MuseumsForward

Museums our own way: accessibility and inclusion for disabled individuals with multi-faceted access needs in a science-based museum

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Abstract

Research on accessibility in museums tends to focus on narrow constructions of disability based on the medical model. Therefore, it overlooks many of the nuances and overlapping complexities of the lived experiences of disabled individuals in museums. Additionally, science-based museums are underrepresented in this research. This phenomenological study used a self-narrated visit to examine the experiences of four disabled adults with multi-faceted access needs in the Burke Museum through the lens of the human rights model. The goal was to understand what barriers to accessibility exist in museums and whether and how disabled adults feel included in science-based museums. The results show that significant access barriers remain in museums which require disabled visitors to expend additional energy and resources before, during, and after their visit. Additionally, supports when available are often difficult to navigate or access. These barriers and the lack of supports negatively impact adults' sense of inclusion and belonging in science-based museums.

Keywords accessibility; museums; multiple disabilities; inclusion; science-based museums; visitor experience

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Introduction

Museums remain inaccessible for many visitors and we lack the research to understand how or why. In terms of accessibility for disabled people in museums, the research has focused primarily on specific segments of the disability community who are perceived to share a relevant or prominent access need. Specifically, research has focused on visitors who are blind or have low-vision, wheel-chair users, or individuals with intellectual and developmental disabilities. This ignores the reality that many disabled people have multiple access needs, and a broad variety of access needs impact the experience of disabled people in museums. Further, research on accessibility in museums often focuses on access to objects or labels in art and cultural heritage museums. Therefore, there is a gap in the knowledge of accessibility in experience-based science museums and centers. This article describes qualitative research on the experiences of disabled-identifying individuals with multiple access needs in science-centered museum settings.

Literature Review

Definitions and Models of Disability

Disability is a natural part of the human experience. The World Health Organization has identified over one billion disabled people or 15% of the global population and this figure continues to grow due to aging and global health trends (World Health Organization, 2011).

Definitions and conceptual models of disability have been rapidly evolving throughout the twenty-first century. Many

conversations about disability in America are heavily shaped by the language within legislation such as the Rehabilitation Act of 1970 and the Americans With Disabilities Act (as amended in 2008). These bills define disability as "a physical or mental impairment that substantially limits one or more major life activities of such individual" (Americans with Disabilities Act, § 12111, 1990. This definition is based heavily in a deficit-centered medical model of disability.

Similarly, the medical model of disability used to describe norms that traditionally govern disability within western society, categorizes people into clear categories of "abled" and "disabled" and assumes that disability is a personal medical problem requiring medical intervention (Areheart, 2008). The responsibility for barriers experienced by disabled people is placed solely on the body, or mind, of the disabled individual. The medical model of disability is also referred to as the "individual model of disability" (Areheart, 2008; Hogan, 2019).

In contrast, the United Nations Conventions on the Rights of Persons with Disabilities defines persons with disabilities as including people who have "long-term physical, mental, intellectual, or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others" (United Nations, 2006). Key differences in these definitions include the inclusion of societal barriers and the focus on full and effective participation as opposed to substantial limitations.

International views of disability tend to be informed by the Human Rights Model of Disability. The human rights model is based on legalistic principles of human rights and claims disability is a natural part of human diversity that must be respected and supported; therefore, disabled people have the same rights as everyone else in their society and disability must not be used to deny or restrict people from rights or freedoms. The United Nations Convention on the Rights of Persons with Disabilities uses this framework to list the rights which should be assured to disabled people globally. Relevant to museums, it specifically lists "participation in cultural life, recreation, leisure, and sport" including "the right of persons with disabilities to take part on an equal basis with others in cultural life" and ask signatories to ensure disabled people "enjoy access to places for cultural performances or services, such as theatres, *museums*, cinemas, libraries, and tourism services, and, as far as possible, enjoy access to monuments and sites of national cultural importance" (United Nations, 2006). However, museums are becoming a growing part of our changing educational framework post covid. The 2022 Annual Forecasting Report on Museum Trends argued that museums are becoming a pillar of American

education (AAM, 2022). Therefore, access to museums is increasingly an important part of accessible education.

This research follows the assertion that access to museums is a protected right for disabled individuals and that museums have a duty to protect and preserve that right through the ways in which they develop, design, and facilitate museum experiences. However, an important step forward for museums in preserving that right is the adoption of a more advanced model of disability which suits the ways museums operate in our society. One fitting option is the identity model.

