Impact of Sensory Architecture on Spatial Experience of People with Disabilities

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Abstract

This research focuses on the way sensory architecture affects spatial experiences of disabled people. It is well known that sensory factors in a built environment play a role in providing levels of comfort, accessibility, and an ease of navigation by means of experiences of light, sound, texture, and orientation. However, how the disabled people are affected by these are somewhat unknown due to limited research. This research examines this issue in order to fill the gap that exists between the theoretical backgrounds of multi-sensory design and the practical experiences of disabled persons in architectural spaces of daily life.

The research adopted a qualitative methodology using structured questionnaires. Data was collected from 20 individuals. The Bahrain Mobility International Center (BMI) and the Bahrain Society for the Blind (Al Noor Society). The sites were chosen because they serve people with different types of disabilities and incorporate various sensory design elements. The questionnaire included a mixture of closed questions and also open-ended ones so as to place all views of users in perspective relative to sensory experiences in architecture.

Results indicate that most respondents were affected by lighting, noise, disorientation, and in ways that typically brought a feeling of discomfort and compelled them to just avoid using certain spaces. In fact, most participants were in favor of sensory-inclusive design and promoted the use of features such as tactile flooring, noise control, and good lighting. The study concludes that sensory design serves a good purpose in improving accessibility and emotional well-being, while an inclusive approach to spatial design must go beyond the bias of the visual aesthetic to embrace all the other senses.

Keywords: Sensory architecture, disability accessibility, environmental comfort and human-centered design.

Introduction

Sensory architecture plays an important role in designing spaces that suit and meet the diverse needs of people with disabilities. Traditional architectural designs often prioritize visual aesthetics, structure, and function, yet they frequently overlook the varied sensory requirements of individuals with disabilities. Sensory architecture considers elements such as sound, texture, lighting, and spatial layout to create inclusive environments that enhance comfort, accessibility, and well-being. Investigating the impact of sensory architecture is essential for identifying gaps in current design practices and developing strategies that improve the quality of life for people with disabilities.

Historically, architectural design has focused mainly on able-bodied users, with little consideration for accessibility. Over time, awareness has grown about the importance of creating environments that address sensory and physical challenges. While ancient architecture has often incorporated multisensory elements, the explicit focus on disability inclusion has emerged more recently especially after the World War II, when many soldiers returned with disabilities, raising awareness of accessible design. Disability rights movements in the 1960s and 1970s have further accelerated this shift. Architects like Ronald Mace have pioneered concepts such as universal design and tactile communication, which remain foundational to sensory architecture today.

In this context, this research aims to explore how sensory architectural strategies can be integrated into the design of spaces to better serve people with disabilities. Its objectives are as follows.

1. To identify key sensory design principles that improve accessibility, analyze existing architectural examples that incorporate these principles, and
2. To propose practical, low-tech design recommendations to enhance sensory experiences for individuals with disabilities.

Theoretical Background

This paper explores the experience of people with disabilities in architectural environments and spaces and their way of navigating them, with a strong emphasis on inclusive design that considers and understands the physical and sensory needs of people with disabilities. Universal design, first formulated by Ronald Mace in the 1980s, is the foundation of inclusive architecture. As Mace (1985) explains, universal design focuses on creating spaces that can serve a wide range of users of all abilities without requiring special modifications to design.

This approach, which originated in the disability rights movement, prioritizes equitable access through design features such as clarity of information and reduced physical effort, establishing an ethical and practical foundation for accessible architectural practices. Based on this concept, sensory architecture challenges the dominance of vision in spatial design. Lang and Berkhout (2020) argue that architecture must draw on all human senses, such as sound, touch, smell, not just sight, to create inclusive and comfortable environments, especially for people with disabilities. This approach ensures that environments are not only physically accessible but also responsive to a wide range of sensory experiences and interactions.

To deepen this sensory interaction, the book "Embodied Cognition" proposes that spatial understanding is rooted in physical interaction. According to Varela, Thompson & Roche (1991), perception and knowledge arise through the body's interaction with the environment, which is through physical experience, not just through cognitive processes. This means that architecture must respond to the changing needs and physical experiences, especially for people with disabilities. This theory emphasizes the importance of considering posture, movement, and tactile cues in spatial design.

