Traversing the Boundaries of Map and Navigation Apps

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Technology has come far in recent years and lives have adjusted to include these changes. One of the technological advances includes digital maps and navigation tech. With the advent of smartphones, these have been packaged as phone apps that each have a variety of special features. The following report discusses the findings of an interview study completed to discover, "What features of a map or navigation application are most valuable to users?" among synonymous research questions to gauge users interest and use of map and navigation applications. This interview was designed in order to understand when and how users use map and navigation applications in their life and understand what features users felt were most valuable and important in a navigation application. The participants, all with varying ages and technical capabilities, gave insight into what they like and dislike in a navigation application and provided insight in all of the different ways they use digital maps.

INTRODUCTION

The objective of conducting interviews is simple: to gather insights from the interviewees' points and views to remove meaning from their experiences. This work builds on this idea to better understand, from conversations with users of map apps, which features are considered primary, in addition to gaining knowledge of how they interact with these tools. This work aims to evaluate the results of an interview study developed from six interviews with users from different backgrounds and usage profiles. The participants provided, in their own words and perspectives, information on how they started using the apps, what are the contexts in which they currently use, what they value most in these tools and what are the problems they frequently encounter, among several other valuable points.

Previous Research

Technology has become a part of people's everyday lives and is beneficial in many aspects. Map and navigation applications are making it easier for users to travel near, far, and everywhere in between through the use of step by step directions, recommended landmarks, and live traffic updates. Map and navigation apps are a still growing field, with a vast history of research behind them.

One of the basic components of maps is wayfinding. That is, the ability of a person to turn the directions from a map into an actionable path based on understanding how their surroundings indicate where they are on the map (Bouwer, Nack, & El Ali, 2012). Turn by turn directions are common in modern day map and navigation apps, but there are times when that option is not available or is inaccurate. In Bouwer, Nack, & El Ali's (2012) paper, they examine how digital maps of a fair (a contained, novel location) impact wayfinding. One of the main findings was that digital maps impact user's awareness of their surroundings, a finding that will come up later in this paper as well.

Google maps is one of the most popular app systems, and Google map products (i.e., Google maps and Waze) are the two most widely used map and navigation apps (Panko, 2018). Google maps alone makes up 67% of the market share according to a survey given by *The Manifest* (Panko, 2018). From the same research, Waze makes up an additional 12% of the market, while Apple maps accounts for 11% of the market (Panko, 2018). Thus Google map products hold 79% of the market altogether. McQuire (2019) argues that Google map's firm grip on digital mapspace is due to their rapid integration of satellite image, their adoption of a user participator strategy, the creation of exclusive data streams, and their development of a mobile platform. Miller, in a 2006 paper published soon after Google maps' 2005 launch, identified some of the same key components as innovative. These features are now considered commonplace as other map and navigation apps have conformed to Google's offerings.

Perhaps one of the most interesting topics is that maps and navigation apps are no longer just for getting from point a to point b. They are now being used for education (Landicho, 2020), or, as one of our interviewees mentions, for remote tourism. The data streams that map and navigation apps produce can be used for contract tracing during epidemics and pandemics (Sonkin, Alpert, & Jaffe, 2020).

Based on the previous research completed that has informed how current map and navigation applications are created, updated, and used, this research team wanted to further discover what users find to be imperative key features of map and navigation applications. Today, many map and navigation applications do more than just give directions. Within these applications, a user can search nearby locations, get reviews of a nearby restaurant, read a menu, order a meal, reserve a table, schedule an appointment and more features that can distract a user from their end goal; getting to a desired location. In order to improve current applications, features deemed necessary by users are what should be brought to the forefront of the application for easy navigation.