The identity model is closely related to the social model of disability which states that disability is not a quality possessed by an individual but rather the result of an individual interacting with a "disabling" society (Degener, 2017). However, the identity model shifts disability from a socially constructed barrier to a positive identity (Retief & Letsosa, 2018). "Under the identity model disability is a marker of membership in a minority identity . . . a social and political experience of the effects of a social system not designed with disabled people in mind" (Brewer et al. 2012, p. 5).

Research on Accessibility in Museums

Discussions of accessibility for disabled visitors in museums began gaining prevalence in research and practice with Salmen's (1998) publication of "Everyone's Welcome: The Americans with Disabilities Act and Museums." Salmen uses the Americans with Disabilities Act (ADA) to outline a nine-step process for improving accessibility with museums through compliance with the law. His process includes establishing an accessibility statement similar to the non-discrimination province of Title II of the ADA, appointing an accessibility coordinator, recommended by the ADA, and focusing on staff training and review to prevent discrimination.

However, studies show that these strategies have not been fully implemented by many museums (Garnese, 2016; Henrich et al., 2014; McMillan, 2012; Pressman & Schulz, 2021). Henrich et al. (2014) evaluated three museums participating in the Art Beyond Sight program, and while not explicitly using Salmen's framework, the results showed that the museums did not have comprehensive staff training, advisory boards, and comprehensive review processes. Romero (2018) focused on the Tuscon Museum of Art which facilitates several programs specifically for disabled adults. Romero found that the

implementation and knowledge of these basics principles was not consistent within the program. Thus, many of the issues which prompted Salmen's work remain in museums (Mcmillen, 2012; Langa et. al., 2013; Starr, 2016, Zakaria, 2020; Romero, 2018). Further, as "Welcoming Everyone" predates the expansion of the social model and the birth of the human rights model of disability, it is heavily reliant on the medical or deficit model; this does not align with the preferences of modern advocates.

The majority of research done on accessibility in museums is centered on art and cultural heritage institutions. A search on the largest research database, Google Scholar, for "accessibility + museums" returns 230,000 results, a search for accessibility + "science museum" | "science museums" returns only 17,200 results. The research tends to focus on accessibility of objects, such as paintings and labels, or access to the building as a whole. While these are applicable, to an extent, to all museums there are significant differences in the structure and content of art and science museums which may present unique barriers. For example, in an art museum the content and visitors are not competing for space often as most art is displayed on the walls; yet, in a science museum large floor-based interactives, skeletons, and display cases compete with the visitor and can complicate navigation. Art museums most often ask visitors to simply look whereas science centered museums often have hands- on interactives with varying fine and gross motor demands. Art and object-based museums most commonly ask visitors to contemplate and provide seating from which to do so, but science-based museums ask visitors to explore, often through movement and the senses.

Research on accessibility in museums additionally tends to focus on specific disabilities with obvious accessibility issues in art museums such as blind visitors who would be unable to see a painting or sculpture, d/Deaf visitors, who may have trouble understanding tour guides or programming, or visitors using wheelchairs who may have trouble physically accessing the space. Therefore, the current knowledge of experiences of disabled people in museums center heavily on those distinct populations.

Research on Experiences of Disabled Visitors in the Museum

Blind Visitors

There is extensive research on the accessibility of museums to blind visitors. The key finding is that museums, despite extensive investment and research on alternate technologies and techniques, are still inaccessible for this population. Asakawa et al. (2018) found that out of nineteen adults with vision-based disabilities, none had ever experienced a typical, independent museum visit. Further, fourteen had never visited a museum without bringing their own support in the form of a sighted family member or friend. The other five used museum escorts or specialized tours specifically for blind visitors. They identified two key areas of accessibility barriers including mobility and orientation, expressing concerns of getting lost or injured within the museum setting, and content accessibility, with one museum surveyed relying on visitors inputting visually displayed codes to access audio descriptions (Asakawa et al., 2018).

Other accessibility concerns for blind visitors include training for staff serving as escorts and tour guides; community involvement, including focus groups, in program development; and attitudes towards museums, with blind visitors feeling like museum visits are not a suitable leisure opportunity (Lisney et al., 2013; Henrich, 2014; Vaz et al., 2020; Vaz et al., 2021).

d/Deaf Visitors

Although there is less research on d/Deaf visitors in museum settings, the trends follow a similar pattern. Research on d/Deaf visitors in museums has found that most museum exhibits are accessible, aside from audio devices without subtitles or hearing loop receivers. However, d/Deaf and hard of hearing visitors face difficulty buying tickets, interacting with staff, or attending programming and talks which often are not interpreted or captioned (Lisney et al., 2013). Additionally, for d/Deaf or hard of hearing individuals who use assistive listening devices or speech, galleries are often too noisy and reverberant which make communication difficult (Meyer et. al, 2017). These results emphasize the importance of staff training and considering disability when designing physical space (Lisney et. al, 2013; Meyer et. al, 2017; Renel, 2019).

