the least valuable to you?**
    a. Feature 1:_____
    b. Feature 2:_____
    c. Feature 3:_____
    d. Feature 4:_____
    e. None of the features were least valuable (i.e all features were very much valuable)
9. ***OPTIONAL* Which features would you have liked to see added?**
    a. [Insert feature]
10. **Did you ever feel uncomfortable while using any of these apps?**
    a. No
    b. If so, please explain your reasons of uncomfort or negative experiences?
        i. [Insert reasonings]
11. ***OPTIONAL* Which app(s) made you experience this discomfort?**
    a. [Insert app names]
    b. Prefer not to say
12. **If there is anything else you would like to add about your experiences with these apps, add it below.**
    a. [Insert experiences]

These next few questions are inquired to wage the different levels of demographics between respondents

13. **Age group**
    a. 18 - 25 years old
    b. 26 - 35 years old
    c. 36 - 45 years old
    d. 45 - 60 years old
    e. 60+ years old
14. **Gender Identity**
    a. Man
    b. Woman
    c. Other [Insert**]**
15. **Type of Phone?**
    a. Android
    b. iPhone
    c. Other
16. **On a scale of 1 - 5 (1 being the least, 5 being the most), how populous would you say your city is?**
    a. Urban (Tier 1, or Tier 2)
    b. Rural (Tier 3 or greater)

APPENDIX C: INITIAL INTERVIEW GUIDE

Questions List:
问题列表: 以下问题请您尽量用英文回答, 如实有不便, 也可以用中文

What is your name?

After talking with students from the Wuhan University of Technology, we had some questions about how COVID-19 related apps work in China.
经过与武汉理工大学学生的交流之后, 我们希望能问您一些问题.

In the WeChat/Alipay, students mentioned something about a 'Health Code'. Could you explain again how it works and what you think about it?
武理的同学们经常提到微信/支付宝中的健康码小程序, 您能解释一下其背后的工作原理以及您对它的看法吗?

- (If unanswered) What information do you need to give in order to start using the health code?
  您需要提供哪些个人信息才能开始使用这些小程序?
- (If unanswered) Under what circumstances do you need to actually use these health codes?
  在哪些情况下您需要提供或者更新您的个人健康码?
- (If unanswered) Do you know how the administrators of the health code determine how you are healthy or not?
  您知道健康码的颜色是基于哪些数据和逻辑更新的吗?

What is your personal opinion on these apps? Do you feel these apps have been implemented well? Do you feel that they pose any threat to people's privacy? You do not have to answer this question if you do not want to.
[可选] 您对于小程序的个人看法是什么? 您认为这些小程序的实行效果如何?您认为这些小程序危及到了公民个人隐私吗? 如果您不想, 您可以略过此问题.

Students also mentioned some services provided by Chinese telecom companies like China Unicom. Could you tell us again what they are and how they work?
一些学生还提到了中国三大运营商也提供了相关服务 (地理位置历史查询), 比如中国联通. 您能更详细的解释一下它们是如何运作的吗? (如: 需要什么信息, 基于什么技术... 同上)

Are there any good Chinese information or news sources that you think we should look at for more information on these topics?
您能提供一些中国的可靠消息来源吗? 您认识其他相关领域的专家/学者可以推荐给我们采访吗? 您能提供他们的联系方式吗?

感谢您抽出时间回答这些问题, 您的回答将对我们有非常大的意义.

APPENDIX D: FINAL INTERVIEW GUIDE

Questions List:
问题列表: 以下问题请您尽量用英文回答, 如实有不便, 也可以用中文

What is your name?

After talking with students from the Wuhan University of Technology, we had some questions about how COVID-19 related apps work in China.
经过与武汉理工大学学生的交流之后, 我们希望能问您一些问题.

In the WeChat/Alipay, students mentioned something about a 'Health Code'. Could you explain again how it works and what you think about it?
武理的同学们经常提到微信/支付宝中的健康码小程序, 您能解释一下其背后的工作原理以及您对它的看法吗?

- (If unanswered) What information do you need to give in order to start using the health code?
  您需要提供哪些个人信息才能开始使用这些小程序?
- (If unanswered) Under what circumstances do you need to actually use these health codes?
  在哪些情况下您需要提供或者更新您的个人健康码?
- (If unanswered) Do you know how the administrators of the health code determine how you are healthy or not?
  您知道健康码的颜色是基于哪些数据和逻辑更新的吗?
- (If unanswered) Do you think there are too many similar apps that could cause confusion?

If someone's health code turns red, how do officials make sure that this person quarantines? Are there any penalties for having a red health code and refusing to quarantine? Whose responsibility is it to ensure that these potentially infected people quarantine for a full 14 days?

What is your personal opinion on these apps? Do you feel these apps have been implemented well? Do you feel that they pose any threat to people's privacy? You do not have to answer this question if you do not want to.
[可选] 您对于小程序的个人看法是什么? 您认为这些小程序的实行效果如何?您认为这些小程序危及到了公民个人隐私吗? 如果您不想, 您可以略过此问题.

Students also mentioned some services provided by Chinese telecom companies like China Unicom. Could you tell us again what they are and how they work?
一些学生还提到了中国三大运营商也提供了相关服务 (地理位置历史查询), 比如中国联通. 您能更详细的解释一下它们是如何运作的吗? (如: 需要什么信息, 基于什么技术... 同上)

Near the end of our WeChat conversation, they also mentioned something about food delivery. Could you also give us a bit more information on that? Is it something that is handled by the government or just private companies?
在与同学们的交谈快结束的时候, 有同学提到了食物配送服务. 您能更详细的解释一下相关内容吗? 比如: 这是一个政府提供的服务还是第三方组织提供的? 这是免费的还是收费的? 强制的还是自愿的? 地区性质的还是全国统一的?

Are there any other programs that are organized at the community level? For example, does the community help distribute things like PPE (Personal Protective Equipment)?

Are there any good Chinese information or news sources that you think we should look at for more information on these topics?
您能提供一些中国的可靠消息来源吗? 您认识其他相关领域的专家/学者可以推荐给我们采访吗? 您能提供他们的联系方式吗?

感谢您抽出时间回答这些问题, 您的回答将对我们有非常大的意义.

APPENDIX E: TRANSCRIPT 1

Interview 1

Xianhan:
Could you please introduce yourself?

1:
My name is [redacted], that's the spelling of it

Xianhan:
From your perspective, how would you use it, rather than how it works? For example, when should you scan those pre-placed QR code in the public spaces? Or when do you show your own code to the staffs?

1:
Recently it is no longer that strict in Wuhan, but during the hardest times, it was compulsory. When you get in and out an area, for example a community, or a bank, you need to scan both when you come and leave, and the program will record the time period that you were their, so if later it's discovered that in that period of time, someone around you was diagnosed, then you will be classified as contacts. then it will change color, from green to pink, or red. After the color is changed, you will know you have contact history, then you can self quarantine, or if you show any symptoms, you can go to the hospital.