End Users

Digital map and navigation apps are used by 77% of smartphone users (Panko, 2018). According to Pew Research Center (2019), 96% of Americans have a cell phone, and 81% own a smartphone. If those two facts are true, then map and

navigation app users account for about 62% of Americans, on average. This number would change based on end user groups; for example, the number of rural Americans with a smartphone is only 71%, while the number of Americans over 65 with a smartphone is an even lower 53%, conversely those aged 18-29 had the highest smartphone adoption rate at 96% over any other group (Pew Research Center, 2019). However, we approached this research with the idea that most of the people we reached out to would be map and navigation app users.

The research team also believed that there would be different end users depending upon their intended purpose for using map and navigation apps, why they wanted to use map and navigation apps, and what features they most highly desired. We used those aspects of our theoretical end user groups to design our research questions and interview protocol, as well as keeping that in mind during participant outreach.

Research Questions

The basic question that this research has set out to answer concerns what features users value the most. However, the survey results have shown us that simply asking for their favorite features is less helpful than the context in which they use their favorite features. Thus, the ancillary research questions exist to provide further background details to support answering the primary research question.

Thus, we have a main research question and its two sub-parts:

RQ1: What are user opinions about map and navigation app features?

RQ1A: What are the favored or must-have features?

RQ1B: What areas do map or navigation apps need to improve?

In order to provide important contextual information about RQ1, we were also focused on learning the following:

RQ2: What history do users have with map and navigation apps?

RQ3: When and why do users engage with map and navigation apps?

RQ4: How have map and navigation apps changed the way they travel, opt to get to locations, or otherwise navigate?

RQ5: How dependent are you on using map or navigation apps in your daily life?

RQ6: How has the global pandemic changed the way you use map or navigation apps?

Answering these research questions will provide the framework with which this report is organized.

METHODS

Materials

Interview Protocol

We based the interview protocol on data from the survey pilot as well as the slight change in research question since the survey pilot. Overall, our core research focus is still the same from the survey pilot, but our anticipated use case has altered based on initial findings in the previous report.

The interview protocol is split into three sections, the intro, the main part, and the outro (or conclusion). We allotted 10% of the time on intro and outro (5% each) and the remaining 90% on the main section of the interview. The intro covers a self-introduction, time for consent, small talk and rapport building. In this section we provided a small script which summarizes the consent and also provides general instructions on how the interview will go.

The main section is where we have interview questions that answer the research questions, The first section covers participants' background information such as their age, gender, race/ethnicity, and industry/job field. We also added the first question that is pertinent to the topic here, a question about their history of map and navigation apps. In this we are addressing RQ2, and we want to understand their phenomenological experiences that have led to their current opinions of map and navigation apps.

The second and last section of the main section dives into their usage of map and navigation apps. This ends up covering the remainder of the research questions. The first question is finding out how long they have been using map and navigation apps. We acknowledge in the protocol that this might have been covered when they discussed their history. We also ask a series of questions that are intended to answer research question 3. These include how many map and navigation apps do they use, with probes from there on when (in what context) do they use map and navigation apps, and what devices do they use them on. This is inquiring about some of the main use information, not only how many do you use, but when do you use them and what do you use them on. They are nested in the same question because they often go hand in hand, particularly as some people might use different apps in different contexts and on different devices.

We also ask them how often they use map and nav apps, and there is a related question later in the interview about how dependent they feel they are on map and navigation apps in their daily life. For these questions we wanted to understand users' frequency of use and their feelings about their frequency of use. The question of dependency is also conceptually tied to the question about if they feel that maps and navigation apps have changed the way they travel, get places or otherwise navigate.

We asked this because we were interested in seeing if they had noticed any differences between past and current behaviors. For this we anticipated seeing a greater difference across age groups, where younger users might not remember maps any other way while older users can remember a time before smartphones.

The next question was topically relevant as we felt that map and navigation apps usage might have been impacted by the current global pandemic. This is in part because of stay-at-home orders or other restrictions in travel might make map and navigation apps less used. We also asked this to make sure we disentangle the current unusual behaviours from their usual, normal usage of maps and navigation apps.