Finally, accessible architecture, as formulated by Steinfeld and Maisel (2012), translates and implements these theoretical insights into practical guidelines. This emphasizes that accessibility should not be considered an afterthought, especially for people with disabilities, but should be considered from the earliest stages of design. Their approach emphasizes independence, ease of use, and dignity for all, and calls for environments free of unnecessary barriers that promote independent mobility for people with disabilities.

Review of Literature

In recent decades, there has been a clear expansion in the literature on sensory architecture and universal design, but key challenges remain, both theoretically and practically. According to Pallasmaa (2005), the experience of architecture is inherently multisensory, encompassing not only vision but also touch, sound, and proprioception. Similarly, Malnar and Vodvarka (2004) argue that the built environment must be understood and experienced through the full range of sensory interaction. These insights emphasize the need to move beyond the dominant visual approach. However, as Imrie (2012) points out, practice still prioritizes visual aesthetics and basic structural accessibility, often neglecting the embodied and sensory experiences of users with disabilities. This results in a gap between theoretical understanding and the real-world applications in architectural practice.

This disconnect is further reflected in the application of universal design. In this regard, Steinfeld and Maisel (2012) propose a model based on inclusivity and autonomy. Their framework encourages equitable access through design that reduces the need for adaptation or specialized solutions. However, Imrie (2012) and Heylighen (2008) argue that such frameworks often result in minimal compliance features, like ramps and elevators, while ignoring the emotional and sensory dimensions of accessibility. While Pallasmaa, Malnar, and Vodvarka advocate for embodied spatial design, Imrie notes that these ideas are rarely realized in practical projects. The gap between intention and implementation reveals persistent barriers in integrating inclusive principles into mainstream design.

Lang and Berkhout (2020) advocate for smart technology, sensors, and digital interactions to enhance sensory environments. They believe that such systems can help adapt spaces dynamically to individual sensory needs, offering a more personalized experience. However, Heylighen (2008) cautions that these high-tech approaches may be unavailable, inappropriate, or expensive in many contexts, particularly in low-income or less technologically advanced settings. In contrast, Malnar and Vodvarka (2004) emphasize low-tech, material-based strategies such as natural light and textured surfaces as more widely accessible and affordable. These contrasting views reflect a tension between technology-based and material-based approaches, highlighting the need for context-sensitive solutions that consider a wide range of users and conditions.

Another gap is the lack of shared perspectives on disability. While many studies address individual disabilities, such as visual or hearing impairments, Steinfeld and Maisel (2012) argue for designs that accommodate a broader range of cognitive, sensory, and motor needs to achieve true inclusion. Inclusive environments should not only support physical access but also encourage independence, dignity, and ease of use for a wide range of individuals. However, current architectural practices still tend to follow standard accessibility codes that fail to address these more nuanced experiences of space.

Research also tends to ignore complex public spaces. Imrie (2012) and Heylighen (2008) point out that most universal design studies focus on small-scale environments, such as residential homes or healthcare settings. In contrast, larger environments, such as transportation hubs or shopping malls, remain under-explored despite their complex sensory requirements and high user diversity. These environments are especially significant for people with sensory processing issues or neurodiverse conditions, who may struggle with navigation, acoustics, or lighting in overstimulating settings.

Although Malnar and Vodvarka (2004) address cultural adaptation, most of the literature remains focused on Western contexts. There is little research into how sensory-inclusive designs respond to regional and climatic conditions, particularly in the Gulf region, where traditions, climate, and social use of space vary greatly. Factors such as high temperatures, dense social interactions, and the use of courtyards and shaded areas present unique design opportunities and challenges that have not been fully examined from a sensory or disability-oriented perspective.

In summary, while the theoretical foundations of multisensory inclusive design have been well developed by scholars such as Pallasmaa (2005), Steinfeld and Maisel (2012), as well as Malnar and Vodvarka (2004), its practical application remains limited. There are still gaps in multisensory integration, an overreliance on high-tech solutions, narrow disability ranges, a lack of focus on complex public environments, and a lack of contextual consideration. Bridging these gaps is essential in advancing truly inclusive design that does not merely meet technical standards but genuinely enhances the lived experiences of people with disabilities.

Research Methodology

This research adopts a qualitative methodology, using a questionnaire-based data collection method to explore how sensory architecture enhances spatial experiences for people with disabilities. The qualitative approach is appropriate because the research seeks to understand subjective, lived experiences: particularly how individuals perceive and interact with sensory elements such as light, sound, texture, and spatial orientation in built environments.

