Mobile Wayfinding: An Exploration of the Design Requirements for a Route Planning Mobile Application

THESIS

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By

Taurean Addair Jones

Graduate Program in Industrial, Interior, and Visual Communication Design

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Masters Examination Committee:

R. Brian Stone, Advisor

Professor Paul Nini

Dr. Noel Mayo
Abstract

This thesis investigates mobile wayfinding as an application, which proposes to assure efficient destination success and resource access. Currently, academic institutions are growing at a rapid rate and have underutilized resources due to limited visibility; mobile wayfinding can address some of these shortcomings. In large collegiate environments such as The Ohio State University, wayfinding systems appear to be lacking in clarity and location. It is my belief that in leveraging the current technology adoption trends there is a need for the development of a well-defined mobile wayfinding system—a system that offers the type of wayfinding and resource access experiences that college students really need. The research includes an audit of current mobile wayfinding and global positioning technology. An audit, along with design research, informed the construction of a methodology that can effectively frame a mobile wayfinding experience for college students.
Dedicated to the Village (my family)

that never stopped supporting and believing in my dreams.
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Vita

2004 ...........................................Bachelor of Fine Arts, Graphic Design,
West Virginia University [Morgantown]

2004 ...........................................Graphic/ Web Designer,
West Virginia State University [Institute]

2005 ...........................................Graphic/Web Designer
The Ohio State University

2009 ...........................................User Experience Designer, OCLC
San Mateo, California

2010 to Present ................................Instructor, The Ohio State University
Department of Design

Fields of Study

Major Field: Industrial, Interior, and Visual Communication Design

Area of Specialization: Visual Communication and Interaction Design
# Table of Contents

Abstract.............................................................................................................................................. ii

Acknowledgments......................................................................................................................... iv

Vita.................................................................................................................................................. v

Fields of Study ................................................................................................................................ v

Table of Contents .......................................................................................................................... vi

List of Figures ................................................................................................................................. vii

Chapter 1: Introduction .................................................................................................................. 1

Chapter 2: Audits ............................................................................................................................. 17

Chapter 3: Research ........................................................................................................................ 24

Chapter 4: Methodology .................................................................................................................. 40

Chapter 5: Conclusion ...................................................................................................................... 59

Appendix: Supplemental Materials................................................................................................. 66
List of Figures

Figure 1. Map Altarpiece for the Cathedral at Hereford, England ................................. 5
Figure 2. 15th Century Plotemy Map ................................................................................. 6
Figure 3. ECAR Technology Ownership ............................................................................. 10
Figure 4. The Ohio State University Mobile Web Application ........................................... 17
Figure 5. Hampic—Ohio State Campus Application .............................................................. 18
Figure 6. University of Texas Campus Application .............................................................. 19
Figure 7. The Ohio State University Web Campus Map ....................................................... 20
Figure 8. Campus GPS simulation ......................................................................................... 21
Figure 9. Dashfly Route Planning ......................................................................................... 22
Figure 10. New York and London Schematic Maps ............................................................... 28
Figure 11. Ohio State Satellite View 1 .................................................................................. 28
Figure 12. Ohio State Satellite View 2 .................................................................................. 29
Figure 13. Symbolization and Spatial Relations (Absolute and Relative) ......................... 32
Figure 14. Aspects of Spatial Cognition (Structural and Functional) .............................. 33
Figure 15. Paper Prototype Setup ......................................................................................... 43
Figure 16. Paper Prototype Questionnaire Results .............................................................. 45
Figure 17. Wireframe Participant Setup ................................................................................. 50
Figure 18. Map Study Participant ......................................................................................... 56
Figure 19. Participant 21 (Map Study) Result ....................................................................... 58
Figure 20. Paper Prototype Questionnaire ............................................................................ 126
Figure 21. Home Screen ....................................................................................................... 127
Figure 44. Path View 5 ............................................................... 149
Figure 45. Bus Selection Screen 1 ................................................. 150
Figure 47. Bus Selection Screen 2 .................................................. 151
Figure 48. Buckeye Village Bus Route Window .............................. 152
Figure 49. Navigation Window – Design 570 ................................. 153
Figure 50. Buckeye Village Bus Route ........................................... 154
Figure 51. Campus Loop South Bus Route Status ............................ 155
Chapter 1: Introduction

1.1 Why Wayfinding

This research topic is a result of countless navigational struggles as a student and an employee of higher education for more than a decade. Closed systems, such as large universities, function like small complex cities to the unfamiliar faculty, staff, and student. Accessing information and resources is vital in an academic environment. The method at which to access these information points of interest is wayfinding. There is a language embedded into the environment of a campus. Yet, only those who can speak this navigational language can find their way to the answers (resources). If a student is to survive in college, that individual must find a way to navigate to the information. This investigation shows how this “walk” can be made successfully.

Gibson (2009) says, “The wayfinding designer’s work lies at the intersection of people and places. It is a collective enterprise, done with and for people, seeking to make extraordinary, interesting, and accessible places.” Further, if we can build massive complexes of information access, we can also make a way to this knowledge. A well-defined map, or wayfinding system can make sense of the inaccessible locations we have made.
Late in my design career there was great fulfillment in producing environmental graphics packages. Unbeknownst to me was the psychological affects my designs would have on people while they navigated these newly built facility spaces. Nevertheless, my experience with environmental graphics and wayfinding began prior to my graduate education and has now become a fundamental structure to my approach to design.

So what is wayfinding? Chubukcu (2003) says, “Wayfinding is the spatial knowledge about ones current location, destination, and the spatial relationships between them.” Another definition refers to wayfinding as the ability to “find your way” to a destination or location in an efficient manner, but still recognizing the target while approaching it (Chen, 2009). Wayfinding is how we observe and navigate our visual world. We grasp landmarks, paths, and other clues to lead us through visual confusion to our destination. Traditionally, wayfinding has been reduced to signage systems and maps in two-dimensional forms. Yet, with the rise of Google Maps, Google Earth, MapQuest, and other geo-spatial location-based navigating systems, wayfinding emerged in the digital domain. With the growth of handheld devices and access to the Web in transit, wayfinding has evolved and become mobile. With this mobility wayfinding provides users with a level of freedom from printed map experiences. Moreover, with this mobility came new opportunities to satisfy the navigation and route planning needs of end users who were seemingly lost in designed or non-existent wayfinding systems. Before we can
touch on the mobile experience in great detail, we must acknowledge the history and influence of printed maps.
1.2 History of Printed Maps

Gibson (2009) states, “As map designers for wayfinding systems, we have developed rigorous standards for informational hierarchy, typography, and color. Cartographers today focus mainly on database maps, which are often complex but visually unsophisticated because the original digital data they receive is crude or inadequate. Additionally, technical cartographic training rarely promotes understanding of, or commitment to, design quality. In a sense what we are doing is anachronistic: it integrates the design, illustration, art, and visualization skills once practiced by traditional map designers.”

In this statement Gibson references the foundation of map-making, which the mobile wayfinding industry rests on. As mobile map designers we have the ability to integrate the Web and on-site experience, which is becoming critical in information architecture and wayfinding. The lines are seemingly blurring and the results can only yield advantages and resolution to the visual madness that has persisted in some environments for far too long.

However, to find better comprehension we must look back into the beginning of cartography. There is a sequence to map development across time. Some cartographers might even call the transition of map development an “evolution” or the key points of change, a “revolution in map development.” Robinson (1995) says, “Each revolution leads to a new map type.” Map transitions, such as aeronautical
charts, special navigation carts, nautical charts, topographical maps, image maps, general reference maps, thematic maps, statistical maps, astronomical, and figurative maps, are a result of these evolutions in map design. Research shows that early maps were more figurative than literal. Early map users lived in environments that were very chaotic and mysterious (similarly to collegiate student experience). Therefore, these map users used things other than physical space to simulate their environmental conditions. These early maps were very figurative in design and emphasized low spatial fidelity (Robinson, 1995). The 13th Century map altarpiece

Figure 1. Map Altarpiece for the Cathedral at Hereford, England
for the Cathedral at Hereford, England, (Figure 1) was very figurative and allegorical. Moreover, its 1,000-year counterpart from 15th Century Ptolemy (Figure 2) reflects the geographical knowledge of the known world. The view of the data is conflicting in idea of the known world.

Figure 2. 15th Century Ptolemy Map

However, figurative non-geographical mapping design is still represented in maps we use today. One can infer that this non-representational form of map design has adverse effects on the end user. Dorling (1997) states, “In many societies there were irreconcilable differences in the worldview shown by maps produced by and for the philosopher or thinker, and those of the traveler or scientist. Variations between cultures has also been apparent, even at similar time periods in history.” This is a remarkable quote, which emphasizes the differences in people of different
disciplines and cultures, and how they see the world and use maps to find their way. It can be inferred that map design cannot be broad based, because people see their spatial world differently. Mobile wayfinding seemingly could fill some of those gaps in perspective. Yet, there are still gaps in the development of these evolutionary map designs.

1.3 Why Mobile Wayfinding

Bowles (2009), states, “The ideal wayfinding system dissolves into behavior. It requires no inputs, and automatically knows our location and destination. Its feedback to us can take the form of subtle visual, audible, or tactile cues—highlighting the path ahead on some display, or even providing a gentle tap on the shoulder when we move in the wrong direction.” Mobile wayfinding is a complex and evolving issue. It is a topic that is etched in the anxiety shared by individuals around the world. A feeling that is not rooted in gender, race, socio-economic status, or even age. This feeling is being lost and the inability to find your way to destinations and resources in scenarios that are complicated by spatial relationships and time.

Follet (2007) says, “Technology adoption today offers an unforeseen solution to finding your way. Mobile devices offer the greatest opportunity for satisfying people’s wants and needs by providing context-specific, time-sensitive interactive experiences.” Therefore, it is my hypothesis that a well-designed application using global positioning system technology can empower a student to more efficiently
plan routes and access resources via mobile wayfinding, thereby streamlining and enhancing the collegiate experience.

In this document you will find a proposed set of requirements for a mobile wayfinding application that will enhance the collegiate experience by increasing routing efficiency through campus walking paths. Other enhancements include mobile access to nearby dining service locations, class schedule, and bus routes. The findings from my study focus on the first-year experience student population at The Ohio State University.

Research shows that college campuses, vibrating with life and new possibilities, can also be a scene of stress and anxiety. It can be inferred that the access to available resources can easily decrease student stress if necessary resources are known and have clear accessible paths. Famed psychologist and industrial designer Donald Norman, author of The Design of Everyday Things, once stated that the operation of products and spaces should be self-evident, humane, and intuitive. Nevertheless, college campuses are everyday spaces and should be usable, not only by the local students, but students from all over the world who have dreams of academic excellence and self-actualized pursuits. Poorly constructed wayfinding systems can make these pursuits more challenging.

Further, approximately 7,000 new college students at The Ohio State University are subjected to these poorly constructed university wayfinding systems. Managing the route planning associated with critical destinations or points of interest is becoming a difficult undertaking. First-year experience students
seemingly enter into a totally different world. Buildings look the same, and streets and paths yield little distinction from the next. Each quarter offering a new experience, a new destination, a new anxiety nested in unfamiliar locations bound to places they must travel to. If that anxiety is not enough, students often have changing schedules on a campus with exponential growth and unforeseen construction. They fall victim to detours due to development plans attempting to keep up with resource demands. Data from (S.D. Smith, 2010) and the ECAR study show undeniable statistical data for the development of a well-defined mobile wayfinding system for collegiate environments. This research shows that 285,000 students were polled ranging from freshmen to seniors at 100 four-year accredited United States institutions and 27 Canadian two-year intuitions (Figure 3). The ECAR study shows that 62.7% of students nationally own an Internet-capable handheld device. Therefore, it can be inferred that many universities are not updating existing campus wayfinding signage. There is an opportunity to keep pace with technology adoptions trends as well as to accommodate the navigational experiences that college students need.

Implementation of a mobile-map-enabled application could fill a critical gap in student wayfinding needs on campuses in the United States and Canada. Further, to understand how mobile map experiences can benefit this population we must first analyze the history of mobile maps.
1.4 History of Mobile Maps

To better understand mobile wayfinding you must first understand map-based mobile services, specifically the origin of mobile maps. Maps are one of the easiest forms of communication for users to understand. It can be inferred that most people can pick up a map and orient themselves in any environment fairly quickly. Moreover, mobile devices (PDAs, mobile phones, tablet computers) have far exceeded the number of traditional personal computers. The tools that were once called toys are now being seen as necessary to enhance productivity and efficiency.

With the advantages of remote access to mobile maps and the Internet, people of all demographics and socio-economic statuses are better prepared to take on their wayfinding tasks at hand. Historically, nomadic tribes had to rely on sensorimotor perception of the ambient environment. Nevertheless, having
technology that can increase mobility by directing and redirecting individuals to specific resources is not always an advantage unless the device does not become intrusive to the user. Meng (2005) says, “...the synchronous interactions with the reality of its map that is usually not “life-like” exert and increased cognitive load on the part of users.” A users interaction with a map extends beyond the traditional dimensions of its physical form. Something happens in the psyche when end users view a printed or digital map. Consequently, if there is mental strain to relate the visual elements, symbols, or paths to reality, there will be increased cognitive load. This cognitive load will ultimately result in a lack of desire to utilize the map or application as a resource or guide (Meng, 2005). Therefore, to design a mobile map or wayfinding system, the visual elements must relate to the physical world and be well designed or it will not serve as a mobile enhancement, but as an impediment.

