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Pedestrian Navigation: A comparison of navigation aids under time pressure.

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Master Thesis , SS 2015

Abstract

Nowadays pedestrians use a number of different navigation aids in order to facilitate their navigation in familiar and unfamiliar urban environments. Researchers investigate how these different navigation aids can make pedestrian navigation more effective and efficient. The current thesis examines the impact on user experience and navigation performance that comes from three different navigation aids, namely mobile digital maps, voice instructions and the combination of the two when these are used under time pressure. The thesis reviews the literature concerning the different navigation aids which are used in pedestrian navigation and it mainly focuses to studies which investigate the impact on user experience and navigation performance that comes from mobile digital maps and voice only guidance.

Research Question

R.Q.: By using which aid do users navigate more efficiently and effectively under time pressure? By voice instructions, by a mobile digital map or by the combination of the two navigation aids?

Hypotheses

In order to give an answer to the research question of this study, several measures are collected and analysed through and after the experimental phase. Furthermore, three different hypotheses are tested with the analysis of the collected data:

H1: Participants will navigate more efficiently and effectively under time pressure with voice instructions only than with a mobile digital map.

H2: Participants will navigate more efficiently and effectively under time pressure with the combined use of the two navigation aids than with a mobile map or with voice instructions individually.

H3: User experience will be better with the combined use of a mobile digital map and voice instructions than with a mobile map or with voice instructions individually.

The Study

Test routes

The three test routes are part of the virtual city and they were designed to have the same characteristics having as purpose to produce comparable data sets (Table 1).

	Virtual length of the route (m)	Number of Decision points	Level of Complexity (Type of intersections)	Time to walk on average
Route 1	1332	11	2 Y, 2T, 2 Star, 2 Cross	3' 40"
Route 2	1332	11	2 Y, 2T, 2 Star, 2 Cross	3' 40"
Route 3	1332	11	2 Y, 2T, 2 Star, 2 Cross	3' 40"

Table 1: The characteristics of the 3 virtual routes

Participants

A total of 33 participants took part in the study.. From these participants, 23 were males and 10 were females. The participants had different cultural (Greek, Swiss, Cypriots, Spanish) and professional (e.g. Geomatics, Bankers, Physicists) backgrounds. The youngest person was 19 and the oldest 32.

Experimental Design

The study uses a within subject design. This means that a group of participants takes part in all conditions or tasks. In the current study all 33 participants had to navigate along all three different routes but with the use of a different navigation aid in each route (Table 2).

Number of Participants (33)	Route 1	Route 2	Route 3
Eleven Participants	Mobile Digital Map	Voice-only instructions	Mobile Digital Map & Voice instructions
Eleven Participants	Voice-only Instructions	Mobile Digital Map & Voice instructions	Mobile Digital Map
Eleven Participants	Mobile Digital Map & Voice instructions	Mobile Digital Map	Voice-only Instructions

Table 2: Within Subject design with counterbalancing

Measures

- **Effectiveness:** number of stops and number of errors
- **Efficiency:** completion time of the task, walking time between the decision points.
- NASA TLX, SBSODS, UEQ, Level of Time Pressure, Level of experience with the used technology

Set up

Participants had to stand behind a desk and use a 3D joystick to navigate in a virtual city that was projected on a wall through a projector. Participants had to navigate the city from a first-person perspective. For the purpose of landmark based navigation colourful textures were applied to the buildings of the virtual city (Figure 1).

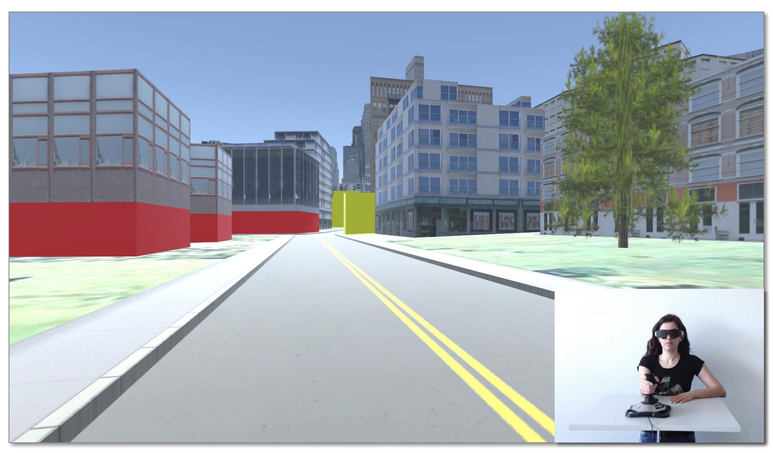

Figure 1: Virtual Environment first person view

Results

Findings revealed that:

- Participants had high level of Spatial Abilities.
- Participants were experienced in using navigation systems which support digital maps and voice instructions but they were not so experienced in using 3D virtual environments and 3D joysticks.
- Navigation performance was similar for all three navigation aids.
- User experience was similar for all three navigation aids.
- Participants felt being under time pressure but they did not experience high level of time pressure.
- Load on visual attention dramatically increases with only map based guidance while it significantly decreases when both navigation aids are available.
- The cognitive workload stays the same among all three navigation aids.

Conclusions

In conclusion, pedestrians seem to be able to navigate effectively and efficiently with all three navigation aids, under moderate time pressure. The load on visual attention is extremely increased with map based only navigation. Last but not least, the findings of this thesis, which was conducted in a virtual environment, are aligned with findings of real environment studies.

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