Master Thesis

Virtual Reality as an Accessibility Tool to Cultural Heritage Sites for People with Autism Spectrum Disorder

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Master Thesis
June 14, 2023

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ABSTRACT

Cultural heritage sites hold immense significance as they have the ability to embody human development. In many ways, cultural heritage is a representation of everyone for everyone, consisting of our shared history, traditions and cultural diversity. Due to its relevance to our society, access to cultural heritage is seen as a fundamental human right. Despite this, the perceived lack of accessibility surrounding cultural heritage sites has been widely discussed in academic literature. This accessibility is especially overlooked when it comes to people with invisible disabilities. One group of people in particular that is often neglected in such conversations is individuals with autism spectrum disorder (ASD). A limited amount of accessibility initiatives exist for people with autism, and those that do have occasionally received mixed reactions. Recently, the use of virtual reality (VR) technology has joined the conversation surrounding accessibility. Virtual reality has been used both for virtual tours of heritage sites and as an intervention tool for ASD, but rarely has the combination of virtual reality to increase the accessibility of heritage sites for individuals with autism been discussed. Thus, this thesis seeks to answer the question: How can virtual reality contribute to the accessibility of cultural heritage sites for people with autism spectrum disorder? An in-depth qualitative research was conducted through interviews with individuals with ASD and primary caregivers of children on the autism spectrum. Participants were asked about their experiences with accessibility at cultural heritage sites, their opinions on virtual reality and possible benefits and risks of the use of virtual heritage for the accessibility for the autism community. The social model of disability was used as a theoretical underpinning. Results show that if developed and implemented correctly, virtual reality could contribute in an exceedingly positive way to the accessibility of cultural heritage sites for people with autism. Certain features, such as customisation based on hyperreactivity to specific sensory inputs and the ability to use virtual heritage for preparation or repetition of a visit could be advantageous to many individuals with ASD. However, specific constraints such as the possible apprehension towards head-mounted-displays, the resulting divide between visitors with autism and neurotypical visitors, and the abandonment of physical accessibility initiatives could influence the perceived usefulness and ease of use of virtual heritage for people with autism. Results conclude that a widely available virtual heritage option which prioritises the accessibility needs and wants of visitors with autism could simultaneously increase autism awareness amongst neurotypical visitors whilst providing visitors with autism with the

possibility to adapt a heritage site in a way that feels comfortable to them. Furthermore, there should be an emphasis on the concept of co-creation with members of the autism community which takes into account the heterogeneous accessibility needs of visitors with ASD. Hence, by reflecting the social model of disability, this research highlights the importance of ensuring accessibility to cultural heritage sites for all individuals, regardless of ability.

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1. Introduction

Cultural heritage plays an intrinsic and valuable part in our society. It shapes our history and embodies our human development. In many ways cultural heritage serves as a central and continuous element of human identity (Francis-Lindsay, 2009). Despite this, the lack of accessibility surrounding cultural heritage is widely discussed in academic literature. Accessibility to cultural heritage is seen by institutions such as the United Nations as a human right (Marconcini & Pracchi, 2019). Providing accessibility to people from all backgrounds, ages and abilities contributes to more equality, inclusivity and educational opportunities. However, the concept of accessibility often remains overlooked for people with disabilities (Huh & Singh, 2007). Many cultural heritage sites are not as accessible to people with disabilities for many different reasons. For example, locations are often not accessible for individuals with physical disabilities and the complexity of information shown at sites often provides difficulties for people with intellectual disabilities (Yalon-Chamovitz, 2009). One community in particular that has historically been overlooked is people with autism spectrum disorder (ASD). Accessibility initiatives for people with autism are often absent due to the invisibility of their accessibility needs (Yalon-Chamovitz, 2009). Therefore, visits to cultural heritage sites can often be anxiety-inducing and stressful for members of this community. In recent years, a number of initiatives have been implemented at several heritage sites in an attempt to increase accessibility for individuals with ASD. These initiatives, such as the relaxed visits and sunflower lanyards, have been met with mixed reactions for how effective they truly are (B. Fletcher-Watson, 2015; Pritchard, 2021).