Later in mental models we will touch on how visual elements on schematic maps and their fidelity play a critical role in cognitive recognition and usability. However, more specific to this topic is the physical form. Research shows that in order for a device to be unobtrusive it must be almost invisible to the user, yet have unparalleled visibility of these types of visual elements (map symbols), which are easily comprehensible. This topic has been difficult to research because of its demands. Augmented reality and ubiquitous computing experiences have now become a reality. The implications of these enhancements and their results are beyond the scope of this study. Nevertheless, it is impossible to ignore these factors. With further technological advancements, screen size and the clarity of symbols and
elements on mobile maps will break free from the traditional barriers of the device and present an unprecedented wayfinding experience for students in higher education—experiences where they are not cognitively limited to rendering their location in space via a device. Students will be navigating in a geo-spatial system with limited or zero visual constraints.

**Map Types and Multi-Views**

Map design, or visualization in cartography is an intensive psychological process. Designers must be able to bridge spatial and non-spatial attributes. Three-dimensional elements are flattened on a plane and rendered seamlessly in order for the mind to resolve the visual elements, distance, and points of interest. These elements are often scaled down to accommodate a limited display in the pre-digital era of map design. However, computer-aided design has dramatically expanded the possibility of map based interfaces depending on their intended usages. Screen maps in the pre-Internet era can be resolved into three categories. These categories are view-only maps, analytical maps, and explorative maps, (Meng, 2005).

**View-Only Maps**

These maps similarly to those printed were used as a storage medium and a presentation medium for geo-information. Mostly these maps were for knowledge transfer from the map designer to a particular individual or audience. Moreover, multimedia solutions, such as infographics, acoustic symbols, 3D graphics, and
animations, can essentially improve the expressiveness of map symbols and open up many new perspectives and modalities of map perception (Meng, 2005). Therefore, in the pre-Internet age the possibilities were large for these types of maps. However, much was left to the user's ability to receive the information that was being given and apply it to their domain knowledge and routing needs. Further, the reliability of these maps was contingent on the quality of graphics, aesthetic aspects, and geometric accuracy of map symbols. All of these were usually the main criteria for evaluation.

**Analytical Maps**

An analytical map serves as a presentation medium and an interface that connects users with a database of geographical information. What it visualizes can be both the geographic space and the associated hyper-dimensional information space spanned by the geo-database. Seemingly these types of maps could be useful if the database did not interfere with the aesthetics of the map design. Further, (Gabbard, et al., 1999) believes that there are two distinct domains that make up interactive system development—the behavioral domain representing the view of the user and the user’s interaction with the system, and the constructional domain representing the view of the system developer and the overall system. Meng expresses that the downfall of analytical maps is that users have to spend an overwhelming amount of effort in learning advanced interactions with the map. Coincidently, the usability of these maps were likely to decline because of the
increased cognitive load associated with learning complex map interactions for wayfinding.

**Explorative Maps**

MacEachren and Kraak (2001) state, “An explorative map serves as a presentation medium, an interface and a thinking instrument that visually supports its users to confirm or generate hypotheses, detect hidden concepts, and value-add the underlying geo-database. Multiple expressions that stress different aspects of the same dataset and their multimodal access are typical design strategies to facilitate the exploration.” These types of maps give a more rich experience to the end user. Users are given a type of maximum freedom to manipulate the mapping content. The experience becomes much more hands-on with this freedom. This facilitates an environment of interactivity through mutual information gain. However, this atmosphere also has cognitive implications because there is a learning curve with this effort. The user also will run the risk of getting lost in the virtual map environment’s infinite possibilities.

**Web Maps**

The emergence of Web maps brought on a multitude of opportunities for map users. The ability to access maps and interact with them in real time via personal computers was a huge step forward for map designs and wayfinding. Nevertheless, Web design and Web map design proves a more complicated process
due to the accessibility of worldwide spanned data sources and changing user behavior. A familiar principle with these technology situations is that technology will change rapidly, yet people change fairly slowly. However, when people (end users) do change it can have disastrous outcomes of technology adoption and applications. Weinreich, et al. (2003) says, “Statistic investigations have revealed the fact that about 50% of Web interactions are hyperlink actions.” There is a great opportunity for a user to lose their way attempting to find their way.

As a whole, Web maps are a rather intrusive and “thick” interface. Being bound to stationary computers it usually occupies the entire vision field of the user, thus demands their exclusive attention. As previously stated, Web maps made huge strides as a utility for wayfinding. However, the interface associated with Web maps can hide the wayfinding experience. There is nothing worse than a virtual layer of confusion seemingly clouding your vision while you attempt to navigate to your destination. The stationary nature of Web maps eventually proves to become a hindrance as well. Routing to a destination via screen recall or printed directions in an unfamiliar environment has its own difficulties.

**Mobile Maps**

Mobile maps however, are not free from their shortcomings as well. As previously stated, it is difficult to research mobile maps because much can be said about the impact of the intrusive or unobtrusive form of a mobile device and the size of wayfinding elements in the device’s display. Other technical factors that are
Influential are energy supply and bandwidth of the wireless network. The non-technical plays a factor, such as critical user tasks, constantly altering environments to volatile user emotions (stress from environment). These factors force designers to sacrifice visual elements to accommodate only the information that is truly needed and can be accessed with effortless comprehension and light interactivity.

Mobile maps are somewhat like a snapshot of an environment around a certain location and time, but with highly selective information and integrated intelligence.

Often a few points of interest (POI) floating on a skeletonized background graphic would suit the short-term memory of a mobile user better than a more detailed presentation. Because of the volatile nature of mobile maps the designer focuses the use of the map to first-time or one-time use. Apart from the technical issues, such as network accessibility, positioning quality, and transmission speed, the designer has the essential task to match a “meager” map with the “meager” user requirements filtered through a very narrow space-time slot. The matching must take place in real time or pseudo real time, which means that its user will not accept a mobile map unless it is immediately usable (Schult and Kretschemer, 2003).
Chapter 2: Audits

2.1 Wayfinding Systems out of Context

In order to gain a better understanding of the design requirements for a mobile wayfinding system of this nature, audits of existing campus geo-location systems and general global positioning technology were performed. The purpose of this audit was to focus on how geo-location technology is currently meeting the needs and can better address the needs of campus populations nationally; specifically Ohio State. Systems
that were analyzed closely via this audit were The Ohio State Campus–Hampic, University of Texas Campus Application, The Ohio State University Web Campus Map, Campus GPS (Simulation), and Dashfly. It was important to identity through this audit what systems were in context with the route-planning objects of the research.

Figure 5. Hampic—Ohio State Campus Application

In Figure 4, Ohio State has developed a mobile Web application that addresses some of the issues that are unresolved in the campus Web map (Figure 5). However, per my research it is link heavy and can create confusion through the hierarchy. One could infer that many of the features of this program are not really what the students want and appear to be a result of organizational mandates. The research conducted via the paper prototype study in Chapter 4 yielded findings that are more reflective of the needs of the first-year experience student populations. Athletics, Downloads, Social Media, etc. were not at the top of the list of features for a device focusing on mobile wayfinding.
(specifically route planning) as a critical need for first year experience students. These students are a demographic that is the majority at Ohio State. The Ohio State University Web Application (Figure 4) is in general an allocentric mobile map that needs to be transformed into something egocentric so that the end users’ needs are more adequately addressed. The device does, however, touch on the bus routes (CABS) and some other needs addressed in my investigation. My secondary research also found the Ohio State University Campus Application, developed by Hampic Design (Figure 5). This appears to be another application, which is not focused on the route-planning needs of the student population.

Figure 6. University of Texas Campus Application

The emphasis seems to be geared toward finding locations on a campus via driving routes and quick access to Ohio State football scores. Finally, my research also discovered numerous applications similar to those illustrated in Figure 6 that are more focused on the exploratory wayfinding tasks than scenarios where students are placed in
exhaustive searches. This investigation will go into more detail of wayfinding tasks in the research portion of this study.

### 2.2 Wayfinding System in Context

Similar to the mobile application, the The Ohio State University has for years used a Web map that has several critical usability issues. However, as a tool it still emphasizes the key principle of how students search for building names by finding them in their spatial environment. As far as the issues, the campus map is viewed at a distorted angle. This is problematic, as students attempt to cognately orient themselves. The map is divided into quadrants with the north being to the east. It is a pictorial representation that is linked to Google to supply the routing needs. Though Google Maps is a powerful tool, it does not map the walking paths necessary for students. Instead, the map uses traffic routing to guide students to buildings that are not easily identifiable by the map.

![Figure 7. The Ohio State University Web Campus Map](image-url)
Gibson (2009) says, “A more schematic map can be labeled with text directly on the illustration or by means of a key. The key lists the different symbols, colors, and marks that appear and shows how to decode the information.” Ohio State’s Web map does not seamlessly work with the environment and its users’ needs. It is difficult to find where you are on the map because there are no location-based services to plot your current location in space. A user can find bus stops but travel times and a real-time view of where the buses are in relation to your location is not available. In the future, location based technology, specifically RFID-based wayfinding design, will even assist users on campus with cognitive disabilities via human-activity assistive technology (Change, 2010). Figure 8 shows secondary research conducted in a rich media class at The Ohio State University. Research

Figure 8. Campus GPS simulation
from this simulation led me to refine my focus of the application. I perceived that parking, biking, and driving were no longer critical as the investigation was pointed at first-year experience students who may not have been utilizing these resources in high volume. My primary research from the paper prototype study (Chapter 4) would support this assumption. Figure 9 is from a Web site called Dashfly, which utilizes routing points that a user gives to calculate the exact route destination order a student should follow. The downfall to this Web application is that it utilizes road directions instead of walking paths to take students to their desired locations, losing critical time via underutilized campus walking paths.

Figure 9. Dashfly Route Planning

Through this audit it can be inferred that mobile wayfinding is a complex system to construct for a college campus. Several of the systems outlined in this section have designed wayfinding experiences, but have missed the mark in regards to mobile route planning needs. Systems similar to the University of Texas’s application are more
exploratory based, while Dashfly is close to the functionality of a route-planning application, but does not utilize available walking paths, which are critical for efficient routing. This audit proved to be important in distinguishing the function of the design guidelines that were constructed, and how to better focus the functionality on route planning and not other geo-location-based initiatives. Next is the research section of this study.
Chapter 3: Research

The approach to this research was to understand the psychology and visual tools used by students to orient themselves in their spatial world. The method to my research was to understand how to construct a map with affordances and how survey knowledge influences cognitive maps. Further, for design guideline development it was important to develop a comprehension of how mental models could influence the representational model of a student, the strength of symbols in defining spatial relations, and how to delineate wayfinding tasks. In addition, specific aspects of human spatial cognition were relative to the construction of these design guidelines, as well as understanding the setting of mobile navigation and what egocentric, allocentric, exocentric maps meant to mobile wayfinding for college campuses.

3.1 Affordances of Maps

Affordances relate to what you can do and cannot do in relation to a task or process. Affordances are critical to interactions with maps. A good example of affordance is a door with a long push bar for access. The cognitive interpretation of the bar would lead the user to think that they can seemingly push anywhere on the bar and the door will open. However, if the door is not designed properly and the weight is not evenly distributed, a user can be left dumfounded with their progress halted. Why? Because the affordance of push cognitively has been replaced with the
reality of "You can only push this specific spot to open." Meng (2005) outlines some of the most important affordances in the visualization of maps as follows:

- As a visual stimulus to be seen. The overall layout is perceived as an advertising and eye-catching unit.
- As a work of art to be admired. The aesthetic aspects of design elements are perceived and evaluated.
- As a valuable document to be carried with. Due to its general usage a map is able to emotionally safeguard the user for his spatial tasks.
- As a regenerative knowledge pool to be shared. Networked users can exchange their spatial ideas synchronously or asynchronously through a map and depict the results in the map.
- As a symbolized presentation to be decoded. Descriptive information answering the questions such as ‘what is it?’, ‘where is it?’, ‘how much is it?’, ‘how far is it from one place to another?’, ‘why is it so?’ is embedded in map symbols and their relations. It can be interpreted by virtue of map legend, interactive tools and user association.
- As an intelligent agent to be relied upon, procedural knowledge on ‘how to do what and in which order’ is encoded as self-explaining instructions or self-evident gestures can directly guide user activities, such as travel planning, fleet management, traffic monitoring, etc.

Map–based mobile services are a special type of value-added location base service (LBS). They afford both the descriptive information and procedural knowledge through mobile maps.