The primary tool for data collection is a questionnaire composed of both open-ended and closed-ended questions. This format allows respondents to reflect on and articulate how sensory features affect their comfort, mobility, and overall experience in different spaces. Open-ended questions provide space for in-depth responses about sensory discomfort or preferred design elements, while closed-ended questions help structure the data and highlight common trends across participants.

To ensure relevance and real-world insight, the study was conducted at two case study sites in Bahrain: the Bahrain Mobility International Center (BMI) and the Bahrain Society for the Blind (Al Noor Society). BMI is a facility that serves individuals with physical disabilities and incorporates sensory architectural features such as calming colors, controlled lighting, and accessible spatial layouts. Al Noor Society supports visually impaired individuals and integrates design strategies such as tactile paths, acoustic guidance, and minimized visual clutter. These two centers were selected because they offer distinct, yet complementary examples of how sensory design can meet the needs of users with different types of disabilities.

The questionnaire includes three sections. The first section collects basic demographic information such as age, gender, and frequency of visiting the site. The second section explores sensory experiences in space, asking participants which senses they notice first when entering a space, whether they have avoided spaces due to discomfort, and how they rate current buildings in terms of sensory design. The third section addresses perceptions of accessibility, asking what sensory features would improve inclusivity and whether participants support policies that mandate sensory design in public architecture.

Participants were selected from both study sites through purposive sampling, targeting individuals with various disabilities and backgrounds to gain a broader range of responses. The goal is to collect responses from 15 to 20 individuals, allowing for meaningful qualitative analysis without overwhelming the scope of the project. Participants responded either in written form or through oral dictation if needed, and no audio recordings were taken to ensure comfort and privacy. Notes were taken by hand where necessary, and all the responses were anonymized to protect the identities of the participants. This approach ensures that the research remains user-centered, ethical, and focused on improving design outcomes for people with disabilities.

Findings

A total of 20 respondents completed the questionnaire.

Total participants: 20
Age range: 16–50 years
Gender: 12 female, 8 male
Disability status: 6 with disabilities, 14 without (including staff and caregivers)

Table 01: Closed-Ended Question Summary Based on 20 Participants

1. First Sensory Element Noticed in a New Space

Sensory Element	Responses
Sight (light, colors, layout)	9
Sound (noise levels)	5
Touch (textures, temperature)	3
Smell (odors, air freshness)	2
Taste (if applicable)	0
Other (temperature, etc.)	1

2. Avoided a Space Due to Sensory Discomfort

Response	Count
Yes	14
No	6

3. How Well Do Buildings Consider Sensory Comfort?

Sense	Very Well	Sometimes	Rarely	Not at All
Sight	4	7	6	3
Hearing	0	6	9	5
Touch	1	9	7	3
Smell	0	10	7	3

4. Do You Think Public Spaces Are Accessible?

Response	Count
Yes	5
No	11
Not Sure	4

5. Support for Sensory Design Policy

Response	Count
Yes	18
No	1
Not Sure	1

Open-Ended Question Summary

Have you ever avoided a space because it was too uncomfortable in terms of sensory experience? If yes, please describe what made it uncomfortable.
Common Themes:

- Noise and Echo: Many participants described avoiding spaces like malls or waiting rooms due to loud noise or echoing voices.
- Harsh Lighting: Overhead fluorescent lighting or overly bright, unfiltered daylight was a common complaint.
- Temperature Extremes: Several respondents avoided spaces that were too cold or had no airflow, especially in public offices.
- Unpleasant Smells: A few noted avoiding restrooms or closed spaces with poor ventilation due to strong cleaning product odors or lack of fresh air.
- Crowding and Confusion: Some with anxiety or sensory processing differences found cluttered or chaotic environments overwhelming.

Do you believe sensory design could help people with disabilities navigate spaces better? Why or why not?

Most frequent responses:
Yes (strong agreement from 16 participants)
Reasons included:
"It helps reduce stress and anxiety, especially for autistic individuals."
"People who can't see or hear well rely on other senses. The building should support that."
"Clear signs, smells, and textures can guide people who use wheelchairs or have cognitive disabilities."

Uncertain/Qualified (4 participants)

Comments:

"It depends on how it's done; if it's too obvious it might not work for everyone."
"Not sure how much difference it makes unless users are trained to use it."