When discussing the increase of accessibility at cultural heritage sites, virtual reality technology has frequently joined the conversation. Despite being around since the turn of the century, virtual heritage has made an exponential uprising ever since the world shut down due to the COVID-19 pandemic in 2019. With travel down and people having to remain home, several cultural heritage sites turned to virtual reality to retain some form of tourism (Roman et al., 2022). Now, with the world opening up to travel once again, the possibility of virtual heritage remains and there is general wondering about how this technology could perhaps contribute to the accessibility of cultural heritage for communities, including autism spectrum disorder, that have historically experienced a lack of accessibility. Therefore, this thesis aims to answer the

question: *how can virtual reality contribute to the accessibility of cultural heritage sites for people with autism spectrum disorder?*

  A qualitative research method in the form of interviews was used for this research. Participants consisted of adults with ASD and primary caregivers of children with ASD. The interviews delved deeper into personal experiences with accessibility of cultural heritage sites, attitudes towards virtual reality and possible benefits and risks of virtual heritage for people with autism. In order to illuminate these benefits and risks, two separate virtual tours were shown as examples. Further inquiry was made regarding how virtual tours could be developed and implemented in the most beneficial way.

Scientific and Societal Relevance

  From a scientific standpoint, the use of virtual reality for cultural heritage and for individuals with autism spectrum disorder have been explored separately but rarely in combination with each other. Virtual reality has been explored from a medical standpoint as a means to help people with autism improve possible social communication skills (Bravou et al., 2022). However, there is a lack of scientific literature approaching the relationship between autism and virtual reality through the social model of disability. Furthermore, since the COVID-19 pandemic virtual reality has been increasingly common as a method to provide online access to cultural heritage sites (Roman et al., 2022). Scientifically, this research may help to understand how virtual reality could be used to create more accessible cultural heritage experiences for people with autism who may face challenges navigating heritage sites due to hyperreactivity to sensory inputs or other factors.

  This research is also relevant from a societal point of view. The chosen topic addresses the lack of accessibility that some individuals with ASD face when visiting cultural heritage locations. The importance of increasing accessibility for a vulnerable community is often overlooked. The accessibility for these so-called 'invisible disabilities' often flies under the radar and limited academic literature exists about the relation between these subjects (Yalon-Chamovitz, 2009). This research has the potential to increase cultural participation and engagement amongst individuals with autism, who may face barriers to accessing and experiencing cultural heritage sites. Moreover, this research can contribute to a broader

discussion surrounding the concept of accessibility and highlight the importance of creating inclusive experiences for all individuals, regardless of ability.

Thesis Structure

In order to analyse how virtual reality could contribute to the accessibility of cultural heritage sites for people with autism spectrum disorder, the thesis is structured in the following way. Firstly, the theoretical framework defines the core concepts of cultural heritage, accessibility, autism spectrum disorder, virtual reality technology and virtual heritage. Secondly, the methodology explains the chosen research design and goes in-depth into data collection techniques and data analysis. Furthermore, ethical considerations and constraints are included. Finally, results of the research are discussed and a conclusion is made with recommendations for future research.

2. Literature Review

2.1. Cultural Heritage

Cultural heritage is a valuable and essential part of human experience, encompassing the customs, beliefs, artefacts and practices that have been passed down from generation to generation. Willis (2014) defines cultural heritage as "the legacy of physical artefacts and intangible attributes of society inherited from past generations" (p. 146). Pelegrini (2008) states that cultural heritage is "the legacy that we receive from the past, experience in the present, and transmit to future generations" (p. 2215). Cultural heritage can be divided into two types; tangible and intangible. Tangible cultural heritage includes historical monuments, groups of buildings, sites and towns (Ahmad, 2006). The United Nations Educational, Scientific and Cultural Organization (2003) defines intangible cultural heritage as "the practices, representations, expressions, knowledge, skills - as well as the instruments, objects, artefacts and cultural spaces associated therewith - that communities, groups and, in some cases, individuals recognize as part of their cultural heritage" (p. 5). They further state that this intangible cultural heritage is constantly recreated from generation to generation and reflects the environment and

history of the community as well as providing them with a sense of identity (UNESCO, 2003). Therefore, cultural heritage is an important aspect of human identity and serves as a bridge between past, present, and future. The increasing significance of heritage experiences as an economic, environmental and social driver is not to be underestimated (Marconcini & Pracchi, 2019). These economic, environmental and social aspects are reflected in cultural heritage tourism. Cultural heritage sites are an integral part of tourism as they can provide economic benefits to local communities, create employment opportunities, and support the conservation of cultural identity (Silver, 2007). Tourists flock to destinations with a rich cultural heritage because they offer unique experiences. Tourists, locals, tourism agencies and organisations, environmental preservation organisations, governmental and local authorities, owners and investors, research institutes, universities, cultural organisations and institutions are all stakeholders in cultural heritage tourism and play a part in cultural heritage experiences (Tinaj & Stojanović, 2021).

