EXPERIENCING LANDSCAPES WITH SPATIAL NAVIGATION BY VISUALLY IMPAIRED CHILDREN OF THE BLIND SCHOOL, RATMALANA, SRI LANKA.

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Abstract

Navigation through the environment helps experiencing the landscape by all the users including the ones who are having different sensory capabilities. The current research study focuses on spatial navigation of visually impaired in experiencing landscape Architecture. The research objectives were to explore the nature of sensual perception and the parameters pertaining to experiencing a familiarArchitectural landscapeby visually impaired childrenleading to favored and dis-favored navigations. The research study was conducted with a sample of visually impaired children (n=10, age=15-20, male: 5 and female: 5), who are students of blind school, Ratmalana. Sensory Ethnography was adoptedas the principal method and the data collection was done via small group observations, interviews anddiscussions. The hierarchy of sensory modalities associated with perception of visually impaired was identified as; haptic perception (34.5%), auditory perception (34.5%), olfactory perception (14%) and visual perception (17%) respectively. The psychological factors associated with overall navigation ofvisually impaired were recognized as; sense of comfort (30.5%), sense of freedom (21%), sense of discomfort (30.5%), sense of safety (9%) and sense of being unsafe (9%). The significant parameters leading to favored navigation were identified as less distance to the destination, availability of solid and void difference, natural ventilation, thermal comfort, connections to nature, less glare and being uncrowded. Dis-favored navigation were found to associate with more distance, crowded spaces, more turn-offs in the paths, darker spaces, spaces with more glare and noise.This investigation highlights the importance of transcending beyond the bias of vision and addressing different perception modalities when designing landscape architectural interventions to achieve optimal and inclusive spatial navigation.

Keywords: Visually impaired, Sense, Perception, Experiencing the landscape, Ratmalana, Sri Lanka

Introduction

People navigate through the environment with the expectation of reaching a destination. In order to reach a destination, a person has to plan and execute a series of decisions through these environments (Chebat, 2016). In addition, people tend to experience the surrounding landscape while going through such environments. Considering this factor, landscape Architectural solutions should provide pleasant and meaningful experiences to the users in the most appropriate manner.

Visual experience of space predominates in spatial navigation above all the other human sensatory modalities. However, visually impaired people experience the landscape in a unique way incorporating other senses. This concept was supported by Millar's research findings (1994) on spatial representation of blind vs sighted people, which confirmed that visually impaired people sense the environment with different sensory stimulus.
The currentinvestigationwas focused on how visually impaired people sense and perceive the characteristics in experiencing the landscape of a familiarized navigation. The study addresses the current issues of landscape architecture with reference to visually impaired communities. It is focused on exploring how the visual impaired sense and perceive landscape while progressing on with their familiarized navigation. The study has three research objectives as mentioned below.

- To explore how visually impaired people perceive the space using different senses.
- To explore how visually impaired people sense overall navigations.
- To identify the parameters of visually impaired for their experiencing landscape on favored and dis-favored navigations.

The scope of the research is limited to visually impaired children and not for all ranges of visually impaired population. The context being limited to the Ratmalana Blind School, the research findings may not be possible to be generalized for a larger context. Considering the time factor, ethical aspects and less disturbance to the academic schedules of the school, the research sample was limited to a smaller group of students.
The study focuses on how visually impaired students experience the physical spatial framework of their learning environment and landscape while navigating, aligned with the activities of theirdaily routing at the school. The physical spatial framework consists of elements such as pathways, corridors, trees, playground, buildings and other landmarks and also the natural elements such as sun path, breeze, rain and other events of vehicular and human movements etc.
The time factor for the navigation in the studywas limited to school time; 8.30 am to 2.00 pmconsidering the participation of both hostel accommodated and daily visited students in the research sample while the starting point of all navigations was limited to the 'class room'.

