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Paths or walls? Designing tactile maps of building interiors.

Emily Holmes and Aries Arditi
Arlene. R. Gordon Research Institute, The Lighthouse Inc.,
111 East 59th Street, New York, NY, 10022, USA.

Abstract

In designing tactile maps of buildings interiors, two alternative ways to represent spaces are 1) in a fashion that echoes the physical structure of the environment (wall" style maps), or 2) in a fashion that mimics the path of travel through that space ("path" style maps). We report an experiment comparing these two map designs. Our focus was on maps that could be used by blind users wishing to independently plan a route in an unfamiliar building area. Taped instructions were developed to accompany the maps to make them accessible to people without tactile map experience and to convey the graphic conventions of each map style. Participants performed significantly more accurately and expressed greater preference for the wall map than the path map.

Introduction

Map technology allows the representation of geographic spaces of arbitrary size, by exploiting humans' exquisite capability to apply certain geometric transformations like scaling, rotation and translation to mental images of visual scenes (Shepard and Hurvitz 1984). Much of the research in tactile mapping has focused on perceptual differences between vision and touch in making maps, such as in increasing tactile symbol discriminability, and the selection of tactile medium (cf. Ungar and Espinosa, 1995; e.g. Loomis 1990; Jansson 1988). The experiment we report here instead uses highly discriminable tactile features but focuses the issue of overall map style or layout. The methodology uses the practical, goal oriented task of route planning. We are concerned with a specific type of tactile map, one that might be installed in a stationary location in a building interior to allow a blind user aid in route planning on a single floor of an unfamiliar building. We attempt to examine the relative importance of positive information that gives the user an explicit route or "path" vs. negative information that gives the user information about barriers (i.e. walls) in potential travel routes.

The Tactile Maps

The particular maps used were designed for The Lighthouse Inc.'s new Manhattan headquarters building by Roger Whitehouse of Whitehouse & Co. They are illustrated in Figure 1.