Cultural heritage experiences allow individuals to explore and learn about the rich history and traditions of cultures. By engaging in cultural heritage experiences, individuals can gain a better understanding of the past, present and future of a particular culture, community or location Pelegrini (2008). Every individual can benefit from cultural heritage knowledge, for both the educational and community aspects (Council of Europe, 2005). Throughout history, society has identified cultural sites as inherent parts of different cultures due to their historical meanings and thus, access to these sites is seen as fundamental (Georgieva, 2018). Cultural heritage is an asset to people's lives and therefore, it is a necessity to provide everyone with the opportunity to access it (Marconcini & Pracchi, 2019). This underscores one of modern culture's most compelling themes: the concept of cultural goods as 'common goods', which, as such, should be available to the greatest number of people of each community (Silverman & Ruggles, 2007). Access to culture is considered to be one of the fundamental rights provided by various legal systems, including the Universal Declaration of Human Rights from the United Nations, which states that each individual has the right to freely participate in cultural activities (Marconcini & Pracchi, 2019; Silverman and Ruggles, 2007).

2.2. Accessibility

Ensuring accessibility to cultural heritage is essential to promote inclusivity and diversity in society. All individuals, regardless of abilities or disabilities, are entitled to have equal opportunities to access cultural heritage (Marconcini & Pracchi, 2019). Accessibility can be defined as "the usability of a product, service, environment or facility by people with the widest range of capabilities" (Petrie & Bevan, 2009, p. 3). The degree of accessibility is dependent on the availability of a product, service or environment for as many individuals as possible, regardless of ability, age or situation (Web Content Accessibility Guidelines, 2008). In recent years, there has been a growing awareness of the importance of accessibility across various sectors, including education, technology, art and heritage. Feder (2022) identifies a theoretical framework that identifies four dimensions of access to the art sector; rights, opportunity, participation, and reception. The right to access cultural heritage is well documented in legal settings, including declarations of the United Nations and European Council. The UN Universal Declaration of Human Rights states the right of everyone to participate freely in cultural life and the enjoyment of the arts (Marconcini & Pracchi, 2019). However, opportunity, the second of Feder's (2022) four dimensions, is identified as a central issue by the majority of the constitution of the European Union States (Marconcini & Pracchi, 2019). Marconcini & Pacchi (2019) identify two main categories that illustrate the complexity of human needs in terms of accessibility; the physical needs framework and the sensorial and cognitive needs framework. The physical needs framework refers to physical accessibility in the built environment. The sensorial and cognitive needs framework, on the other hand, refers to an environment that is easily perceivable and legible, with an emphasis on providing different perceptive channels of communication in order to facilitate the use of the residual sensory capabilities of people with disabilities (Marconcini & Pracchi, 2019). Iwarsson & Stahl (2003) identify the physical environment as the most common dimension when discussing accessibility. For instance, all buildings constructed through funds supplied by the United States Federal Government are required to meet minimum accessibility requirements for people with physical disabilities under the Architectural Barriers Act of 1968 (Burgstahler & Cory, 2008). However, as Marconcini & Pracchi (2019) demonstrate, the concept of accessibility extends beyond the physical environment. Treccani et al. (2016) state that "accessibility does not only deal with architectural and perceptual barriers, but also with intelligibility of cultural heritage" (p. 108). Thus,

accessibility also refers to the practice of conveying knowledge and understanding about a specific site through the experience itself (Paladini et al., 2019). Thus, accessibility does not solely encompass the built environment but access to information and experiences as well. These experiences and the complimenting information are especially essential in cultural heritage. The accessibility of cultural heritage, in the physical, sensory and cognitive dimensions, promotes cultural exchange and understanding between different communities, contributing to the preservation of cultural sites (Georgieva, 2018). The quest to increase access to cultural heritage benefits everyone, but it is especially beneficial to people with disabilities, who traditionally do not experience the same level of accessibility as people without disabilities.