The last questions actually cover the main research question. These ask users what they felt their favorite features are and what areas do they think that map and navigation apps need to improve. For the first, if they have difficulty coming up with any features we reserved the option to go over the list of features (shown in Appendix A) with them, we also had a specific probe on finding out if they had any 'deal-breakers', such as items that must be present or not present for them to like or use the apps. We hoped that this would get us a sense of what people found the most useful overall. The second half of the main research question was their overall guess of what they felt needed to be added in order for the map and navigation apps to improve.

The final section of the interview protocol was called the outro or conclusion. This was meant to conclude the discussion. We first asked if participants had anything else to say about the topic that the interview might have covered. This was also the time to wrap up any earlier discussion of the interview questions that might have been knocked off course by the flow of the conversation at the time. We then ended the interview by asking if we could follow up with them if we had any more questions and thanked them for their time.

Consent

The informed consent was designed to provide the required information to the participants. The consent was largely unchanged from the survey consent, so only the changes will be discussed.

One of the changes included updating the duration of the study, as we anticipated the interview to take about half an hour. We also changed the procedure section, as this is an interview and not a survey. We let the participants know the rough content of the interview in this section in terms of what topics that the interview questions would cover. When it comes to risks, we assessed this study as minimal risk, and informed participants that their participation is voluntary and they can refuse to participate or discontinue at any time. However, while the survey was technically anonymous (although we only claimed confidential) the interview manifestly cannot be anonymous due to the methodology. In the confidentiality section, we let participants know that they would be recorded using audio or audio/visual equipment, and that notes, including quotes would be extracted from the interview. We also let them know that these quotes will be reported only with members of the research team and with the class professor. Additionally, we declared that the recordings would be deleted at the conclusion of the course.

The final change is that we moved from an anonymized consent language to a signature consent. This is because we are now collecting personally identifiable information in the form of recordings. Participants have to mark that they agree to participate in the study and then they sign and date the consent form.

Full text of the informed consent can be found in Appendix C.

Participants

Each member of the research team interviewed two adults. All sessions were recorded for later transcription and coding of responses. These participants are a combination of peers, co-workers, and housemates. A decision to select participants close to the researchers was made in order to ensure a quick turn around with regards to scheduling, implementing, and reviewing interviews. The participants were also selected because the researchers have a strong rapport with them and have their various contact information on hand in case follow-up questions need to be asked. In general, it was easy to recruit participants willing to be interviewed about their use of map and navigation applications. Participants were eager to participate especially given the interview procedure was estimated to be less than thirty minutes long.

In addition to the ease of access to these participants, they were also contacted to share their unique knowledge and point of view using map and navigation applications. For example, Participant 1 was specifically chosen because they were previously a commercial and military driver. In contrast, Participant 2 does not know how to drive and primarily depends on public transportation and walking. The information provided by these two participants offers quite the variation in the ways users interact with map and navigation applications.

Participant 3 and 4 were referred to the respective researcher through mutual friends. Participant 3 is a taxi driver who was referred to the researcher by a friend who is a manager at the drivers union. Participant 4 is a bike delivery person who was referred to the researcher through a mutual friend who owns a restaurant. Participant 3 and 4 were recruited because they each have their own unique needs from map and navigation applications for their jobs.

Participant 5 and 6 were chosen with their specific ages in mind. Participant 5 is a nineteen year old college student and Participant 6 is a fifty-five year old administrator. The goal of selecting these two users is to differentiate between how different age groups use the applications. Participant 5 is a young driver and needs maps to get to most places whereas

Participant 6 is comfortable with their surroundings and primarily uses maps to navigate to unknown areas. In general, these two participants were selected to determine which additional map features were used by people from vastly different age groups. More specifically, these two participants were selected to determine if the technological competency of their generation had an effect in the use of additional map application features.

Overall these participants were selected in order to procure data from different views with an overall anticipated end user in mind. These participants vary in age, location, and occupation, and thus can provide inside knowledge to their use of map applications that can be used to formulate an ideal application usable by anyone looking to get from one location to another without distraction. Additionally, the information given by these users provide us with a better scope of the necessary and unnecessary features of map applications.

