How to investigate and improve legibility of urban projects to make them understandable for blind people?

Contribution of Social and Behavioral Sciences Methods to Design for All Approach

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ABSTRACT

The following article is an overview of how well the architects are equipped with knowledge and rules of art regarding the issue of engaging disabled persons into user groups in environment built upon rules of full equivalency and a suggestion of further directions of complementing the Design for All principles and consequently rules and regulations based on research conclusions from related branches.

The research report analyzed legibility of urban space (and architectural), the way it was understood by Lynch (1960), as a dimension essential to ease of learning by blind persons of a given terrain and creating its cognitive maps. Four land management urban projects of Olympia Park Berlin (Pichselberg Tip) in form of tactile maps were presented to participants of research. After a standardized procedure of acquaintance with each of these projects a structured interview was conducted with each of the research participants, in which they were asked for items facilitating or hindering familiarizing with the map, learning the terrain and items potentially hampering individual movement around it. Qualitative data from these interviews as well as geographical data that presented trouble spots for blind persons in urban projects allowed determining which one from spatial systems was the most and which least legible and thus present recommendations for potential changes in eventual, further designing stages of Olympia Park Berlin.

Research presented in such format inscribes into participation design trend, which stipulates involvement of participants (future and/or potential) into designing process. Featured research, however, is an example of an urban projects evaluation method concerning the needs of blind persons and how can they become involved in designing process.

Keywords: Design for All, participatory design, cognitive maps, spatial orientation, blindness, tactile map
INTRODUCTION

Design for All is contemporarily a term functioning with certain connotation, understood rather as a symbol for opening environment to people with various disabilities, whereas these disabilities are perceived as existing within standards. This conviction was not easy to introduce – last decades of 20th century are an evidence of struggle in this area. They show a record of strenuous creation of designing standards for widened people’s needs. (Kuryłowicz, Thuresson & Johni, 2005, pages 12-18). Drawing designing recommendations for such needs cannot be as simple as defining spatial parameters for example for passages accessible to wheel chairs. Acoustic and visual aspects of environment perception are more demanding issues, however for architects this is more an intuitive and experimental domain than normatively established conviction.

SPACE LEGIBILITY AND SPATIAL ORIENTATION OF BLIND PERSONS

Looking for designing solutions that will facilitate blind people’s movements around a given terrain, learn it and understand cannot base on personal observations from designers’ individual experiences. Differences between the blind and a person with blindfolded eyes result from different mechanisms of collecting and classifying spatial data about environment (Golledge & Stimpson, 1997).

From diagnose dimensions of architectural and urban space that decide on how easily blind persons can understand it and move around independently legibility seems to be the key factor. Repeated spatial elements, clearly visible rules of using it as well as topical continuation of different types of space facilitate coherence and legibility (Kaplan & Kaplan, 1982, after: Evans & McCoy, 1998; Lynch, 1960). Lack of coherence and legibility is also the cause of difficulties in creation of cognitive maps of a given space. Cognitive maps are spatial representation in users’ minds (Downs & Stea, 1973; Gould & White, 1986). How detailed map-representation are we able to create depends on our individual ability of perception on one side, on the other hand depends on space characteristics, its legibility, cohesion, diversity or presence of distinctive points. Legibility of architectural space, its structure, is including: traffic routes, displacement of distinctive points makes it easier for users to move around it and find their way (Abu-Ghazzeh, 1996; Dogu & Erkip, 2000; Evans, 1980, after: Evans & McCoy, 1998; Gärling, Böök & Lindberg, 1986; Golledge, 1999a, Passini, 1996; Peponis, Zimring & Choi, 1990).

Tactile maps as representation of architectural and urban space

Use of maps is one of ways to purchase cognitive maps of terrain. According to McDonald and Pellegrino’s (1993) classification the use of maps and other environmental descriptions is derivative space learning. For blind persons tactile maps are above all a tool to ease orientation in a given area (Arthur & Passini, 1992). Research proves that use of tactile maps of an unknown terrain simplifies moving around it. Use of maps raises efficiency and safety for moving by a given route in comparison to crossing it upon an earlier description or passing it with a sighted guide (Espinoza et all., 1998). Mode and technical parameters for preparing maps have significant influence on efficiency of their perception (Berla, 1982).
Guidelines regarding adequate marking of elements on tactile maps can be found among others in elaborations of American Printing House for the Blind (2004).

Depending on purpose of tactile maps to perform certain tasks and for certain needs of their users we distinguish different types of maps. According to James (1982) we can distinguish: (1) “orientation maps” that enable general perception of a given area, for instance the entire city or a block; they are drawn in a relatively small scale and contain most characteristic elements for a given area; (2) “mobility maps”; they are drawn in considerably larger scale so that all key elements can be clearly shown when moving across this given area.

