Exploring Multisensory Experiences to Improve Accessibility for Blind and Low-Vision Individuals in Museum Settings

Exploring Museum Accessibility

Strategies and Innovations for Inclusive Museum Design

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This study explores the multisensory experiences of blind or low vision (BLV) individuals in museum settings to improve accessibility and engagement. We interviewed four participants, aged 35 to 62, to understand their challenges and preferences when visiting museums. We analyzed the interviews using sticky notes on FigJam to find common themes related to multisensory experiences, wayfinding, and accessibility frameworks.

Our findings highlight the need for tactile engagement, flexible and responsive audio descriptions, and immersive multisensory elements such as scents and ambient sounds to enhance the museum experience. Our findings suggest integrating these elements to create more inclusive and engaging museum experiences. This research can help museums create more inclusive experiences for BLV individuals.

Additional Keywords and Phrases: Accessibility, Inclusive Design, Museum Exhibits, Blindness and Low Vision, and Multisensory

1 INTRODUCTION

Museums are important places for learning and self-discovery. However, despite efforts to improve accessibility, visiting and enjoying museums can be challenging for blind or low vision (BLV) individuals [1,. As Asakawa et al. noted, many BLV visitors want to explore museums independently, but face obstacles related to mobility and inaccessible artworks [1]. They suggest features like navigation systems and detailed audio descriptions to enhance their experience. Similarly, Sun Jingyu et al. mentioned the difficulties visitors face while accessing information, making exhibits less engaging [5]. They argue that museums should improve accessibility by providing easy access to museum grounds and raising public awareness. These studies point out issues in the current museum experience for BLV individuals, and the need for more comprehensive and user-friendly accessibility solutions.

We organized the literature review into three categories: 1) Multisensory Experiences, 2) Wayfinding, and 3) Accessibility Frameworks. Our research combines findings from recent studies with insights from online interviews with BLV individuals. We aim to suggest possible technological solutions and highlight standards for a more inclusive museum experience.

1.1 Multisensory Experiences

Museum exhibits and galleries tend to be visual-focused spaces, and many fall short in regard to accessibility and inclusion [1, 2, 9]. To address this gap, museums can adopt a variety of multisensory tools, such as audio descriptions, tactile exhibits, and haptic experiences [2, 3, 7, 8, 9].

Audio descriptions, typically heard through a museum app and a pair of headphones, can be helpful for BLV individuals. However, researchers have found that wearing headphones at a museum may interfere with communication and interactions with others and their surroundings [5].

Because touch may be crucial to perceiving and understanding the material properties of museum artifacts, some museums have also incorporated tactile elements into their exhibits [7, 8]. Studies applying Techniques to Support Artistic Development (TADA) have investigated digital and manual collages with Braille, relief or embossing tactile features, textures, auditory applications, smells, and other elements [9]. This research has shown that applying TADA to exhibits can increase accessibility within the art world and inclusivity in museum and gallery spaces [9].

Other emerging tools allow curators to incorporate haptic feedback into museum exhibits. In one such exhibit, researchers found that combining mid-air haptic and auditory feedback helped participants feel immersed and provided positive experiences [11]. These multisensory displays can enhance all visitor experiences, especially for BLV individuals.

Altogether, these techniques and practices may allow museums to go beyond visual-focused exhibits and conventional art experiences and ultimately create more inclusive and accessible spaces. However, there are critical limitations to the current utilization of multisensory tools in museums, such as uneven implementation, lack of standardization, and barriers to access [3, 4].

1.2 Wayfinding

Efficient wayfinding is crucial for ensuring that BLV individuals can navigate museum spaces safely and independently [1, 6]. Current practices often require BLV visitors to either adhere to rigid schedules or make advance reservations for specialized but mostly pre-fixed tours [2, 6, 8]. This can potentially limit spontaneous visits, impede the overall accessibility of museum experiences [8], and restrict the freedom of visitors to explore the museum at their own pace and according to their interests [6]. Researchers have argued that innovative solutions should prioritize real-time access to navigational information to address these limitations, which enables visitors to dynamically adapt their routes based on their preferences and interests [6]. Additionally, researchers have observed a desire for increased autonomy among BLV museum visitors, which technology-based solutions may be able to support [1, 6, 8].