What features do you think would make public spaces more inclusive for people with disabilities?

Most suggested features:

- Sound control (acoustic insulation, quiet rooms)
- Visual cues (clear signage, color-coded areas)
- Tactile paths (textured flooring, braille signage)
- Adjustable lighting (to suit sensitivity levels)
- Natural elements (plants, daylight, fresh air)
- Sensory rooms (especially in health or education buildings)

Case Study Observations

The two sites used as case studies in Bahrain were the Bahrain Mobility International Center (BMI) and the Bahrain Society for the Blind (Al Noor Society). Both institutions cater to disabled persons and account for several levels of sensory design in the architectural layout. Study of these sites unfolded crucial practical and ground-level knowledge on sensory architecture.

1. Bahrain Mobility International Center (BMI)

BMI mainly caters to the physically challenged. Several intentional sensory design features were noted on-site. It uses soft and calming colors in public areas that reduce visual bombardment. The lighting system is carefully controlled, devoid of aggressive fluorescent lighting, rather opting for natural daylight and warm ambient lights wherever feasible. This lighting arrangement renders a calm sensation and, if anything, torments impatience-sparked glare or intensity restraint.

The layout is mostly transparent and user-friendly, with wide corridors and ramps and clear spatial definition that aids movement and orientation. Tactile contrast on flooring between rooms or zones helps with subtle spatial cues without bombarding the senses. Sound-wise, noise was considered generally low and peaceful, though echoing was noticeable in the larger open areas, so additional acoustic treatment (e.g., ceiling panels, soft furnishings) would further improve auditory comfort. Though BMI performs relatively well in terms of sensory design, the same cannot be said for scent control or ventilation. There seem to be no intentional treatments regarding any smells at all. Otherwise, simple HVAC systems take care of it. Consideration of fresh air flow, plants, or even subtle scent zoning would further complement the sensory experience.

2. Bahrain Society for the Blind (Al Noor Society)

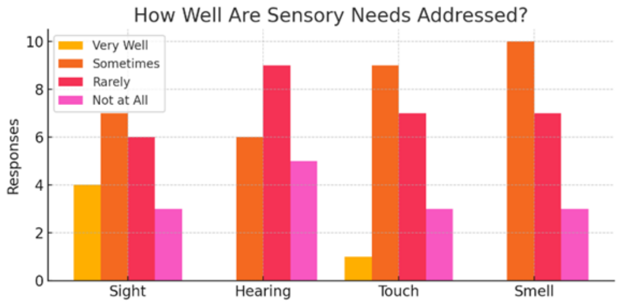
Al Noor Society undertakes work for the blind and provides more aimed non-visual sensory cues. Among its many remarkable elements is a tactile path system featuring textured flooring, metamorphosing users from room-to-room into key areas. Such a system assists independent movement and spatial orientation for those who are blind or visually impaired. There has also been an intentional development of acoustic cues. In this regard, some areas make use of sound-reflective surfaces in a controlled way, thus enabling users to perceive spatial boundaries. The degree of visual clutter has also been kept to a minimum so that partially-sighted individuals can focus attention on relevant visual elements, such as high-contrast signs or color-coded doors. Certain areas were at times afflicted with poor auditory clarity or wayfinding cues, mainly the corridors which were prone to background noise, thereby rendering navigation challengs. That was a hindrance to complete independence here and there, with some of the corridors lacking distinct tactile or auditory cues at doorways or key junctions. The sensory environment was characterized overall by being low-stimulation and calm, thus triggering a feeling of safety.

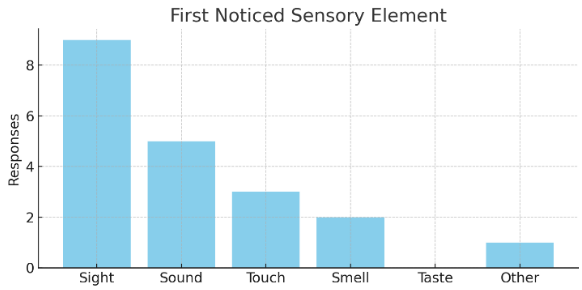
However, temperature control and air quality could certainly be worked on for greater overall comfort.

