DESIGNING A VISIBLE CITY FOR VISUALLY IMPAIRED USERS

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Abstract

This paper reports on an ongoing doctoral research project which aims to identify the main barriers to access within the built environment for persons with a visual impairment. The research seeks to investigate whether these barriers are common for all types of visual impairment and degree of vision loss and if so, what inclusive design solutions can accommodate the needs of the majority of visually impaired users. An access audit has been conducted within Glasgow city centre which sought to quantify the number and type of hazards present within a typical built environment. This was followed up by a questionnaire which asked participants to rate factors which may prevent them from making independent visits to their nearest city centre including psychological factors, physical features and obstructions resulting from the presence of street furniture. Participants also indicated the colours and contrasts which they find easiest to detect within the built environment. These findings will be used to inform the creation of a new set of design guidelines to assist designers, architects and urban planners as to how they can provide more accessible and inclusive environments for the visually impaired population.

Keywords

architecture, barriers, blind, cognitive map, urban design, visual impairment

Introduction

There are approximately 2.3 million visually impaired individuals living in the UK, out of which 97% are aged 65 or over. This number is set to double by the year 2030 to an estimated 4 million[1]. This can partly be attributed to the increasing age of our society in conjunction with the predicted obesity epidemic and rise in cases of diabetes. Our urban environments have not been designed with the full requirements of the visually impaired population in mind. Building on these facts, this paper reports on an ongoing doctoral research project by a visually impaired researcher, which argues that it is essential for urban design methods to be adapted in order to accommodate the needs of this growing population.

The main aim is to identify whether there are commonalities between colour combinations, contrasts, materials and physical hazards experienced in the urban environment by individuals with different types of visual impairment and degrees of vision loss, and if so, what inclusive design solutions can accommodate the needs of the majority of visually impaired users.

Literature Review

In order to design an environment that better suits the needs of the visually impaired, it is necessary to come to an understanding regarding how this population processes spatial information. Previous theories within this area of research have argued that the blind and visually impaired have either no spatial awareness of their surrounding environment, the deficiency theory[2], or that they have an awareness that is inferior to that of a fully sighted person, the inefficiency theory[3]. Both of these theories have been challenged by the quantitative difference theory[2], which proposes that the visually impaired are able to process information in the same way as the fully sighted but are not able to execute their decisions to the same degree due to a lack of past independent travel, heightened stress levels and absence of accessible information. The hypothesis of this research is therefore that it is the environment that disables the visually impaired user and not necessarily their impaired vision.

Past research as described by Passini and Proulx[4] suggests that the blind and visually impaired are able to represent to some extent an environment using cognitive mapping abilities. They are therefore able to perform shortcuts even along unfamiliar routes while traversing within an area of which they have spatial awareness. However they are limited in doing so due to the fear and stress associated with entering unfamiliar streets where unexpected obstacles and dangers may be present. The navigational skills of visually impaired people are also dependent upon the time of onset of vision loss. Several studies have shown spatial accuracy deficiencies in the early onset vision loss group compared to late onset vision loss adults[2 5]. In particular Reiser, *et al.*[6] proposed the Developmental Phenomenon which states that those with past broad field vision, experience accelerated learning of new environments compared with individuals with early onset visual field loss.

The potential is there to give the blind and visually impaired population more freedom and independence to travel around the city, to make shortcuts where appropriate and not be restricted to a few key familiar routes. In order to do this there is a need to identify the main hazards present within the built environment, how these can be diminished, removed or relocated and what colours and materials would make them more visible.

Access Audit

An access audit of Glasgow city centre was carried out in order to quantify the number and type of hazards present to visually impaired users. The study area was located within the grid pattern of the city centre, a mixed use area currently undergoing modern aesthetic alterations. The area included a major transportation hub, university campus, public square, pedestrian shopping streets and numerous intersections with busy roads. Measurements of pavement width, kerb height, type of paving, presence of dropped kerbs, location of inaccessible/accessible crossing points and items of street furniture were recorded and presented electronically using an interactive map. It is the intention that this map will be made available online for future use by visually impaired residents of the city and visitors to the area. It will provide them with the opportunity to preview the city centre and decide the most accessible route for their needs.