Xianhan:
So when will the code change back to green?

1:
Well, for now the order is to self quarantine for 14 days, after 14 days you will [Inaudible], but since I haven't experienced it, so I'm not so sure how it will, but it could, for a fact.

Xianhan:
So what information do you need to provide in order to start using this mini program? For example phone number, personal ID or something else?

1:
Only Personal ID and contact [Inaudible]

Xianhan:
Personal ID and ..? Sorry I didn't hear that.

1:
Contact details, that is to say, phone numbers.

Xianhan:

Ok, now we would like to ask what your personal ideas on mini programs are, do you think it violates peoples' privacy? Or do you think it helped dealing with this pandemic? If it has, what is it? If it hasn't, why?

1:
First of all, I don't consider it a violation of privacy. A simple example, at the beginning of the epidemic, people were frightened. As an example, I took a train during that time, so I'm not sure whether I have contacted any patient, so during that stage of time, railway system released a query system, it can check location specific to a car in a train and whether it had patient in it, then when government try to get reach to all the contacts, they can't gain all the information about him/her, it can only rely on distributing these information to the public and hope those related saw this. Everything went much simpler after the mini program, from the government's perspective, they can check whether a person is a contact or not, so the spread chain is easily shut, from a personal perspective, I can check whether I have contacted with patients or not. And there's no personal information leak in this app, since you can only know you have contact or not. So overall I don't feel there's a violation of privacy.

Xianhan:
So you think there's no violation of privacy because you don't need to provide much personal information?

1:
yeah, that is to say, on one hand, I want to know if I have contact history, that require me to provide some personal information, (because) others also want to know if I'm sick or not, I think it's reasonable.

Xianhan:
Ok, Students also mentioned China Mobile, China Unicom, (and) China Telecom, the three phone service providers in China, provided tracking service, do you know something about this?

1:
Not so much, but I can talk about it briefly, it can only provide location specific to cities, but not actually which area in the city, or public places. The technology behind this, I believe, is based on the certification your phone left behind on the signal tower.

Xianhan:
Do you know what information you need to provide when you use the platform?

1:
You don't need to, since your information has been registered when you got your phone number, so you don't need to.

Xianhan:
So what do you need to provide before performing a query?

1:
I don’t get you.

Xianhan:
Since you have left you information at the phone-service providers, what do you need to provide when using this service?

1:
no, just phone number

Xianhan:
phone number and SMS captcha?

1:
I haven’t use [Inaudible] before.

Xianhan:
Students also mentioned something about food delivery, do you know something about this?

1:
I wasn’t at Wuhan, I was at Henan, so I can only talk about Henan. One of my family member caught a cold and was in a fever during that time, so was identified as a suspected case, and was later excluded (from suspected). But during the period, staff from the community ordered us to stay at home and quarantine, we only need to provide, shopping list, and they will help us buy those then deliver to our home.

Xianhan:
So you mean the delivery service only covers those families with suspected or confirmed cases?

1:
Since we were in a countryside in Henan, so yes. But I heard it's different in Wuhan, food for all the families of a community will be delivered to a specific place, and each family need to assign one family member to take it.

[silence]

Xianhan:
You were talking abou Wuhan?

1:
Yes

[silence]

Xianhan:
Could you provide more reliable sources from inside China? Any way we can gain more insight about China?

1:
I don't understand your question

Xianhan:
Sorry, let me try that again. I mean do you have any reliable sources so we can know how China is now, and how it used to be (during the pandemic). Since we don't know much about China, many sources are from self-media and rumors on the internet, such as Tencent news, Baidu news, or Weibo, clearly we can't count them as sources in a paper.

1:
Well, for people like me, we gain information only from officials.

Xianhan:
Yeah sure, officials, but could you give us some names, of the platform, that is to say, where do officials public their information?

1:
Normal websites usually just report the data from the officials. For me, I have UC browser on my phone, it has a dedicated channel for all the information, only informations, no comments [Inaudible].

Xianhan:
So you mean all the information related to COVID is controlled? Has the government intervened?

1:
To say reliable, I think the information from the officials are most reliable.

Xianhan:
I mean how can we get the information directly from the officials, not from third-party paraphrases.

1:
I have a link, I don't know how to copy that, like there's a dedicated thing in UC browser called "pandemic moving", including progress of the pandemic, this is informations from the officials, including daily new cases, new deaths, also like stats of other countries, I think these data are (good) [Inaudible], it also have some professionals, publish some predictions, and informations, like that.

Xianhan: 呃... 以上应该就是我们所有的问题了 eh...so, do you guys have any more questions to ask? sorry…That should be all of our questions [...

[Transcript end]

APPENDIX F: TRANSCRIPT 2

Interview 2

Bill: So we wanted to ask you a few questions. We reached out to some of the students that we are working with over WeChat and we asked them a couple of questions and so we just wanted to ask you those same questions in order to get some more information. Because this is an interview I wanted to make sure you are ok with this being recorded and us taking notes.

2: Thats ok.

Bill: Ok, awesome. If that's the case then let's jump right into it. So in our conversation with some of the students, they mentioned something about a Health Code in the WeChat and AliPay apps. If you know anything about it, could you explain what it is for us and what you think about it?

2: You mean the Chinese government implement a way to conquer the disease?

Bill: Yes, the Health Code to help determine whether you are healthy or not.

2: I think the most effective measure is isolation. No mobility. Do you know what I mean?

Bill: Yes.

2: Until now, we are stay at home for everything. We work at home. Especially we are teachers so we should take care about our security in our campus. Actually, the disease - the medical care for the disease is very important for everything. Most of the patients are being taken care of, and a major amount of the patients have been cured in the last three months. We have some software to predict what situation you are in - are you healthy? Are there any infected ones around you? Something like that. So I think that it is very safe in Wuhan, Hubei because the government has taken much focus in this area.

Bill: I see, so when you do go outside - say you visit a shopping mall - I've heard that you have to scan a QR code or something on your phone. Could you explain how that works and what you think about it?

2: Do you know about Zhi Fu Bao and WeChat?

Bill: Yes I know WeChat.

2: Every place - like the shopping mall - will provide a code from Zhi Fu Bao or We Xin, if you want to enter the place you should scan the code first. Then the process will be showing your healthy status. If you are healthy, you can go in and you will take a note on an interim place in the system. When you get out you will be assigned a thing, the

system will take note of you coming out of the place. If you are driving to a park, no one there, but you must still scan the code to log what you are doing. Am I clear?

Bill. Uhh yeah, yeah yeah yeah. If you don't mind me asking - you don't have to answer if you're not comfortable. What do you personally think about the code? Is it a good thing, bad thing? Do you have any problems with it at all?