Visually impaired and their sensation towards spatial understanding and representations on spatial navigation:

Visual impairment

Vision is generated with the light rays hitting the retina and consequently the optic nerve transmitting signals to the brain. Visual impairment is defined as the loss of functional vision completely or partially. It would happen with inadequate amount of light hitting the retina, or due to the incorrect delivery of visual information to the brain. ("Blindness," n.d.). Visual Impairment can be categorized according to the 'visual acuity' as follows;

- Partially sighted – having limited vision (e.g.: blurred vision or inability to identify the shapes of objects.)
- Low Vision – a severe visual impairment and not necessarily limited to distance vision.
- Legally Blind – having less than 20/200 vision in the better eye
- Totally Blind – unable to see at all
  ("Blindness," n.d.)

There is also a categorization as early blind and late blind depending being blind by birth and aging respectively.

- Early blind –born blind or totally lost sight before age 6.
- Late blind - with sight at birth and then lost sight after age 12 (Burton, 2003).

Spatial understanding and representation of visually impaired

In early history, the opinion on spatial understanding by blinds was negative. As argued by Von Senden (1932), spatial concepts are impossible within people who have been blind from birth, and aforementioned visual experience which gained during early period is essential even for a minimal understanding of space.

- The 'Deficiency' theory: The lack of visual experience/input may result in a total lack of spatial understanding.
- The 'Inefficiency' theory: It may result in spatial abilities which are similar to, but necessarily less efficient than, those of sighted people.
- The 'Difference' theory: It may result in abilities which are qualitatively different from, but functionally equivalent to, those of sighted people(Ungar, 2000)

However, the most recent work, has challengedthe position of Von Senden's methods which comes under critical analysis. A large number of empirical evidence has been accumulated which has gone against his position.

Millar: Informational Conditions and Spatial Coding (1994).

In Millar's recent publication, she proposes a new theory of spatial representation namely ; 'working model' of spatial development, called 'CAPIN' (Convergent Active Processing in Interrelated Networks) which is derived based on researches conducted considering both blind and sighted subjects. Depending on her approach, the study of spatial understanding and representation in the absence of visual experience conveys a tremendous outcome on spatial cognition in general, as same as providing practical solutions for the needs of blind children and adults. According to this theory, information from each of the different senses is specialized but also complementary and overlapping, providing a significant degree of redundancy in the information entering the system" (Ungar, 2000)

Arecent research executed by Fernando and Hettiarachchi (2016) clearly depicts that the blind's sense of space is distinctly different from the way how sighted perceive the built environment.

Spatial Navigation and perception

Experiencing the landscape can be considered as a time-space continuum taking place as someone moves through it. As someone moves, his/her perception of the place physically changes and is also affected by what was previously experienced and what is anticipated(Motloch, 2000). Spatial navigation involves immediate responses to environmental features, such as avoiding a fire hydrant or stepping over a curb. These immediate responses are invariably egocentric because environmental information is acquired with reference to the observer's body (Wang &Spelke, 2000). The dominant perceptual input for sighted observers is vision, although proprioception and audition are useful as well (Loomis, Lippa, Klatzky, &Golledge, 2002). In the absence of visual support (e.g., walking in the dark), egocentric updating is more effortful and capacity limited (Rieser, Hill, Talor, Bradfield, & Rosen, 1992).

Serial Vision

Landscape perception involves serial vision, specifically, vision as a series of perceptions. Through the series of images, the mind's eye develops a spatio-temporal image of a place, and the scene viewed at any time is perceived within this overall spatio-temporal context. In the mind, the perceived image synergizes with the past and anticipated experience to produce a complex, evolving sense of place(Motloch, 2000) .

Frames of Reference (egocentric or allocentric)

The navigation of the human beingsdepends on both egocentric and allocentric representations consisting within environment. Therefore, finding a path through closely spaced trees, for example requires the computation of precise self-to-object spatial relations to guide spatial navigation (Andersen, Snyder, Bradley, & Xing, 1997). But in the process of planning a strong route to a distant goal should maintain a sense of orientation in large-scale environments which require enduring representations of the locations of objects relative to other objects (e.g., Loomis & Beall, 1998).

In spatial navigation, both aforementioned egocentric and allocentric reference frames generally involve at least one observer, two environmental features, and the spatial relations among them (Shelton & McNamara, 2001). Thus, unlike egocentric reference frames, the “allocentric reference frames are primarily comprised of object-to-object relations and/or an abstract coordinate system” (Zaehle et al., 2007).