Visitors who use wheelchairs

Significantly less research has been done on the accessibility of museums to wheelchair users. One study found that out of three disabled populations - blind, deaf, and wheelchair users - museum staff estimated the highest accessibility for wheelchair users. For example, 58% of science center staff surveyed said they believed 90% or more of their exhibits were accessible to wheelchair users (Tokar, 2004). However, other studies focusing on evaluating accessibility do not support this estimate. In fact, studies find that access issues for wheelchair users begin well before exhibits and often prevent them from accessing the museum at all (Worthley et al., 2018). Barriers include the lack of van accessible parking, poor signage for accessible parking and the museum entrance, difficult-to-open doors without buttons, the lack of adequate and accessible bathroom facilities, high counters, sinks, lockers, and signs (Lisney et al., 2013; Worthley et al., 2018).

Disability as a Complex Experience

Museums must understand and respond to the complexity of disability. An emphasis on universal design, a design philosophy which aims to make a product or experience universally accessible by appealing to the widest possible base, fails to address the intersectionality and fluctuation of disability. One study found that 51.6 percent of adults with intellectual disabilities had a second disabling condition such as epilepsy, mental illness, or a mobility-impacting condition (Cooper et al., 2015). Often individuals can experience multiple disabling conditions through natural processes like aging, disease, accidents, or injury. These may be fluid rather than fixed processes, and further affect individuals who already identify as disabled. Therefore, the access needs for individuals are often complex and not defined by a preliminary diagnosis or identity.

Mastrogiuseppe et al. (2021) used a participatory research paradigm to understand the experiences of visitors with intellectual and developmental disabilities in cultural heritage museums. Of eight participants with intellectual disabilities, multiple used alternative communication systems and one used a wheelchair; this is noteworthy due to a rare intersectional approach. The most frequently cited barriers were not related to anticipated concerns of individuals with intellectual disability such as language, symbols, comprehension, or engagement with knowledge, but instead centered on physical access to the content; “the presence of several environmental, physical, and perceptual obstacles represented elements that did not encourage

interaction with textual contents, perhaps limiting access to knowledge" (Mastrogiuseppe et al., 2021 p. 118). Exhibit labels were often too far away, poorly lit, or not printed large enough to be readable by many participants who had vision-based challenges. Unstable floors and stairs without handrails also prevented access to entire sections of the cultural heritage museums. These results indicate the need for additional intersectional research on accessibility in the museums.

An additional relevant topic is conflicting access needs. Because disability is a nuanced and individualized experience, different disabled individuals can have conflicting experiences of the accessibility of a space. Further, the elements which enable accessibility and participation for one disabled individual can create additional barriers for other disabled individuals. For example, in "Museums and technology: Being inclusive helps accessibility for all," Lisney (2103) discussed how technology in exhibits and virtual accessibility improve her experience as a wheelchair user. Yet, a coauthor of the same paper, Kristen Hearn describes how often technology is dependent on sight and makes no sense to her as a blind visitor (Lisney et al., 2013).

Methods

Purpose

The purpose of this study was to understand the experiences of disabled people with multi-faceted access needs in science museums using a think aloud approach. Additionally, it aimed to answer the following research questions:

1. How do disabled people with multi-faceted access needs access science museums?
2. To what extent do disabled people with multi-faceted access needs feel included in science museums?

In this study, individuals who self-identified as having multi-faceted access needs narrated their experiences while visiting a science museum, the Burke Museum of Natural History, with the primary investigator using a think-aloud approach (Koro-Ljunberg, 2013). After the visit, semi-structured interviews were conducted. Interview questions were focused on understanding their experiences through the lens of access and inclusion. This study was designed as a phenomenological study aimed at understanding the shared experiences of a population through a qualitative story-focused approach.

Positionality Statement, Ethics, and Consent

This research was conducted by a single researcher who identifies as disabled and autistic. This influenced the framing, development, and conduction of research. While some participants were connected to the research through shared networks, there were no previous personal connections. This research aims for the highest ethical standard including ensuring that data collected from populations is used to benefit those populations. Research was subject to IRB approval and participants were read and provided a printed copy of relevant information before obtaining verbal consent. To preserve privacy, participants are referred to by randomly assigned letters.

Sampling

Participants were recruited virtually through a variety of means. The researcher posted recruitment information on a range of professional and personal networks including social media platforms. Additionally, research recruitment information was shared through organizations which serve, support, or are led by disabled individuals including the Student Disability Commission of the University of Washington, the Disability Studies Department at the University of Washington, the ARC of King County, and others. The researcher also presented recruitment information in front of student organizations and community groups.