2: Actually I think it is very good for everyone's health, everyone's safety. But I sometimes I think it is annoying. It makes some people upset. Because some older people don't use mobile phones. I want to just go to some place for a few minutes, but I still must scan the Zhi Fu Bao or WeChat. Actually, the temperature in Wuhan has increased, so the disease will be dismissed after the temperature coming over 22 degrees (Celcius). I think we should make some adjustments on the measures.

Bill: And do you know how the people from WeChat and AliPay determine how you are healthy or not?

2: Yes. Actually if you are not sick for 14 days, then that means you are healthy. If you go to some place to buy medicine or go to a hospital to take care of yourself, your healthy code will become red, rather than green. That means you are at some risk so you are restricted. This is the mechanism. 14 days continuous logging. That means you are in healthy status.

Bill: And just to go back a little, do you know what information you need to give WeChat and AliPay to start using the health code?

2: Yes, the name, your ID code, and your telephone. That's all.

Bill: Oh, is that it? You don't have to give anything else?

2: Yes. Actually for computer science, if you use WeChat or AliPay, all of your information are transferred to the center.

Bill: And do you mind telling me what kind of information WeChat and AliPay store?

2: Maybe its in America?

Bill: We do have WeChat but its not the same version. We don't get all the special things that the Chinese version has. So I just wanted to make sure we have the right information. Not your personal information of course, but does it store your payment information and all of that?

2: Actually information about the disease. WeChat and AliPay is high security level. Anybody else cannot get in touch with your data. This dataset is very specialized and useful, but I think, except the government, nobody can get access to this dataset.

Bill: And what kind of data is in this dataset.

2: Your healthy status, your consumer code - what you buy and want to buy - your connection with each other. All of these things will be stored in this dataset because some researchers have done some work on this. But this is just simulation, not real software for everybody.

Bill: Ok cool. So during our conversation with some of the students. They also mentioned some services offered by phone companies - like China Unicom - that helped track Covid related things. Do you know what I'm talking about?

2: Yes. Everyday China Unicom will send information to our mobile phones. If you drive from Wuhan to another city far away from here, you will get [internet problems] you may get some information about mentions of like "today the government as published some policy, you have some rights to do something" and if you come across some district, you will get an early warning about things. LIke if you drive from Wuhan to somewhere far away from here, you will get some information.

Bill: Do you know if they also track your location and all of that? Do you know how they work?

2: The computer science, every intelligent mobile phone has a GPS inside. I think they use this technique.

Bill: Cool, so moving on a little bit more. The students also mentioned that the government handled pretty much everything that they needed. So specifically the said that they could have food delivered. Could you give us a bit more information about that as well? Like is it actually the government doing delivery or is it a few different companies.

2: The most serious situation I was not in Wuhan. I was in another city far away from Wuhan. I know my friend got some food supply for free from the government. Now the water of our society has been stable a long while. When I got back to Wuhan in April - it was ok. You can go to any place you want, you just need to scan the code to prove that you are healthy. The price of food is ok.

Bill: And do you know of any similar services to food delivery that were also handled by the government during the lockdown?

[Communication problems]

2: Yeah.It's difficult for me to answer your questions because I came to Wuhan in April. The serious moment of the disease was February. I don't know what happened in Wuhan so I can get some information from my professor or my friends - its ok for everybody. Just some increase in price of all the things. But if you wanted to buy something, its ok. The food supply was enough in the situation.

Bill: Ok, so I think that's all the questions that I had about our conversation with the students. My last question is, do you know of any good Chinese sources that we can use to learn more about this kind of thing?

2: You want a good dataset, is that what you mean? You should get some cooperation with some hospital or the CDC. If we get some - you know China has setup a new department named the Emergency Department. In 2018, the Emergency Department. Our school in Wuhan University has some cooperation with the Emergency Department. The Emergency Department is meant to handle nature disaster or accident from companies(?). But the defending of the disease was handled by the CDC and the health department. We can have some cooperation with these two departments and get some information. But for now China is undergoing a strict defending status. Maybe after two or three months, everything is ok, we can get into contact with these departments. But for now we cannot. I think the worst thing about the disease right now is getting some relation with politics.

APPENDIX G: TRANSCRIPT 3

Due to scheduling conflicts, the 3rd expert agreed to respond to our interview questions via written response

In the WeChat/Alipay, students mentioned something about a 'Health Code'. Could you explain again how it works and what you think about it?

- *(If unanswered) What information do you need to give in order to start using the health code?*
  To better conduct epidemic prevention, protect what Chinese have done to prevent the pandemic, personal information should guarantee their authenticity and accuracy. It's everyone's duty to protect what we have done to prevent the pandemic. Including information on living places in past 14 days, whether have contacted with suspected person, and so on.
- *(If unanswered) Under what circumstances do you need to actually use these health codes?*
  When going to crowded places (such as hospital, supermarket, stations...), personal health code should be updated twice a day.
- *(If unanswered) Do you know how the administrators of the health code determine how you are healthy or not?*
  Based on personal health status, contact history with suspected person and so on.

What is your personal opinion on these apps? Do you feel these apps have been implemented well? Do you feel that they pose any threat to people's privacy? You do not have to answer this question if you do not want to.

Mini programs have its important role battling this pandemic in China, there's no negative news related to citizens' information leaks so far.

Students also mentioned some services provided by Chinese telecom companies like China Unicom. Could you tell us again what they are and how they work?

Near the end of our WeChat conversation, they also mentioned something about food delivery. Could you also give us a bit more information on that? Is it something that is handled by the government or just private companies?

Chinese people joined their forces together, joined their forces together, joined their forces together, joined their forces together during this pandemic. It's all free, with a voluntary principle, with a regional nature.

Are there any good Chinese information or news sources that you think we should look at for more information on these topics?

Information provided, or news reported by the Chinese news agency are all reliable sources.

APPENDIX H: TRANSCRIPT 4

Interview 4:

*****Due to severe technical difficulties this interview had to be conducted on WeChat, and recording the interview audio was not an option. This transcript is based on notes that were taken in real time during this interview. We believe they are quite accurate to the text and context of the original interview*

Wechat/Alipay health code:

Mini-app in Wechat/Alipay

high risk area will change your code to yellow or red, low risk areas are safe.

travel history for 14 days to determine your risk level.

also track temperature & contact with patients

public crowded places such as university and shopping mall required you to provide health code

government-controlled database, region dependant. travel systems have an independant system.

The risk level depends on the city, area, and time you stayed.

contaminated salmon fish a few days ago, in Beijing

penalties are region dependant

How health codes work:

If you went overseas, to someplace with a lot of coronavirus, then buying a ticket registered you went there, and then your health code might get red. If you have gone to many red colored places then your green becomes yellow.

How do red health codes get made to quarantine?