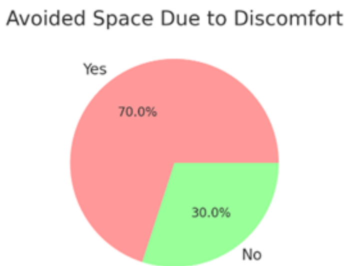
Analysis and Discussion

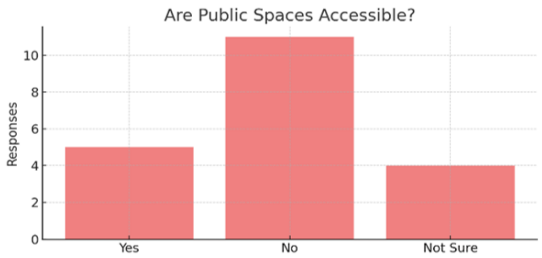
The analysis reveals that sensory architecture plays a key role in how people with disabilities experience spaces. Out of the 20 participants, 14 reported avoiding spaces due to sensory discomfort, citing issues like loud noise, harsh lighting, poor air quality, and extreme temperatures. Most participants first noticed visual elements such as lighting and layout, followed by sound, touch, and smell. While sight was dominant, responses from visually impaired participants emphasized the importance of tactile and auditory cues, such as textured flooring and sound-based guidance.

Participants rated current buildings as only sometimes or rarely accommodating sensory needs, particularly in terms of sound and smell. Despite these limitations, 18 out of 20 participants supported policies promoting sensory design, indicating strong public interest in more inclusive environments. Suggestions included acoustic control, clear signage, tactile pathways, adaptable lighting, and natural ventilation. These features were seen as essential for supporting comfort, navigation, and emotional well-being









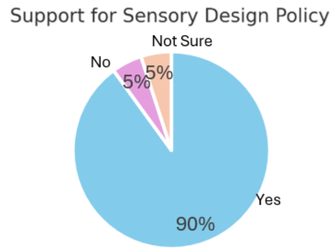


Fig. 1: Survey – Bar Charts and Pie Charts

Conclusions

This study set out to explore how sensory architecture affects the spatial experiences of people with disabilities, using data collected from 20 participants. Based on the questionnaire responses, several clear conclusions can be drawn regarding the impact, challenges, and potential of sensory design in public spaces.

To begin with, the findings clearly show that uncomfortable sensory environments negatively impact the willingness of the people to engage with space. Majority of the respondents (14 out of 20) admitted to avoiding certain places due to sensory discomfort. These issues included loud or echoing noise, overly bright or glaring lights, poor ventilation, extreme temperatures, and unpleasant smells. This suggests that when sensory factors are not carefully addressed, they create exclusion, particularly for individuals with sensory sensitivities or specific disabilities. Secondly, while most participants identified visual aspects like lighting, color, and layout as the first things they notice in a space, responses from those with visual impairments emphasized the importance of non-visual elements such as sound and touch. This highlights the need for multi-sensory design strategies that cater to diverse sensory needs, rather than focusing solely on visual features.

Third, data reveals that most participants find current public buildings insufficient in terms of sensory support. When asked how well different sensory elements are considered in design, most responses indicated that these are either rarely or not at all addressed especially in terms of sound and smell. This points to a significant shortcoming in standard design practices and suggests that sensory architecture is still not widely integrated into conventional public design. Another important conclusion is that there is strong endorsement for policy-level change. A large majority of participants (18 out of 20) expressed support for regulations that require public spaces to incorporate sensory design features. This shows that people directly affected by these issues recognize the value of sensory-inclusive spaces and believe that formal guidelines could improve accessibility and user experience.

Finally, participants proposed a range of practical solutions to enhance sensory inclusion. These included better sound insulation, tactile pathways and signage for easier navigation, adaptable lighting systems to accommodate sensitivities, improved ventilation, and the use of natural elements like greenery and daylight. These suggestions are grounded in real-life experiences and point to simple yet effective interventions that could significantly enhance comfort and usability for people with disabilities.

In summary, the study confirms that sensory design has a significant impact on accessibility and well-being yet is often missing from mainstream architectural approaches. There is a clear need to integrate multi-sensory considerations into both design practice and policy to ensure environments are welcoming, functional, and inclusive for all users, especially those with disabilities.

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Conflict of Interest: The author states that there is no conflict of interest in this research to declare.

Availability of Data: Data presented in this research are available for scrutiny if so required. In any case, they were used in this paper with the consent of the owners of that data.

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