One of the most significant results from the access audit was the issue of accessible pedestrian crossings (or lack thereof). A total number of 84 controlled pedestrian crossings were located within the study area, out of which 64% were accessible, 22% were inaccessible and 14% had maintenance issues which effectively resulted in them being classified as inaccessible at the time that the audit was carried out. The access audit revealed that large areas of the city including the university campus, bus station and public square were effectively unreachable islands due to the lack of accessible crossing points. In order to reach these destinations it is necessary to either rely on help from the general public, try and guess when it is safe to cross or ultimately turn around in defeat. This is clearly a worrying and dangerous situation which is unacceptable in this modern age especially when the technology is available to facilitate the movement of individuals with impaired vision. The findings highlight the emergence of a postcode lottery whereby the location within a town or city can determine the extent to which a visually impaired person is able to participate in even the most basic of activities.

Questionnaire

In order to understand which features identified within the access audit present the most difficulties, it was a necessary and important step to give the blind and visually impaired population the opportunity to rate those features within the built environment that they find the most problematic and hazardous. A questionnaire was launched on a national scale and completed by over 200 blind and visually impaired individuals. Questions aimed to identify both the physical and psychological barriers to access within UK town and city centres.

The questionnaire was made available using a number of different formats in order to make the data easily accessible and target as many user groups as possible. A dedicated website was constructed (www.urbanacuity.co.uk) which hosted an accessible online version of the questionnaire, compatible with screen readers and magnifying software such as JAWS and ZoomText. Participants without access to the internet were sent a large print postal questionnaire and in cases where neither option was suitable, individuals were contacted via telephone. The design of the questionnaire evolved over time as a result of continuous feedback from blind and visually impaired participants. This led to the provision of alternative colour schemes and formats, such as an additional downloadable version in MS Word format.

In order for the results to be representative of the views of the visually impaired population as a whole, it was necessary to source participants from all age groups with a wide range of eye conditions, varying degrees of vision loss and differing ages of onset of vision loss. This resulted in a nationwide recruitment campaign which involved contacting University Disability Services, placing posters in eye hospitals, adverts in printed newsletters and talking newspapers, and contacting relevant groups and societies.

Results

In total, 217 participants completed the questionnaire, 42% of the respondents were male and 58% were female. The participants aged from 16 to 65+, with the 65+ category accounting for the largest age group with a 24% majority. This is to be expected as the majority of the visually impaired population is aged 65 years and over. 21% of the sample group reported loss of central vision, 20% reported loss of peripheral vision, 37% had mixed vision loss, 15% were blind and 7% reported other types of vision loss.

A number of significant results emerged from the travel behaviour section of the questionnaire. 30% of the respondents stated that they made no independent visits to their nearest town or city centre. This mirrors the statistic presented in a paper by Clark-Carter *et al.*[7]. 50% of the survey sample also expressed a wish to make more independent visits. A key aspect of the survey was to ascertain what features within the built environment are prohibiting such freedom. In order to gather this data, participants were required to answer a series of questions, pertinent results being given below.

Participants were asked to rate the 10 factors which may prevent them from visiting the city centre alone, scoring each from 1 to 5, with 1 being the most influential and 5 the least influential. Personal factors including, “the fear of getting lost” and “lack of knowledge of the area” were rated as less important reasons for preventing an independent visit than physical features such as the “positioning of unexpected obstacles”, “problems walking along pavements” and “inaccessible pedestrian crossings” (see table 1). It should be noted that all factors listed were given low ratings (2.4 to 3.5) and as such are all influential reasons for not making independent visits.