Fish market in Beijing had some Coronavirus because of fish from Norway. Some people in Beijing get sick, and the contact tracing traced it back to the fish market. So now that area is red, and the neighboring places are yellow. Beijing now has one red and six yellow colored places. If you pass through yellow or red you are still green, but if you stay for a while it is more likely for you to become red or yellow. Beijing is getting more serious.

Asking Question again:

If you are red then you need to go to hospital, and then you probably stay there. Some places they get you a hotel, but in some places they put you in a hospital bed. If they don't have a bed then they will send you to a hotel, but it is done province by province. Several hotels now exist for this purpose. They will send lunch and dinner into your room, and take care of you (Government).

Are there penalties?

If you don't stay at home then you will be reported to the people that are managing that street, and then they need to report your temperature every morning and night. They make sure you stay at home, but there are penalties for breaking quarantine. Differs by place - might be money, or might be more serious. Varies by color coded area that you are in.

Who's job is it to make sure that people follow the 14 day quarantine?

Each city is divided into many many streets. These are called zones, and each zone has a certain type of people (students, ect.) The president or boss of the neighborhood company is responsible for the safety and behavior of the entire place. Chinese homes are often smaller gated communities, which have an elected committee (risk committee) and the manager for this area (they clean and stuff). These two groups are responsible for keeping people inside.

Personal opinion on these apps?

In China these apps have been done well. Around 10 years ago this was created in Beijing. Beijing was divided into many sections, and one person was responsible for each small section. And this one "grader" would manage around 1000-5000 people and report things about diseases as they spread. We are still pretty dependent on these people. Apps makes it easier?

Privacy?

Ethical issues and privacy issues. Using this for something other than health. But there is a time limit on this data. So after a certain time period this data will be destroyed. Each city has a different limit on how long they will keep this data. Since there is so much information there is a danger that the information might be leaked. Deciding how to best deal with this data is an ongoing process that will have to be dealt with once this crisis is over.

Services by Chinese Telecom companies - how do they work?

Not sure. Many small companies and big companies tried to roll out innovation services, which try to sell products. They tried to do some innovation technology. Lots of services - they have app for buying things like vegetables and other services. App which lets you see city and where is red and yellow and green. Then you can avoid the yellow and red places. They also provide a service for ellderly people who cannot move quickly, which helps people do services for them. So there are lots of volunteers that are using apps to arrange how to help people, so these apps are valuable as well.

Xianhan: [Chinese] Could you talk about the service provided by three phone-service providers in China

In china most people use these three telecom services. On top of these three companies (工信部 Ministry of Industry and Information Technology)

These agencies can share the info with other agencies, like the airline under the agency of transportation, so the Chinese CDC is allowed to exchange information with the telecom companies. So from the cellphone you know you are in which city, and this is how it is happening during this period, but afterwards this thing will be stopped.

Students mentioned food delivery

The food is delivered by a company. You have the Chin Don (京东 jd.com). There are a couple of companies, and before this time they had other services, but because everyone stayed home their business are booming. This big company used to do delivery (顺丰 SF express), but not because of quarantine their business is booming. There are lots of delivery companies that are doing very well right now.

Are there any other community organized things?

Committee has an app which tells what the committee needs, and then the committee goes and buys vegetables and things. These apps are managed by the Risk Community, and the Manager Community. Risk is democratically elected, Manager is the people who manage the property. The Risk committee manages the app (物业 estate managment / 业主委员会 Owners Committee)
Usually you can buy stuff yourself, but go together you can get discount

Any Good Chinese Information Sources?

Most information is local. For example, if I stay in this place then I get the local news, and we don't care about the national news. Basically it becomes two part,s you want to know entire nation news, and there are lots of apps for that that are usually from government agencies. They have a media conference every day (cities and other places). Many times though you want the local news, so you make your own local APP to just have local news - new case counts, places for cheaper discounts etc. Another thing, universities have their own app that gives more information specifically to the people. Info like which cafeteria is open and at what time? Either we have a very detailed app, or a very large nation-wide or city-wise app. Two types, these types.

Can we access that here in the US?

The local level you need to register. Example, you need your student ID in order to get the university app, so if you don't belong then they won't let you get the app. And if you stay in the community then you have to say which building you are in to qualify. You must be a resident to get these local apps.

APPENDIX I: TRANSCRIPT 5

Interview 5:

How does the WeChat and Alipay Health code work?

During the outbreak of COVID-19 we used many mini programs such as health codes. It is the most commonly used. This health code is used to prove whether a person is at risk when people go to a new city of a supermarket. If your healthcode is green, but if your healthcode is yellow then you are not allowed to go into the supermarket, or you need to stay alone for 14 days. But now the COVID-19 in China has been controlled well. The healthcode in some low risk regions - there is no need to use it. People can travel freely. I think the healthcode have most to control the COVID-19, because China has a large population. The use of healthcodes is very convenient to see people's risk level, and it really saves time and increases the efficiency. For example when you go to the supermarket, when asked to write down your name or idea, maybe it will take 30 seconds, but when scanning the healthcode it just needs 1 or 2 seconds. That is my opinion about the healthcode.

When people apply for health codes, they need to supply address, and other forms of information used in apps. For example, if you have symptoms of the COVID-19, whether you communicate it, or have been near patients infected with COVID-19, or if you have ever gone to the high risk regions. If your answers are no then you will get green health codes. But if your answers are yes then maybe you will get a yellow healthcode.

Personal Opinion of the Apps offered in China

I think it really helps a lot, especially in this special time. I really think that the apps are very very very convenient. It saves a lot of time and also improves the efficiency. It can track and alert the ones who travel, and also show a person's risk level. These aspects really help a lot to control the COVID-19 because this information can be provided to the Government, and they can use this data to make policy and take other measures.

Do you feel these apps have been implemented well?

Yes, works very well.

Do you feel that they may pose a threat to people's privacy?

Really I don't think so. As I have mentioned a lot, the person only needs to provide basic information, such as name, ID, and travel record. Just this basic information, and as far as I know personal privacy hasn't been leaked online, or used to other effects. So after disease, it doesn't influence my life.

Chinese telecom companies?

The Chinese telecoms can provide one's travel records to their cell phone. When you text to unicom ,they will send your travel record in the last 14 days to your cell phone, and this travel record can be used to prove whether you have been to the high risk regions, to show if you are at risk or not. In terms of how it works, because I'm not

an engineer, I don't really know very well, but I think this service is based on the signal you use.

In terms of the apps offered in China, do you think having so many can be confusing?

We usually use the WeChat and Alipay the most, so the miniprogram can be found in these two apps, so I do not need to download many other apps. I don't think so many influence my life. I just use the healthcode and another code to go in or out of the university, so there is not so many mini programs I need to use.

