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Analysis of the Wayfinding Strategies of Pedestrians Using the Google Maps Mobile Application

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Following the advancements in public transportation and shared transport worldwide and the current prevalence of smartphones, a growing number of people are using navigation applications (apps) to find their way to their destination (i.e., “wayfinding”) or travel between public transport transfers. Therefore, designing an effective and user-friendly navigation system and interface is worthy of exploration. Previous studies on navigation systems have mostly focused on automobile drivers. To optimize a navigation system designed specifically for pedestrians, this study attempted to identify the operating patterns and strategies of pedestrians while using the Google Maps app on a smart phone to determine which direction to take toward the target destination. Behavioral observation, interviews, and video recordings of app operation by users were used to analyze how each participant utilized and interacted with the app to reach real-world destinations. Subsequently, a hierarchical cluster analysis was performed to classify the collected data into six types of wayfinding strategies following which users determined their departure direction. The six categories are further detailed as follows: (A) Users observe the geographical relations between landmarks and the virtual routes on the digital map without rotating the phone or turning their body. (B) Users rotate the digital map to align the landmarks on the digital map with their real-world counterparts in the physical environment. (C) Users observe the geographical relation between the heading direction of the blue beam on the digital map and the virtual route without rotating the digital map or turning their body. (D) Users turn their body to align the heading direction of the blue beam with the final destination on the digital map. (E) Users turn their body to align the heading direction of the blue beam with their departure route. (F) Users turn their body to align the heading direction of the blue beam with their departure route and then rotate the departure direction on the digital map upward on the phone. The aforementioned findings provide a deeper understanding of pedestrian behaviors when using navigation apps for wayfinding. Furthermore, future research should compare different wayfinding strategies to make suggestions on personalized navigation interface designs, thus optimizing user experience in navigation apps.

Keywords: *Google Maps app; individual differences; pedestrian navigation; wayfinding strategy*

Extended Abstract

Wayfinding, referring to moving to reach a particular destination, is an integral part of daily life. With the advancement of public transport and shared transport around the world, an increasing number of people are wayfinding on foot between public transport transfers and their destinations. Moreover, with the prevalence of smartphones, most people use Google Maps to obtain enough surrounding information for wayfinding.

Wayfinding is divided into three stages that occur in cycles: (1) location and heading, (2) route planning, and (3) route execution. In an unfamiliar environment, people have to rely on navigation systems providing surrounding information to help them maintain a sense of orientation throughout the wayfinding process. Therefore, designing an effective and user-friendly pedestrian-centered navigation system interface is worth exploring.

Although previous studies on navigation systems have mainly focused on automobile drivers, some pedestrian-centered navigation research has shown that most pedestrians prefer to use graphic maps for wayfinding, indicating that the information and modes presented on graphic maps (e.g., map perspective and location-based services) affect users' wayfinding efficiency and feeling. However, there is still insufficient evidence and research on interface design guidelines to make pedestrian wayfinding more efficient. Most navigation apps provide multiple and flexible map interfaces allowing users to adjust freely (e.g., zoom in and rotate). However, previous studies have revealed that too much information and greater freedom of adjustment can interfere with users' understanding of maps and their wayfinding strategy through information overload, which can lead to an increase in the time and effort that users spend on navigation apps while wayfinding.

To optimize a navigation system designed specifically for pedestrians, this study explored pedestrians' usage habit of Google Maps for wayfinding. Specifically, it focused on the first stage of wayfinding, when pedestrians most need to use a navigation system. To determine how pedestrians identify their set-off route to their destination using Google Maps in an unfamiliar real-world environment, we collected their operating patterns and goals through observations and interviews. We imported these data and performed hierarchical cluster analysis to classify users into six wayfinding strategies.

Materials and Methods

Materials

Participants

Thirty-one students from National Cheng Kung University who reported being frequent users of Google Maps and unfamiliar with the task area participated in the study (11 men, 20 women; mean age = 20.6).