Analysis

After collecting data, the research team transcribed their interviews. Two of the interviews had to be translated to English as well. We then shared the transcriptions in Google Docs, before transferring the highlights to a Google Sheet (Appendix D). This spreadsheet is laid out so that each of the main questions of the interview protocol is a column and that each interview is a row. As information for each question could come from multiple points in the interview depending on flow and probing, this allowed us to consolidate the interviews into manageable sections of text. The process of consolidating the interviews directly into the questions that are in line with our research questions ended up being an essential part of understanding our end results. It was also somewhat challenging as the conversations flowed and the semi-structured method meant that questions were answered when the topic came up rather than in a strict order. Thus picking out which parts corresponded to each question meant that we as a team had to dig in deeply to each interview and pick it apart. While this was time consuming and difficult, it also gave us a better understanding of the interviews overall.

The grid layout also allowed us to begin understanding themes across the interviews, which will be further discussed in the next section.

RESULTS

RQ1: What are user opinions about map and navigation app features?

Research Question 1 concerns user opinions about map and navigation features overall, but is broken down into two complementary questions.

RQ1A: What are the favored or must-have features?

The first half of Research Question 1, denoted A, covers users' favored or must-have features. Primary map application features that are key for users in order to use the application include accuracy, real-time information (such as traffic and obstacles) and nearby recommendations. Users found that their preferred navigation application is the one they like best because of accuracy of directions as well as accuracy of geolocation. Some of the most popular features are live traffic updates and the ability to reroute to avoid a traffic jam and having the ability to know how long the trip will take given the traffic and road conditions. As participant 1 said "Real-time information. That's pretty much my go-to favorite feature." This is in line with Participant 3's needs as a taxi driver "When I choose a path with traffic, it changes and shows me the best option." Similarly, another key feature is the ability to search around a location or route for gas stations or restaurants nearby.

Deal-breakers tended to focus on direct needs, such as non-driver Participant 2's integration with public transport "If it didn't have public transit, why would you even look at it?" or bicycle delivery Participant 4's need to control music without stopping his bike "By far, the best thing was when they put the option to control the music without leaving the app.". Participant 5 also valued an audio option, in that they need the app to "speak the directions to me".

RQ1B: What areas do map or navigation apps need to improve?

The second half of Research Question 1, denoted B, was about what areas that users felt map and navigation apps need to improve. While users value the accuracy of digital maps and directions, because it is the most valuable feature, it is also the feature users expect to work perfectly. In this instance, participants recommended that maps improve their accuracy and are better at giving more specific directions. As navigational technology improves, the ability to provide better directions to the nearest foot is what users are looking to have implemented into their navigation applications.

Given the way cities are constructed and how many cities have multiple roads or highways in close quarters to one another, users are looking for more specific locations within the map. Some users complained that the apps often show wrong information, displaying the car in nearby locations, such as a parallel street, due to the lack of precision. "You'd be going under a bridge, and all of a sudden you'd be on it going, or you're over it", said Participant 2. Accuracy and precision, like previously discussed, are what users are looking for and specifically with regards to seeing their vehicle and location in comparison to the map view. Users have noticed lags in the display and know that applications have not updated the view when they are driving and are instead shown that their vehicle is a mile or two behind their current location.

Users are also aware of more than just lags in their digital maps. They have additional concerns regarding when they are traveling through areas where cell service and signal is minimal, resulting in a digital map to not load or update

properly. They prefer if a map can download all of the information necessary to ensure they can complete their trip regardless of a digital connection.

RQ2: What history do users have with map and navigation apps?

The users that participated in this interview had a wide variety of experience with map and navigation apps. More than one user was familiar with non-digital, paper maps which required more knowledge of an area and the ability to properly navigate without technological assistance. Other users have had experience with Global Positioning Systems (GPS) that were previously used before digital maps were embedded in smart phone devices.