Michel (2000, after: Harder & Michel, 2002) introduces a new type of tactile maps – “individual map” adapted to specified tasks and for defined users. A particular case of individual map being a conjunction of maps described by James (1982) is a target-route map. It contains a detailed representation of a chosen road and its surroundings in general outline with characteristic elements. Consideration of route’s surroundings allows finding it once it was lost. It is important that on the target-route map the chosen route is considerably larger that its surroundings (Michel, 2000; after: Harder & Michel, 2002). Research on usefulness of target-route maps (Harder & Michel, 2002) shows that research participants get faster acquainted with target-route map than orientation or mobility maps referring to the same terrain.

Research target

Research described in this study inscribes into activities of participatory design that aim at verification of alternative design solutions and their accommodation to blind persons needs. Main target of the research was verification, which of urban projects prepared by students are easier to learn than others, thus are more legible, and why are they so perceived. It is anticipated that the complexity of spatial system of presented projects alters the ease of learning a given system upon a tactile map. It is assumed that blind persons will be able to indicate on tactile maps potentially difficult to them elements of area development from a spatial orientation point of view. Limitations arising from applied research data in form of tactile maps were taken into consideration in the analyses and drawn conclusions on legibility of suggested design solutions

METHOD

In order to accomplish research target and therefore answer questions quoted above a study in form of structured interviews with use of tactile data has been conducted. Qualitative data on declarative evaluation of development projects and usefulness of tactile maps as space presentation has been gathered. Subject to analysis were also mapping evaluation results on development projects as they present a graphic representation of evaluation of urban projects’ legibility.
Participants

In research took part 12 blind persons (six men and six women) with age ranging from 32 to 74 years and all living in Warsaw, Poland. Most respondents are working (ten persons) and obtained a higher education (nine persons). All persons have declared a substantial loss of vision. More than half of research participants is blind from birth, three persons have lost sight in childhood (in second, third and seventh year of life). Two persons got blind – one since 15th year of life the other lost sight 2 years before the research. All respondents declared that they go out every day and use a blind stick when moving around. Five persons added that occasionally they use a guide. Only one person does not use city transit. All other persons use means of city transportations daily. All respondents read Braille and had earlier experience with tactile graphics.

Procedure

Each participant received all experimental maps (land development projects) and a control map. Entire experiment has been registered with a camera. Research participants, before they started their duties have been informed that there are no good or bad answers and that evaluated are not their abilities but presented projects. Respondents have not been informed that time of task fulfillment will be measured. Such information could disturb research results by raising participants’ stress level or shifting their attention from map elements to task performance time.

Each time the interview consisted of two stages: preparation and research. During preparation stage participants were presented with a control map containing the elements consistent for all maps. These elements included: 1) area limits, 2) railroad tracks, 3) buildings that could not be moved by students in their projects, 4) main roads, 5) railroad platform. It should be noted that in one project roads have been designed underground and thus were not presented on the map. After acquaintance with the control map participants were asked to point out certain elements marked on maps. Apart from getting acquainted with location of elements common for all maps participants could at this stage get acquainted with texture of certain types of objects that were cohesive for all maps. Research phase included subsequent presentation of all maps of projects. Each participant was presented with maps in different order to avoid effects connected with order of presented data.

For each project map the research proceeded along the same scheme, which included: 1) phase of map learning, 2) phase of map analysis and 3) map evaluation phase. Learning phase included time to get acquainted with the map and to fulfill the tasks (indicate the platform and amphitheater) that verified the level of acquaintance and therefore readiness for next phase (analysis). During the analysis phase participants have been asked to find the easiest way from the platform to amphitheater and then show this way and describe the route. During the last phase of interview the spatial data regarding evaluation of development projects was gathered. Evaluation rested on indication by respondents the illegible places, difficult and too complex to imagine and how potentially they could pass them. During this part participants have been also asked for a declarative evaluation of the complexity level of the spatial system, and ease in learning the map. Upon presentation of all project maps came the phase of summation of results. Participants have been asked to point out the easiest and the most
They were asked about the usefulness of tactile maps as a tool helping to learn a given terrain. They were also asked to express their opinion and observations regarding technical side of using tactile maps.

**Research material**

For the purpose of the experiment all projects we used in experiment were assigned with capital letters: A, B, C and D. Specific character of tactile maps and the way they are being used imposed in research material the consideration for only significant elements. Apart from the area limits and the railroad track only buildings and roads have been marked. Also tactile maps contained no information about terrain topography. In addition the adaptation of projects to tactile function meant perturbation (in relation to original values adapted in projects) of spatial relations between objects. Certain objects (buildings and roads) were enlarged/reduced, pushed away from each other and deprived from details so that they could be easier read with fingers. Maps were prepared using Braille print technique on “Tiger” ViewPlus printer. According to classification of tactile maps (James, 1982) the maps used in this research could be described as mobility maps.