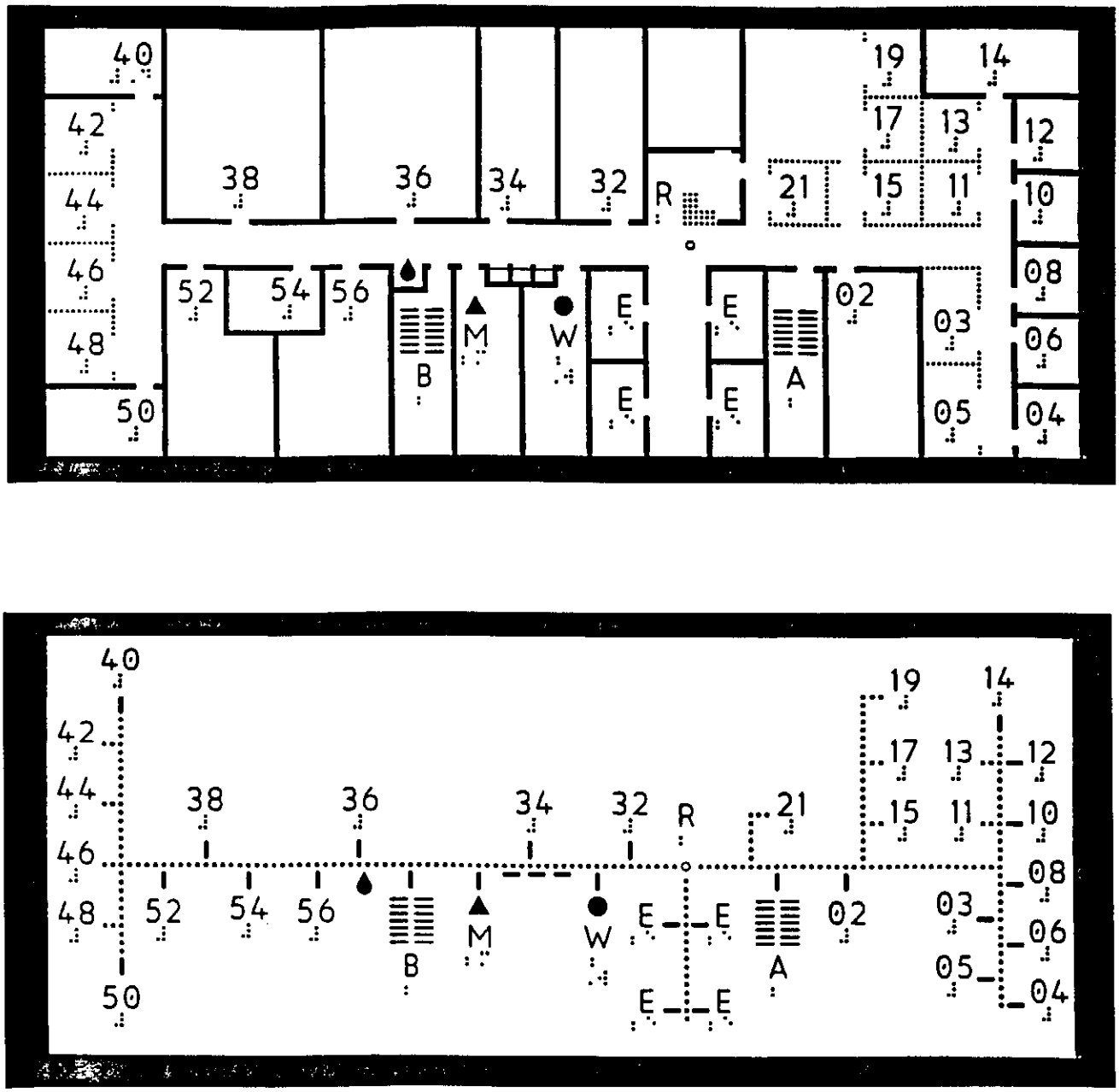

Figure 1. The wall map (above) the path map (below).

Tactile Map Reading Instructions

Audio taped instructions of tactile map usage were developed for each map. These explained each map's graphic conventions, and provided a tutorial on its key features including locating the map on the stand and the title, the participants current location, how raised symbols such as lines represented the building space, and the meaning of point symbols. (The instructions are printed in full in Holmes and Arditi (submitted) and are available from the authors). The instructions took a mean time of 5 minutes 50 seconds.

Method

Participants

Four male and two female participants who had never been to the test floor of the Lighthouse building, and ranging in age from 31 to 64 years, participated. Five were totally blind and one had slight light perception. Three participants were congenitally blind and the remaining three had lost their vision before the age of 12 years. One participant had previous experience with tactile maps.

Procedure

Each participant explored and was tested on each map design in two separate sessions, with map order counterbalanced across participants. After listening to the map reading instructions, participants then had to plan a route to six goals named by the investigator using the map. Their map reading behavior was videotaped for analysis. After each they were asked to verbally describe the route they would walk to reach the goal. Next, they were given four questions to test the spatial knowledge of the building area they had built up using the map. Participants subjective responses about the maps were gauged using five rating scale questions, concerning issues of map learnability, usability for route planning, quality of cognitive map developed, acceptability of the map as a wayfinding device and the likelihood of using the maps. Finally serveral open-ended questions were asked to elicit further comments.

Results

To summarize, participants spent longer time exploring the map for route planning using the wall rather than path map (mean time =134.9 seconds vs. 77.5 seconds, $z= 2.608$, $p<0.005$).
The route descriptions for goals were coded for correct and incorrect information. These *were* then scored as "*accurate*" - containing navigational information needed to reach the goal, "*incomplete*" - containing accurate information but lacking some information required to reach the goal and "*incorrect*" - containing information that contains incorrect navigational decisions to complete the route. Figure 2 shows that participants described routes more "accurately" using the wall than the path map and made more "incorrect" descriptions using the path map. These differences are significant using a sign test ($x=0$, $n=5$, $p<0.05$, and $x=0$, $n=6$, $p<0.025$ respectively). There was no significant difference in the number of "incomplete" descriptions. Participants overall subjective rating were significantly higher for the wall than the path map ($t(29)=2.41$, $p<0.025$).