3.2 Survey Knowledge

Another important component in wayfinding is survey knowledge. The best cognitive maps utilize well-defined survey knowledge and topical structures for environmental applications. In London, England, tourists struggle with navigating the city because it does not have strong visual indicators for survey knowledge. The famous underground map is a schematic map that does not align with the surface geography. The map clearly defines subway routes. It is confusing and off-putting
for tourists and locals who will often exit stops early because it is more efficient to walk than to use the next stop in transit. Similarly, if Ohio State students use the University Web Application, Google Maps, or MapQuest they may find defects in spatial distance. These defects affect their ability to gauge survey knowledge. Further, because the knowledge gleaned from maps is orientation-specific and separate from poor mapping resources, people eventually learn those environmental visual clues. For students learning these visual cues is necessary in order to navigate and judge distances with schematic maps that are bad representations. Bowles (2009) states, “...we learn areas better by exploring them, which gives us survey knowledge that isn’t, based on any particular direction.” This means that cognitive maps are fluid, changing with context and time to form more coherent wholes.

3.3 Mental Models

An interesting application of wayfinding is mental models. When dropped in complex environments, people form their own representational model of the world, or a mental model. Therefore, when in application to cities, the same mental process takes form. As previously stated in regards to survey knowledge, we digest and interpret visual cues that are engrained in our surroundings.

“Some cues are implicit, woven into the fabric of our surroundings: urban density, landmarks, or even the flow of traffic. Others are explicitly designed to describe the structure of a city, such as maps, signs and street naming conventions. As with any designed system,
some cities are more learnable than others. Contrast the regular grid, tall landmarks and self-explanatory street names of New York with the organic sprawl of London,” (Bowles, 2009).

Our minds ability (or inability) to find legibility in these visual cues and decipher them into something tangible has heavy cognitive load and implications on our (a student’s) ability to navigate an environment. The following figure shows an aerial shot of the New York and London city structures (Figure 10). Clearly there is a distinction in the visual legibility of the map from New York to London, and one can infer that there is increased difficulty in navigating these environments.

The same perspective can be applied to Ohio State, shown here through Google Maps (Figure 11-12). You can see the increased overall legibility in the satellite views. Both maps are shot from the same perspective. However, as the map pushes from reality and applies a schematic tone, legibility increases but some walking paths are defined while others vanish as if they were never there. These paths, however, are critical in mental models. A student must not see a deviation from the mobile map to the reality if they are expected to plan a route to a destination efficiently. It would be as if a road that is routinely traveled each day by a commuter suddenly disappeared and they were forced to take an alternate route.
Figure 10. New York and London Schematic Maps

Figure 11. Ohio State Satellite View 1
3.4 Wayfinding Tasks

For a student to plan a route, there must be a wayfinding task. These tasks can be broken down into three categories. The first is naive, or exhaustive, search, which is when a student does not know where their destination is. The second is primed search, where a student knows exactly where they are going. And the last is exploratory search, which can be explained as having no set destination. In the user experience domain, these methods sound ironically similar to digital information retrieval. There is a commonly accepted notion that most wayfinding tasks will have a mix of these three procedures. Directed wayfinding is also tied to these tasks. It is associated with the behavior of a navigator who is seeking to access a destination or multiple destinations. The success of this action is the result of the distance of destination and the navigator’s current location (Weiner, 2009).
Ohio State Department of Design Alum, Mark Potnick, touched on the
theories of procedural knowledge, survey knowledge, and landmark knowledge in
his thesis *Organizing Our Spatial Lifestyles*. Bowles touches on procedural knowledge
as it applies to planning routes, as follows:

“Complementing survey knowledge is procedural knowledge: the
means of getting from A to B, via C. Sometimes this can be sufficient
alone. Plan a route in advance or get directions from a passer-by and
you may well find your destination, but if the instructions are flawed
or there’s a change in conditions (roadwork), procedural knowledge
collapses quickly and you’re left to improvise or retrace your steps,”
(Bowles, 2009).

It is important to understand when designing applications for mobile wayfinding
that the context also cannot be controlled.

As referenced in mental models, the environment plays a huge role in how
the device will be used. Users, or students in regards to this study are on the move.
It is difficult for them to concentrate on physical environment factors and the digital
context simultaneously. Consequently, if there is a breakdown in the procedural
knowledge (mental model/ virtual / reality), the wayfinding task becomes
inefficient.

To further elaborate the importance of procedural knowledge, there must be
an understanding of spatial characteristics. Meng (2005) states, “There are multiple
map types and multiple views. Alternatively we can adopt the term used in
spatialization research of ‘fidelity,’ which describes map-types in terms of how faithful they are to reality.” You can then decipher the level of spatial relationships as it applies to the above maps. Are they simple or are they complex, and what type of load does it place on the cognition of a student as they define their wayfinding task? In one of the satellite views, more information is available about spatial arrangements. However, the map will become less legible and the users will lose understanding as they view the map.

3.5 Symbolization and spatial relations

Symbolism is key to mobile maps because it impacts a student’s cognition and their ability to understand spatial relationships. Meng references symbolism as either absolute or relative. If you view a symbol on a map as absolute, it is seen as holding a region of space or consuming “white space.” Further, if you view a symbol as relative, suddenly it has dimension, contours, and a form in space. An example for a college campus would be trees or buildings not being viewed as flat structures but with dimension that can give a student visual cues and structure in their landmark, procedural, and survey knowledge.

3.6 Aspects of Human Spatial Cognition

Further knowledge in understanding wayfinding as it applies to route planning can be placed on wayfinding “chromes.” Klippel (2003) defines wayfinding chromes as mental conceptualization of primitive functional wayfinding and route direction elements. Because they point to the functional aspects, i.e. the actions that
take place in environmental structures; they reflect procedural knowledge objects (Neisser, 1976). In this sense, wayfinding chromes are schemata and do not as such concern categorical knowledge about physical spatial environments.

Further, these chromes can be broken down into two forms, structure and function. This is critical in wayfinding systems for college campuses. These systems outline a grid of roads and paths, which would be the structure. However, the function is specific to how a student would navigate the environment, or more specifically, the decision points. In order to find successful navigation wayfinders need to know these points especially when the environment becomes unfamiliar (Schmid, 2011). Therefore, in defining the design requirements for a system of this nature, you must have a well-structured map that also shows the function specific to how a student can navigate the complexity of the environment. Several applications in the audit sections of this study show the structure, yet place little emphasis on the function.
More emphasis on the design can be placed on focus maps. Focus maps are maps that are designed in such a way that a user’s attention is drawn to a specific region of the map—usually the region that is necessary, or critical, for navigation. Different shades of colors and intensity focus the users attention to the critical part of the map. A fading effect away from the critical point of interest will lead the user’s eye to the points.

3.7 Mobile Navigation

Another important aspect of mobile wayfinding is the context of the users focus while moving. Context-dependent navigation is vital to a mobile student user. Different situations can impair the student’s ability to utilize navigation while on the move. Meng outlines the specific variables to be considered. Some of the most important factors are as follows:
Skills and Experience
- Map experiences
- Abstraction ability (turning the map to north)
- Knowledge about environment
- Familiarity with map features
- Age, health

Mode of movement
- By car
- By bicycle
- By foot (pedestrian)

Reason of moving
- Direct path to goal
- Tourist tour
- Shortest, fastest, specific distance, most scenery, secure, or easy route

Time of day/year
- Rush hour
- Road restrictions
- Daytime/nighttime (some objects cannot be seen at night)
- Summer/ winter (restricted visibility)

A critical point from this data as it applies to designing a mobile application for college students is that they will be bound by their environment. There are factors outside of the constraints of a map that will play a vital role in how a student will utilize a mobile application on a campus. Some may be limited to specific distances because of disabilities, age, and season. Yet, others are limited by daylight because they find it unsafe to travel to certain points of interest at night. Nighttime navigations for women may add an element of danger. From fear comes the desire to rest on prior critical explorative navigational tasks (Zhang, 2011). “A navigator needs to understand spatial relationships among objects in virtual environments to construct a comprehensive cognitive map. Being able to explore the space is as
important as being able to reach the destination quickly in these areas," (Zhang, 2011).

Moreover, for a mobile navigation user the processing of routes is also based on weighted graphs. Different graphs are used in application to the different degrees or levels of freedom. A user who is driving has less freedom than one who is biking. A user, or student who is bipedal has more freedom and routing options than both a biker and a motorist because of the availability of multiple walking paths. Pedestrians, or students, have the complete open space to navigate to destinations. The bipedal nature allows them to avoid mobile impediments by motorists, such as traffic jams, and red lights. Bicyclists are unable to ride on sidewalks and are constrained by other limitations as well. First-year experience freshman make up the majority of the population at universities, such as Ohio State. Nevertheless, research from the wireframe and paper prototype study references the bipedal and bus route planning needs of this demographic (Chapter 4). Consequently, further research shows that weighted graphs are the reason for the lack of routing efficiency for student pedestrians.

Meng (2005) states, “This needs an adaptation of the graph for the route processing for pedestrians, e.g. by changing the weights in the graph. In most cases, especially in city areas, the pedestrians will use the roads or footpaths along the roads. Because of the lack of adequate data, in our case the existing data for car navigation system are used instead.” Critical time efficiency is lost because car paths or bike paths are used instead of strong walking paths. A well-designed mobile
wayfinding experience for college students must have graphs that are sensitive to the walking paths that they are using.

There are two types of route directions to communicate navigation information. A user either receives this information through **description**, or verbal instructions. Or they are receiving it through **depiction**, a visual routing map. In addition, the structure of the semantic content has specific characters. The content is composed of **landmark**, **orientation**, and **actions**. Landmarks can be divided into three categories: **visual**, **cognitive**, and **structural**. Meng (2005) says, “In our view, landmarks are topographic objects that exhibit distinct and unique properties with respect to their local neighborhood. These properties determine the saliency of the objects, which in turn depends on different factors, like size, height, color, time of the day, familiarity with situation, and direction of route.”

However, the most specific usage of this information about landmarks to mobile wayfinding for students comes in its application to route-dependent generation. Research shows that mobile computation of landmarks in this phase is divided into two different phases—one being the detection of potential landmarks in a digital database. The other is the choosing of landmarks that are relevant to a route. Apparently, the detection of these landmarks is completely independent of a specific route chosen for a user (student). Nevertheless, in the scenario of a mobile application developed for end users in a collegiate environment, efficiency is likely a priority under the constraints of new schedules and points of interest. I conclude from evaluation that if a user is to orient themselves in this environment, greater
transparency of landmarks in a district is needed especially in the case of re-routing and choosing multiple points of interest. It is my belief that it would be extremely difficult to orient yourself in a new environment with landmarks that are only relative to the path that is prescribed to you via a database.

3.8 Egocentric, Allocentric, and Exocentric

A highly theoretical concept, but possibly resulting in the positive implications for a mobile wayfinding application as developed for college students is the idea of egocentric map design. To understand egocentric map design you must understand allocentric mapmaking, which derives from making map experiences for a broad base of users. Whereas egocentric map design is more suited to individual users. The application of this map design can directly be applied to students who navigate a closed environment, such as a college campus. If an environment can generate location-sensitive maps, then their maps do not need to abide by allocentric design rules (broad user base). Also, in contrast to maps, egocentric images show data from seldom-viewed perspectives, which in turns connect their alignments to the environment (Moser, 2011).

Further, since egocentric maps are instruments of well-designed user tasks and not exploration devices, there will be reduced memory usage. This will cater to an ever-growing market of telecommunication devices that are nested in ubiquitous computing environments. From a usability standpoint this is a difficult task to accomplish, yet it has the greatest return for the end user if performed successfully. It can be inferred that environment-specific maps for a specific population will give
the greatest advantages for routing efficiency and what this population (students) really want in regards to a mobile wayfinding experience.

It is also important to understand that in these contexts, specific user emotions are a high priority. In high-stress environments, such as the first week of a quarter, an egocentric map that is developed with strong user-centered design principles could add a certain comfort and a feeling of safety in the midst of the visual chaos of changing schedules and new destinations via unknown travel times. Possibly a feeling of self-confidence, or advantage will replace the feeling of being lost or not empowered in a new environment. Similarly, the concept can progress the collegiate experience by adding confidence to replace the stress from the inability to access points of interests efficiently. If this is accomplished, then we find very positive outcomes. Nevertheless, defining a egocentric mobile map will be dependent on generating characteristics derived from user goals, demographic data, personal preferences, habits, visual literacy, ability of spatial cognition, domain knowledge, and computer experiences (Meng, 2005). All of this is still contingent upon the mobile environment and the intrinsic tasks, time, and pressure (new schedules). The map must be immediately accessible and yield shallow structured and available focused information to the user.

This structure could possibly come from context-aware adaptive maps. Users are hungry for intelligible systems that are user centered. They are desirous of the development of mapping experiences that access data for them and prepopulate their routing grids. Awareness of routine tasks and locations per
schedules and specific days would be a nuance that could amplify the mobile wayfinding experience as applied to collegiate systems. Automatically generated notification of specials of your favorite campus eatery, buses that are delayed, and campus-based errand task solutions could become the norm.