Participants

A total of four adults participated in the study. All four participants used the pronouns she/her. Three of the four participants were currently pursuing post-graduate education and one was currently completing two bachelor's degrees. All participants identified as white, and one additionally identified as Hispanic.

All participants identified as having unique disabilities including Autism, ADHD, Charcot-Marie-Tooth Disorder, Postural Tachycardia Syndrome, and disabilities resulting from injury. However, some supports, symptoms, and traits were shared by participants. Three of the four participants described limited vision and although all believed their vision to be fully corrected with glasses or contacts only one was wearing these aids during their visit. Additionally, three of the four participants utilized mobility aids all or part time. During the visit, one

participant used a wheelchair, which they use full-time, one utilized a sit-stand cane, and the third used frequent breaks to support mobility needs. Lasty, all participants shared a sense of anxiety around heightened risk during the covid-19 pandemic which they believed to be significantly impacting their daily life and leisure habits including museum visits and behavior within the museum.

Results

Data Collection and Analysis

Data were collected through think-aloud, or self-narrated experiences, at the Burke Museum of Natural History located at the University of Washington. During this visit, participants were prompted to share their thoughts about decisions they made during their experience, barriers they encountered, and their overall experience. After the visit, participants completed a brief interview on overall accessibility of the museum and feelings of inclusion or exclusion experienced by participants during that visit (see Appendix A for the interview guide). Interviews lasted approximately thirty minutes and were transcribed through Trint. These recordings were hosted on a password protected server. The data were analyzed using emergent coding methods. A matrix was created by looking for patterns, themes, and shared experiences across transcripts while preserving context of the museum visit.

How do disabled adults with multi-faceted access needs access science museums?

Highlighted themes from the experiences of participants include preparation, transportation and mobility needs, benches, and personal technology. Overall, the results highlight a variety of barriers remaining which impact the museum experience.

Preparation

In order to access the museum, participants used a variety of tools, including technology and community supports to prepare for the visit:

> "Yeah, typically I'll do a Google Street View to be like, 'Alright, what does the entrance look like?' Just if I know anyone who has been there before, I'll be like, 'Hey, do

> you remember going there? What was it like? Do you think I would be able to easily get around?"' (Participant A)

Participants mentioned using online resources to research many factors of the museum experience which can impact accessibility:

> "I mean, sometimes I look up certain things about the museum. I just kind of want to see like what the cost is going to be, how open the space is like, how big it is, how busy they typically might be." (Participant C)

Some participants used online photographs specifically, to examine physical accessibility of museum spaces, looking for factors such as carpets, inclines, and open spaces:

> "Think, if the pictures have a lot of carpet in them because carpet sucks. Which they usually don't, but there is a portion of the [regional art museum] that is carpeted. I don't really understand why, it's not doing anyone any favors." (Participant B)

Participants also utilized energy budgeting to account for the increased demand of the museum visit on their physical and mental energy. Multiple participants mentioned rest days, and Participant A stated, *"I took it easy yesterday, and I cleared my schedule for tomorrow."* Participants had to rearrange work activities, school demands, and activities like grocery shopping around their museum visit.

All participants mentioned checking for an accessibility statement on the museum's website. Participant B said, "*I looked at the website and saw their accessibility paragraph and it looked good."* Participant A explained, *"Normally, I go to their website and if they have an accessibility section...or I go in and make sure that it's at least existing. That's always a positive sign if they even have an accessibility section."* Participant D stopped to use their cell phone to check the accessibility statement of the Burke Museum during the visit:

> **"**Do you have a website? Yes, you do. OK, cool. So 'About exhibits?' OK, maybe 'Visit?' OK, I'm looking for a giant...like sometimes at the bottom of the page, like an accessibility...Aha!. It has accessibility on the website. Why is it not in the menu at the top? Why is it the bottom? OK, well, I guess I found it."

Transportation and Mobility

Participants were surprised when they discovered, upon seeing another visitor using one, that the wheelchairs provided by the museum allowed visitors to self-propel and appeared to be well-maintained: *"They have the push chairs where you can vroom vroom yourself.* (Participant D.) Additionally, the sit-stand canes provided by the museum, which participant D examined at the end of their visit, were a more stable seat than the model they were using that did not require the user to balance with their legs: *"This is like a full-on chair. I don't have to balance. We might be using this next time."* The availability of mobility aids at the museum is significant because museums present unique mobility challenges and barriers to individuals who have trouble standing but not walking. As Participant A explained, *"Because of my chronic pain, it's easier to keep moving. If I stand still, it gets worse. So, I can't really stand and read this whole thing. I graze.*" Participant C said,

> "Like if I'm just going on a walk, I'm generally pretty good because my circulatory system is moving harder because you're moving. But just standing in one place and just, you know, lingering, which is kind of the definition of a museum...that's just the kind of thing that will make all the blood pool in my feet and make me super dizzy and pass out."