2.3. Disabilities

People with disabilities who travel or want to experience cultural heritage sites make up a sizable but often overlooked market segment (Huh & Singh, 2007). The fundamental foundation of disabilities has focused on the nature of restrictions faced by people with disabilities (Darcy, 2010 as cited in Adam et al., 2016) People with disabilities are often assumed to be constrained by spheres in life such as social, political, environmental and leisure, including travel and cultural heritage experiences (Darcy, 2010). Cultural heritage sites often consist of physical and sensory barriers, reducing both physical and knowledge access (Perciavalle & Sagone, 2021). Allday (2009) argues that the lack of cultural heritage sites adapted for these visitors promotes the discrimination and segregation of these communities. According to estimations, over one billion people worldwide have one or more disabilities, equating to just over 15% of the global population (Davies & Christie, 2017). Disabilities are often categorised into four dimensions; mobility, sensory, communication and intellectual (Iftikhar et al., 2022). Another term, developmental disabilities, is a broader term that refers to abnormalities of the growing neurological system that appear as developmental delay in one or more domains, such as cognition, motor skills, vision, hearing and speech, and behaviour, throughout infancy or childhood (Solarsh & Hofman, 2006). All of these domains require individualised needs in order to have increased accessibility to cultural heritage. Physical disabilities are discussed relatively often within accessibility literature, however invisible disabilities, frequently including autism spectrum disorder (ASD) and intellectual disabilities, are often overlooked (Yalon-Chamovitz

(2009). Allday (2009) states that intellectual disabilities are less assessed on heritage sites, due to the classification of these collectives by their medical view. The social model of disability is often preferred when discussing disabilities. The social model posits that disability is not an inherent trait of an individual but rather a social construct devised by society (Shakespeare, 2010). It states that disability results from the barriers and exclusion that people with impairments face in society, rather than from the impairments themselves. The shift from the medical model to the social model thus reflects a 'shift from societal expectation for individual change and adaptation to societal responsibility for environmental change and accommodations to enable full access and participation' (Feldman, 2007 as cited in Yalon-Chamovitz, 2009, p. 396). The social model has been analysed for both its strengths and weaknesses. Its main strengths include its influence on a political level to advocate social change and its psychological effect in improving confidence of people with disabilities whilst building a positive collective identity (Shakespeare, 2010). However, the model is criticised for its simplicity and its strong disownment of medical approaches (Shakespeare, 2010). Despite this, a purely medical approach risks ignorance about intellectual and developmental disabilities that are often overlooked in cultural heritage sites.

2.3.1. Autism Spectrum Disorder

Autism Spectrum Disorder (ASD) or Autism, has been defined as "a constellation of early-appearing social communication deficits and repetitive sensory-motor behaviours associated with a strong genetic component as well as other causes" (Lord et al., 2018, p. 1). Whilst autism, a developmental disorder, varies greatly from person to person, social communication and repetitive sensory-motor behaviours are considered to be two main defining traits of ASD, regardless of race, culture, ethnicity or socioeconomic status (Lord et al., 2018). According to the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM)-5, social communication deficits are manifested by deficits in social-emotional reciprocity, non-verbal communicative behaviours and developing and maintaining relationships. Repetitive behaviour patterns are often manifested by traits including, but not limited to, hyperreactivity or hyporeactivity to sensory inputs, repetitive motor movements, inflexible adherence to routines and highly fixated interests (Fig. 1) (Lord et al.,

2018). The adherence to inflexible routines in particular often causes an aversion towards uncertainty. Due to this, the concept of preparation regularly occurs amongst people with ASD. Amongst developmental disorders, autism is often considered one of the most challenging to address due its heterogeneity. In the context of ASD, heterogeneity is referred to as 'denoting diversity or variability, describing dissimilar parts that are somehow connected' (p. 123) (Georgiades et al., 2013). Therefore, ASD is characterised as being associated with a diversity of functional qualities with different severity levels varying for each individual. For example, one individual with ASD could exhibit mild social communication deficits, extreme fixated interests and extreme repetitive behaviours, whereas another individual could exhibit the opposite profile (Georgiades et al., 2013).