Wayfinding Routes

Each participant participated in three real-world outdoor wayfinding tasks. Each task had a specific start and destination. To ensure that the participants were unfamiliar with the environment of each task, none of the tasks were connected. The starting point for the three tasks was a different type of road junction (e.g., T-junction, road junction) and their destination was a store name corresponding to the daily life of the participants. In addition, to allow the participants to use Google Maps for wayfinding as usual, we did not display any recommended routes on Google Maps, so the length of the wayfinding routes depended on the participants' route choice. The distance of each task was less than one kilometer.

Wayfinding Tool

The navigation device used in this study was the iPhone 6 with Google Maps as the wayfinding tool. On the Google Maps program, a blue dot represents the user's current location, and the blue beam displayed in front of the blue dot represents the user's current direction, which rotates with the phone's rotation.

Recording Tool

This study adopted the built-in screen recording function of the iPhone 6. We recorded all of the operations, reactions, and interviews of the participants in each wayfinding task.

Methods

This study included three fixed-order wayfinding tasks. Each task took about one hour. The participants were instructed to complete the wayfinding tasks in sequence using Google Maps. Before each wayfinding task, the experimenter led the participants to a specific starting point, opened Google Maps, and handed the navigation device to the participants and asked them to go to a specific destination. There were no restrictions on usage. Therefore, in addition to the think-aloud method, the participants could use any function of Google Maps. As the participants might not be able to promptly or consciously describe their psychological process and the purpose of their behavior, in the wayfinding tasks, the experimenter not only observed and recorded the participants' behavior and oral content to understand their wayfinding strategies, but also conducted semi-structured interviews after each wayfinding task to collect information missed or ignored by the participants.

Analytical Method

First, we manually transcribed the interviews and think-aloud content of the participants during the wayfinding tasks and listed the information, behaviors, and strategies adopted by all users. Second, we used the usage proportion of all users based on this list for hierarchical cluster analysis to classify the wayfinding strategies of the participants after ensuring that their usage was stable.

Results and Discussion

This study explored how pedestrians identify their starting route with Google Maps in wayfinding tasks. We divided this process into three parts to discuss the results, including the information and operations used by the participants; their usage strategies—the combination of operations and information used simultaneously; and their wayfinding strategies—their combination of similar usage strategies, to divide the participants into different wayfinding strategy categories.

Operations and Information

Operations: According to our observations, there were two steps in the participants' use of Google Maps for wayfinding. They first used the Google Maps interface to enter the navigation mode, then identified their starting route. There were 93 wayfinding tasks in this study. At the entry stage, all participants entered the destination in the search bar, using the route recommended by the system based on the "route" button in 67% of the wayfinding tasks and pressing the "start" button to turn on the auto-navigation mode in 25% of the tasks. At the departure route identification stage, the participants relied on the blue beam by turning their bodies or orienting the device to identify the departure route in 62% of the wayfinding tasks and rotated the map on the interface in 37% of the tasks.

Information: After entering the custom navigation mode, the participants used the blue dot in 100% of the wayfinding tasks, the blue beam in 70% of the tasks, the route recommended by the navigation system in 75% of the tasks, and landmark information in 28% of the tasks, and they looked for the target shown on the map in 16% of the tasks.

Usage Strategies

Regardless of the navigation mode selected, all participants searched for specific information with certain operations for successful wayfinding. Therefore, we combined the selected information and the operations used to create the usage strategies. There were 10 types of usage strategies based on our observations: some users adopted only one type of usage strategy at a time, but others adopted multiple strategies at a time.