With regards to current map and navigation applications, many of our participants were familiar with MapQuest, one of the first mapping websites on the internet in 1996. Other users have had experience with TomTom, another navigation product popular in the early 2000s. In general, most users interviewed have some experience with either Google Maps or Apple Maps as well as Waze. Today, many of our users use map applications right through their smart phone rather than the computer.

Participant 4 has a wide variety of map application usage through different platforms that they shared in the interview:

> "I think the first one I used wasn't even using a cell phone. My dad had an old TomTom GPS, black, a little bigger than a cell phone. It had a horrible touchscreen, I needed to push. I loved it; I thought technology was impressive. Today we think it's rough, but at that time, it was pretty cool. We used it for many years in our car, plugged into that cigarette lighter plug. It had a base that stuck to the glass. But over time, the battery started to last very little, and my dad dropped it. I didn't use it for a few years. Then, I think I used Google Maps for a while, but there was a time when it didn't work well on the iPhone. And Apple's I didn't like. I think when waze came out, I immediately started using it. This thing about having traffic in real-time helped me a lot."

RQ3: When and why do users engage with map and navigation apps?

Our participants are using maps for a plethora of reasons; for work, for personal travel, for searching restaurants and more. Users who have worked in the food delivery service industry have provided plenty of anecdotes suggesting that their job could not be completed without the use of map and navigation applications. Given that many times, these deliverers are traveling to areas they do not know as well, map applications give them the confidence and the ability to ensure they will make it to their destination and deliver a customer their order in a timely fashion.

Users engage with their applications by previewing their route and searching for their desired location well before departing, as well as searching locations on the go. Respondents also narrated that they use apps when they want to trace the fastest route, even though they know how to get to the desired location. Participant 3, a taxi driver, said that the quickest way is required by his clients. "I always need to get there quickly, customers are in a hurry." For example, Participant 4 reported using the app because he often needs to find the most effective way, since he does his bicycle deliveries. "As I do bicycle deliveries, I can't waste energy. I need to go the right way, shorter, faster," he said.

The same user stated that he uses the apps when planning longer trips to another state to get an idea of the journey, but also of what he will find in the desert. He notes that "Sometimes I have to go somewhere, and I see how to get there on the computer first. I see how long it will take. The distance. Then I use Street View, take a look at the place." The use for planning in advance is also the custom of Participant 1, who says that "I tend to use it more for checking times and stuff. So it's before I leave".

Participant 4 also talks about an unusual use of the maps: remote tourism. He explains: "From time to time, I take a look at other countries too, I see sights. I see a city in a film, in a series, then I see on the map, the photo of the satellite, it's really cool."

RQ4: How have map and navigation apps changed the way they travel, opt to get to locations, or otherwise navigate?

Depending on the participant's age, map applications have a minimal or large change in their travel behaviors. Participant 3 shares that these applications have immensely altered the way they navigate sharing, "It has changed a lot. I used to carry a phone book (like the yellow pages in the US, with printed maps) in the glove compartment. If I didn't know an address, I would look there and find a way to get to where I wanted." This user has gone from stopping at gas stations along a route to search an address in a book to being able to search along a route with a smartphone without stopping.

Younger drivers, like Participant 5, feel more secure in their travels and more confident in their navigation. Participant 5 notes, "I only know how to get to so many places. And even when I've gone somewhere multiple times, I would rather just put it in to make sure I'm going the right way." Similarly, Participant 1 notes that they do not feel that map applications have altered navigating specifically, but have instead altered the preparation to travel noting,

> "I don't think they've changed the way I travel to places. They do change the way I prepare to travel to places. Because I remember, when utilizing the maps and having to learn an area, there was like prep steps. There was designing a route via the map. And then there was also looking at other side routes, and other like emergency plans... And I would learn, 'All right, in this chunk, if something goes wrong, I can't do anything about it. In this chunk, if something goes wrong, I've got this turn off and

this turn off, that will then lead me back to where I wanna go.' And I'd have to remember that. Now that it's both turn by turn and it gives you traffic up to date and it will redirect you and all that kind of stuff, I no longer have to plan my trips."