Persistent deficits in social communication and social interaction across multiple contexts, as manifested by
- Deficits in social–emotional reciprocity (eg, abnormal social approach and failure of normal back-and-forth conversation; or reduced sharing of interests, emotions, or affect)
- Deficits in non-verbal communicative behaviours (eg, poorly integrated verbal and non-verbal communication, abnormalities in eye contact and body language, or deficits in understanding and use of gestures)
- Deficits in developing, maintaining, and understanding relationships (eg, difficulties adjusting behaviour to suit various social contexts; or difficulties in sharing imaginative play or making friends)

Restricted, repetitive patterns of behaviour, interests, or activities, as manifested by
- Stereotyped or repetitive motor movements, use of objects, or speech (eg, simple motor stereotypies, lining up toys, or flipping objects)
- Insistence on sameness, inflexible adherence to routines, or ritualised patterns of verbal and non-verbal behaviour (eg, extreme distress at small changes, difficulties with transitions, or rigid thinking patterns)

- Highly restricted, fixated interests that are abnormal in intensity or focus (eg, strong attachment to or preoccupation with unusual objects)
- Hyperreactivity or hyporeactivity to sensory input, or unusual interests in sensory aspects of the environment (eg, apparent indifference to pain or temperature, or adverse responses to specific sounds or textures)

Notes on diagnosis
- Individuals with a well established DSM-IV diagnosis of autistic disorder, Asperger syndrome, or pervasive developmental disorder not otherwise specified should be given the diagnosis of autism spectrum disorder
- Symptoms must be present in the early developmental period (but might not become fully manifest until social demands exceed limited capacities, or might be masked by learned strategies in later life)
- Individual must have social communication deficits (past or present) in each of the three areas defined above
- Individual must have two of the four restricted, repetitive patterns (past or present), as defined above
- Symptoms must cause clinically significant impairment in social, occupational, or other areas of current functioning

Fig. 1 Lord, C., Elsabbagh, M., Baird, G., Veenstra-Vanderweelde, J. (2018). Autism Spectrum Disorder.

It is estimated that 1 in 88 people have autism spectrum disorder (Dillenburger et al., 2013). Girls are less likely than boys to be diagnosed with autism spectrum disorder, with a ratio typically estimated at roughly 1:4, however this is increasingly shifting to reflect the realities of autism and gender, as well as the differences in how autism presents in boys and girls (Moore,

2020). Furthermore, the changing clinical diagnosis of autism and its distinction from similar conditions has influenced prevalence estimates (Zeidan et al., 2022). This prevalence data, as with the majority of ASD research, mostly comprises children with autism whereas data regarding adults with autism is much more limited (Howlin & Moss, 2012). According to Dillenburger et al. (2013) due to the growing number of diagnoses and autism campaigns worldwide over the past decade, there has been an increase in awareness amongst the general population surrounding ASD and its heterogeneity. Huws and Jones (2010) further state that interaction between lay people and people with autism over extended periods of time can contribute to increased awareness and lead to the development of positive conceptualisation. In a general population survey conducted by Dillenburger et al. in 2013, results showed that 80% of the sample had a high level of autism awareness and were relatively aware about the challenges faced by the ASD community. However, there was a lack of clarity over the responsibility of autism initiatives by service providers such as the department of education and heritage institutions (Dillenburger et al., 2013).

Approximately one in 100 children in the United Kingdom receive a diagnosis, leading to a growing need for research regarding autism, including in the cultural heritage sector (Bradley & Newbutt, 2018). Magkafa & Newbutt (2018) posit that the accessibility for people with autism is still a challenging issue. They further state that loud and crowded spaces and lack of staff training are some of the main reasons some people with autism are deterred from visiting museums (Magkafa & Newbutt, 2018). A survey conducted by Ecclesiastical in 2019 found that 42% of respondents with children with special needs, including autism, felt they were "unwelcome" at heritage sites in Britain and called for heritage institutions to provide more support and increase the level of awareness among staff members (Alberge, 2019). This corroborates with literature from Elkin (2015) and Broach et al. (2003) as cited in B. Fletcher-Watson (2015), stating that in a theatre environment, individuals on the autism spectrum are often made to feel unwelcome and are seen as potential 'disruptors' for other visitors.