Maps are tools for planning and navigating from point “A” to “B” and often the addition of “C.” A system that can accommodate the sporadic wandering nature of college students who sometimes adhere to time-sensitive schedules would be of great benefit. “In wayfinding directions and in the maps we find two different kinds of spatial understandings. The egocentric view is the natural view of man and his many intuitive prosperities connected to it. The exocentric view is a synthetic view that has to be learned. It involves several difficulties, as we have to transform the view from exocentric to egocentric to be able to act on it,” (T. Porathe). Later, in Chapter 4 this investigation focuses on a map study that gets to the very core of how this very view can influence the wayfinding behavior of students. Exocentric, or the bird’s-eye view of a map, has its benefits and even scenarios where it is not as applicable in use for student navigation.
Chapter 4: Methodology

The methodologies utilized for this research were a paper prototype study, wireframe test, and a map study. The paper prototype study was a qualitative exercise, which was utilized to determine what the real requirements for the mobile wayfinding system are. The wireframe test informed the general structure and task flow of the system, while the map study defined the specific map perspectives necessary for route planning. The participants that were utilized for this study were first-year experience freshmen and graduate students. This specific population of the university was chosen because it could be inferred that they would have the least exposure to the university and could provide the greatest qualitative feedback regarding their frustrations (needs) and how a well-defined mobile wayfinding system could provide a resolution to their needs.

4.1 Paper Prototype Study

Paper prototyping (testing with paper) is a rapid contextual design tool. It is a quick way to get the first iteration of the user interface of a system. It is recommended that you test your prototype on participants in the field you are building the system for. In this process, participants were invited to co-design an experience with the interviewer. In the application of this methodology the user interface that was the outcome was important. However, the developed user interface was subordinate in comparison to the critical data that received from the
qualitative interviews that proceeded the work session. By asking participants to perform real-life tasks they, become fully immersed in creating an experience for themselves (Holscher, 2005). The root of this exercise as applied to my research was to receive feedback on what are the "real" experiences this closed population really desires and does not desire to have. These paper interface experiences are very simple for a user to understand. Similarly, it is easier for the investigator to receive what will work and what will not work. There is a contrast in your (cognitive) understanding prior to the exercise and your understanding (experientially) after the exercise (Buxton, 2007).

Recruited Participants:

Twelve participants participated in the research experiment. They were all first-year experience students, the majority of whom were freshman students. However, there was one first-year experience graduate and transfer student who participated.

Time:

The participants were informed that the exercise would last approximately 60 minutes, but would likely not run that long. A consent form was supplied from the Institutional Research Board (IRB) that outlined that each participant was free to leave at any time during the exercise.

Location:
The Frank W. Hale Jr. Black Culture Center (The Green Room). The Green room was a private room with no distractions from the culture center’s frequent visitors and staff. The Green Room allowed me to be hands-on with the participants in a more intimate setting, which enabled me to illicit participant confidence and feedback for the construction of the design guidelines.

Planning/process:

For the planning of this methodology there were several steps, which included the following:

The planning process for paper prototype methodology began with the configuration of the study. The planning of the data and the space (location) to collect information was also essential in the beginning. The next step was to make a paper prototype in order to develop a general understanding of what the final result should be. After the prototype was established, the brainstorming of user interface elements specific to a mobile wayfinding system began. The next step after the brainstorming was to the administration of the study and the analysis of the interviews. Finally, the careful analysis of the data and qualitative interviews informed the construction of the wireframes, which would define the structure and task flow of the mobile wayfinding system.
Setup:

User interface elements (search bars, arrows, buttons, weather icons, Carmen button, class schedule button, student services button, OUAB button, campus walking button, etc.) were supplied for each participant to utilize. Whenever a student could not find the element they needed, the investigator made it for them immediately or gave that individual the opportunity to draw it.

Figure 15. Paper Prototype Setup
Script (prior to the beginning of the activity)

“Thank you for agreeing to participate. Again, my name is Taurean Jones and I am a second-year graduate student here at The Ohio State University. I am performing research on mobile wayfinding. Here is a consent form. Please read and sign.

This research study consists of a survey + task. As you complete the survey I will ask you to place the paper user interface elements (supplied) on the blank pieces of paper (supplied), as you believe they should be arranged. If there is not a specific element here you or I can create it very quickly using these posted notes. At the completion of the survey/ task I will ask you how the application will help you in route planning (functionality). Your response will be video recorded, but your likeness and identity will not be divulged.”
Outcome:

<table>
<thead>
<tr>
<th>Participant #</th>
<th>Path</th>
<th>Satisfaction Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Path</td>
<td>$5 Yes</td>
</tr>
<tr>
<td>2</td>
<td>Path</td>
<td>$5 Yes</td>
</tr>
<tr>
<td>3</td>
<td>Path</td>
<td>$10-15 Yes</td>
</tr>
<tr>
<td>4</td>
<td>Path</td>
<td>Free Yes</td>
</tr>
<tr>
<td>5</td>
<td>Path, Rain</td>
<td>Free Yes</td>
</tr>
<tr>
<td>6</td>
<td>Path</td>
<td>Free Yes</td>
</tr>
<tr>
<td>7</td>
<td>Path</td>
<td>$10 Yes</td>
</tr>
<tr>
<td>8</td>
<td>Path</td>
<td>Free Yes</td>
</tr>
<tr>
<td>9</td>
<td>Path</td>
<td>$30 Yes</td>
</tr>
<tr>
<td>10</td>
<td>Path</td>
<td>Free Yes</td>
</tr>
<tr>
<td>11</td>
<td>Path</td>
<td>Free Yes</td>
</tr>
</tbody>
</table>

*Figure 16. Paper Prototype Questionnaire Results*
The outcome of this study provided clear information that would allow me to make inferences about the experiences and structure of a mobile wayfinding system specifically for college students. It can be inferred from the pool of participants that this population desired to have a device that utilized an exocentric satellite view for route planning purposes and an egocentric path view for efficient destination success. The participants felt that they needed multiple views in order to orient themselves in the environment. The user interface elements that were picked were across the board. Possibly emphasizing that the way that students utilize an application is not set in stone. However, it can be inferred that the key elements for route planning are campus walking paths, CABS (campus buses), and class schedules. All of the students felt that this application would have great value for them and their colleagues. Per this collegiate population, cost was a factor and the majority emphasized that “Free” was the best price point. Lastly, there was not consistency in the “deal breaker” for software experiences of this nature. Each student had specific elements that they found important. There were little or no trends in the data, which further supports the idea that a wayfinding system for a population such as this must not be allocentric or broad based. Though these broad-based geo-location systems have served us well, through interaction design we can break free from these molds into the products that do things that have done before (Cooper, 1999).
4.2 Wireframe Test

The next stage in my methodology was the development of wireframes or quick graphic representations of user interface elements. The wireframes were developed as a direct result of the data influences from the paper prototype interfaces, qualitative feedback, and survey information from the previous stage in my research methodology. The focus of this study was to test the architecture of the system and whether the experiences that were selected from the paper prototype data are appropriate. Six of the previous 12 participants from the paper prototype study were asked to participate in the wireframe study. The selection was not based on any gender or specific prototype development. The criteria for selection was influenced by availability considering the experiment was incentive free. Some of the following tasks had an “A” option and a “B” option in order to determine the appropriate structure, and function for the system experiences.

The tasks were as follows:

- Will you show me via the wireframe how you would check your class schedule? (A+B option)
- Will you show me via the wireframe how you will find a walking path from the Ohio Student Union to the Frank W. Hale Jr. Black Cultural Center? (A+B option)
- Will you show me via the wireframe how you will find out when the next Campus Loop South Bus will stop at the Ohio Student Union?
• Will you show me via the wireframe where the closest campus dining/food is in proximity to yourself?

Planning /Process:

Some of the things that were focused on during the development process are as follows:

The planning and process of the wireframe study began by creating user interface elements at a relative size and reasonably accurate. In addition there was the development of button elements, as they would be found on the actual user interface. Real words were utilized to set the context for utility and task flow. The next step was to make each element have simple shades for emphasis but not high fidelity—minimalized design was the appeal. Finally, the final step was the analysis of wireframe interfaces in relation to the qualitative feedback that was received. The data that led me to the structure and task flow of the system as well as a need to better understand the map view(s) that were applicable for a route planning application of this nature.

Time:

The participants were informed that the exercise would last approximately 60 minutes, but would likely not run that long. A consent form was given supplied via the IRB that outlined that each participant was free to leave at any time during the exercise.

Location:

The Frank W. Hale Jr. Black Culture Center (The Green Room). The Green Room was a private room with no distractions from the culture centers frequent
visitors and staff. The Green room allowed me to be hands-on with the participants in a more intimate setting, which enabled me to illicit participant confidence and feedback for the construction of the design guidelines.

**Setup:**

Similar to the paper prototype study, the wireframes were arranged in the Green Room on a desk. The tasks were arranged in a straight row with the experiences that had two options on top of each other. After the introductory script, each participant was allowed to move through the experiences voicing their actions and asking questions whenever they were confused. The functionality had two options: each student was asked to voice which they preferred and why. Again, this experience was to establish the architecture of the system and to lead to a firm conclusion on the appropriate experiences for a collegiate wayfinding application.

**Script:**

“Thank you for agreeing to participate. Again, my name is Taurean Jones and I am a second-year graduate student here at The Ohio State University. I am performing research on Mobile Wayfinding. Here is a consent form. Please read and sign.

This research study consists of a wireframe test. I will give you four route-planning tasks and I would like for you to show me how you would use this wireframe/clickable prototype to complete them. Each task will be audio recorded, but your likeness and identity will not be divulged. I would like for you to speak aloud each action and what you are thinking as they are performed.”
Outcome:

Participant 13:

- The “remember me” (password) option was important.
- The first page should have current schedule.
- Classes should be displayed by date.
- System should default to current location.
- Weighted graphs (bikers, student walkers) to show routing options for different modes of transportation.
- Estimated time of arrival is important.

Participant 14:

- Exit button for system works best on bottom.
- Routes are good, but participant would prefer the map to show different paths and routing of shorter distances.
- The “find my location” option should be the first option at the top of the screen.
- System should show the directions the buses are going.
- System should show the estimated time of arrival.
- System should highlight the buildings it would stop at based on my time schedule.
- System should connect with student class schedule and calendar.

**Participant 15:**

- [Walking Path Task] Participant would prefer to type in their current location and the destination.
- [Walking Path Task] Participant liked the first option [A]. Being able to see two buttons and the ability to enter in destination information and be done with it was a plus. This screen took the participant a little more time to process.

**Participant 16:**

- Exit button should be on the bottom.
- Menu button at the top.
- Student would like to read the route of the bus they want to take [screen before map].
• Participant told investigator that there is an application now that shows you campus bus stops and times the bus will arrive [Ohio State Bus Application-Hampic]. Student expressed that if she is running late, she does not care about where everyone else is going; she just wants to be able to see where her bus is.

• Participant could not understand the verbiage “or.” Student felt that it should say “and” instead. Option B was more confusing to student.

• Student felt that estimated time of arrival was important for when you want food fast.

Participant 17:

• Student preferred menu button at the top.

• [Walking Path] Student found Option B to be less confusing. The student was hopeful that they could click their destination and the GPS would know their specific location.

• Student expected to see a menu with the different stops. Student expected to click which bus they wanted. Participant also would want to see the estimated arrival times.

Participant 18:

• Participant wanted to see aesthetic bubble icons to present their current location and destination. The labeling of “A” and “B” on map was not desirable. Student preferred to see icons instead.
• Current time was important. Estimated time to route and distance was very important to participant.

• Student was not fond of the letter “F” in representation of food in the wireframe. The student would prefer to see designed symbols or bubbles in on map.

• Student desired to have control over the population of food on map. Student preferred to be able to pick which types of food populated the map before viewing.

Participant 19:

• Student felt that there should be no abbreviations for classes and that they should be in order.

• [Walking Path] Student felt that it would be strange in the scenario if they could not route a location somewhere different from where they currently are.

• Student preferred to see list of food first before they were displayed on map.

4.3 Map Study

The map study emphasized in Figure 19-20 was a method to further resolve the legibility of schematic maps, how they are communicating information, and whether students had a preference as it relates to mobile wayfinding and route planning. The core of this study was to determine the utility of exocentric maps (bird’s-eye view) and egocentric maps (path view) and whether students preferred one to the other in
application to route planning. Three exocentric (satellite) maps were chosen: an exocentric map in color with high legibility, an exocentric halftone map in color with low legibility, and an exocentric map that included multi-routing functionality on the map. Also, included were an egocentric (path view) map and a plain-text map. The results of the study are in the detailed under “outcome.”

**Time**

The participants were informed that the exercise would last approximately 60 minutes, but would likely not run that long. A consent form was supplied via the IRB that outlined that each participant was free to leave at any time during the exercise.

**Location**

The Frank W. Hale Jr. Black Culture Center (The Green Room). The Green Room was a private room with no distractions from the culture centers frequent visitors and staff. The Green room allowed me to be hands-on with the participants in a more intimate setting, which enabled me to illicit participant confidence and feedback for the construction of the design guidelines.

**Planning/process**

The planning process of the map study began by reviewing the map selection data from the previous studies and finding the trends. The next step in the process was to recruit participants for the map study and detail the questions for the
session. Finally, the last step was the data analysis of the qualitative interview. This step allowed me to apply the information received to the overlying design guidelines.

Setup
The study consisted of five maps viewed via a PDF on a laptop. The participant was asked to sit and review all of the maps then while being read the following script:

Script
Question 1:
“In regards to planning your route, which map would you want to be your default? A: satellite view, B: more detailed satellite view, C: a view to show you terrain and multiple routes, D: a path view to show you how to directly get to your destination, or E: view to show you words and how you get to your destination via text?”