Table 1: Psychological barriers to access

Influencing Factors	1
Uneven paving	2.02
Street Furniture	2.04
Unexpected level changes	2.13
Varying kerb heights	2.63
Narrow pavements	2.64
Type of street lighting	2.95
Type of paving	3.01
Lack of dropped kerbs	3.26
Misuse of tactile paving	3.39
Lack of tactile paving	3.41
STREET FURNITURE	Average
Bollards	2.28
Bins	2.55
Outside dining areas	2.68
Signage	2.69
Lampposts	2.79
Seating	2.97
Bus stops	3.31
Railings	3.33
Trees	3.33
Telephone boxes	3.93

Further questions focused on the physical aspects of the built environment. Participants were asked to rate (i) the factors they find the most problematic when walking along pavements and (ii) the items of street furniture they find most hazardous. The results show that street furniture, unexpected level changes and bollards were all rated as being highly problematic, (see tables 2 & 3).

Participants were also asked to rate the colours they find the easiest to detect within the built environment. The graph below illustrates the colour choices according to type of vision loss. There is general agreement for most colours and type of vision loss with the exception of the rating of black and orange by the central and peripheral vision loss groups. General trends show that warm, bright and vibrant colours such as yellow, red and orange are preferable to blue, green and silver. Interestingly, it is becoming increasingly common for silver, (stainless steel) to be implemented within the built environment in the form of bollards, seating, signage and bins. This could explain why unexpected obstacles and street furniture were given such low ratings in tables 1 and 2.

Figure 1: Easiest colours to identify according to type of vision loss

Conclusions & Future work

The results from the questionnaire support the research hypothesis that physical features within the built environment disable the user more than their visual impairment. An investigation of travel behaviour demonstrates that visually impaired people are less disabled by their own personal factors such as fear, stress and level of confidence as opposed to the design and physical influence of features within the built environment. The research highlights that physical elements are more of a deterrent than a lack of spatial understanding of the area and that the visually impaired are more than capable of independent mobility given reasonable adjustment to the design of the built environment. The survey responses show a general trend favouring the visibility of warm, bright vibrant colours and also establish silver as the most difficult colour to identify. Results suggest that the contemporary trend to use stainless steel for items of street furniture is making a significant contribution to the disabling nature of our urban environments.

As a follow up study, a number of walking experiments are currently being conducted with a group of 15 blind and visually impaired individuals alongside a sighted control group. Participants will be asked to navigate between two specified locations within the city centre; the navigational behaviour of both groups will be compared in terms of route chosen, distance travelled, time taken and cognitive mapping abilities. It is anticipated that this further study will highlight the disabling nature of more aspects of the built environment and may assist further in the development of a new set of design guidelines.

References

1. **Charles N,** The number of people in the UK with a visual impairment: the use of research evidence and official statistics to estimate and describe the size of the visually impaired population, RNIB. July 2006.
2. **Fletcher J. F,** Spatial representation in blind children. Development compared to sighted children. Journal of Visual Impairment and Blindness, 1980; 74 (12): 381-385.
3. **Andrews S. K,** Spatial cognition through tactual maps. Proceedings of the *First International Symposium on Maps and Graphics for the Visually Handicapped.* Association of American Geographers, 1983; pp. 30-39.
4. **Passini R and Proulx G**, Wayfinding without vision: an experiment with congenitally, totally blind people. Environment and Behaviour, 1988; 20 (2), 227- 252.
5. **Dodds A. G, Howarth C. I. and Carter D. D. C,** The mental maps of the blind: the role of previous visual experience. Journal of Visual Impairment and Blindness, 1982; 76 (1): 5-12.
6. **Rieser, J. J, Hill, E. W, Taylor C. R, Bradfield A. and Rosen S,** Visual experience, visual field size, and the development of nonvisual sensitivity to the spatial structure of outdoor neighborhoods explored by walking. Journal of Experimental Psychology: General, 1992; 121: 210-221.
7. **Clark-Carter, D.D, Heyes, A.D, and Howarth, C. I.** The efficiency and walking speed of visually impaired pedestrians. Ergonomics, 1986; 29: 779-789.