1.3 Accessibility Frameworks

Museum curators struggle to apply accessible features to exhibits due to a lack of standards [4]. Current accommodations lack robust ways to communicate multisensory information. Additionally, BLV museum visitors find that assistive technology lacks standardization and does not fit their needs [4]. Our exploration of proposed accessibility frameworks focuses on the experience from pre-visit, on-site visits, and post-visit [2, 10]. Some pre-visit accommodations might include accessible websites to help museum visitors plan their visit [10]. On-site visit accommodations may include tactile and experiential activities [2, 8]. Post-visit accommodations suggest physical souvenirs and accessible social media engagement [10]. Overall, museums must structure accessibility throughout multiple points of interaction rather than just during the visit itself.

We plan to combine findings from recent literature with our online interviews to either dispute or affirm current accessibility frameworks. Then, we will propose a potential technological solution that could increase enjoyment through expansions in multisensory experiences and autonomy in wayfinding. Our contribution may assist in highlighting standards for an inclusive museum experience for BLV individuals.

2 METHODS

2.1 Participants

In this study, we aim to understand the behaviors and challenges BLV individuals face when engaging with museums. We invited individuals aged 18 and older who have experience visiting museums. We interviewed four participants, ages ranging from 35 to 62 with diverse backgrounds and varying degrees of vision impairment.

2.2 Interviews

We conducted interviews with the participants via Zoom. Each interview lasted about 45 minutes. Before each interview, we sent an accessible document with our informed consent policy and obtained verbal consent at the start of each interview. During the interview, we asked participants about their museum experiences and specific obstacles they have faced. We also asked about their preferences for accessing information about exhibits, as well as any accommodations they find helpful.

Table 1: Participant Summary

Participant	Gender Identity	Age	Location
P1	F	35	Georgia
P2	F	52	Indiana
P3	M	62	Illinois
P4	F	56	Pennsylvania

2.3 Recruitment

Target Population

Our target population was BLV individuals aged 18 and older with past experiences visiting museums. This helped us find a diverse group of participants who shared their experiences and challenges with visiting museums.

2.4 Data Analysis

After interviewing the participants, we transcribed the recordings and used a FigJam board for analysis. We created sticky notes for each response and organized them to identify common themes and patterns in the affinity diagram.

3 FINDINGS

3.1 Wayfinding

Independent

According to our participants, there are assistive technologies that exist that help BLV visitors navigate on their own. Participants noted tactile floor markings to assist those with white canes, along with apps or sites accessible through QR codes that offer indoor maps/navigation. P3 went into depth about how some technologies can use LiDAR to navigate, but noted that it is only available if a user has a phone that supports LiDAR. P2 described positive experiences with traditional assistive technologies, such as Braille directions.

P4 specifically stated she hasn't "used many wayfinding tools because [her] husband and [herself] usually engage together." Additionally, P1 and P3 both noted many museums may not have wayfinding technologies available. P1 further described even with indoor maps accessible from her phone, she finds it difficult to orient herself. P1 is also the only participant who indicated any form of independent wayfinding. P1 utilizes a guide dog but states that varying structures that museums use aesthetically to partition rooms can be hard to navigate. For example, P1 described how she cannot give commands to locate a door if an exhibit is

partitioned by curtains. The lack of available and robust assistive technologies does not allow for independent wayfinding in museums for BLV visitors.

Dependent
All participants tended to visit museums with another person, usually a person with sight. P1, P2, and P4 noted they tend to go with their husbands or boyfriends, which meant they did not need to wayfind independently. P1 and P3 both stress that if they were to get lost, it would be imperative to find a museum guide to reorient them.