Parking lots, walkable locations, and public transportation were also important accessibility factors for participants:

> "But they do have a lot of parking and not all of it was taken which is nice. Most [museums] don't really have that many accessible parking spots or even just like a flat parking lot. I don't know. At other museums it's janky sometimes." (Participant B)

For one participant, this form of accessibility was the key factor in deciding whether to visit a museum:

> "I think maybe this is the only one I could do just because it was close, and I didn't have to use any public transit to get there which is kind of my other concern about doing this. I don't have a car." (Participant C)

Participants stressed indoor and outdoor signage as another key accessibility factor and an extension of the information, planning, and decision making that shaped accessibility during preparation:

> "If I were new to the museum, it might have been nice to have a sign or maybe I just missed it. . . .That could be helpful if you're somebody who has limited [mobility] or a sensitivity, so you know the exact path, you know it's going to come around the east side of the building, the gorge on the west and come back up here." (Participant D)

The need for directional signage inside the museum was also expressed by other participants. For example, Participant B said, *"Oh, I think throwing a map at me would be cool."* Participant A said, *"So that would be really nice, to have a bit more clear signage about that"* referring to difficulty finding a restroom.

Benches

During their visit, all participants expressed a concern or desire for seating/benches. Participant A explained, *"I'm constantly looking for the benches and keeping track of where they are.* Participant B noted,

> "They could even put benches and stuff like so that even if you are not using a wheelchair like me...I don't think there were any benches other than where those parents were sitting with the injured child. I don't know...because I didn't notice a lot of seating, so people who need to take a break or anything like that I might not recommend this to."

Specifically, participants expressed a desire for benches which would allow them to still participate in the exhibit or view content: *"I don't want to be in the corner. This bench is a good one because I'm still in the exhibit, I can see things, read the signs*." (Participant A.) Participants with sensory based disability desired benches in quiet places that allowed them to take breaks from the sensory stimulation of the museum: *"I think also since I was just sitting down, I could still like, look*

around and absorb some of the information just kind of from afar. And that was helpful for me" (Participant C).

Use of Personal Technology to Support Access Needs

Three of the four participants used personal technology to support their museum access during the visit. Most commonly participants used cell phones to allow multiple ways of engaging with the information or to change the setting or pace in which they accessed information:

> "I was just so bummed when it's like, you know, in a case that's like this high and I can't, I can't see and I don't want to like just hold my phone above it and take a picture and hope for the best. Even though I totally do." (Participant B)

Another participant said *"I take pictures and videos a lot, so I can look at them and read everything once I'm at home. Then I can know what it's about."* (Participant A)

Participants also discussed how the museums could provide technology to support their access for visitors who do not have access to personal technology for example to improve the access to viewing areas for "behind-the-scenes" work:

> "If they had a screen of a bird's eye view of what's going on because I know it's cool. Also, maybe if it's crowded, and you don't feel safe to be up there with a bunch of people and you want to watch on the side. You can still see everything, but also maybe even a better view because it's from a camera." (Participant D)

Conflicting Access Needs

Often study participants felt that their access needs were directly contradicted by the access needs of other museum visitors. For example, participants had conflicting comments on the height of interactives or other information. Participant A, who had difficulty bending commented, *"Everything is too low. It's for kids and I can't really bend over."* While Participant B said,

> "I think you have decently low signage or the interactives that were low. That's really nice and it's not specific, explicitly, for kids or like, you know, a bunch of cartoon characters, which I would still totally go up to even if it was characters, but that was nice and not having to like stretch and try to see stuff that's up super high."

Reflecting on a higher surface, Participant A said, *"This is a great height. Everything should be this height."* However, Participant B, who used a wheelchair remarked, *"Why is that so weirdly tall? I can't see anything."* and was overall happy with the height of museum content.

Likewise, the use of video content throughout the exhibits benefitted some participants but presented a hazard to others. They were beneficial when paired with benches, allowing participants to feel involved during a rest: "*I love the videos because then I can sit and watch them and see a lot.*" (Participant A). However, the auditory content provided an extra layer of stimulation which some participants felt was unnecessary:

> "Honestly, I would maybe even be fine if all the videos were just silent with captions like that. I would be so fine. I don't really find the noise that necessary or helpful, I should say. If anything, it kind of overwhelms me if I'm already in a space with a lot of things going on around here. It tends to be too much" (Participant C).