The ability to have up to date geolocations at a users fingertips provides a better sense of security when navigating than solely relying on landmarks like one would using a paper map.

RQ5: How dependent are you on using map or navigation apps in your daily life?

Regarding their dependence on apps, users had mixed opinions. However, they tended a little to the side of not being dependent. Participant 3, who adopted the technology as an elderly man, was incisive: "I am not and will not be," he said. The user even criticizes those who depend on technology and do not consider it just a convenience. "I know people who can't reach the corner without the map app. I like it, but I don't need it."

The two youngest interviewees, ages 19 and 28, admitted that map apps play a crucial role in their lives, especially in their professional performance. Participant 4 exposed the concern with the day that, for any unexpected reason, will be without the app, being in a complicated situation. "The cell solves everything for me, and I end up not knowing anything. Someday, it stops working, and I'll be lost", affirms him, who carries a backup battery, as navigation maps use a lot of energy. The same interviewee also stressed fearing that the app will influence his learning in his ability to learn the paths and landmarks of the city. The participant fears that his already perceived dependence may increase with time.

Most users pointed out that they can get by without the app and that its use is more geared towards making life more comfortable. For these users, and be a support tool in their travels. Participant 1 notes that he " still knows how to find where I need to go without a map app. I could still navigate via a normal map just fine. And I feel very comfortable doing that.". Participant 2, on the other hand, states that in its daily use, it has a general knowledge of the city, sufficient to not need the program. "Walking around, I'm fine. I'm usually doing the same bus routes or train routes or that kind of thing, so I am familiar with the stations and the stops I need. So, I'm not really that dependent on it.", She said.

RQ6: How has the global pandemic changed the way you use map or navigation apps?

The vast majority of respondents to the interview said that the coronavirus pandemic that affects the world has hardly changed their use of apps. Those who pointed out some differences talked more about the frequency of use than with the use itself. For example, Participant 1 stated that he seldom leaves the house and is left without driving. According to him, due to not being able to register his car, he could not drive and, consequently, to use map apps. Another one who also reported a decrease in use was Participant 3. According to him, due to the small number of flights at the airport (his primary customer base), his usage has dramatically decreased. The user also stated that he has checked the traffic conditions less since the streets are more empty. There is also no need to choose less busy roads. "I use the app much less. And the streets were also empty, traffic also decreased. So I wasn't too worried about the traffic. I put the address and go ahead", he added.

Participant 4 stated that his use of the map apps has increased, as the number of deliveries he makes to the restaurant he works for has increased during the pandemic. Participant 2 noted that despite the changes in the SEPTA schedules, Google Maps is still up to date, providing accurate information about the schedules, and the app highlighted the changes. "I personally haven't ended up noticing too much of a difference besides certain things [buses/trains] have been canceled, so I can't use them, but in terms of the map use, it's been about the same," she said.

DISCUSSION

Overall, the interview protocol and process was successful in procuring user thoughts on these applications. The ability to be flexible between structured questions and unstructured conversation allowed participants to freely discuss their thoughts and feelings about these applications. When discussing the different application features, some users needed more prompting and assistance remembering and realizing all of the features map applications have to offer, which was beneficial in leading to more in depth conversation. If this process needed to be repeated again for this study, the same protocol would be followed given that it produced anticipated results.

The users who participated in the interviews were forthcoming with information regarding their relationship with map and navigation applications. Users reference digital maps when they are in both known and unknown places. Maps provide a sense of security and comfort for divers ensuring that they will reach their desired destination in a timely manner without any errors. However, should there be changes in traffic or road closures, users enjoy having live updates about the world around them. Users continue to use map and navigation applications where they are in areas they have been before or are comfortable in just as a sense of security,

There are other additional features that users feel are imperative for a map or navigation application other than live traffic updates. Users enjoy that they can use the same application to navigate by car, or bicycle, or by foot in cities where they may be travelling by different methods of transportation on different days.