Food delivery services

The food delivery can be a part of people's everyday life. I know that food delivery always is organized by the community. There are many volunteers, they directly work with the farmers, vegetable companies, and super markets, and they then collect the need or the requirements of the residents - what they need such as vegetables, and meat. Then they transfer this information to the farmers, supermarkets, and vegetable companies, and then they deliver these vegetables and meats to the community. And then these residents go there to buy these things. The price is fair, and according to the market price. For food delivery, it is not mandatory. You can decide whether you use it or not. But many residents use this food delivery service, because they do not want to go to the supermarket.

Handled by Government or private companies?

It is provided by the communities. Of course it is a volunteer organization within the community.

Are there any other community things?

About the ppe, the residents need to buy it first at the market. It is not provided by the government. But at the beginning of the outbreak of COVID-19 the government and the community will buy many PPE and then send it to the citizens to help them. But at the end of this outbreak the PPE can be bought at the market easily, so the government and community won't provide them.

Any good Chinese information or news sources?

Maybe I can - - - out of consideration I can provide some scholars or experts to you. I need to ask for their information to see whether or not they are waiting to receive your interview.

About the color of the health codes

If your healthcode is green at the beginning, if then you go to the high risk regions, or you have connected with the person infected with COVID-19, your healthcode will be changed to yellow or red. Maybe it changes to yellow, and then it will show you as "at risk." This is how it works in terms of the changing of color, That's what I know. Because the health code color is determined by the big data, and this service is provided by WeChat, Alipay, or the government, so the mechanism of how it works - I really don't know. But as far as I know, if you have connected or been to high risk regions then your health code will change.

APPENDIX J: TRANSCRIPT 6

Bill: A few weeks ago we were talking with some students from the Wuhan University of Technology and they gave us some information that we would also like to ask you about as well just to get more knowledge on this subject. So they told us that there was something about a Health Code in the WeChat and AliPay apps. Could you explain to us how it works and what you think about it?

6: Yes. WeChat is one of the most popular apps in China. Something like Facebook or Twitter. Almost everyone has WeChat on their mobile phone. After the Lunar New Year of China… About February? February, yeah. There were a lot of people infected. So we used the Health Code almost everywhere. For example if you go to the shopping mall, you need the health code. If we go to the hospital, even if I go back to my university, I need to use my health code. There are three colors, green, yellow, and red. Green is healthy - no problem - you can go ahead. But yellow means you must stay at home for 7 days. And red means very very high risk. So we must stay at home 14 days. Miss two weeks. So this is basic background information. You can ask now whatever questions you want to ask.

Bill: Ok, so what information do you need to give the apps in order to actually start using the health code?

6: Yes we need some personal information. For example the full name. The first name last name. And also the ID, similar to the social security number and telephone number and location - where do you live in which city in which part in which building. And the room number. Make sure that some people can find you if you have some problems with health.

Bill: Ok. And do you know how the administrators of the health code - the people who manage it - how do they determine what code you get? Whether you get a green one or red one.

6: I think it's based on risk analysis. Which city do you live or which part of location do you live? If I live in a city with a lot of people diagnosed with coronavirus 19 then my code will probably be red or yellow. If I go to Wuhan or other place where there are a high risk, probably my code will also red. So it depends on where you live and which place you have gone. Yeah. Probably they use some big data AI or whatever to make decisions.

Bill: Yeah. Cool. And do you think there are too many similar apps? Or like different things like these health codes that could cause confusion with different people?

6: For me it's ok. Because we young people already have lots of apps on our mobile phones. But for some other people for example my mom is almost 60 years old she doesn't use mobile phones too much and she doesn't know how to use apps, it's really hard - even struggle - for her to use health code. Because for either WeChat or AliPay we need to connect our personal information with the app and also click a lot of next

next next so we could have the health code. So for some people its really hard but for me its ok. I personally like the health code, divide the different people based on their health information.

Sam: Thank you! So if someone's health code turns red, how do officials make sure they undergo a 14 day quarantine? Are there any penalties for not going into quarantine if your health code turns red?

6: Thanks for your questions. For example if my health code is red my colleagues and community members I must stay at home and my room will be put paper write my name where I have gone, why I turned red, and I must stay at home 14 days. I cannot go outside. Because whenever I go other place I must show color. If I have red color, nobody allow me to go to that place. For example, super market, university, or train station. If the health code is the red color I will go to hotel or my home must stay 14 days.

Sam: So are there any penalties for refusing to quarantine?

6: What does penalties mean? Do you mean some people for work they must require you to stay at home and check whether you are home or not. Do you mean that?

Sam: I mean.. So if someone is supposed to quarantine but they don't is there any sort of punishment or fine or something like that?

6: China and America have very different policies and healthcares. In China if my code turns red I must stay at home. Hopefully if I go outside other people are not allowed at my university [unintelligible]. Not a lot of rules. No monetary punishment. Just yeah.

Sam: Ok that makes sense you just wouldn't do it. Ok so whose responsibility is it to oversee people when they're under quarantine? Is that the communities' responsibility or is it the central government's responsibility?

6: It depends. Sometimes the people have responsibilities. They know where there is high risk when they go to crowded places. But sometimes it's the local government or community. But not the central government I think. Normally we just have four or five levels the central government the progress the city community and your university or other place. [unintelligible]

Sam: Ok. So do you feel that the app system has been implemented well?

6: Personally, I think it's good. Because my major is safety science I've learned how to make people health and keep safety. But some people they think it takes a lot of time. Because the health code is used every time and every place. When I go to university I should take my mobile phone and [unintelligible]. But for other place I show another code so it takes a lot of time. It depends on people.

Sam: What ways, if any do you think, that these apps could maybe be improved in the way that they work?
6: It's a very good question because almost every city or every province has their own health code. If my health code is green in our city, but I go to another city [unintelligible] (they might think that I'm not healthy?) whether I'm safety or not safety or healthy or not healthy. We need a standard to determine green, red, or yellow, to make it [unintelligible] so you can go wherever and whenever you want to go but only use one code

Sam: And do you think that there are so many different systems because maybe this had to be created really quickly because of COVID-19 or are there lots of different health codes on purpose?

6: Yes, We never think the worsed happened that it developed so fast and everybody thinks its [unintelligible], but I don't know how to make a standard that can be recognized by other cities or other provinces, probably this is a part of (managment?)

Sam: Do you feel that there are any privacy concerns when it comes to use of these apps?

6: yes a little bit. Because our alipay is connected to our bank card, we're worried about our money. If there for example, people who are bad guys and steal our information, because they can remember our name, our [unintelligible], and the locations we work, all information about us. So we're worrisome but it is acceptable because health and life are our top priority in this moment, but after the COVID-19, I dont want to connect to the health code app and other apps due to the personal information.

Sam: Someone else we spoke to said that the data that is collected by these apps only exists after a certain amount of time, for example after 30 days the data will be deleted. Do you know if that's true or have you heard anything like that?