For some participants, the videos triggered feelings of dizziness and caused them to feel excluded even though they recognized the videos could be important to others:

> "Yeah, overall, I guess the only other biggest thing that was that I wish they didn't have the auto playing videos. But I also recognize that's kind of weird. For me, and I'm fine if some of that labor just relies on me being careful, I'd be fine with that because I know that that is a really cool, engaging way for a lot of people and kids and things to engage, and I don't want to hinder their experience with my access. So, a bit of like, I don't know, conflict in dynamics there."(Participant D)

Overall, while some access barriers are unpreventable due to a variety of conflicting access needs, many mitigatable barriers remain in place.

To what extent do adults with multi-faceted access needs feel included in science museums?

When discussing inclusions, trends included freedom of engagement, the lack of barriers, staff and policies, as well as ways in which general audiences are included within a museum as key factors.

Freedom of Engagement

The ability to explore the museum in their own way and pace was a valuable form of inclusion for participants:

> "It feels like a very introverted space and that feels like a welcoming space to me. I feel like whenever the employees are kind of reading their books, sitting on their stools, just waiting for someone to ask for help, I feel like I am welcome to just kind of explore at my own pace and do my own thing. And I don't know, as long as I'm not causing a disruption, it feels like I'm welcome to explore, however feels best for me." (Participant C)

Another participant said, *"I felt like I could explore in my own way, on my own time, and learn something new every time. So, I felt welcome*."(Participant A)

Lack of Barriers as a form of Inclusion

Participants had mixed feelings of both inclusion and exclusion in regards to specific aspects of the museum visit which reflects the complex nature of accessibility. When asked to identify aspects of the museum which made them feel included, visitors often pointed to the lack of exclusion: *"Yeah, I don't know. There was just nothing too antagonizing about the space. Maybe it wasn't actively welcoming, but there wasn't a ton about the space that was making me feel antagonized or not included in any way"* (Participant D). Participant B said,

> "I mean, no one seemed like, 'You're not supposed to be here.' I didn't feel obligated to dress nicer or like to keep my voice down…We only had to take one picture of something that I couldn't see easily, that was nice."

A third stated, "*I'm not sure I can think of a specific example of me feeling included. But, I just had a general feeling I guess of inclusion, maybe a lack of exclusion feeling*" (Participant A).

Similarly, ease of access to supports was also a key factor in feeling included: *"I felt included, I loved it. There was a bench in front of my favorite exhibit, like the art on the wall, I really appreciated that I could consume that from a seated position" (Participant D).*

General Audience Inclusion

Participants also mentioned behind the scenes viewing, and other actions the museum was taking to reach out to their general audience, as making them feel included:

> "There's something cool about being able to see so much of the behind the scenes stuff, like letting you be privy to some of the more behind the scenes stuff. You feel like you are maybe being included in the mechanics" (Participant D).

Barriers to Inclusion

Within the museum, staff, policies, and social atmosphere presented common barriers for some participants while providing needed support for others. As a trend, these were commonly referenced as aspects of the museum that made participants feel excluded. Participant C described how the social atmosphere of the museum stopped them from using fidget tools which would have allowed them to focus more deeply on content:

> "It's just here in museums honestly, you know, because I use it when I'm at work, or like, in a restaurant You know, it feels more public, you know. In classes, I'm fine. But something about museums, it feels like I shouldn't have this out there. I don't really know why though."

The museum in question offers similar sensory fidget aids for guests at the front desk, suggesting that they welcome their use, however this information is not readily available to guests within the museum. Participant D discussed the intersection of policies and health needs:

> "The most not welcoming thing to me is the confiscation of water and things… you need to check your water. That's the thing that makes me feel the most antagonized because I kind of know I'm breaking the rules, but I have to."

Additionally, barriers to accessibility impacted participants feelings of inclusion within the museum. When participants were unable to access exhibit components, they cited these as moments they felt excluded. Participant D noted, "*Definitely the hardest part for me were some of those moving videos like the moving grass production thing.*" Participant B said, *"Some of the larger interactives like the slug thing, it wasn't super easy to maneuver, and cubes. Like if it was just me, it wouldn't have made sense because I could really only access two sides."*

Staff and Policies as an Asset to Inclusion

However, when staff or policies made disability visible or adjusted their practice to include disabled guests they were cited as positive factors to inclusion. This shows the complex role of the museum, and staff as an extension, as both barrier and facilitator and indicates the potential for improvement.