Scales of Space

Egocentric as same as allocentric references frames can be used to represent spaces differing from one another in scales. Whilst several frameworks are proposed there, it will use the typology described by Schinazi specifically developed for the classification of experiments with blind and visually impaired individuals. This typology distinguishes between micro- (i.e., manipulator space that does not require full-body navigation), meso- (i.e., space that is larger than the observer but can be apprehended from one viewpoint), and macro scales (i.e., space that is larger than the observer but must be apprehended from multiple viewpoints). (Pingel & Schinazi, 2014)

Research Methodology

This qualitative research has been designed to explore the nature of sensual perception and the parameters of visually impaired which contribute in the experiencingof landscape characterized by favored and dis-favored navigations.

A sensory Ethnography was adopted as the method of study which takes in to account the sensory experience of participants. This method records the sensory perception and sensory categories whichhasbeen used and communicated by the participantssimilar to the manner as to how an individual describes his or her experience in everyday lives (Pink, 2011) .The data collection was done via small group observations, interviews and discussions.

Case Study

Ratmalana Blind School was selected as a case study, which is located in an urban context having the facilities of nursery, primary, secondary education and hostels.It was selected as it is a familiarized context to the visual impaired children in accessibility and the resources.

Fig. 1: Location of Ratmalana Blind School
Source – Google maps

Research Sample

The research sample consists of visually impaired students (n=10, age=15-20, male: 5 and female: 5) of the Blind School, Ratmalana. Eight students were selected from grade 11 and other two students were selected from grade 10. The sample was selected focusing on the considerationsmentioned below.

- Children were selected as they react more spontaneously and are less enculturated than adults (“Haptic design research,” n.d.).
- Providing clear explanationson the research purpose and the methodology to obtain participants’ consent to take part in the study ensuring ethical clearance.
- Balancing the sample with different vision status.
- Less variation of age to ensure less variation in knowledge andlevel of experience of the students
- Balance the gender proportions to enhance the generalization of findings.
- Less disturbance to students’ academic schedules.

Research Process

The research process consists of three phasesnamely; the preliminary, pilot and final research study. At the preliminary stage, it was focused on getting familiarizedto the research field via reviewing the available literature on visual impairment and spatial understanding on navigation. Pilot study was conducted to achieve three main goals. They were;

- To getfamiliarized with Ratmalana Blind School environment.
- To select the research sample.
- To understand the best method of communication with the research subjects to conduct the research study effectively.

It was very important to identify and understand the places/ spaces of the school premises involved with the day today routine of visually impaired children. Accordingly, several visits were made to the school premises and the surrounding context to get familiarized with the spatial qualities, while taking photographs of the spaces to carry out further investigations.
The selection of the appropriate research sample was done subsequent to observing the students over a one month of period. All the participants were asked personally whether they were willing to participate in the research process and discussionswere taken with the officials for any ethical concerns, privacy and academic factors. After the selection of the research sample, it was a challenging task to communicate with the research subjects effectively. A number of oral discussions were done while their daily activities during the pilot study to reach an effective level of communication with the selected subjects while building up a good rapport.

It was a factor that lead the way to collect most informativeand valid data verbally from the subjects. The verbal discussions was selected as the most effective method of communication subsequent to the discussionsheld with the academic staff, observation of results of braille exams as well as referring to literature. Their varied visual capacities results in inconsistent outcomes in writing and reading tasks whereas the verbal discussions were identified to give them broader freedom to express their thoughts effectively.

The final research study was focused in identifying the perception of space and relevant senses associated with overall navigation of visually impaired respondents with use of a Sensory Ethnography Study. The data collection was conductedvia interviews, observations, verbal discussions and voice recordingsfollowing the field study program mentioned below.