Question 2:
“Please tell me whether you want this view to be able to change or do you want it to always be this specific view?”

Question 3:
“What view would you want it to change to [A, B, C, D, or E]?”
Outcome

Figure 18. Map Study Participant

A=Halftone Exocentric  B=Low legibility Exocentric  C=High Legibility Exocentric
D=Egocentric (path view)  E=Plain Text

Participant 20:

1st Choice (Default): C
2nd Choice (Option): E

Participant 21:

1st Choice (Default): A
2nd Choice (Option): D

Participant 22:

1st Choice (Default): A
2nd Choice (Option): D
Participant 23:
1st Choice (Default): D
2nd Choice (Option): C

Participant 24:
1st Choice (Default): C
2nd Choice (Option): E

Participant 25:
1st Choice (Default): A
2nd Choice (Option): D

From the results, it can be inferred the best view for route planning is a satellite/exocentric view in collaboration with the egocentric path view. More participants responded to the path view and its ability to “efficiently” route them to their desired destination with minimal error.

A=3  B=0  C=3  D=4  E=2
Map Study - Participant 21

Figure 19. Participant 21 (Map Study) Result

Participant 21: Sometimes you have the street, but I think **[D] the path view** gives you a more real life surrounding than **[A] the satellite view**, so I guess this one is more visual-based. The last one [E] is more straightforward rather than you try to find a place based on a map [like MapQuest].
5.1 Benefits of a Mobile Wayfinding System

Maps have come a long way since 15th Century Ptolemy designs, and so have wayfinding systems. Moreover, some of the same age-old struggles with non-representational forms continue to linger in this medium. Therefore, more resolved user-centered map research would be needed in order to make map experiences better. Understanding the vernacular of maps and that they are culture specific is essential in making informed printed map, mobile map, and wayfinding design decisions. In recent history, Web maps have had their struggle with hierarchy and architecture due to hyperlink abundance. Mobile maps appear to be keeping pace with technology adoption trends, but attention needs to be paid to the environmental conditions that affect users while routing to destinations.

S.D Smith (2010) shows that the United States and Canadian higher education populations are adapting to Internet-enabled mobile devices at exponential rates. This same demographic is the core of The Ohio State University population. Statistics show that there is a market for a well-defined mobile wayfinding application when over half of the approximated 7,000 first-year experience students each year are equipped with Internet-enabled mobile devices. A system of this nature only makes sense, especially when the system may decrease
the stress from the inability to access resources and find information efficiently.

The first experience student population is the major recruiting/prospective student demographic. If these students can be sufficed it is highly beneficial to the university. Similarly, it would be advantageous to market this application to parents of prospective students who may be looking into smaller more hands on private universities for fear that their child may get “lost in the crowd.”

Financially, the university benefits from bus transportation costs being reduced. There would also be a decrease in overcrowded buses. The City of Columbus and Ohio State overall will have increased public health awareness, because more students would be encouraged to walk through the new map system, which could be a major positive public relations move if the university can gain the branding of being a health conscience and sustainable campus. There are unforeseen advantages to better enabling students to manage their time and pre- and post-class travel desires.

As for the design community, there are several benefits as a result of this research. Paper-prototype methodologies are applicable in resolving usability and experience issues in wayfinding software. Also, per my findings it can be inferred that egocentric and exocentric map views are necessary in collegiate mobile wayfinding designs. Design benefits from knowing that student end users value the ability to view their schedule on maps in real time. Other real-time applications are for buses and warnings for unforeseen environmental circumstances. Design will benefit from student end users’ desire to have categorized lists of buses and food
choices several layers architectural before a map is displayed. This is possibly to keep clarity and serve as an accelerator through map information. My research shows that the success of this application may be contingent on its availability to be marketed at zero cost. More findings can infer that egocentric and exocentric map views are essential for route planning—exocentric, particularly for plotting points of interests for destination, and egocentric for reducing error while navigating environmental conditions while in transit. Figures 21-49 illustrate my proposed design solution based on my research.

Further, design will benefit from an understanding that there are few consistent map elements trends via participant research. This possibly highlights that closed-system environments like The Ohio State University must have egocentric mobile map design and not allocentric. Location defaulting is important, but the device must be flexible to accommodate other routing location desires. Also, my findings show that weighted graphs are desirable and needed to emphasize multimodal route-panning options for students.

Finally, estimated times of arrival are likely a must in determining if routes are possibly within class-time constraints. This has heavy implications on a user’s willingness to venture a particular distance. The ability to plan routes is important, but equally important are the shortest paths in that closed environment. In addition, bus route functionality is a plus, but students not only need to see the location of the stop, but the direction the buses are moving. Symbols are important for serving as identifiers and accelerators on low fidelity maps.
5.6 Next Steps

In closing Holcher (2008) says, “Finding one’s way around public buildings, such as airports, hospital, offices, or university buildings, often proves to be a tedious and frustrating task. Wayfinding in a complex setting with less than perfect knowledge requires decision making under uncertainty...” More research must be done in this area to decrease these scenarios of uncertainty. Large systems, such as The Ohio State University, are very complex with unforeseen resources. This investigation only scratches the surface of possibilities for student populations nationally and internationally. Per the previous statement, contexts that can benefit from a mobile wayfinding application of this nature would be zoos, parks, malls, hospitals, and airports.

Also, quantitative data associated with wayfinding via gender on campuses would be beneficial as well. Hund (2006) says, “Men and women are faster and more accurate when navigating based on cardinal directions than when navigating based on landmark direction.” Spatial anxiety can increase errors in complex or new environments. On a college campus there is likely the highest anxiety for men and women the first week of a quarter or semester. More research should be done on women who show greater versatility than men in these settings and how mobile wayfinding can be structured to accommodate their skill and experience levels (Stone, 2009).
Bibliography


Appendix: Supplemental Materials

Participant 1

Investigator: Tell me about your navigation screen and your home screen and how it works.

**Participant 1:** My navigation screen basically has your map and direction information. It will display your main map, which is your path view to show you which way you are going to help you navigate the city in detail. Then it has the satellite in a smaller screen in the upper left most corner. It will have an overall view of the general area that you are in and it will show **different destinations** if you want to get food at the Ohio Union or different services that they have on campus. If you are trying to find undergrad admissions or the Haile Center, then it will show your actual destination here, or wherever you might be. It will have your zoom buttons if you need to go in or out. It will also have a button up here for your **alternate routes.** I think it should basically use your **class schedule** and **different appointments** you have and key them into the GPS to show you what you need to do that day. It will show you the **fastest routes** to get from point A to point B. And at the bottom it will have a menu if you wanted to **toggle between the screens** to make it larger or if you have different options like volume or display or if you want
to change the voice of someone trying to give you directions. And then it will have a home button, which will take you to the home screen. On the home screen you can search for different Web sites or different things that are going on [around] campus. It will have different buttons for you to register for classes, activate GPS, Weather, BuckeyeLink, Carmen, OUAB, check your grades, features where you can connect to Facebook and Twitter and comment on things that are going on.

Investigator: What do you mean when you say comment on different things that are going on?

Participant 1: Say that you just checked the weather; you can update your Facebook or Twitter saying. “Oh there is bad traffic on such a such a street, or this building is closed or classes for today is canceled after five. Or, you know the Ohio Union is putting up tickets at such a such a time so other students can know and be in the loop.

Investigator: Tell me why class schedule, BuckeyeLink, CABS, and Campus Walking are important for route planning for you.

Participant 1: I think CABS because of the bus schedule, and a lot of students that live off campus use the bus to get around, and because parking is horrible on campus. Class schedule basically so you can know what is coming, whether you
have a class at this time or that time so you can know where you are going.

**Buckeyelink, because that is how you schedule classes**, that is basically the link to your financial and academic success. **Campus walking** is basically going to tell you information about what is going on as you are traversing through campus.

**Investigator: Tell me about your top three, then your top two.**

**Participant 1:** Top, three Maps + Directions, Finding Quickest Routes, Calendar.

**Investigator: Why are these two important to you?**

**Participant 1:** You need the maps because you need to know in depth where you are going. And show you your destination, you need to know that. **The quickest routes because the main point of this app is finding the quickest way to get to A to B throughout your day.**

**Participant 2**

**Investigator: Will you tell me about your navigation screen and how it works?**

**Participant 2:** First this is a **pathfinder**, it will show exactly what you are seeing and show wherever you turn and show real-life directions. This will be for pointing out a **little marker** to show **where food** is where a **classroom building is, library**,
[or] stadium, [the marker] it will highlight it to show clearly where something is at. These are just **different routes** you can put on when you want **campus bus, or walking**. [A] Keyboard to type in where you want to go. **Weather** to show what conditions are like. [A] **Activate button** to activate [the device] after you type in where you want to go. A **search** in case you don’t spell something correctly you can type it in and it will find it for you, then activate [the device].

**Investigator:** What about your home screen here?

**Participant 2:** Just [A] pretty basic [screen], [A] Menu, Keyboard, [so that you can] type in what you are looking for and destinations [for] where you want to go.

**Investigator:** Why did you pick Class Schedule, CABS, and Campus Walking as the most important for route planning?

**Participant 2:** The schedule actually tells you what building you need to be at throughout the day for classes. **CABS** will be how you get there as far as [transportation] BUS if you don’t want to walk. Your other option will be **Campus Walking**.

**Investigator:** The most important features where?
Participant 2: For it [the application] to have clear directions and buildings.

Investigator: Why so much the buildings?

Participant 2: So you can relate to it if you see something that stands out to you, so it shows on the GPS and in real life to relate to where you need to go.

Participant 3

Investigator: Will you tell me about your navigation screen and why you built it like this?

Participant 3: I wanted it like this because you can see the aerial view [satellite] of the whole campus. But you can also follow words [plain text], because I also look at street signs when I want to follow [find] something. A marker to tell me where I am at [current location]. Then markers [icons] [symbols] for if I want to go work out, [play] basketball right here, [here is] food, or libraries [here].

Investigator: What about your home screen here?

Participant 3: And for this one, this is the home screen, you would login with your OSU ID [Buckeye ID] then search for whatever you wanted to search.

Investigator: Why did you pick Class Schedule, CABS, OUAB, Campus Walking
for Route Planning?

Participant 3: Your class schedule tells you what building your class is in and then the CABS has the bus routes on top, and they get you around campus. And OUAB has different programs, for instance in the RPAC, so you will know how to get there from the programs.

Investigator: Why do you think the navigation is the most important feature?

Participant 3: [Because], that is what I would use it for, I would not use it for anything else besides to use it for something I need to do [wayfinding tasks].

Participant 4

Investigator: Why did you construct your navigation view like this?

Participant 4: The reason why I selected this to look like this is because it is the most effective and easy way to use it. I thought it was really cool that you can go straight to your Buckeyelink and Carmen. Find out what places you need to go, because that is predominately where your schedule is. The BAS [text a bus to find location] system is a great resource as well because you can use the BAS and instead of just texting the bus you can just go on here and figure out what times the buses are running. The reason I put two views on here is so that you can have a better reference. I think you would need a better reference. I also added in the zoom in
and out function, that way you will be able to see things more clearly if needed. I also put the search engine in because if you have a question or need to know where something is you will be able to find it easily.

Investigator: Will you tell me about your home screen here?

Participant 4: The home screen, I put in the same things that I put for the first page on the top left corner. I thought it was cool if you could have an account (login). So that you can always go to a Buckeyelink or a Carmen or something like that. But you can also connect it to your Twitter feed or Facebook feed. Having the weather as a top resource would also be pretty cool, because you would like to know exactly what the weather is outside right before your travels. I also put an avatar to have because that is something different. You obviously need to login on the front page. And you also need to have your search engine. That is normally what they have.

Investigator: Why did you pick Class Schedule and CABS as the most important for route planning?

Participant 4: Because as a freshman you are not going to have your class schedule down packed the first day unless you just studied [naïve-exhaustive wayfinding tasks prior] or something. But, normally with your class schedule
you need to know what times you need to be in class and you need to know what the building is called. That is why I selected class schedule and CABS, and obviously you can get there faster with CABS.

Investigator: Why are views and search engine the most important features?

Participant 4: The reason I picked views and search engine as the most important features is because I felt that, for me I am more of a visual person and if I need to know how to get somewhere I think having a viewing of what it looks like and what is surrounding it is very important. And with the search engine, obviously if you need to know something extra you can go to the search engine and it can connect you to what you need to know.

Participant 5

Investigator: Please tell me about your navigation screen here?

Participant 5: I have a visual screen that has your current location and destination, and has food and any other places that pop up on the screen and has their names. It has the zoom in and zooms out [feature]. It also has the text in case someone can’t find their way by looking at the pictures or the screen. It has the up arrows and down arrows and there is a back [button] in case you want to redo your search and there is [a] next [button] in case you want a new search. There is
the home screen in case you want to start all the way over. Or if you want to have a **bus route or walking route**. And there is the keyboard.

Investigator: Why are CABS and Campus Walking the most important in route planning?

**Participant 5:** Because, you should already know where you are going. Already have in mind where you are going, what class you are trying to go to. Either way if it takes you longer [travel time] you would rather know if it is easier to walk, or if it would be longer based on how long it would [routing estimation] take to wait for the bus, or how long the bus [CABS] takes. That is why I said the bus and walking are the best features.