6: My friend talked to me, similar to [unintelligible], and asked me about the information we input and asked if people view our personal information to make money or if there are things we can do. But actually, I have no solutions and i don't know who collect the information. Probably [unintelligible] or other institutions. I am uncertain. Probably you can search some information online on google or whatever. But can [unintelligible] and search a lot of information.

Sam: Ok, moving on, the students that we talked to also mentioned that some Chinese telecom companies like China Unicom, are providing some services during the COVID-19 crisis, do you know anything about that?

6: Yes, take me for example, I go to other cities [unintelligible]... when I go to other cities, there are several telecom cities that you must use your mobile phone to secure information likeyour telephone card, similar to AT&T or companies. So you just secure your information and store your information for your health code. I think the telephone

companies can know where do you live and they can give a number or a QR code so that you can go to other places, or else you are not allowed.
Sam: So we also heard that there were some food delivery systems set up during the COVID-19 crisis, to ensure that people were able to get food delivered to them. Could you tell us anything you know about that?

6: yes normally we order food online because we don't want to go outside, qwe're worried about COVID-19. The company workers send it over by bus, car, or whatever. So they send the food near to our home. Sometimes my university buys a lot of food and orders vegetables and fruit for us, but it's not free. We need to pay some money. So they reduce tge people that need to go outside, just to make it as close to our university as possible. So it's a way t reduce connections between people.

Sam: So is that managed by the community and the government or by private3 companies?

6: Smetmes by the companies but mostly by the community, but it's mostly provide the companies.

Sam: Are there any other things that are done n the community level around COVID-19, for example were face masks or sanitizer distributed by the community?

6: Actually the community does a lot of things, for [unintelligible] whoo come and go. You here that people from other (planes?) take ur information. Sometimes if I have some problems, [unintelligible]... I try to understand better, I stay at home. I do a lot of things. But currently our situation has gotten better and better. We don't need to monitor skin temperatures [unintelligible]. But one month ago or tow months ago, other people should monitor their skin temperature before they go in or outside their community.

Sam: Last questions. Do you have any good news sources or ideas on websites that we would be able to look at to gain more information on COVID-19 in China and the use of apps?

6: Yes, there are a lot of sources. First you can research some papers online that are part of websites. You can see some publications from China, relative to the apps, can be hard. Anbd second, I think you can search online not in English, because a lot of papers are in Chinese so you trust [unintelligible] or google, so you can put whatever questions you like into Chinese (translate?) and copy it into google to search so information. This is a very [unintelligible] and easier way to get information. The third is t0 talk to people similar to our courses in Wuhan University and students about COVID-19 life and other things.

End of interview…

APPENDIX K: TRANSCRIPT 7
[Transcript]
Sam: Ok great. K, Xianhan is recording. Would you mind just stating your name?

7: Ok, my name is [redacted]. Ennn…

Sam: Ok thank you! So our first question is… umm… about how the health code system and the, um, mobile apps that deal with COVID-19 work in China. So um, could you generally explain how that the health code system works?

7: Yeah, it's a… uh… generally it just based on the health code, you know. It's combined in Wechat, Alipay, so where you go you will have a scan. You have this Wechat, or uh… Alipay QR code, so we can scan, and you can scan us, use with uh… the health code, but what isn't about the health code, it's generally information about your name, your address, your contact number, your ID, and your health condition, and also the family member, ennn…

Sam: alright so…
-and then!…especially!...
-sorry
-especially, sorry, especially we have the health condition, the temperature, and also the other unusual feelings, you know, and also the… uh… the, you know, coughing, and other symptoms, yes, this is that [Inaudible] health code.

Sam: So… so with the health code, um, do you report your own symptoms and your own temperature to Alipay or Wechat?

7: Uh yes! We register… Initially this health code was developed by the, uh… government, so we have a… special uh… reporting system like a(n) app or a… 公众号, how to say, it's something like that, so we just registered on this system, input all information there, and the second stage they combined these health code with uh… Alipay, and Wechat. So initially it's a government uh… behavior, we log in and we… and then this health code was [Inaudible] by Wechat and Alipay, so because you know in China Alipay and Wechat being the most… uh… primary tool… app… we are using, we have uh… both of these app we have identity information in these app.

Sam: So do you think that, um… the fact that the app that you used for the health code system, Alipay and Wechat, the fact that a lot of people already have that, do you think that helped the app, kind of, um… succeed?

7: Yes yes, because you know we uh… we already use uh Wechat and Alipay, so that why gradually we combine this health code into Alipay and Wechat, so it's very convenient because we already have information in these two app(s).

Sam: Uhum, so when do you have to use the health code? Do you have to use it, you know, every time you go out, or has that changed over time?

7: uh, yes, uh… initially, uh… these health code was only for collecting information, you know, like the health monitoring, uh… so we can record/report through this app, or condition of individual conditions, and gradually because you know, with this uh… virus situation getting better and better, so we are allowed, uh… to go out, you know for shopping, or for other business, so gradually this app, was like a… permission, to go out, or get in, if it is green. This green and or red color, it's based on the situation in your suburb, you know, if you... this building, or this campus, or this uh… location have one or more patients, you know, identified patients, the color will be red, it means that this area is at high risk, so if the people from the high risk, if they want to go out or get in, it should be forbidden, you know. So this is the second step, they use it for tracing. Initially it's just data collection, and health condition monitor, and second step if for uh… tracing, where you goes, and… and also it's identified, it's also to identify unusual person that get in or get out.

Sam: So we've also heard that there are a lot of… other apps, from, outside of Wechat and Alipay um, a lot of apps that are specific to certain neighborhoods, or regions, or even universities?

7: YEAH, I'm not sure whether we have app but I know we have a… it's a link, you know, like website, in this website we have just like a map, you know, the whole China, different cities, in this link, you press in this link, you get the whole map, of the information, you know. For example, I live in this university, and in a small area in this campus, how many cases of the patients, I can… I can totally understand and get this number, I know whether I'm safe in this campus, or I can know other suburb, or other locations, they have all the numbers of the patients and they show in this map.

Sam: Okay, um, do you think that the kind of, the number of apps can be confusing? Um, kind of like there are so many apps that it's…
-NO
-a little overwhelming?
-Not confusing because as a… as most of all Chinese we use Wechat and… and Alipay so it's... it's not confusing, it's very easy and convenient to use

Sam: Enhem, so... um… moving on... from that, if someone's health code turns red, um… how do officials um and community members know that that person has quarantined for 14 days, and if they're supposed to quarantine?

7: Ok so for this red code it doesn't mean that you have some, you know, your personal have some health… conditions... problems, it's mean that you come from this high risk, area, so, they want to double-check right? So we will first check whether you, you are ok, so they will have test your.... um...temperature and all the other… test, eh, if you are ok, they will just, you know, this suburb, they will have a check. So, this is… this red color doesn't mean that the person who have this red code is… have problem, it only have, it means, this person have high risk, for this virus.
-Ok

-This is only the first step to identify the high-risk “vacants”.