3.2 Audio and Tactile Experiences

Engagement Methods
When visiting museums, two primary means of audio information among participants are audio descriptions and live docents. P3 and P4 expressed content with live docents, as they are the most flexible in adapting information based on visitors' responses and questions. P1 mentioned that she mostly relies on the person she visits the museum with.

In addition to audio information, all participants also interacted with exhibits through tangible experiences like touching exhibition pieces, models of statues, or replicas of artwork.

Audio Description Preferences
Preferences for audio descriptions varied among participants. Three participants preferred descriptions that include descriptive details and contextual information, so they could get a more complete picture and greater understanding of the exhibits. P3 preferred audio descriptions identical to wall descriptions, so there is consistency between his experience and those of his sighted counterparts.

Tangible Experiences
Participants highly valued the ability to physically interact with exhibits through tangible experiences. P2 expressed that "it brings a whole new level of enjoyment when there is that opportunity to be able to touch things, get hands-on with everything, and be a part of the experience." Other participants also emphasized that they appreciate tactile opportunities; for P4, the opportunity to touch and feel objects is a deciding factor when choosing to visit a museum.

3.3 Immersiveness and Impact

Multisensory Experiences
Aside from audio descriptions and tactile engagement, participants also described being open to other sensory experiences. P3 stated that olfactory elements could make exhibits more engaging, especially in settings related to plants, fruits, or spices. In addition, P2 described a submarine exhibit in which they could distinctly smell the setting of the submarine.

An individual's senses and feelings while being in an exhibit are also important to consider. Some examples of this include the temperature of the exhibit, the airflow, the sound/texture of the flooring, and more. For instance, P1 described a nautical exhibit in which "the room had a lot of ocean stuff… [and] you felt like you were on a boat." The participant described how "they had wind whipping in the room and things like that." As a result, they thought "that was an immersive experience that spoke to every type of sense."

Impact and Enjoyment
As part of the interview process, we asked our participants to describe what they seek to gain by visiting a museum exhibit. P2 explained that they want to feel like they are in another world because "instead of just hearing about history or just learning about it, you're actually a part of it or actually reliving it." All four participants explained that this feeling of immersiveness and enjoyment is directly impacted by the level of multisensory elements and accessibility considerations in the exhibits.

When asked to describe a perfect-world scenario, participants touched upon various technologies. Some participants want to see better audio guides that incorporate storytelling and music, while others want more 3D replicas and opportunities to touch artifacts. Others mentioned braille/graphic displays, artifacts they can take home, multilingual options, and interactive exhibits powered by AI that allow for back-and-forth conversations. Altogether, these suggestions can be summed up by P4, who asked for museums to "engage the senses that I have."

4 DISCUSSION
Our findings highlight several key implications for museum accessibility design:

4.1 Wayfinding

Participant wayfinding experiences are most notably dependent on a sighted guide, either from a companion or museum staff. Participants have few opportunities to access robust assistive technologies that allow for independent wayfinding. Available technologies may consist of advanced LiDAR navigation only accessible from specific mobile devices to traditional guides, such as braille maps. BLV visitors may encounter issues with these aids if their phones lack LiDAR functionality and if they cannot read Braille. Therefore, if museums are to provide proper wayfinding assistive solutions, they must support both dependent and independent forms of wayfinding. Museums might employ knowledgeable guides at all entrances of exhibits to direct and offer inclusive experiences to BLV visitors as a dependent aid as part of their accessibility framework [2]. Current staff should undergo training to properly provide guidance. Independent wayfinding aids, such as mobile apps, should utilize simple capabilities available to most phones. NFC (Near Field Communication) tags can be placed at each piece and navigational landmarks, sending basic short-range information to a mobile app that can help a BLV visitor orient exactly where they are [2, 6]. Additionally, any preferred BLV navigational aids, such as white canes and guide dogs, should be anticipated and compatible in exhibition spaces. For example, exhibits should be partitioned with temporary walls instead of curtains.

