

# **NAVIGATION APP AND FUTURE SPATIAL THINKING: IMPACTS OF MOBILE NAVIGATION APP ON TRAVELER ROUTE CHOICE**

Vindaya Garusinghe, Amila Jayasinghe

*Department of Town & Country Planning, University of  
Moratuwa*

*vindayaegarusingha@gmail.com, amilabj@uom.lk*

**ABSTRACT** - This study investigates the use of mobile navigation apps for way finding by travellers and the possible influence of these apps on navigator's route choice and interaction with space. The study is based on data collected by distributing a questionnaire on- and offline among travellers who visit the Colombo metropolitan area on a daily basis. This research uses a questionnaire survey and accessibility scenario analysis using spatial analysis tools. Findings indicated that travellers use navigation apps for selection of route and destination in unfamiliar areas more often than in familiar areas. By now, a higher percentage tend to select routes which high in spatial configuration in terms of the betweenness and closeness centrality despite the high travel time at peak hour. Further, the study identified accessibility level varies based on two scenarios, i. Route choice influenced by the spatial configuration and ii. Travel time.

**Keywords:** Mobile app-based Navigation; Configuration; Accessibility; Route choice; Planning.

## **1. INTRODUCTION**

“Spatial knowledge acquisition is needed to build a mental representation of space, which is essential for way finding and other spatial tasks” [1]. During way finding, people make route decisions to find a connection between a start point and an endpoint without an external guide of the map [2]. A Siegel and White [3] identified three types of spatial knowledge for the guide to travel. Those are landmark knowledge, route knowledge and survey knowledge. This spatial knowledge allowed people to find routes with a general frame of reference. When planning a city or region, urban planners' study cognitive behaviour to understand urban space [4]. Many recent researchers describe mobile navigation apps as reducing the cognitive effort of mental representation. Gramann, Hoepner & Karrer [5], identified that “spatial cognitive skills deteriorate with increasing use of navigation system”. Hence, it emphasised that transport planners, urban planners and designers now need to consider the routes that will likely be suggested by GPS navigation in terms of how they design, manage, and operate street and pathway network. Also, it required to account the impact of navigation apps when designing urban activities [6]. Therefore, in this study attempts to make a significant contribution to the following two key limitations noted in emerging research in the domain of urban transportation planning and urban designing. I. To investigate the use of mobile navigation app for way finding by travellers. II. To investigate what are the possible influence on mobile navigation apps on traveller's' route choice decision and interaction with space.

## **2. MATERIALS AND METHODS**

The study used questionnaire surveys for primary data collection. The survey data was collected from distributing questionnaire forms to people who visit the Colombo Metropolitan Area on a daily basis and also by conducting an online survey (i.e., Google Form). Additionally, a few discussions were conducted for taxi drivers and travellers. Questionnaire survey consisted general information regarding traveller; questions related to if they are familiar or unfamiliar with the area, and how they selected route and destinations, reasons to use navigation apps, how often they travel in selected destinations and finally their perception about future travel pattern. It followed in-situ questionnaire surveys and online surveys to acquire the data. Also, selected origin and destination pairs in Western Province given to the travellers and asked to select most preferred O-D pairs and route options they frequently followed using navigation apps to identify their perceptions regarding to transportation route choice. The sample size for the questionnaire survey was selected by considering travellers those who are above the age of 17 years. The study followed Solvin’s Formula. The selected confidential level is 95% suggest that margin error was 5%. Hence, sample size for this study was 300 questionnaires.

### 3. RESULTS AND DISCUSSION

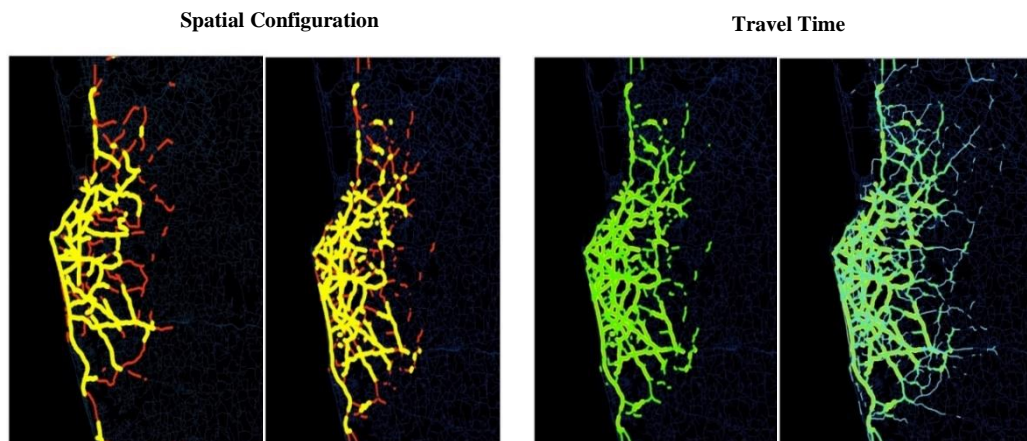
When considering how gender affects route selection of familiar area, men use navigation apps more (67%) compared women. They are also more likely to use navigation apps to select routes, even in unfamiliar areas. Age categories influence on route selection, too: travellers between ages of 17-26 utilized Google map more than any other age group. When considering the trip mode, three-wheelers (91%) often use navigation app to select routes in familiar and unfamiliar areas more than other modes. Furthermore, when considering the travellers trip purpose, the purpose of leisure leads to increased navigation app use (80%) to select routes in familiar and unfamiliar areas. omen more like to use navigation apps (26%) to find their destination in familiar areas than male. When comes to travel mode, cars (29%) used the navigation app to find destination in more familiar areas than other modes. Considered the unfamiliar area, motorbike uses navigation app (97%) more than any other modes. When considering traveller’s trip purpose, people travelling for studies used the navigation app to find destination in both familiar and unfamiliar areas. Table 1 depicts the changes of the use of navigation app to find route and destination in past and present condition.