- Understanding the places within the blind school according to the layout - 13.06.2018
- Understanding the daily routine of children aligned with their time schedule - 21.06.2018
- Selecting the research sample according to the criteria.
- Obtaining the participantspersonal information.
- Identifying favored and dis-favored navigationsin general
- Identifying the physical characteristics of places associated with relevant navigations.
  Layouts
  Photographs

  } 21.06.2018

- Recording information on perception of space and sense ofoverall Navigation, taking one participant at a time

  } 28.06.2018 and 29.06.2018

Aligned with this process, the most preferred and least preferred navigations by each subject was mapped by the investigator supported with a photographic survey. Analysis of data was

done on percentage basis using analytical graphs and tables. Finally, the conclusions and recommendations were arrived at with the interpretations of research material.

Findings and Analysis

With the evidence of this research, visual impaired children experience the landscape while navigating based on sensation of touch, sound, smell, light and colour. According to the research data each of 34.5% respondents considered touch and sound perceptions. 17% responded to the light and color perception and 14% responded to perception of smell. These research findings mainly connected with the Difference theory and CAPIN theory, which describes that the spatial understanding of visual impaired is different from the sighted.

- **Finding 1: Hierarchy of sensual perception for the spaces.**

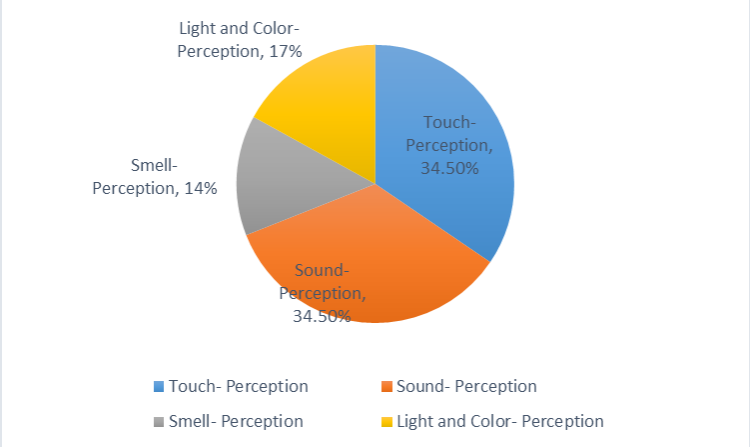
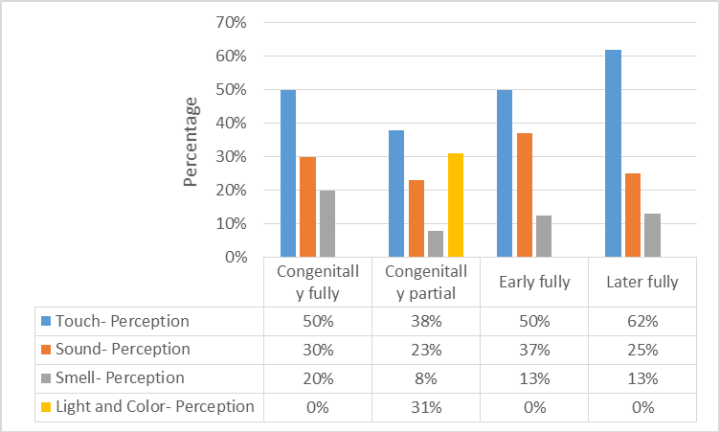


Fig. 2: Sensual Perception ratio

Participants' perceptions wereanalyzed according to their visual status of being congenitally fully blind, congenitally partial blind, early fully blind and later fully blind as follows in the figure 3;



	Congenitally fully	Congenitally partial	Early fully	Later fully
Touch- Perception	50%	38%	50%	62%
Sound- Perception	30%	23%	37%	25%
Smell- Perception	20%	8%	13%	13%
Light and Color- Perception	0%	31%	0%	0%

Fig. 3: Sensual Perception vs. Visual Status

According to this analysis, it was revealed that the most important and common perception for all the research subjects is the touch perception or the haptic perception. Also, all the fully blinds have relied on haptic, sound and smell perceptions. Congenitally partial blinds have the light and color perceptions. With those identifications, it can be suggested the landscapes which address haptic perception can bring comfort to visually impaired children.

When considering the number of years being at school as a factor of getting familiarized to the context in perceiving the landscape. The following findings were arrived it.