Investigator: Why did you pick text and search box as the most important?

**Participant 5:** Because without the text some people may not be able to visually, they may get confused maybe. It could even be the traffic that gets you confused. The search bar needs to know where you are going, to make sure you typed it in right to make sure it is the place you would like to go.

**Participant 6**

Investigator: Will you tell me about your navigation screen here?
Participant 6: It has **satellite view** and a **path view**. The satellite view is to see the overall picture of where you need to go. The arrows are to move you up and down through the path screen. The keypad [is] for you to type in where you need to go and search, tell you how to get there.

Investigator: Why did you pick Cabs and Campus walking as the primary in route planning?

Participant 6: Because those are the two ways to get you around campus, you can either walk or catch the bus. So those are two of the most important [methods of transportation].

Investigator: Please tell me about your home screen?

Participant 6: Basically you have the option of getting on **CABS** or **Walking**. You type in where you need to go then you pick **CABS** or **Walking** and it tells you when the bus comes, how to get there whichever [however] one you want.

Investigator: Why are Path View and CABS top features?

Participant 6: Because those are the **two most important** elements for getting you
Participant 7

Investigator: Please tell me about your home screen.

Participant 7: Well, I picked the home button for the home screen, because that is common sense why would you not have a home button for the home screen. I picked the search engine because there is a lot of different places that you are going to want to search and if you cannot have a place where you can search [for] them then the Web site is going to be useless. A login button so that you can login and make it more convenient for you as you login and it can tell you quickest route for you and not someone else.

Investigator: So [the] quickest route for your specific classes?

Participant 7: My specific classes, no one else’s.

Investigator: Why is the plain text important for your navigation screen?

Participant 7: For me I felt that the plain text navigation was more relevant than the other three possible ones, satellite, path, [and] street view. This being my first time on campus I have never seen those places before and I was like, if I could have directions and look at signs it is more relevant and convenient than
looking at these buildings that I have never seen before. I feel that I would still be lost, and it would not be working for me. I feel that this is better.

**Investigator:** As for the features you picked that would help you plan your route better, why did you pick these specific ones?

**Participant 7:** I picked the class schedule because if you do not know my class schedule how would you know how much time I have in between class and where I am going. With the class schedule it tells you where you are going and exactly what time you need to be there. For the CABS it depends on your classes [because] they can be really far apart and the CABS can get me there [better than by foot]. It depends on what time the CABS is coming whether or not I should have walked or I could have waited for the CABS because the CABS could have been coming while I was in route. And for campus walking sometimes you walk around campus you get familiar with campus and you will just know directions yourself.

[She stated, “And for the rest of the stuff I was like, what am I going to check my grades for, that has nothing to do with me getting to class”?

**Investigator:** Do you like this concept?

**Participant 7:** Yes

**Investigator:** Is this the most you would pay? $100
Participant 7: I mean I would not say the most, but I felt that it was similar to what most GPS’s [sell for]. Most GPS systems are around $100. I am just cheap [a college student] so that is why I wrote down $100. There are a lot of people who will pay a lot of money for certain stuff. I would say it could range from $100 to a good $200 dollars.

Investigator: If it was free would you think more people would use it?

Participant 7: Oh yeah free, that is all you have to say is free, everybody will use it.

Investigator: As for the two main features, why did you say these two were the most important?

Participant 7: I felt that my main purpose was to find my class and get the quickest route, so that is why I said those were the most important because that is why I wanted the things [application] for, to find my class and get the quickest route.

Participant 8

Investigator: Why did you feel that the path view and the street view where the most important?
Participant 8: Because I feel that it is easier to follow compared to the other views. Because I am not going to count how many feet I am going to be walking whereas on the path view it tells me exactly where to go.

Investigator: For the navigation screen why did you pick the arrows and the things you put on the page here?

Participant 8: Maybe to change the view like to go to the next step [screen] maybe, if you are going straight to see what the next step is ahead of time.

Investigator: Why do you find these features to be the most important in route planning?

Participant 8: Because I need all of those things, I walk on campus and I might need to know if there is a CAB [bus] around or something.

Investigator: Any reason you would want your class schedule there?

Participant 8: So you can know which building to go to in referencing your schedule.
Investigator: Why did you pick these buttons for the home screen?

Participant 8: Because, I feel they are very important. Search engine to search for things on the app.

Investigator: What type of things on the app?

Participant 8: Your schedule and the weather and such [similar features]. Facebook and stuff [similar features], because that is important nowadays.

Investigator: Why do you think it is important for it to be free?

Participant 8: I believe more people would be drawn to it if it were free. If it were over $10 I would not even look to see what it is [the application], [because of] where I am in my life.

Investigator: Why did you pick alternate views and weather as the top two deal breakers for this [application]?

Participant 8: The views are very important because some people may just want to look at the satellite as they are walking to class. My preference would be to have the pathway view, but different people want different things. And the weather because some people are on the go and they need to know what the weather is going
Participant 9

Investigator: For navigation view why did you feel path view and plain text view were most important?

Participant 9: A lot of people are better with directions by seeing it, and others are better at reading it but I think that is what people are more into now.

Investigator: Will you tell me about your navigation screen here?

Participant 9: I made a navigation screen for dummies, because if you cannot figure it out by what it is saying then I don’t know. This is the direction [symbol] telling you were to go (pointing). This is the time (pointing). And if you want to change your route to go the other way or go back (pointing). This is for if you are walking, riding bus, or bike.

Investigator: Why did you feel that Class Schedule, CABS, OUAB are the most important in route planning?

Participant 9: I know for me, my first quarter I could not find anything. I did not know what time buses came, I barely could keep up with my class schedule and timing for that. OUAB that could tell you if you are trying to get to a stepshow
(collegiate fraternity and sorority choreographed dance competition) or something, it can tell you how to get [to the event] on time and early. So, I feel that is important if you want to get there and on a timely manner [route efficiency] it can help you with that.

Investigator: Will you tell me about your home screen?

Participant 9: Pretty simple. As soon as you open it here is your location (pointing). So you know exactly where you are, because you may not know where you are so you can open it up and it can tell you that you are in the middle [where you are] of the oval, near Thompson library or something like that.

Investigator: [Is] all you need on this screen is to know where you are?

Participant 9: Yes

Investigator: What happens on this screen?

Participant 9: That is the options screen. Say if you are on a bus stop and you want to know what time your bus comes, you can check that one, your class schedule to see what time you should be at class. And direction, to plan out your directions (route) either in path view or the plain text writing. Buckeyelink and Carmen are
great features you can always check your grades really fast. Through Buckeyelink you can always do your class schedule too. And webmail, I like to check my email while I am outside, I barely check my email at home.

**Investigator:** Why did you pick $30 dollars?

**Participant 9:** I want it to be inexpensive, but not too cheap, but not make it too cheap. I do not think it is worth being free.

**Investigator:** Why did you pick path view and Buckeyelink as the two most important components?

**Participant 9:** Because, it is supposed to be more of a GPS system so at the end of the day you still need to know how to get there. I put class schedule and it will tell you where your class is which can connect with the path view.

**Participant 10**

**Investigator:** So, please explain your navigation screen.

**Participant 10:** In my navigation screen the first thing in the middle is the path view. I feel that it is the easiest to use but also under it there is plain text so if you get confused on the plain text, you can use the path view. There is also weather on
the right hand corner, that way before you even [start your route] go out you will know what it [the weather] is like before you go out there. There is a back arrow if you need to go back, and a home screen if you need to go to the home screen.

**Investigator:** You picked class schedule and CABS as important for route planning; why?

**Participant 10:** First, your **class schedule**, because that is why you are here basically, so you will need to know where you have to go. For the bus, you may not want to walk from south campus to north campus so knowing the bus times when they come and where they come will help you plan to be where you need to be on time.

**Investigator:** Will you tell me about your home screen?

**Participant 10:** I have the **CABs button** to plan where you need to be on time, there is the keyboard, the **time, weather**, and there is the media up top [top of the screen] for **Facebook,** **Twitter,** and **sports** in case you are just sitting on the bus so you can have **entertainment** while you are going [traveling] where you need to go. There is also a **lock [security]** that I suggested because there are things like Facebook and Twitter and if people got into it there can be problems.
**Investigator:** What were the two most important features?

**Participant 10:** The weather and the bus, because they go hand to hand. If the weather is nice you may be less likely to use the bus. But if you are in a rush and the bus is there you can use it and take that chance on being a little late rather than 15 minutes late because you had to walk all the way across campus.

**Participant 11**

**Investigator:** Please tell me about your navigation screen here

**Participant 11:** My navigation screen should have a home button, a search button, it should be voice activated along with a headpiece [ear piece]. It should be able to tell me the weather, I should be able to zoom in and zoom out

**Investigator:** Why do you need the headpiece [ear piece] with the voice?

**Participant 11:** Because not everyone needs to know that I am lost or know exactly where I am going.

**Investigator:** What is this about the zoom in feature and the search box?

**Participant 11:** To show me exactly where I am instead of the satellite view, which shows me from above [satellite view].
Investigator: The next and the back?

Participant 11: To go back, simple to go back button

Investigator: What about the hotspots and the previous address?

Participant 11: It should be able to tell me about the spots that are frequent on campus or nicknames for spots that are on campus or locations that most students search for whether that is within the day or the quarter.

Investigator: Why do you find the weather important?

Participant 11: I always wanted to know weather. I am not from here so it helps me to keep up with what I should be wearing.

Investigator: So as far as the login screen, tell me about it.

Participant 11: My favorites [most visited places] should be imported; I should be able to check my grades within the day. My class schedule because I usually forget my schedule [web map memory recall]. A search button and a satellite view, and the weather.
Investigator: Why did you pick these features as being the most important for route planning?

Participant 11: CABs because I still get lost on CABS, Register for Classes can help me to pinpoint where one building is relation to another location. Class schedule would be [do] the same, to help me. You should have a time button on here as well, an estimated time of arrival. The ETA should be in terms of good and bad weather.

Investigator: Why should it be free?

Participant 11: [This] technology should be able to be sponsored; tuition is already expensive, so maybe it could be less than $5 if it is an app.

Participants 12

Investigator: Ok, tell me about these features on the navigations screen and why you picked those.

Participant 12: I picked the weather because I like to know what to wear based on the weather. The home screen because if I mess up I can go back to home. Same reason for the back button, so that since it is not really a feature but I guess a
component. I need that for the **search** bar, I think that if I search something it will be easier [for me] to lookup what I am searching. And the **favorite**, if I go to the same place a lot but I can’t remember where it is at, I think it will be helpful.

**Investigator:** What about the home screen here, why did you pick these?

**Participant 12:** I like **Twitter** and **Facebook**—**social networks**—and I go on them a lot so that is why I did that.

**Investigator:** Would that help you find your way?

**Participant 12:** I would see where my friend were at, and when they tell me [their location] I can search it using that [search bar]. And then um, and that picture of me, I like taking pictures and seeing my pictures.

**Investigator:** Tell me why you picked these as the most important for planning your route

**Participant 12:** **Buckeyelink**, that is where I register for classes, I need to know where my classes are, that type of stuff. **OUAB** knows where the concerts are, they tell you when they are selling tickets. **Campus walking**, you **walk everywhere**, which is important.
**Buckeyelink is mentioned as a means to find where the student’s course is—specifically the building name.**

Investigator: Why did you pick the search bar and the favorites are the top two?

Participant 12: Search bar when I want to search for something I think it will be easier, and favorites for if I go somewhere frequently I can just go to the favorites.

Participant 13 (wireframe pilot)

Investigator: If you were going to check your class schedule using this wireframe, what would you do [steps would you take] from the beginning of the application, to logging in, to checking your class schedule? What would your steps be?

Participant 13: Based on what I know already about the existing system, I would type in my name.# [Dot number] and then type in my password, which is the same one that logs me into Carmen, Buckeyelink, or THE OHIO STATE UNIVERSITY Library. This is different from my wireless password. Then I would select “remember me” because I would assume that this tells the wireframe [system] to remember both my username and password. I’m not sure why there’s a “remember my password” option because I thought that these two would be the same thing. Then I would sign in.
**Investigator:** So [do] you think that having the two [remember me and remember my password] options are redundant?

**Participant 13:** Yes, because when I select the “**remember me**” option on my Yahoo email account, it automatically remembers both my username and password. But I do like the option at the bottom to log in as a different user, in case I wanted to loan this to my friend.

**Participant 13:** After signing in, I would expect my first page to be my current schedule for this quarter, the program would already know what quarter I am in and be able to tell me what classes I am currently taking. Maybe there would also be a way to highlight each class with the corresponding day of the week that I had it. Example: Tuesday would be a certain class at 2:30. I would expect to see this sort of page after I sign in, before I see a picture of a map showing where my classes are located. If I saw this map directly after logging in, I wouldn’t know what it was for.

**Investigator:** if you wanted to manage your student services through this application, what would you do?

**Participant 13:** I would expect a main navigation page where I can see my class schedule, my current account, a faculty student, my bill, etc. Those are the main things I would use. There definitely needs to be an in-between screen here because
if I were expecting to log on to something like Carmen or Buckeyelink, the next screen I see wouldn’t be of a map.