> "The little thing on the main sign that said, ask here about accessibility, I love that that was front and center that the person didn't question me when I was like, 'Hey, can I see your access materials that they were very, welcoming, and helpful with that.'"(Participant D)

Feelings of Belonging

Overall, participants had mixed responses on whether they felt like they belonged in the museum: "*Yeah, I don't think that I belong in this space. Exactly. I think that's kind of what it is, and it makes me grumpy that that's how I thought about that*."(Participant D) Participants who felt that they belonged in the museum often cited their background: *"Yeah. I'm a scientist and this is my background.*"(Participant A). Alternatively, they shared a connection to the University of Washington, where the museum was located: *"Well, I think somehow it being like on UW'S campus, it feels like this is made for you. To students, it feels like very much like we're the target community to be coming here*." (Participant C)

Overall, while visitors reported positive or neutral feelings of inclusion at the museum. Visitors more often felt "not included" rather than actively excluded.

How do disabled adults with multi-faceted access needs access science museums?

Discussion

Disabled individuals with multifaceted access needs expended additional energy and navigated additional demands before, during, and after their museum visit. Participants utilized multiple sources to prepare for their visit including official materials, peers, and third-party information sources. Participants also had to "energy budget" around other life activities. One participant mentioned using a grocery delivery service the day before in order to conserve energy for the experience after having to reschedule a previous interview time due to fatigue and others had cancelled plans for the following day in order to rest.

However, previous studies on accessibility and experiences of disabled visitors focuses only on the experiences of the museum during the visit (Heinrich et al. 2014, Meyer et. al, 2017; Asakawa, et al., 2018). Findings from Langa et al. (2013) found that the families of autistic children heavily utilized and credited museum provided preparation materials with improving their museum experiencing, including access and feelings of including "having a normal museum visit."

The extensive need for preparation and rest is likely a consequence of the narrow construction of disability centered in the medical model which is still prevalent in museums (Salmon, 1998; Areheart, 2008). The current model does not account for interactions between disability and the environment which may cause fatigue or pain which becomes further disabling in the museum environment which are included in social, identity, human rights centered models. Pain and fatigue, both mental and physical, explain the emphasis on museum infrastructure and supports by participants. This is corroborated by the Mastrogiuseppe et al. (2021) where participants highlighted how lighting, stairs, length of labels, and other aspects of the physical environment impact access to content and overall museum accessibility. Despite focusing on different segments of the disability community, several results were duplicated in terms of concerns.

The combination of pain, fatigue, and energy demands mean that disabled participants are not able to engage with museums or

exhibits as fully as they desire and impacts their understanding of museum content.

To what extent do adults with multi-faceted access needs feel included in science museums?

Participants felt welcomed within the museum, but often had moments where they did not feel included. Previous research has determined that museums lack a cohesive and impactful definition of inclusion for disabled individuals (Zakaria, 2020). One way this is evidenced in the results of this study is that even though the Burke had done significant work to increase accessibility of the museum within the community, the long length of their exhibit labels was a significant barrier for all participants. Similarly, Zakaria (2020) found that inclusion policies for museums focus on broad societal ideas rather than directly addressing barriers to inclusion within their museum, programs, or websites.

The lack of an actionable definition of inclusion is further evidenced by the availability of supports within the museum. Participants felt uncomfortable using sensory or fidget tools to aid their focus because they felt it was against the unwritten rules the gallery. However, the Burke offers those tools to all visitors. Because that information was not readily available to visitors within the museum, they experienced unnecessary discomfort and exclusion. Using an identity model of disability to make disability a visible and accepted social identity that is explicitly welcome within museum spaces may increase visitor awareness and use of supports and overall comfort.

Conflicting access needs, similar to those discussed in Lisney et al., (2013), also impacted feelings of inclusion throughout the visit. For example, videos that projected audio allowing participants to sit and view them provided respite for some participants but an additional layer of overstimulation for others.

Limitations

Data were collected in the spring of 2022. At this time, the Covid-19 Pandemic was still heavily impacting disabled people who may be at higher risk. Therefore, many individuals within the population of interest had not recently visited a science museum. Therefore, the methodology was altered to facilitate these visits. Additionally, this perception of risk meant that only individuals heavily motivated due to

interest in research, science, museums, or other related topics participated in the study.

Covid protocols in place at these institutions likely improved the accessibility of these institutions for some individuals by reducing noise, crowds, and other sources of stimuli, but also increased barriers for others through face masks, the removal of benches, and the lack of tactile engagement opportunities. However, restrictions like showing proof of vaccine or negative test results posed a barrier for other populations.