Map reading is not a natural skill but one that must be taught. People have differing skill levels in reading and understanding maps in addition to having differing levels of comfort and skill with technology. This means that there are two levels to

understanding and using map and navigation app: map skills and technology skills. In this and past research we asked for their technology use and skills, but have not addressed the map skills aspect that would need to be addressed in future research.

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Appendix A - Competitive Analysis of Map and Navigation Apps

	Apple Maps	Google Maps	Waze	Yahoo Maps	Mapquest
Street View	Y	Y	N	N	N
Satellite View	Y	Y	N	Y	Y
3D view	Y	N	N	N	N
Terrain View	N	Y	N	N	N
Turn By Turn	Y	Y	Y	Y	Y
Places (buildings on map)	Y	Y	Y	Y	Y
Road Speed/Speedometer	Y	Y	Y	N	Y
AutoComplete	Y	Y	Y	Y	Y
Ride Sharing	Y	Y	Y	N	N
Route details based on departure time	?	Y	Y	N	N
Avoid Routes based on tolls/Highways/etc.	Y	Y	Y	N	Y
Live Traffic Updates	Y	Y	Y	N	Y
Speed Traps/Cops	Y	Y	Y	N	N
Other Road Hazards (Construction, Water on Road, etc)	Y	Y	Y	N	Y
Lane Recommendations	Y	Y	N	N	Y
Preview Directions before you Go	Y	Y	Y	Y	Y
Share directions from Desktop to Phone	Y	Y	N	N	N
Suggested Places	Y	Y	Y	N	Y
Download Routes for Offline Use	Y	Y	Y	N	Y
Incognito Mode	N	Y	Y	N	N
Add a Stop to your Trip	Y	Y	Y	Y	Y
View Parking near Destination	Y	Y	Y	N	N
Remember where you Parked	Y	Y	N	N	N
View how Crowded a Train will Be	N	Y	N	N	N
Accessibility (Wheelchair)	N	Y	N	?	?
Navigate by Car	Y	Y	Y	Y	Y
Navigate by Train	Y	Y	N	N	N
Navigate by Taxi	N	Y	Y	N	N
Navigate by Motorcycle	N	Y	Y	N	N

Navigate by Foot	Y	Y	N	N	Y
Navigate by Bus	Y	Y	N	N	N
Share Arrival Time with a Friend	Y	Y	Y	Can send a route	Can send a route
Drop a Pin	Y	Y	N	Y	Y
Share a Pin	Y	Y	N	N	N
Augmented Reality	N	Y	N	N	N
Adjust Map Icons	N	N	Y	Y	N
Sync Calendar Events	Y	Y	Y	N	N
Time to leave notifications	Y	Y	Y	N	N
Indoor maps (malls, airports, etc.)	Y	Y	N	N	N
Interface - Web Browser	N	Y	Y	Y	Y
Interface - Mobile	Y	Y	Y	N	Y

APPENDIX B - Full Text of the Interview Protocol

Introduction and small talk - Allot about 5% of the time

- General introduction
  - Introduce self, mention what this interview is about in general terms.
    - We're going to talk a bit about map and navigation apps, but more about that later...
  - Give consent form for signature and collect.
    - Mention that the interview will be recorded.
  - Create small talk to build rapport by asking questions or making a joke about the situation to dissolve any tension.
    - Questions: How's your day going so far?
    - Jokes: Don't worry, I'm not going to give you the third degree today.
- Details about the Interview
  - I hope you will enjoy what we are going to do today, let me begin by explaining why I am here and what we are going to be doing in more detail. Any level of detail you want to give about the INFO 690 class or project. Your ideas and feedback are important and your input will be heard. It's okay if you can't answer any of the questions, this is not a test! If at any time you decide you don't want to continue, just let me know and we will stop. Again, the interview is being recorded so that we can review the tapes later. What you say will not be used in any way that could identify you. We will review the recording later, but only so that we can understand how you feel about map and navigation apps and how you use them.