4.2 Audio and Tactile Experiences

Based on our interview responses, participants expressed varied preferences on audio description content; therefore, museums should provide audio information options that include different levels of contextual details. Participants also had generally positive feedback on live docents due to their ability to adapt information based on visitors' feedback. This emphasizes the necessity for flexibility and responsiveness in museums' audio information sources [8]. As previously mentioned, a mobile app that utilizes NFC tags will help to orient visitors to where they are, but it can also offer audio information about the piece they're nearby. Since the app will know what information to play based on what a visitor is near, they will not need to struggle to locate a QR code at each piece [2, 6]. Tangible engagement also significantly enhances the museum experience for our participants; one participant mentioned that tactile opportunities can even be a deciding factor for them when choosing a museum to visit. Therefore, museums should integrate more tactile opportunities, such as touchable replicas or objects, into their exhibits to provide engaging and inclusive experiences [4]. As BLV visitors have diverse needs and preferences for engagement methods, museums should not only consider inclusiveness in their exhibition designs but offer a variety of supportive resources to accommodate the differences.

4.3 Immersiveness and Impact

The findings from our study on multisensory experiences and their impact on museum enjoyment and immersiveness for BLV visitors offer significant implications. To start, participants expressed a clear need for museum exhibits to be accessible and engage senses besides sight. Even in the case of exhibits that focus on visual mediums such as paintings, curators need to consider how other senses may be engaged. Audio descriptions and tactile artifacts are greatly appreciated, as are elements like scents, winds, and changing temperatures. This can be accomplished by leveraging technologies like ambient soundscapes, dynamic lighting, temperature control, and even motion simulators. For instance, by simulating real-world environments, such as a windy day in a nautical exhibit, exhibits can enhance the sense of presence for users. Considering the mobile app mentioned previously, an experience can be further customized through audio controls that can adjust ambiance and audio description information levels.

In addition, our findings suggest a need for more personalized and interactive technologies. As one participant stated, an AI-powered exhibit that could facilitate real-time, back-and-forth conversations would make exhibits more interactive for all ages and audiences. Moreover, museum offerings of post-visit artifacts that users can take home would also add to the experience. Overall, balancing the need for multisensory learning, enjoyment, and immersiveness within the museum space would lead to more inclusive and accessible exhibits for all.

4.4 Basic Framework and Priority Matrix

Based on our findings and literature review, we have created a basic framework that museums can use to standardize accessibility for BLV visitors. As stated, museum industry standards do not exist for curators looking to implement accessibility in their exhibits [4]. Proposed frameworks, like Butler et al.'s, identify current good practices, and, like Vaz et al.'s, offer suggestions from pre-visit to post-visit. These frameworks help reassert BLV visitor preferences and explore what should be included in potential technological solutions.

Table 2: Priority Matrix

No.	Feature	Category	Priority	Impact	Effort
1	Robust Mobile App	*Technology:* Wayfinding, Immersiveness and Impact	High	High	High
2	Knowledgeable Guides	*Experience Standards:* Wayfinding	Medium	High	Low to Medium
3	Adaptive Infrastructure	*Experience Standards:* Wayfinding	High	High	Low
4	NFC Tagging	*Technology:* Wayfinding, Audio and Tactile Experiences	High	High	Low
5	Live Docent Connection	*Technology:* Audio and Tactile Experiences	High	High	Low
6	Tangible Experiences	*Experience Standards:* Audio and Tactile Experiences	High	High	Low
7	Audio Description Options	*Technology:* Audio and Tactile Experiences	Medium	High	Low
8	Multisensory Simulations	*Experience Standards:* Immersiveness and Impact	High	High	High

Limitations to our project, such as a small pool to interview from, have barred us from creating a more detailed framework with specific guidelines. However, our list of impactful features offers future exploration into new assistive technology and basic requirements that should be considered for experience standards. In an industry setting with more time and resources, we recommend interviewing more BLV visitors to expand on preferences. Additionally, we would explore prototyping and testing a robust mobile app with NFC tagging.

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