**RESULT**

**Spatial and declarative evaluation of legibility of development plans**

Upon familiarization with all development projects and completion of all tasks participants have been asked to evaluate which map seemed to be the easiest/most difficult from their point of view. This question has been accompanied by auxiliary questions such as: on which map it was easiest/most difficult to find a good way, which was easy/difficult to learn, which one of spatial systems was easiest/most difficult to move around. Figure 1 shows easy/difficult classification of the maps.

![Easy vs Difficult Maps]

*Figure 1: Evaluation of development plans as the easiest or most difficult.*

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Figures 2-5 present the spatial evaluation of subsequently projects A, B, C, D. Development project’s maps contain information on which routes were indicated by respondents and which of them they have preferred. In addition we have marked places considered by respondents as complex and difficult to pass – illegible as described in bibliography. It has to be noted that for the respondents term “legible” had two default meanings: legible preparation of the map (map easy to read – technical aspects of preparation) and legible spatial system (simple, easy to imagine). In most cases research participants understood “legibility” in its first meaning, what is significant from the relevance of questions’ point of view. In description of results the term “legibility” shall be used as understood in bibliography.

In projects A, B and D research participants most frequently negatively marked the road intersections. The issue of intersections was particularly a problem in projects A and B. Respondents have marked that there are a lot of intersection and road forks. Moreover, when examining the maps and seeking the way they were disturbed when intersections had more than four leaving roads and when the roads did not cross at a straight angle. Following quotations give a good idea what kind of problems are being caused by such intersections:

“… If this was prepared with consideration for the blind and generally disabled people, then the simpler footpaths or communication routes are the better. Communication routes should intersect at straight angles. One should avoid V shaped forks or open angles; as such intersections are poorly legible for the blind. There must be an absolutely straight angle. Moreover footpaths should not be wavy or curved left or right like a zigzag, they should lead straight ahead. I speak not only for the blind but also persons on wheelchairs for which it is also easier to drive straight than maneuver.”

“Such slant (project D; point of junction of two roads running from the platform) should be avoided, because if I leave from here (from the platform) then I can leave, but if I go there (from amphitheater) then just straight up, if I happen to meditate I could touch with my stick the edge of a wrong path. I won’t be able to feel that I am moving slightly right when I wanted to go left.”

In addition untypical road intersections on examined maps have caused that respondents declared problems in finding continuation of their way, even when they repeated showing the road that was already found.

In project A participants noted that roads are “very meandrous”. On the other hand the information points proved to be helpful in road finding and acquaintance with the map, although many respondents noted that “there are an awful lot of them”.

Participants examining project B and performing tasks on this map often noted the large number of roads, an “entanglement”. However, this plan was marked as the simplest of all and a statement was made that “straight angles generally have been preserved”. Respondents recognized diversification of road width as an additional help in reading this map, since it allowed distinguishing main roads from secondary.

From opinions registered during phase of acquaintance with maps project B comes out as easier when preceded by project A, and as more difficult, however, when preceded by project D.
Evaluations of project D were dominated by remarks about smaller number of roads. However, it has been considered doubtful that these roads failed to intersect at straight angle. There were also negative remarks questioning roads that “have no obvious purpose” (loop in upper part).
Figure 2b: Map of illegible places in project A (p1, p2, ... -marking of places).
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Figure: 3a: Map of indicated routes in development project B
(r1, r2, ... - marking of routes; pref. - route indicated as preferred).
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Figure: 3b: Map of illegible places in project B (p1, p2, ... -marking of places).
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Figure: 4a: Map of indicated routes in development project C
(r1, r2, ... - marking of routes; pref. - route indicated as preferred).
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Figure: 4b: Map of illegible places in project C (p1, p2, ...-marking of places).
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Figure 5a: Map of indicated routes in development project D
(r1, r2, ... - marking of routes; pref. - route indicated as preferred).
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Figure: $5b$: Map of illegible places in project $D$ ($p_1$, $p_2$, ... -marking of places).

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Project C in comparison to other projects differs by the way the area has been managed. Instead of numerous exactly predefined roads there is an open space – squares, which can be walked and two routes leading from platform to amphitheater on borders of designed area. The differences in reception of project C and other projects could be well described by this quotation:

“This map is less complicated than other. There are fewer elements. There are no predefined routes; it is me who had defined the route. There is actually an open square. I do not like such situations, this does not mean that it is wrong, but it is wrong for me.”