The first usage strategy used for 13% of the wayfinding tasks by the participants relied on the blue beam directed at the target on the map by turning their body or orienting the device, while the second strategy used for almost half of the tasks was based on turning the blue beam toward the starting route on the map using the above operation for wayfinding. The third strategy used for 3% of the tasks relied on searching for a specific landmark on the map and then aligning the landmark with its real-world counterpart using the same operation as the previous usage strategies. The fourth usage strategy used for 12% of the tasks also intended to align a landmark with its actual representation, rotating the map to achieve this. In addition to this usage strategy, three other usage strategies used the map rotation method to obtain information, including the blue beam, the target, and the route strategies used for 12%, 4%, and 13% of the tasks, respectively. Moreover, three strategies used by the participants searched for the departure route without turning their bodies or rotating the map or device. These three usage strategies used the correlation between the information on the map to determine the starting route, consisting of the relative position of the landmark and the route and the correlation between the blue beam and the route or target, with adoption probabilities of 17%, 13%, and 4% respectively.

Wayfinding Strategies

After applying Kendall's coefficient of concordance (W) to determine the stability of the participants' information, operations, and usage strategies for the three wayfinding tasks, we performed hierarchical cluster analysis to classify the collected data and identify six types of wayfinding strategies, which could be divided into two categories (landmark group and blue beam group) based on the information used for wayfinding. Both groups used different wayfinding strategies based on rotating the map or turning their bodies. There were two wayfinding strategies in the landmark group. One wayfinding strategy used the relationship between a landmark and the suggested route without rotating the map or turning the body to determine the starting route. The other wayfinding strategy of the landmark group used the rotation of the map to align a landmark on the map with its real-world counterpart to determine the direction to go. In the blue beam group, there were four wayfinding strategies: (1) the participants determined the relationship between the blue beam and the suggested route on the map without rotating the map or turning their bodies; (2) they oriented the blue beam toward the destination on the map by turning their bodies; (3) they oriented the blue beam toward the starting route on the map by turning their bodies; and (4) they identified the set-off route only after turning their bodies to direct the blue beam to the selected route on the map and rotating the map.

Conclusion

This study used observations and interviews to classify wayfinding strategies when using Google Maps for wayfinding in an unfamiliar environment. The results showed that different users stably adopted different information and operations to reduce their cognitive load and successfully identify the departure route.

The main difference between this study and previous related research is the wayfinding stage when using a map. Previous research has mainly focused on the route execution stage, while this study specifically examined the location and heading stage, the most useful stage for wayfinding. Although the result that all participants used the graphic map for wayfinding is consistent with previous research, fewer participants used map rotation than in previous studies, and this difference may be due to the blue dot and blue beam displayed on the map to inform users of their current position and direction.

However, although we divided all participants into six wayfinding strategy categories, it is not clear whether the operations and information selected by the participants were affected by the default mode of Google Maps. Therefore, the wayfinding strategies used to divide all users may not directly represent their preferences and the most efficient wayfinding strategies. Moreover, to increase ecological validity, we did not strictly control the navigation mode selected. Therefore, different navigation modes with different designs on the Google Maps interface were used by different users, such as different perspectives and different shapes of the blue beam. Regarding the results of this study, in addition to its relatively small scale, as the wayfinding tasks required a great deal of energy and time, all of the participants were young, familiar with Google Maps and unfamiliar with the task environment, so it remains to be seen whether the results are suitable for other conditions.

Our results indicated individual differences when using Google Maps. Different participants used different information and forms on the map for wayfinding. Therefore, for future research, we recommend that designers redesign the Google Maps interface to personalize it to reduce users' visual search time and increase the efficiency of wayfinding based on different user strategies. In addition, future research should verify the results of this study using other techniques (e.g., eye tracking), explore the reasons for individual differences in wayfinding strategies and the effect of a personalized interface, and compare them with the latest augmented reality (AR) map released by Google.

Overall, this study provides a better understanding of pedestrians' wayfinding strategies when using Google Maps to identify the departure route. To the best of our knowledge, few studies have focused on this topic. We hope that our study can provide useful design suggestions for personalized wayfinding interfaces, reduce people's cognitive load and time spent, and optimize the user experience when using Google Maps for wayfinding.