There is a lot of ground to cover, so please try to remain focused on the core questions. I may give you gentle reminders to bring the discussion back to the core questions. I may also ask you to elaborate or clarify a comment you make.

Do you have any questions?
(After answering any questions and giving further explanations, continue with the interview. If the participant is no longer interested in participating, thank the participant for his/her time and end the interview)

Main part of the interview - Allot about 90% of the time on this.

- Questions

- Background Information
- Now before we begin, I'd like to know a bit more about you…
  - Age (optional or fill in later)
  - Gender (optional or fill in later)
  - Race/Ethnicity (optional or fill in later)
  - Industry/Job field
  - History of map and navigation apps
    - What was the first navigation or map app that you used? What was it like/How was it?

- Map/Navigation App usage
  - How long you've been using Map/Nav apps (if not already covered earlier)
  - How many Map/Nav apps do you use?
    - When (in what context) do you use them? (do you use them at different times or for different reasons?)
    - What devices do you use them on? (Probe, desktop, laptop, mobile phone)
  - How often do you use Map/Nav apps?
  - How has Map/Nav apps changed the way you travel/get places/navigate?
  - How dependent are you on Map/Nav apps in your daily life?
  - How has the pandemic changed the way you use Map/Nav apps?
  - What are your favorite features of any map or nav app?
    - If necessary, go over the list of features with them.
    - Ask them for any deal-breakers (that is, items that absolutely need to be present for them to like or use the app)
  - What areas do you think map or nav apps need to improve?

Ending - Allot about 5% of the time

- Conclusions/Outro
- Prompt if they have anything else to say about map or navigation apps that you didn't cover.
- Wrap up any follow up questions you might have had from earlier.
- Ask for if you can follow up with them at a later date about any of their responses.
- Thank them for their time.

APPENDIX C - Consent Form

INTRODUCTION: Before agreeing to participate in this research study, it is important that you read all of the information on this page. It describes the purpose, procedures, benefits, and potential risks of the study, as well as the steps that will be taken to protect your data. This page also describes your right to withdraw from the study at any time.

PURPOSE OF THE STUDY: The intent of this study is for the purpose of determining information about what map or navigation apps people use, how they use them, and what they like about different apps. This research is part of a class assignment for INFO 690 at Drexel University.

DURATION OF THE STUDY: This interview will take fewer than thirty minutes to complete.

PROCEDURES: The study is a simple interview, you will be asked about your background, what map or navigation apps you use, when you use them, and what you like or dislike about the different map and navigation apps that you have used in the past.

RISKS, DISCOMFORTS, AND PRECAUTIONS: There are no major risks or discomforts associated with this study. Your participation is voluntary and you may refuse to participate or discontinue participation AT ANY TIME. You understand that you will be recorded.

CONFIDENTIALITY: In this study you will be recorded using audio or audio/visual equipment. A member of the research team will take notes based on the audio or audio/visual recording, possibly including quotes. The notes will not contain identifying information and will only be shared with members of the research team and the course professor. The original recordings will then be deleted at the conclusion of the course.

COMPENSATION: There is no compensation for this research. We thank you for your time and dedication.

AVAILABILITY OF INFORMATION: If you have any questions concerning this study, you may contact Jennifer Bochenek (jlb599@drexel.edu), Tanina Urbanski (tmu23@drexel.edu), or Gustavo Ferreira (gsf35@drexel.edu)

Please read the statement below and indicate whether or not you accept the terms of this consent form.

You have read this consent form and have been able to ask questions and state any concerns. The researcher has responded to your questions and concerns, if any. You believe you understand the research study and the potential benefits and risks that are involved. By selecting yes below and signing my name, I am providing my consent.

____ Yes, I want to participate in this interview
____ No, I do not want to participate in this interview

NAME: ________________________________ DATE: ____________________

APPENDIX D: Transcription of Relevant Interview Segments

See attached excel sheet.