Sam: Ok, so that’s interesting. So, just because you have a red health code… a red health code that doesn’t mean that you have COVID-19?

7: Yes! It doesn’t mean… no, it doesn’t mean that. It only show(s) that you have high risk, so you want to identify this risk… the risk of course they will test you right? test your condi… if you are ok, that’s ok, but they will continue to know about why this code is red, right? And they will see, “oh, maybe the suburb A or suburb B we have uh more cases than other area”, you know, we have more connection peoples, you know… so this only mean the risk is high, so that’s why it’s red.

Sam: Ok, so… so for example if suburb A has a yellow code, that means everyone who lives there have a yellow code?

7: Yes… so it’s al... it’s related with your environment, you know, in China we live in different building(s) right? Only in one building we have… uh, hundreds (of) people, hundred of peoples, right? It mean that this building, you have maybe 20 or 30… it depends on how they classify this yellow or red, depends on the cases, right?

Sam: Enhem... ok, interesting, um… so what is your personal opinion on these apps, do you think that they’ve worked well or they implemented well?

7: I think they (are) quite efficient, because you know we have large huge populations here, and… it’s very good new this big data, uh to get information, about people… how… this is a personal uh... reporting, you know, we have to report, is if we want to the government servant to come down to good investigation it’s time consuming, so it’s another direction uh… personal reporting to the government, how our situation is, so we… by the initial stage of the COVID-19, we report daily, each day we have to report, how is our temperature, and how we feeling, and even our family member, whether they are good, you know, so this is… and second uh… I think it’s… how to say that… I’m not quite sure what I’m going to say but it’s quite efficient for data collection, and then it’s very efficient for people tracing, you know, because you know, when people get identified, the second step is to, uh… to investigate, who and where he (or she) goes, and contact with, right? because this places and person maybe have a higher risk to get infections, right? So we have to get this tracked, from… because for example, patient A from home to supermarket, and to the bus station, and come back home, right? And this person A get infected and identified, so the government need to trace, from home to the supermarket, for example by walking, you know, so they go to the supermarket, so they will investigate, on that day, who else, go to the supermarket, and we will have a report right ok so this supermarket is high risk with people identified, so please, for the s… for the people to go to the supermarket, they should personal uh… reporting to the government: “I go there and I will go to the hospital to do the test.” So this is how we work on the tracking, and also they will instead investigate ok from supermarket to the bus station, for example, the bus station and home, so on this bus, you know, the government will do the report: “ok so this bus have a person get infected, so please,

who take this bus, do the report" and they will send you to the hospital test… so this is how we one step by step to… how do you say… filter, the healthy ones and infection ones.
-Enhem… uh…
-It's very efficient, yes…

Sam: Ok, great, yeah, um, do you feel that there's any way… any ways that these apps can be improved on, that you can think of?

7: uh… the only problem I can sense is about as I mentioned before is about information safety because in China it's a very uh… common… not only for this health code, for other applications like 微信, whenever you fill a fill, uh… form for your information, not only you will input your name, you ID, your telephone number, your address, all these information… for example if you buy a house, or if you go to hospital, or you go to some, you know, the government places, so these information are the most compulsory informations, so the only problem is, the information leakage, because everyday we receive uh… the spam phone calls, house selling or other…you know.... so it's only I concern about the safety information safety because all personal information are sold to other commercial organizations, so they have our numbers, so they can phone call to sell things to us, this is very uh… not… the things I don't want. It happened now, it not now but it happened for very long time, not only for this virus time, but (also) previously as I said. Whenever you go to some other commercial places, once your information are leakaged, I mean so with prices.
-Ok
-This is things I want to improved about, I think it's… should be improved by the laws! It should be forbidden to sell the personal informations to other commercial organizations, it should be something forbidden, unless, the government, or the police, or other you know, public servant who want to do some investigations so they can use our information but other things, or commercial applications, I don't think it's a good idea to… do so I think it should be set laws to punish [Inaudible]

Sam: Enhem, did you know if you personal information is sold by the government, or it's sold by um… things like Alipay or Wechat?

7: I think a uh… Alipay is only you know, a platform. We have many uh… I know they have many other companies, you know, together with this development of Alipay, so we can… I'm not quite sure which section these, you know, these sold out, but there must be someone, who have this information, they may have… they can make the deal, uh… the government maybe, could do that, and the… you know, the… for example, housing department, for example if I buy a house, right? The whole building, this housing… how to say, company, who sells the house, right? They have the whole information of the whole building, hundreds of people, right? And the whole district, we have this…[Inaudible], even as I personally experienced for myself, I gave birth in the hospital right? The second day, I received phone calls from the shops: " you want to be this staff or something like that?" So I'm sure that we have something to… to leak… to sell, to sell my information.

-Yes
-Yes, but I'm not sure which section you know, but there must be someone who has already done that.

Sam: Enhem, ok, but the actual way in which the apps work, you think, is working really well?

7: En… I think it's a… you know, not only Alipay or Wechat, even facebook, right? And google, we all have face this information safety issue, right?
-Yeah, definitely, definitely.
-En, ok, so yeah that's for this question…

Sam: Ok, great, that was a very informative answer. We've also heard a bit about some Chinese telecom companies, like China Unicom, also offering some services related to COVID-19? Would you be able to give us any more information on that?

7: Uh… for this one… I didn't apply with uh… but I don't receive messages from the Chinese… we have other companies, I'm not using Chinese… the China Unicom, I use other company's service, but they will send us the message, uh… public… uh notified by the government, so it's… the message are free. So if you sent us, ok… each stage, some very important notification they will send by this message. For the location… search… I'm not using this service, so I have no idea, what is it about.

Sam: Okay! So we can move on to the next question um… so we've also heard that kind of along… with um… some other programs there's ways in which you can get food delivery, um… using these apps? Um… would you be able to tell us a little more about that?

7: En, it is a good question. Because you know, in China it's in the Febu… uh… like January, right? And it's (lunar) new year time, and… we need food... because at that very serious stage, nobody can go out, and for some families, you know, we have problems of the the food shortage, you know, for some cases, for some family, they visit their relatives, right? The whole member of the family, the whole member of the families went to their relatives, and because of the virus we are blocked in their… shut down in their relatives, so in this whole family you can see 10.... for example 10 members of people in this house, the food consuming is very huge, so we need the food delivery services , uh… by the initial stage the service is not good because, not only in Wuhan, the whole Hubei province their delivery system are locked down, right? It's not very uh… convenient to do that because we need the permission from the government, so at the time, it's a little bit slowed down, but once the government clear… uh what is going and how to make this food delivery system more efficient, so with that, the second stage which is uh… in each suburb, they have the supermarket right? They only allow one member or the person, to go out, uh… to shopping, but you know we uh… the government require the… stay behind supermarket, because if I go shopping maybe I go for 1 hour and for other people maybe for two hour, right? But the time is very limited, so we previously we use this Wechat or Alipay to make a(n)... appointment for

the food, what we want, so they will give us a list, shopping list, so we just price, ok what we want, and pay the money, and this… the government, each suburb, each community, suburb community, they will organize this food, the government send the food to the… each communities, so the… public servant in the community, they will assemble this... food, in one place, so the family member can go out and just to fetch this food, in a very short time.
-Enhem, ok so tha...
-Yeah so this [Inaudible] on the food delivery, we use the app just for… pay on app… pay on this app, select what we need and pay, and then it's a quick fetch to go out.