Negative reactions to open spaces, plots, prevailed in evaluation of this project.

“I must say it straight on that it is an awful terrain. Because I have a feeling that this whole area is asphalted and for me that means this is a square and I would definitely get lost.”

“A blind person does not like open spaces. In an open space, though there would just be the road, particularly with left or, right forks one can get lost. All you have to do is to get a little abstracted in your mind and you could wander off right instead of going straight, particularly when such forks exist.”

The generally negative evaluation of entire project C could be the consequence of how open space was perceived:

“One had to adjust somehow, this map was more difficult in feel, but these roads were OK, I liked them.”

“The most difficult was the one that had those funny sidewalks, although the roads were easy.”

The route running by eastern border (see Figure 4a, route r1) has been more frequently indicated as preferred. The following quotation pretty well shows its advantages:

“The best is the one on the right side, because I have there two good landmarks. Here, I go between the buildings and the building on my left side indicates the direction to me. I have here two buildings that actually lead me through more than half of the way. For me it is important that I can walk along the buildings.”

This road, however, has been also rated as too winding near the amphitheater.

“…only this way, since this is such a nice designated road and leads nicely right up to ticket office. It winds however, has many curves, but should one know that this is the road to stick to and follow it as it goes then it is fantastic.”
DISCUSSION AND GENERAL CONCLUSION

The research gathered and analyzed qualitative data, including declarative evaluation of projects’ legibility. The results allowed verifying urban projects. Most frequently respondents have rated maps B and D as the easiest in general perception of their legibility. Simplicity of map D could result from, declared by the respondents’ impression, of the smaller number of elements (roads and intersections) as opposed to other projects. In addition the review of declarative ratings shows that respondents recognized map B as more difficult when it was presented after D and simpler when presented after map A. On this basis we can assume that map D was the easiest (most legible), followed by B, A leaving map C as the most difficult in view of the respondents. Maps of indicated preferred roads (see figures: 4a and 5a) show that in case of both projects routes d1 and d2 have been picked with similar frequency. Thus it can be assumed that these two routes were equivalent alternatives to some extent.

Project A can be considered as the most complicated when considering the number of places marked as difficult (Fig. 2b) and the number of alternative roads (Fig 2a) that have been indicated by the respondents. Finally, however, during declarative evaluation of maps’ difficulty level project C has been most frequently declared as the most difficult. Rating of project C as the most difficult resulted mainly from blind person’s impression about contact with open space. Open space is difficult from practical point of view; it causes confusion that can lead to stress and anxiety (Zimring, 1984). Research participants shared this reflection. Open space proved to be doubtful also during the acquaintance with the map stage (see Figure 4b), and creation of mental image of presented terrain. Taking into account declarative evaluations it can be assumed that rating of map C as the most difficult stemmed from impressions and imaginations of respondents regarding the open space. Significant level of area development complexity in project A has obstructed fulfillment of tasks, however this project was not perceived as negatively as open spaces on plan C.

Collective results of routes indicated by respondents as preferred show that in projects with existing roads preserved on surface in Pichselberg Tip area the most preferred route (d1) led along the already existing roads, geometry of which could not be altered by the students (see Figures 2a, 3a and 5a). This regularity urges a reflection, particularly when we assume that an urban project should bring new/better values to existing land development.

To places identified as most difficult – the least legible are all intersections with more than two roads and intersections that cross at an angle other than straight. As known from the literature of the subject (e.g. Dąbrowski, 1964) and from declarations of research participants the easiest way for a blind person to orientate in space is when they can make a 90 degree turns. Straight angle is for them the simplest way to identify and to learn. Moving on a curve or taking open or sharp angle turns may cause loss of orientation or disturbances with regard to elements of space and cardinal directions.

Application of qualitative research methods which combined structured in-depth individual interviews with spatial analysis of data have resulted in precise diagnosis of the analyzed area development plans. Data from interviews and map results allowed for a detailed verification of crucial points in certain project solutions. The research presented in this study can serve as an efficient tool for evaluation of an urban project from the angle of spatial system’s legibility.
for the blind people. The best moment to introduce such analysis in designing process is at a relatively early stage of an area development general concept’s creation.

This research may serve as an introduction to further analyses – the quantitative research. For example research executed in an experimental framework, using time measurements by fulfillment of tasks on research material could clarify possible significant differences between presented projects, which could influence their specific rating during the interview.

As this research shows a shape of built environment cannot be only the result of activities of architects and urban planners, although they are the only ones from the team of other experts that participate in shaping of the world, whose knowledge concerns an individual, are educated to holistic activities, collecting and synchronizing other peoples’ knowledge in order to improve the existing environment and that suggested for improvement.

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