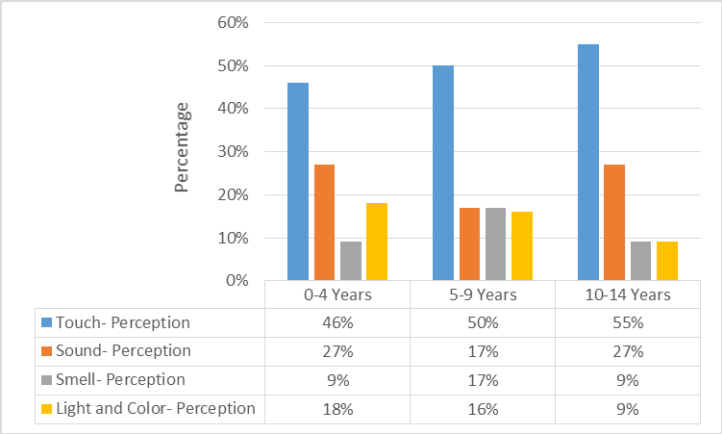


Fig. 4: Sensual Perception vs. Years being at school

It was revealed that haptic perception is the prominent perception modality and with the increase of number of years at school the use of haptic perception has increased.

- **Finding 2: Sense of overall navigation themes**

The visually impaired children were found to rely on sense of comfort (30.5%), sense of freedom (21%), sense of being uncomfortable (30.5%), sense of safety (9%) and sense of being unsafe (9%) in for overall navigation in the school premises.

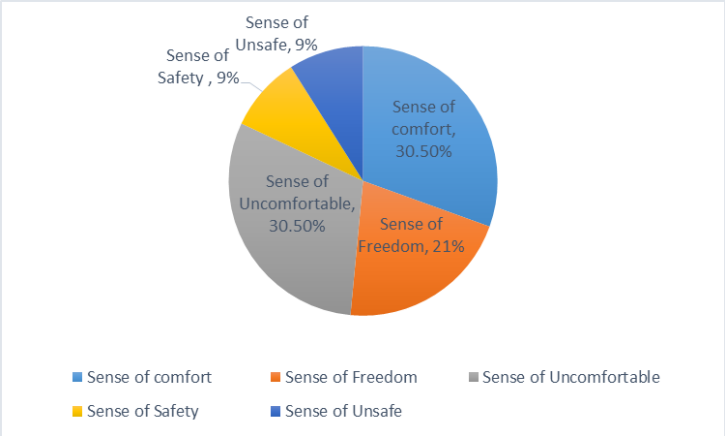
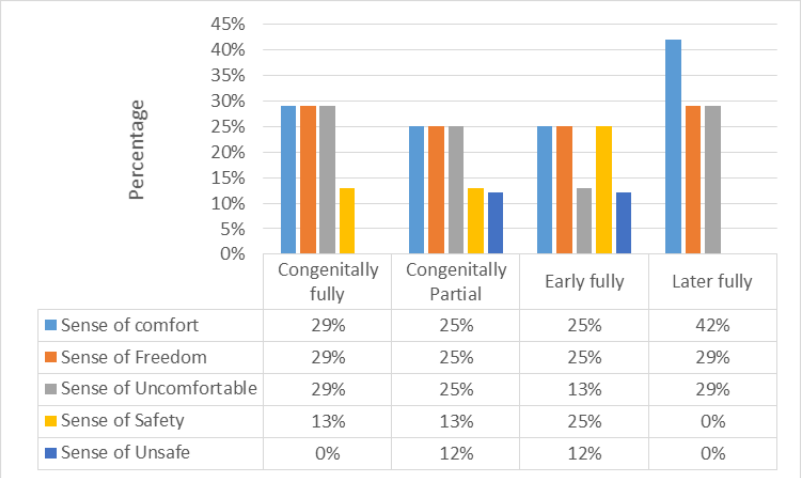


Fig. 5: Sense on overall navigation

Those themes reflect the psychological needs of the visual impaired children. This revelation clearly suggests the direct influence of the physical environment on the psychology of visually impaired children.