Investigator: This is more of a program to show you your classes and where you need to go to get to them.

Participant 13: I would still think that there would be some part that would list my class name; something about that class to look up before actually seeing its location on a map. I guess there could be information at the top of the screen above the map that listed the name of my Tuesday class and its location. I need to see this in order for the map to make sense to me.

Investigator: If you needed to find a walking path from here to the Student Union, how would you use this map to do it?

Participant 13: I would type in my current location, or assume that the [GPS] would default to my current location. Then I would type in “Student Union” and then press “Get Directions.” I would assume that since this device is handheld, that it would default to walking directions. But sometimes I ride my bike so I don’t know if this device would be able to change to a biking route. I also don’t know if there is any need for it to give directions for driving.
**Investigator:** Would you expect it to show you the estimated time?

**Participant 13:** Yes, that would be great.

**Investigator:** How would you expect the system to show you when the next NE CABS bus would be coming near you?

**Participant 13:** I would maybe expect that the color of its route to illuminate with that time and how it progresses.

**Investigator:** Would you want to be able to click a button and then be able to see the buses on the screen?

**Participant 13:** Yes, like how Google Maps shows you traffic. I don’t know the colors associated with the bus routes, so it should show the names of them as well.

**Investigator:** What if you wanted to search for campus dining services? How would you do that?

**Participant 13:** Because I am so familiar with Google Maps, I would expect to be able to search different places for coffee. Then the map would show me the different
spots near me and there would also be some information included about the place, such as its hours and location on my route. It would be cool if I could also see how long the line is there.

**Investigator:** If you could pick three things that you feel would absolutely need to be implemented into this product before it was released what would they be?

**Participant 13:** Definitely already having integrating between my classes, their times and their locations defaulted on the map. That way I don’t have to type in anything for my default “favorite” locations. The food would also be important because students in between classes would frequently use it. You would be able to see where you can pick up something along the way to your next class. I would use it to navigate because I don’t know the campus very well but timing and food is also really important. Another thing would be that if there was any indication of what the weather would be like outside. Maybe it could give you an alternative route that allows you to cut through buildings to avoid the rain. I often walk from St. John’s parking lot to Hayes Hall; I cut through a minimum of two buildings for both efficiency as well as to warm myself up. I often wonder what other ways there are to make my route shorter to other buildings.

**Participant 14**
**Investigator:** I would like you to use the wireframe to show me how you would check your class schedule.

**Participant 14:** I would sign in and select “**remember me.**” I would necessarily want the bus routes but I would want the bus times. I would click the button that says “my class schedule.”

**Investigator:** Here is your class schedule. What would you do next in order to display your class schedule on a map?

**Participant 14:** Click “show map.”

**Investigator:** Remember the orientation of this program here. This is environment A. In a “B” environment, show me how you would log on to see your class schedule again.

**Participant 14:** I would sign in again, press “remember me,” select “class schedule.”

**Investigator:** How did you feel about having the “exit” button at the bottom on this screen as opposed to having it at the top? Which would you prefer?

**Participant 14:** I would prefer it at the bottom because the “back” button would usually be at the top of the screen.
**Investigator:** I want you to show me on the wireframe how you would find a walking path from to the Union from the Hale Center.

**Participant 14:** I would log in again, select “walking paths,” then press “from my location,” click “Go.”

**Investigator:** This map is visually showing you the routes here. How do you feel about this? How do you feel about the different paths it shows you?

**Participant 14:** I like the routes. I prefer the map to show different paths because I would assume this would mean that there are shorter paths that can be taken. The times work as well. I prefer it to show times.

**Investigator:** Was there anything here that seemed confusing? Is there anything you would make better?

**Participant 14:** I’m thinking we could skip the first navigation page because I don’t think I would want to spend time typing in a location when the GPS can just default from my current location.

**Investigator:** What if you wanted to find out how to get to a certain destination from a place other than your current location? Would this page still be irrelevant then?
**Participant 14:** No, it wouldn’t be irrelevant then.

**Investigator:** Back to menu A, if the screen changes, what would you do to get walking directions again?

**Participant 14:** Click “show walking paths.”

**Investigator:** Is this next page better or worse?

**Participant 14:** It’s more confusing because I’m not sure if I’m supposed to put in my current location or enter a location. It confuses me because usually there would be two different buttons instead of a line just separating the two. The “find my location” option should be the first option at the top of the screen.

**Investigator:** What would you do in order to find the next CLS Cabs bus that will arrive at the Union bus stop?

**Participant 14:** I would press “bus routes.”

**Investigator:** As far as this orientation shows you where the bus routes are, would you consider this satisfactory or would you not want it to be like this?
**Participant 14:** It works but I think it should also show the directions the buses are going. It should also show the estimated time of its arrival. It also could highlight the buildings it would stop at based on my time schedule. It would be more as a schedule. It would be really nice if this could connect with my class schedule or calendar.

**Investigator:** Show me by the wireframe how you would use campus dining services and how you would find the closest place to eat near you.

**Participant 14:** I would press “campus food.”

**Investigator:** What would you do next?

**Participant 14:** This map is a bit confusing. I’m guessing I would want it to show me where exactly I’m at [location] and where the food is at. That way I would know where the closest place to eat is. It would also be nice if I could view the restaurant’s menu for the day as well.

**Investigator:** What do you think about having the travel time box here on the screen?

**Participant 14:** I don’t think I need to know the travel time to go to that place. It would be helpful in general, but not for me personally.
Participant 15

Investigator: For the first task, show me by the wireframe how you would check your class schedule.

Participant 15: I would [click] “sign in,” click “class schedule.”

Investigator: What would you expect to happen after this page?

Participant 15: I think that this page would be it.

Investigator: If this would show you your class on a map would you find this helpful?

Participant 15: Yes, I definitely would find that helpful.

Investigator: Notice everything about the orientation on this wireframe. That was “A.” For “B” here, how do you feel about the exit button being at the bottom of the screen? What about the change of the menu button?

Participant 15: I really didn’t even notice the difference.

Investigator: Using the wireframe, show me how you would find a walking path from the Union to the Hale Center.
Participant 15: I would sign in, and then click “walking paths.” Then, I would enter the first location and the second location and click “Go.” Then I would follow the walking path.

Investigator: What do you think about this screen here and how it shows you multiple paths and times?

Participant 15: The lines should be a little bit more clearly and in color. Other than that it’s fine.

Investigator: That was “A.” So in “B” what would you do?

Participant 15: Click “show walking paths.” Whoa, that’s different. I would type in my current location and the destination.

Investigator: Is this confusing or clearer than the way before? Why?

Participant 15: I think the other way was clearer. I like being able to see two buttons and being able to enter the information and be done with it. This screen took me a little more time to process.
Investigator: In this task, show me using the wireframe how you would find when the next CLS Cabs bus would arrive at the Union bus stop.

Participant 15: I would sign in, click “bus routes.” Does this not tell you when the bus is going to come? I would want this to tell me what time the bus would be arriving in relation to where I am.

Investigator: Would you want it to show you where your classes are? Would that be added value or would it be irrelevant?

Participant 15: I don’t think it would be relevant; it would be too much for one screen. Other than that, I like this orientation and how it would work.

Investigator: Using the wireframe, I want you to find the campus dining services closest to you.

Participant 15: I would sign in, click “campus food.” So this screen is able to calculate the estimated travel time.

Investigator: How could this be better? Or would it work? Would there be anything that you would change or improve?
Participant 15: No.

Participant 16

Investigator: I'm going to give you a task and I want you to flip the pages of the wireframe and show me how you would complete the task by speaking out loud. Show me by the wireframe how you would check your class schedule.

Participant 16: I would put my name.#, password, and then sign in. Click “class schedule.” And this looks like my schedule.

Investigator: Is this what you would expect to see?

Participant 16: Yes, it shows the class times and everything.

Investigator: If you were to show this information on a map, what would you expect to see?

Participant 16: Maybe Hayes Hall, or Hopkins [Hall], kind of like Google maps.

Investigator: That was “A.” See if you notice a difference in orientation in “B.”

Participant 16: I would click “class schedule,” and then this next screen looks the
The difference is that the exit button is located at the bottom of the screen. Did you notice the difference? Would you prefer it this way or on the top? Or does it matter?

Participant 16: I would probably want the exit button on the bottom and the menu button at the top. But I guess it works alright with the menu button on the bottom of the next page.

Investigator: Show me by the wireframe how you would find a walking path from the Union to the Hale Center.

Participant 16: I would sign in, click “show walking paths,” then the GPS will find me at my location and then I would type in the Union as my destination. I would want to change where the “from my location” button to the top because that is where it usually is on my phone. Anyways, I would press “Go.”

Investigator: So would this map be what you expect to see on the next page or not?

Participant 16: Yes. Is this my current or arrival time? I would want this to be my arrival time that way I don’t have to do all of the math.
Investigator: Would you still expect to see the times on each of the routes?

Participant 16: Yes, I would expect these times to be included on here if there were multiple routes. So, I guess the main time at the bottom wouldn’t have to be my arrival time. It makes sense to have it there as the current time because I don’t know what route I’m going to take yet. Maybe after I pick a certain route then the main time on the following page would be my arrival time after taking that particular route.

Investigator: Is there anything I can do to make this better for you?

Participant 16: I don’t know about these has marks. But the other two are fine.

Investigator: Show me using the wireframe how you would find when the next CLS cabs bus would arrive at the Union bus stop.

Participant 16: I would click “bus routes.” Wait, did it just skip a screen?

Investigator: No. What would you expect to see here instead?

Participant 16: The last page never asked me what bus route I wanted and there are different ones.
**Investigator:** But what if this screen just showed you the multiple bus routes at once?

**Participant 16:** I guess that's convenient but I rather just read the route of the bus I want to take. There's an app now that asks you what stop you want and you click it and then it tells you all of the times there will be a bus at that stop. If I'm in a hurry, I don't care about where everyone else is going, I just want to be able to see where my bus is. However, if all of the bus stops were showing on the same page, then I would want to be able to select a certain route from there and when that bus is going to be at certain stops.

**Investigator:** What is the name of this app?

**Participant 16:** OSU Bus I think. A student made it I think. [Shows app on phone]

**Investigator:** Cool. So would you want to see your classes here as well? Or is that not relevant for our purposes?

**Participant 16:** Well, I ride the buses all the time so showing my classes would be helpful to me. But some people don't ride the buses so I don't think they would find that very useful.
**Investigator:** I showed you the “A” orientation of the wireframe and now here’s the “B” orientation for when you are choosing a walking path. Do you notice anything different? Which setup did you like better?

**Participant 16:** Why does it say “or”? It should say “and” instead. This one is more confusing.

**Investigator:** Why do you think “A” is easier to understand?

**Participant 16:** Because it clearly shows that you can start at point A or point B. The other screen is saying either/or, and I don’t really understand it.

**Investigator:** Show me by the wireframe the campus dining services closest to you.

**Participant 16:** I would click “campus food” and then the closest one to me right now from the Hale Center? That would be Hale Hall.

**Investigator:** This map shows you the food places surrounding you. Do you feel that this works as far as showing you where the closest place to get food is? What if you could click a button and then it would show you the estimated time it would take for you to get there too? Is that something that you would want?
Participant 16: Yea, I think the time is important because sometimes you want food fast.

Investigator: Is there anything that you would change to make this better?

Participant 16: I would change the “F” on the map to some sort of symbol for food.

Participant 17

Investigator: I want you to show me by the wireframe how you would class your schedule. What would you do on the first screen?

Participant 17: I would put in my username and password and then press “sign in.” Then I would click “class schedule.”

Investigator: So is this next screen what you expected to see?

Participant 17: Yes.

Investigator: Is there anything you would change?

Participant 17: No.
**Investigator:** What if you clicked the “show on map” button? Then what would you expect to see?

**Participant 17:** A map of the campus showing where my class is at.

**Investigator:** Ok, so that was “A” and now this is “B.” Would you still click on “class schedule?”

**Participant 17:** Yes.

**Investigator:** Something has changed on this screen. Did you notice that the exit button was moved to the bottom? Would you prefer it here or at the top?

**Participant 17:** [I would prefer it] at the top because then it’s right there.

**Investigator:** Show me by the wireframe how you would find a walking path from the Union to the Hale Center.

**Participant 17:** I would click “show walking paths.” Then I would type where I’m at and where I want to go and then press “Go.”

**Investigator:** Is this [map] what you expected to see? What do you see on the
Participant 17: Yes, I see where I’m at and the location I want to get to.

Investigator: This is the current time. What do you think these lines are?

Participant 17: Bus routes or different routes I can take.

Investigator: Do you like that or do you not like that? Is there anything you would change?

Participant 17: I like it. There’s nothing I would change.

Investigator: Ok now this is “B.” Which one is better? Is this one less confusing or more confusing?

Participant 17: Less confusing. I would just click my destination and hopefully [the GPS] would know where I’m already at.

Investigator: Show me by the wireframe how you would catch the next CLS Cabs bus.

Participant 17: I would click “bus routes.”
Investigator: And is this [next screen] what you expected to see?

Participant 17: No. [I would expect to see] a menu with the different stops and then I would click which one I want. I would also want to see the estimated arrival times.