The recruitment for this study happened through networks at the University of Washington. Therefore, participants had a significantly higher level of education than the average of the population. Additionally, the skills, supports, and strategies which enabled their success in the American education system may have been transferrable to museums. Further, the sample did not include several populations who may have disparate experiences such as non-speaking individuals, deaf individuals, individuals with limited upper-buddy movement, blind and low vision communities, non-binary people, men, people who speak English as a second language, and people of color.

Implications

Implications for Research

This research demonstrates the need for qualitative research using complex and multifaceted constructions of disability that consider the implications of disability in all aspects of the museum visit as a contrast to the "silo" construction that dominates current research. By constructing research that views disability as complex, changing, and cross-dimensional we can better identify barriers within the museum and learn from the adaptive behaviors already used by visitors.

Further, the results of the study implicate the need for further research on accessible interpretation in science and history-based museums. As the aim of many science and history-based museums is to directly educate through engagement rather than facilitate a contemplative experience, there are many differences which produce accessibility barriers. For example, the label text within these institutions differs significantly from that in art museums who conduct the majority of accessibility research. Many science museums include walls of graphics which provide key information but also significant access barriers. Additionally, art museums often assume a slower

visitor pace and provide more frequent and natural stops which may not be included in science museums. Finally, many interactives are not fully accessible due to fine motor demands, gross motor demands, or the ways they utilize digital technology such as motion blur which can cause discomfort or distress. Additional research is also needed to fully understand the impact of the current models of interpretation on experiences of disabled visitors.

Due to the evolving nature of the museum field during the time of this research, this research does not consider the evolving field of museum education which includes museum schools and museum-school partnerships. As museums expand their educational influence it is important to evaluate the learning experiences of disabled visitors within these museums to ascertain both quality and equity according to their rights.

Finally, the results implicate the need for additional research of museums using progressive models of disability including the human rights paradigm to evaluate whether museums are truly offering equitable experiences rather than merely accessible ones. Additional research is needed for ways to implement human rights models of disability into all areas of museum operation including exhibit design, interpretation, educational programming, and museum architecture and infrastructure.

Implications for Museum Practice

This study identifies several opportunities to improve museum practice for furthering the inclusion and access of disabled people including adjustments to exhibit design, interpretation, and museum infrastructure. For example, to accommodate conflicting access needs, museum exhibits must be flexible and allow for multiple ways for visitors to engage with and view content. One simple way to achieve this is to integrate seating throughout the exhibit. This allows interactive elements to be at a lowered height to accommodate wheelchair users while also allowing access to participants who cannot bend, reach, or stand for extended periods. The integration of technology also has many possibilities in this regard such as allowing participants to read labels, or have them read using personal screen-readers, and view content from a variety of physical positions.

Museums must practice an economy of language. Large walls of texts are inaccessible to individuals with a broad range of disabilities including cognitive, sensory, and physical. They reduce the willingness

of disabled visitors to interact with any labels. Additionally, it can hinder the ability of participants to find important information displayed in wall signs.

Finally, museums must consider what policies and expectations in museums are necessary and how to remediate them with the access and inclusion needs of disabled individuals. Further, they must find ways to counter social expectations and assumed norms within museum spaces such as those which kept a participant from using tools the museum happily provided. One potential solution is by increasing visibility of disability and accessibility tools within the museum space, advertising, and posting reminders in the gallery like those used in some museums to identify noisy areas. Another consideration is how to provide access to personal water while protecting artwork or artifacts.

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Appendix A

Area of Interest	Question	Probe
Icebreaker and beginning conversation	What was your favorite part of that museum visit?	
Access	What did the process of preparing to visit this museum look like for you?	How did you ensure you would have access to areas of interest? What did you plan ahead for and why?
Access	How did you get to the museum?	Was it easy to find where you needed to go once you were there?
Access	In what ways did the museum meet the particular needs you had, as someone with multifaceted access needs? In what ways did the museum not meet the particular needs you had, as someone with multifaceted access needs?	Can you give me an example?
Access	How easily were you able to find and access museum amenities such as water fountains, bathrooms or benches?	If positive: What made those features accessible to you? If negative: What could have been done to improve your access?
Inclusion	Did you feel welcome during your museum visit?	What made you feel welcomed?
Inclusion	Did you feel like you belonged in the museum?	What made you feel like you belonged in the museum?
Inclusion	Describe a time during your visit when you felt included.	What about this experience made you feel included?
Inclusion	Describe a time during your visit when you felt excluded.	What could change about the institution to make you feel more included in the museum?
Inclusion	Would you recommend visiting this museum to other disabled people you know?	If yes: Why? If no: Why Not?