**Table 1.** Comparison of Usage of Navigation App between Few Years Ago & Now

Category	Past	Percentage	Present	Percentage
Every Trip	14	5%	136	45%
Never	50	17%	24	8%
To Find Out Unknown Destinations	140	47%	210	70%
When Traveling By Taxi	22	7%	140	47%
When Traveling Unfamiliar Areas	74	25%	178	59%

The traveller’s route choices evaluated using the questionnaire survey results were found that, currently many travellers select routes in terms of topological distance, (i.e., least number of turns). But in future with increased use of navigation app, this may change. Because navigation app generally shows shortest route with less traffic congestion. Further, the study modelled the impact of mobile app-based route choice on level of accessibility of the CMA road network (Figure 1). It clearly indicated that accessibility level significantly changed under each scenario. As an example, Athurugiriya to Homagama, Katubadda to Hokandara (travel time-based route) recorded low level accessibility in terms of scenario 1 - route choice influenced by spatial configuration and whereas it high in scenario 2 -route choice influenced by travel time-. Thus, it indicated that traffic volume and attraction to land use activities will change in the

era of mobile app-based navigation. Therefore, the planners need to rethink the application of accessibility modelling and way of conceptualising the cities and designing.



**Figure 1.** Level of Accessibility Based on Spatial Configuration & Travel Time in Western Province

#### 4. CONCLUSION

The key findings of the study indicate that travellers predominantly use navigation apps to select of route and destination in unfamiliar areas. Further, young travellers tend to use navigation app more than than the older travellers. Public transport uses navigation apps less private transport such as car, bike, and three-wheeler. More travellers use navigation apps at present than before. Further, results clearly indicated that accessibility level varies based on two scenarios (route choice influenced by the spatial configuration and influenced by the travel time). So, this indicates that traffic volume and attraction to land use activities will be change in era of mobile app-based navigation. In summary, the study highlights the need for novel approaches to analysis, design, and manage the urban space likely to be affected by mobile app-based navigation. Further, accessibility of the road network may need to capture travel time optimisation rather spatial configuration perspective. Travellers may travel along residential areas more than commercial areas. With these changes land use activities also may change. Therefore, engineers, planners and designers need to find out new ways to capture traveller movement patterns and accessibility.

#### REFERENCES

1. Huang, M. Schmidt and G. Gartner, "Spatial knowledge acquisition with mobile maps, augmented reality and voice in the context of GPS-based pedestrian navigation: Results from a field test.," *Cartography and Geographic Information Science*, vol. 39, no. 2, pp. 107-116, 2012.
2. W. Liao, A. U. Kemloh Wagoum and N. W. Bode, "Route choice in pedestrians: determinants for initial choices and revising decisions.," *Journal of the Royal Society Interface*, vol. 14, no. 127, p. 20160684, 2017.
3. A. W. Siegel and S. H. White, "The development of spatial representations of large-scale environments.," *Advances in child development and behavior*, vol. 10, pp. 9-55, 1975.
4. A. Gospodini, "Urban design, urban space morphology, urban tourism: an emerging new paradigm concerning their relationship.," *European planning studies*, vol. 9, no. 7, pp. 925-934, 2001.

5. K. Gramann, P. Hoepner and K. Karrer-Gauss, "Modified navigation instructions for spatial navigation assistance systems lead to incidental spatial learning.," *Frontiers in psychology*, vol. 8, p. 193, 2017
6. R. M. P. N. S. Bandara, A. Jayasinghe, and K. D. P. P. Jayasinghe, "Space Syntax and Mobile GIS Application: Investigation of Relationship Between Human Walking Pattern and Spatial Configuration," *International Journal of Emerging Technology & Research*, vol, 1, no. 6, p. 1-7, 2014.