Investigator: Show me by the wireframe how you would find the closest place to get food. What would you click?

Participant 17: Campus food.

Investigator: What do you think [of the next screen]?

Participant 17: I think it’s good. The “F” is for each food spot.

Investigator: You can click this to calculate your estimated time it takes to get there. Is this good?

Participant 17: Yes this is good because it will help me figure out where I need to go.

Participant 18

Investigator: Show me by the wireframe what you would do to find your class schedule? What would you do on the first screen?
Participant 18: I would sign in my name. and password. Then I would click “class schedule,” which would take me to the next screen. Then I would click on one of my classes. Then I would click “show on map” to see where my class was.

Investigator: And what would you expect to see after clicking that?

Participant 18: I would expect to see a route of where my class is at as well as where I’m at. Then I should be able to tap to zoom in and follow my route.

Investigator: Ok. You see how this layout is here. This screen has a different layout. Would you prefer that the navigation buttons are at the top or at the bottom?

Participant 18: At the top.

Investigator: Show me by the wireframe how you would find a walking path to the Union.

Participant 18: I would click “show walking paths.” “From A” I would type in the Hale Center where I’m at and then “To B” would be where I typed in the Union and then I would hit “Go”
**Investigator:** So would you expect to see this on the next page or not?

**Participant 18:** This is a little too zoomed out. I would want to see a little bubble to show where I am and where I’m going. I don’t like having these two spots labeled A and B. I would like to see it as a hot air balloon or something.

**Investigator:** What time would you want to see at the bottom? How do you feel about having the times along the routes? Do you think this is necessary?

**Participant 18:** It should show my current time. And it would be cool to have the estimated times along the routes too, but it should also show the distance of the route.

**Investigator:** Do you think this next orientation is better or worse than the first one?

**Participant 18:** I like the first one better. I don’t get why it says “or” shouldn’t it say “too?” This one is more confusing because it says “or.”

**Investigator:** Show me how you would catch the next CLS cabs bus.

**Participant 18:** I would hit “cabs bus route.” And I don’t know what I’m supposed to be seeing now. I thought there would be somewhere for me to pick what bus I
wanted or to type in where I wanted to go. This screen doesn’t tell me which bus I want to use.

**Investigator:** So you want to know what time each bus is coming?

**Participant 18:** All the buses that are coming within 15 minutes should be shown.

**Investigator:** Show me how you would find food spots.

**Participant 18:** I would sign in, hit “campus food,” and ok, now it just has “F’s” for food. How are you supposed to know which place you’re going to?

**Investigator:** What would you want this screen to show instead?

**Participant 18:** I’d rather see a list of places and then I can click on which one I want and then see it on the map. Maybe you could click another screen after the list so you can click one, see one, or see them altogether.

**Investigator:** Do you think it’s helpful for the screen to show you your arrival time?

**Participant 18:** Yes, that’s cool. But there should be a list or more visibly show the name of the place first.
Participant 19

Participant 19: I would sign in with my username and password and then press sign in. Then I would press “class schedule.”

Investigator: Is this information what you would expect to see?

Participant 19: Yes, especially if this was my first time accessing it. I don’t think it should be abbreviated because someone may not know what it stands for. I also think [the classes] should be in order by time.

Investigator: Once you click on “show on map” what would you expect to see on the next page?

Participant 19: A map of a route to where I’m going from where I’m at.

Investigator: Do you notice how the navigations are at the top of the page here? Is it any different if they are on the bottom?

Participant 19: I think they are better at the top because then you [automatically] see it. You aren’t searching for it or anything.
**Investigator:** How would you find a walking path from here to the Union?

**Participant 19:** Click “show walking path” then I would type in my location and then type in my second location and then press “Go.”

**Investigator:** And is this what you would expect to see?

**Participant 19:** Yea, kind of. I would expect to do this, but also for there to be an option for me to get closer. This is the initial type of view I would like to see though.

**Investigator:** What do you think about the destination times here?

**Participant 19:** I feel like knowing which route is better is helpful.

**Investigator:** Which menu do you think is better for finding a walking path?

**Participant 19:** The first one [A]. Because what if you want your starting location to be somewhere different from where you are now?

**Investigator:** Show me by the wireframe when the next CLS cabs bus will arrive.

**Participant 19:** click “bus routes.” I see my current time, but I would also want to see when the buses would be arriving.
**Investigator:** Were you expecting to see something in between the menu page and the map?

**Participant 19:** Probably a place where you could type your location in or something.

**Investigator:** Anything else you would like to change on your screen here?

**Participant 19:** No.

**Investigator:** Show me by the wireframe the campus dining services and the closest one to you.

**Participant 19:** Click “campus food.” I feel like there should be a list of food first and then you can tap whichever one sounds good to you and then it can tell you where to go. Some people may not know what kind of food they want.

**Investigator:** Would you still have the times here?

**Participant 19:** Yea.
Participant 20

Investigator: Which [map] would you want to be your default? A: satellite view, B: more detailed satellite view, C: a view to show you terrain and multiple routes, D: a path view to show you how to directly get to your destination, or E: view to show you words and how you get to your destination via text. Right when you open it up which route would you think was the best?

Participant 20: C.

Investigator: I want you to tell me do you want these views to be able to change or do you want it to always be this specific view?

Participant 20: Be able to change.

Investigator: What view would you want it to change to? [A, B, C, D, or E]

Participant 20: E

Investigator: Do you know why?
**Participant 20:** I think it’s better to know your next move than just taking [for example] D, because you don’t know what’s coming up next. But with E, you know what’s coming up next and you know what to expect.

**Investigator:** And how would you want a transition from C to E to happen? [click on a button, etc]

**Participant 20:** Just have a different button to go to a different screen, be able to move C to E. Be able to have a different screen so you could go back would be nice.

**Investigator:** This is showing a type of rerouting here. Do you think that this would be effective usage for a mobile application like this? Something to be able to show you better routes and reroute?

**Participant 20:** Almost definitely because one route might not be efficient as another route. One road might be closed or there might be traffic on the first route, but they can take another route to get there.

**Participant 21**

**Investigator:** Which of these views would you want to see when you open up an application in order to plan your route or find your destination? A: satellite view, B: more detailed satellite view, C: a view to show you terrain and multiple routes, D: a
path view to show you how to directly get to your destination, or E: view to show you words and how you get to your destination via text?

Participant 21: A.

Investigator: Do you know why?

Participant 21: I think it’s because it shows a lot of the [Kennedy Commons, Canfield] halls. I think you sometimes know what street you are on but it’s better when you have more of a location marker. I also like it because you can see a lot more of the major streets than you can with the other views.

Investigator: So, for planning your route and navigating, you feel that view A would be the best view. Would you want to be able to change views?

Participant 21: It might be nice to have the text view, because sometimes you can navigate better when you have words. The path view might also be helpful when you’re walking. So what I’m trying to say is that [A] the satellite view accompanied with [D] the path view and [E] the text view would be nice.

Investigator: So you like to see from different orientations. Is there any other reason why you want to see multiple views?
Participant 21: Sometimes you have the street, but I think [D] the path view gives you a more real life surrounding than [A] the satellite view, so I guess this one is more visual-based. The last one [E] is more straightforward rather than you try to find a place based on a map [like MapQuest].

Investigator: In the midst of trying to find your way through campus for food, classes, etc., would you want to be able to see multiple routes similar to what I showed you in C [multi-route view]? Would this be helpful?

Participant 21: I think for most people it would be very useful.

Investigator: So, if you needed to find your way from here to the SEL library, would the multiple routes in this view [C] be helpful?

Participant 21: It lets the viewer chose which route he/she wants to take. I like that.

Participant 22

Investigator: In reference to using a map to orient yourself or navigate from point A to point B, tell me which of these views would be your default? A: satellite view, B: more detailed satellite view, C: a view to show you terrain and multiple routes, D: a path view to show you how to directly get to your destination, or E: view to show
you words and how you get to your destination via text?

**Participant 22:** [A] The first one because it’s where I live.

**Investigator:** Would you want to have multiple views?

**Participant 22:** No.

**Investigator:** Do you feel that being able to pick multiple routes to a certain destination would be effective or helpful?

**Participant 22:** No. [D] the path view would be easier than the multiple-route view, but I prefer [A] the satellite view.

**Participant 23**

**Investigator:** If you had a mobile device that could show you these views, which one would be your default? A: satellite view, B: more detailed satellite view, C: a view to show you terrain and multiple routes, D: a path view to show you how to directly get to your destination, or E: view to show you words and how you get to your destination via text?

**Participant 23:** If I am on foot, I would probably want [D] the path view.
Investigator: Why?

Participant 23: Because I can see my surroundings better. It’s in closer relativity to me. I don’t need to see a big city or big streets. I just need to see where I’m at right now.

Investigator: Do you feel that you need to able to change views? If so, what other views would you want to be able to use?

Participant 23: I might want some multiple views. Maybe C [multi-route].

Investigator: How would you want this to change views? Would you want a split screen or to toggle back and forth with a button?

Participant 23: I would want them side by side, in a split screen.

Investigator: If you were traveling on a path like this in C [multi-route view], how or would you find it valuable for this view to be able to reroute you in case you needed to go to a different destination on the C [multi-route] view?

Participant 23: Since I’m on foot, I don’t think I would find this helpful. It really depends on how long of a distance I have to go, this view might be helpful. Overall, I
don’t think I would need to use this [multi-route] view.

Participant 24

Investigator: I want to show you a few views. A: satellite view, B: more detailed satellite view, C: a view to show you terrain and multiple routes, D: a path view to show you how to directly get to your destination, or E: view to show you words and how you get to your destination via text. If you were using a GPS system to help you find your way on a campus, which of these views would you want to be your default view?

Participant 24: C.

Investigator: Why?

Participant 24: I like A as well, but this one [C] is more detailed. I like that it has colors along the streets.

Investigator: Would you want to be able to see multiple views?

Participant 24: I would like the see the last one [E: text view]. It tells you everything you’re going to be doing, like what street signs you should be looking for.

Investigator: How would you like this type of change to be done? Would you like to
see both views on the same screen or would you want it to be a different type of orientation?

**Participant 24:** Split screen.

**Investigator:** Why?

**Participant 24:** So that you can see an overall view and then read an overall view.

**Investigator:** If your screen was showing you the route from point A to point B but you wanted to go to a different destination, how would you want this rerouting to work?

**Participant 24:** I would like an option to reroute.

**Participant 25**

**Investigator:** I want you to tell me which map you would want to see as a default if you were using a mobile app to find different places around campus. A: satellite view, B: more detailed satellite view, C: a view to show you terrain and multiple routes, D: a path view to show you how to directly get to your destination, or E: view to show you words and how you get to your destination via text. If you were using a GPS system to help you find your way on a campus, which of these views would you
want to be your default view.

Participant 25: A, the satellite view.

Investigator: Would you want to see multiple views? Or would you want to just see this one?

Participant 25: If was looking at the satellite view, then I would want a button or something I could push that would give a more detailed view like D [the path view]. I would want to see both. I definitely don’t think the text view is effective.

Investigator: Do you think the multi-route is effective and/or helpful?

Participant 25: I do think that it would be helpful, but not for me personally. I wouldn't want to have choices and this view is not my favorite.

Investigator: If you were to use a multi-route view, how would you want it to work?

Participant 25: I would like to be able to type in the name of the place I am at and the name of the place I want to go, so then the view can show me both a map of where I’m at as well as where I want to go.
**Investigator:** What if you were traveling to a certain destination and needed to be rerouted? How would you expect something like that to work?

**Participant 25:** I would have to type in a new destination.
Figure 20. Paper Prototype Questionnaire
Figure 21. Home Screen
Figure 22. Class Schedule Selection Menu
Figure 23. Main Menu
Text

1. Head west on W 12th Ave | 66 ft
2. Turn right toward Hagerty Dr | 482 ft
3. Turn left onto Hagerty Dr | 213 ft
4. Turn right to stay on Hagerty Dr | 210 ft
5. Turn right onto Oval Dr S

Destination will be on the right

Figure 24. Text View
Figure 25. Navigation Window – African American Studies Walking Path Option Box
Figure 26. Walking Path Selection Menu
Figure 27. Path View 1
Figure 28. Navigation Window - Multiple Walking Paths to Ohio Union Option Box
Figure 29 Find Walking Path to Location Menu
Figure 30. Find Walking Path to Location Menu 2
Figure 31. Food Near You Menu
Figure 32 Path View 2
Figure 33. Campus Loop South Bus Route
Figure 34. Path View 3
Figure 35. Navigation Window – 8 Min Walking Path Ohio Union Option Box
Figure 36. Navigation Window – 5 Min Walking Path
Ohio Food Court
Figure 37. Path View 4
Figure 39. Navigation Window – Walking Path Pomerene Hall
Figure 40. Navigation Window – Pomerene Hall Cafe
Figure 41. Navigation Window – Wexner Center Café Route
Figure 42. Navigation Window – Wexner Center
Figure 43. Path View 5
Figure 44. Bus Selection Screen 1
Figure 45. Bus Selection Screen 2
Figure 46. Buckeye Village Bus Route Window
Figure 47. Navigation Window – Design 570
Figure 48. Buckeye Village Bus Route
Figure 49. Campus Loop South Bus Route Status