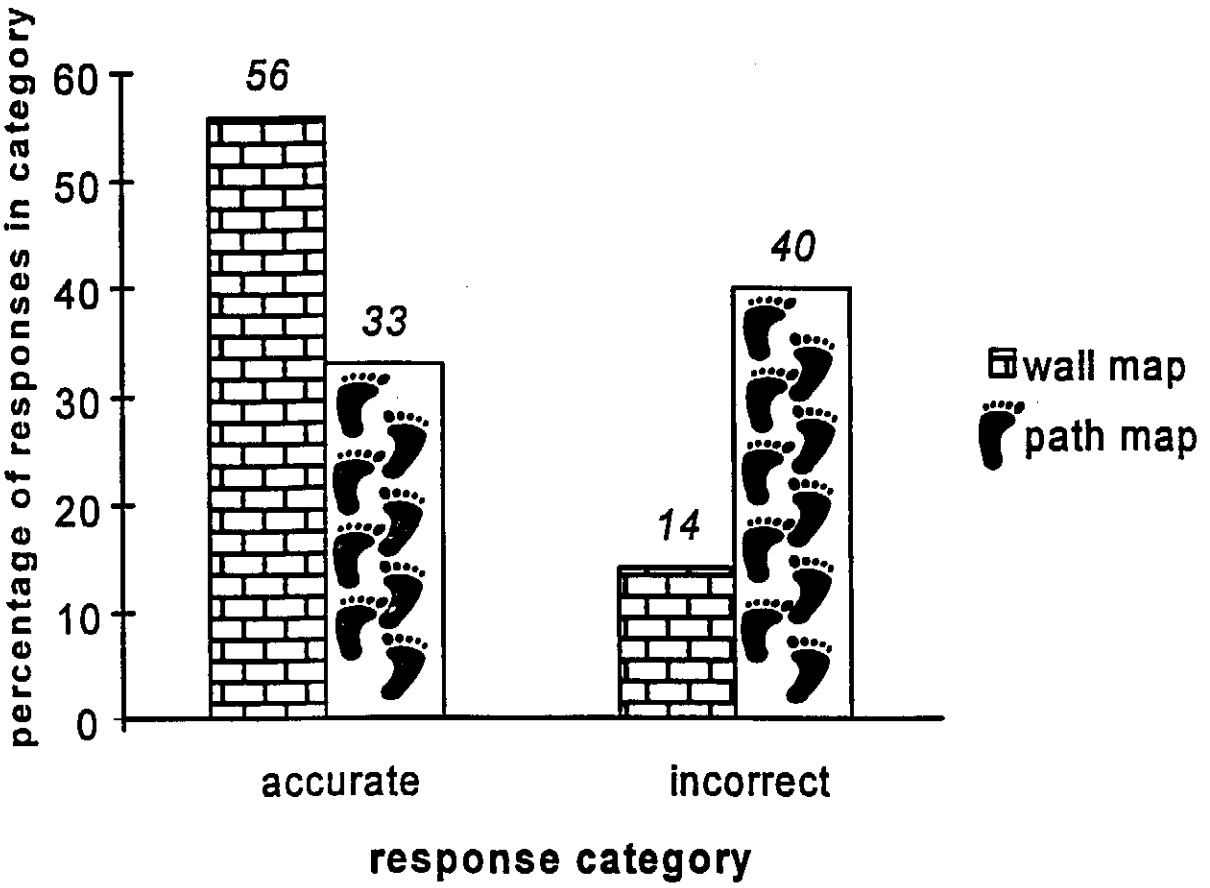

Figure 2. The percentage of accurate and incorrect route descriptions to goals having used each map. (Nb. There is no significant difference between the number of incomplete route descriptions).

Discussion

Tactile maps, in conjunction with pre-recorded instructions, can be independently used by blind people who have not had previous tactile map experience, to plan routes in unfamiliar buildings. The results suggest that tactually represented information about walls rather than paths of travel leads to more accurately planned routes and are preferred by blind map readers. This may be because the architectural information can be used for wayfinding promotes a richer mental representation of a building space. Participants commented that it was easier to image the space using the wall map, four of the six participants noting the gaps in lines as door entrances on the wall map (rather than bars jutting out on the path map) as a positive example.

It should be noted that these results were contrary to our expectations since, for example the path maps are less cluttered which is an advantage in tactile map design (Edman, 1992, p.307). Further, Preisner (1983) had developed a second generation of tactile maps of building interiors

which are similar to path maps, but these do not seem to have been experimentally compared to his original "wall style" maps. However, for tactile maps at a smaller scale (e.g. the same size map representing a larger area) path style map design may be useful. In summary, wall style tactile map design can be recommended for building interiors of this scale. Instructions accompanying tactile maps are key in allowing successful map reading of the tactile representation.

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