According to the subjects'visual status the psychological needs vary as shown in figure 6.It was fairly balanced for all the visual status with some variations and it reveals sense of comfort theme is high for the later fully blinds.



	Congenitally fully	Congenitally Partial	Early fully	Later fully
Sense of comfort	29%	25%	25%	42%
Sense of Freedom	29%	25%	25%	29%
Sense of Uncomfortable	29%	25%	13%	29%
Sense of Safety	13%	13%	25%	0%
Sense of Unsafe	0%	12%	12%	0%

Fig. 6: Themes of Senses vs. Visual Status

- **Finding 3: Relevant Parameters for favoured and dis-favoured navigations.**

<u>Parameters of favored navigation:</u>

01. Less Distance

Library is located in the first floor of the same building where the classrooms are located. Classroom was the starting point of navigation and research subjects commented that navigation is more comfortable, easy and not tiringdue to less distance.

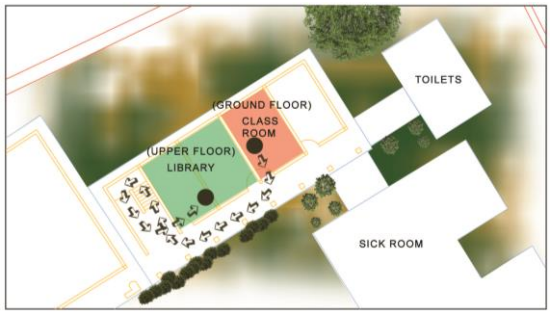


Fig. 7: Common Scenario of Dis-Favored Navigation

02. Natural Ventilation

Natural breeze flows across the playground and then flows along the corridor. As a result, the students' first impression is built with the natural ventilation when they leave from the class room.

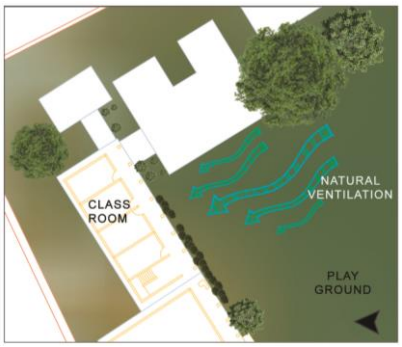


Fig. 8: Natural Ventilation towards the corridor

03. Solid and Void difference

Research subjects identified solid void difference as a parameter to change the direction, continuity and pace of navigation. In this navigation, they identified a building wall and void in one side and columns and in between space on the other side.

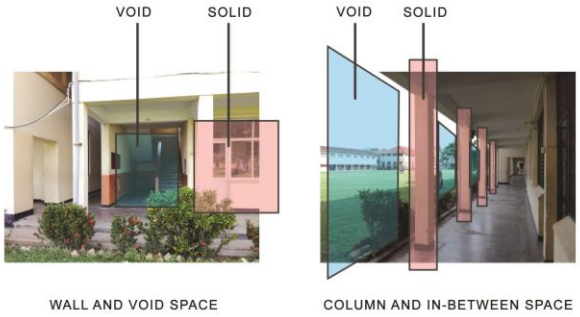


Fig. 9: Solid and Void Difference

04. Connections with Nature

When they are moving along the corridor, one side is the building façade and other side has openness with the playground. Also, there are trees and flower shrubs to harmonize with the nature. The subjects commented that it is very comfortable to walk along the corridor with the experienceof nature.

05. Uncrowded Spaces

According to the responses of the subjects, crowded spaces made them feel safe, but uncrowded spaces gives them more freedom. Classroom to library navigationis not much crowded as that route is located at the edge of school far from the frequently crowded office area.

06. Spaces with less glare

Spaces with less glare was identified as comfortable for the subjects. Both direct and reflected glare was blocked in the preferred areas by the subjects. For instance, 'Sick room' is located in a two story building where direct glare is being blocked and it also covers the direct sun rays flowing to the corridor.