Sam: Ok, and so that is coordinated by um… the community, is that correct? That's what we heard from other people.

7: Oh, oh yeah. I just saw the news message, the… this question, because the first, as I said, it's very serious at initial stage right? So it was organized by the government, and with time you know, we familiar with this whole process, so some other third-party companies, they… do the volunteer, to do the service, you know?
-Enhem
-Food delivery, or, food sellings, like the veggies you know we… many uh… villages, they have the veggies, so they connected with government or the third-party organizations, so… establish very efficient food delivery system
-Enhem, umm…
-So, it's… it's very good, at the second stage it's more efficient and have enough food selection because at initial stage the choice is really limited, you know, especially like the egg, and also the meat, you know, it's very hard to get… it's not say it's very hard but it takes long time, at initial stage maybe it takes, you know, 3-4 days to get what you want, because you know, they need this food delivery check, but gradually it's getting better, so we can go out daily because you just make appointment the day of before the day so the second day or the third day so you can get food you want, it's more efficient and the selection, uh… it's much better.

Sam: Enhem, ok, interesting um… one more question on that, did the prices changed at all throughout that process?
-Pardon?
-Um, did the price of the food items change as um… kind of the system got better? Um… or… cause I'm wondering if the price went down When it got more efficient, or…
-Yeah yeah...
-perhaps the price…
-yeah yeah…
-Ok

7: Initially, the price was… is expensive, really expensive, it's like… double… especially for some very… precious food is… the price is very high.
-Enhem

-and [Inaudible], but when it's getting better and the price goes down… the price goes down, and now you can see uh… from uh… April… and then to now, the price are stable, and just… normal price, but initially, really, the veggies is very rare to see, but…
-Enhem
-But still! En… people can… for some families I think it's very difficult to afford, but the government have, you know, some volunteer, you know, not… because for other provinces, they gave us veggies and other food for free, to support, because at that time, the whole Hubei was locked down, and no production, and no delivery things, so we are supported by other provinces to send that food for free to s… serious districts, and we have the registration, for example, each building we have some poor families, you know, the community, the public servant community, will keep down this information.. actually! We already have this information, we know! which family are poor, we are… have government… supplies… you know… so… we will take care… for me! I'm the volunteer for my building, I take charge for three building… this in my suburb, so we will… take care about the… for example, the old people who live along, and also… for example.... even they have children but their children are live in outside the campus, so it's not very convenient to… for their kids to come back, so the community will take care about what they need and… oh! Another! beside the foods you know, what is important is the medicine, because not only are the community maintain virus disease, but is also some people have some other like, cancer very serious disease, you need to buy the medicine at that time, so we have volunteers in the suburb, we have volunteer to purchase the medicine for them, so the food and medicine are both very important things the people needed.

Sam: Ok, that was really informative, thank you, um, so our last question is, um, are there any, kind of informative, Chinese news or information sources that you could recommend to us, um, as good resources?

7: Uh, I think it just… I don't know, en… for the… as i said is uh... information, reliable sources? En… you can search online and you can talk to the local people, right? Should know the real situation, eh… yeah, because as I… I have experience living abroad, but I understand information searching is little bit weird, you know, so… actually each search engine company… we have filtered informations, and what we want to search actually is not what we want, ok? So...it's very trick(y) problem for the information block, but if you want to search real information in China, as I s… as we have done before, we have connections with Chinese students right? You can ask them to help you to search some information that you need, and list out which aspect information you want and which data you want, and also we have like database for this virus situa… investigation, we have lots of publications, literatures… in the database, so this un… this literature… you can… you know… what the information it is, I think the first is about [Inaudible] this is peer-reviewed publications, it's not somebody very subjective to say it, for me like, my personal idea right? and it's my personal expression, but for the publication, the literatures, they are reviewed by the scientists, or other experts, so it's more reliable information
-Enhem

-And for the Chin!... Uh… for you… if you want to know about the… how to say… the… civil information, how to say civil... 就民间的消息,啊就说是真正的我们...the sighting of China! What the real society of China it behave in this situation, you can… you know we have lots of app in use app right? so you can download and search, and also, of course as I said you can ask Chinese students to help you research. Uh… and for investigation by the professors, I'm not quite sure which kind of the… how many samples do you want to collect, so I think that's the important thing, for example we set up 100 samples… right? So, for the moment we have 50, though still means 50 investigations, then we will maybe provide information about other professors to support your investigations.

Sam: Enhem, um, ok yeah. That makes a lot of sense, um, thank you, so that was all questions we had, I don't know if you have anything you'd like to say before we end this?

7: Uh… I think it's very good project for the moment, because initially we joined in this project I think it's very good opportunity to know the US and China, how we response to this virus and how we fight for the public and the society, so we can know different policies and efficiency of policies, and also the culture, right, it's very good for us, and it's very good project. The only thing is I suggest about the data, the data investigation is very very important, otherwise without the correct data, we don't have a correct conclusion right? So I think we need to do more uh… literature research, and also as you are doing now like the questionnaire right? set uh questions in he questionnaire, and also it's good to use app or uh 公众号 to set up investiga… questionnaire because this app can help you to [Inaudible] analysis the questionnaire result. For the moment I can see from this form, the question list, you have to keep down, right? keep down my answers, and do something like that, and then you would like to all the answers from all the professors and other people and you will analyze and that… it's a lot of work, do the data analysis, it would be…
-Yes
-Yes, it would be uh… more efficient to use the… you know, big data, like some app! To help you… it's more simple, we just select, right? And for some open question we can have description about [Inaudible] but for some Yes-or-No questions or as you… I can see here… if you are waiting to… something like that, or… it's...make some choice… multiple choice or a single choice like… this form of the questionnaire is more helpful for you to data analysis.
-Ok, that..
-IN CHINA, we have so many… many apps, or 公众号 in 腾讯 Tencent, uh… Wechat, and Alipay so which can help us to do questionnaire. Ok, that's my answer.

Sam: Ok well, thank you so much, um, do any of our other members have questions?

[silence]

Sam: Um, sounds like no, so I think that's a good place to leave it off, um, have a good rest of your day

7: Yes, have a good… night! Ok…
-Yes, thank you
-Good luck with the project and… bye
-bye

[Transcript end]