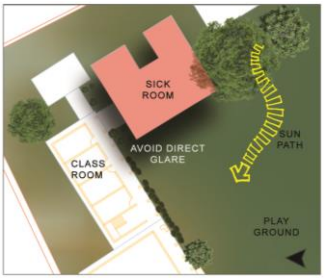


Fig. 10: Avoid Direct Glare

It was seen that the reflected glare has also been blocked in the corridors with the use of minimum reflective floor materials. On the other hand thelayer of trees and shrubs located by the side of the corridor reduces reflection of the sun rays.

Fig. 11: Avoid Reflected Glare

07. Comfort associated with the destination

It was revealed that a favored navigation does not depend only on the factors of navigation but also the comfort of thefinal destination of the route. For instance, thermal comfort achieved through artificial ventilation (air conditioning) was seen as asignificant parameter to favourthe library as the most preferred destination in navigation.

<u>Parameters of the dis-favored navigation</u>

01. Long Distance

According to the responses of the subjects, long distance navigations makes them more uncomfortable and tired. Because of that, those navigations become dis-favoured among visually impaired children. For example the music room is generally a place highly preferred by school children. However, when it comes to the blind school the navigation from the classroom to the western music room involves a long walking distance thus it is perceived to be a least preferred place.

02. More Turnings

Research subjects reported that when having more turning-offs in navigation, they find it confusing and thus identify as dis-favoured.The navigation to the western music room involves more turnings thus is recognised to be a dis-favoured navigation.

Fig. 12: More turning-offs leads to dis-favoured navigation

03. Smaller and darker spaces

According to respondents, it was very difficult to navigate through smaller spaces and darker spaces. When navigating towards the western music room, students identify progressing through the small and darker male hostel staircase area as uncomfortable. Some of the subjectspaused at that space for a while to choose the correct route.

04. Spaces with glare

Subjects mentioned that, it was very uncomfortable when there is glare. Navigation towards the western music room had some spaces with glare, adding towards dis-favouring it as a route in navigation.

05. Crowded spaces

The corridor of the office building was always crowded making the subjectsfeel a little uncomfortable to move through the corridor establishing it to be dis-favoured.

06. Discomfort associated with the destination.

According to students' comments, the darkness inside the western music room and the vehicular noise from the adjacent road has made them feel it as an uncomfortable destination thus dis-favoured significantly.

Conclusion and Future Directions

The study was conducted to explore the manner as to how the visually impaired children sense and perceive the surrounding landscape while progressing in their familiarized navigation. The nature ofperception/sensation of visual impaired and several factors affecting the experience of Architectural landscape aligned with navigationwere identified by the investigation. These findings may lead towards optimum landscape design interventions inclusive for all theusercategories beyond the bias towards sighted persons.

Research findings clearly depict that the visually impaired children are experiencing the landscape with reference to navigation differently from the sighted ones. Visual impaired children were found to rely principally on haptic perception followed by auditory and olfactory perceptions. These findings are aligned with the Difference theory and CAPIN theory which also describe the spatial understanding of visual impaired to be different from the sighted ones.

This studyprovides insights for landscape architects to transcend beyond the distinctive bias towards vision to createeffective and comfortable designs for visually impaired. Focusing on haptic perception is found as vital, followed by auditory and olfactory perception in this regard. The study also identified an array of factors to be considered in creating favourable navigation for visually impaired,namely; providing easy access to the destination, more connections to nature, ventilation natural/artificial, thermal comfort, less glare, less turn-offs, less crowded and less noise. This investigation highlights the importance of transcending beyond the bias of vision and addressing different perception modalities when designing landscape architectural interventions to achieve optimal and inclusive spatial navigation.

Several limitations were encountered in the study which had implications on the final research outcome.For instance, the research study was limited only to a small group of visually impaired children who are familiarised to a specific context and tested only within a fixed time period. Hence, the research findings are valid only for the saidcategory of visual impaired children. It can be more generalized with future researchfocusing on larger groups of research participants who are demonstratingan array of varieties in visual impairment and by selecting broader contexts. It can also be focused on testing the experiences of respondents during different time periods; morning, day time, evening and night.

As future landscape designers, the identified factors have to be carefully considered in creatinglandscape design interventions which are inclusive and optimal, enabling visually impaired people to navigate more efficiently and comfortably.

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