A number of ASD accessibility initiatives have been undertaken by several locations over the past decade, including cultural ones. Two of the most well-known accessibility initiatives are the so-called 'relaxed visits' and the hidden disabilities sunflower lanyards. Both initiatives have been met with mixed to positive reactions. Pritchard (2021) states that at first glance, wearing the sunflower lanyards to indicate a hidden disability may seem like a great solution, but criticised

the need for people with disabilities to have to 'prove' their impairment. For relaxed visits, reactions are mostly positive, although some criticism stems from the fact that they are mostly targeted towards younger audiences, with a very small portion of performances deriving from adult literature such as contemporary dramas for adults on the autism spectrum (B. Fletcher-Watson (2015). B. Fletcher-Watson (2015) classified some main considerations when it comes to receiving visitors with autism for relaxed visits in a theatre environment which could lead to a positive experience. He identified attention to sensitivities, rest areas with entertainment objects, anticipation using visual materials and training of employees as major considerations for heritage institutions. Furthermore, emphasis on co-creation of performances and exhibitions should be the norm going forward (B. Fletcher-Watson, 2015).

The usage of visual materials has major implications for people with ASD. People with autism are often considered to be visual learners and have shown inclination towards visual processing and computer-based tasks (Magkafa & Newbutt, 2018). Assistive technologies, such as virtual reality, video-modelling and touchscreen devices, have been a key focus throughout the past two decades and their potential to help people with autism improve their quality of life is still being investigated (Magkafa & Newbutt, 2018). Such technologies appear to be effective because they incorporate auditory and visual components that assist users with autism in being in a controllable and predictable environment (S. Fletcher-Watson, 2014). Therefore, the question arises whether virtual reality could provide a possible solution to the traditional inaccessibility of cultural heritage sites for people with autism.

2.4. Virtual Reality

Since the turn of the century, the use of technology has been identified as a possible medium to improve accessibility to cultural heritage sites. Virtual reality in particular has been a widely discussed topic in the conversation surrounding accessibility. Despite its continuously rising popularity, there is a wide amount of disparity regarding the exact definition of this new technology. This paper uses the definition stated by Guttentag (2010). He describes VR as "the use of a computer-generated 3D environment - called a 'virtual environment' (VE) - that one can navigate and possibly interact with, resulting in real-time simulation of one or more of the user's five senses" (p. 638). Similarly, Gutiérrez et al. (2008) pose that a VR experience can be described as a combination of physical immersion and psychological presence. Virtual reality

provides a simulated environment that can be experienced through a headset or digital screen, allowing users to immerse themselves in a variety of different environments and experiences whilst being physically present in a different location (Sanchez-Vives & Slater, 2005). Initially used by the military and aviation industries for training simulations (Bhargava et al., 2014), VR technology gained mainstream popularity and widespread adoption in the 2010s due to the video game industry. Today, VR technology has expanded beyond gaming, with applications in education, healthcare, architecture, and more (Mandal, 2013). With continued advancements in technology, VR is predicted to become increasingly realistic and immersive, creating new opportunities for heritage, entertainment, education, and other industries.

Since the 1960s, virtual reality technology has made significant advancements and there are many VR technologies currently available on the market. Virtual reality is often synonymous with head-mounted displays (HMDs), otherwise simply known as headsets, which have taken the feeling of immersion within virtual environments to new heights. The deep similarities between the immersive virtual environment experienced through HMDs and the real environment tend to facilitate knowledge transfer (Freina & Canessa, 2015). Furthermore, immersion using a headset allows the user to construct a mental model of the environment and its objects by freely moving around and studying them from all perspectives. It also allows the user to have an increased level of involvement within the environment due to this free movement (Freina & Canessa, 2015). However, besides being costly and less comfortable in comparison to ordinary computer monitors, headsets may cause so-called 'cybersickness'. Cybersickness refers to the intense experience when using an HMD sometimes resulting in temporary symptoms such as nausea, headaches, dizziness and loss of balance (Bellani et al., 2011). Virtual environments can also be explored through desktop virtual reality technology. Using this method, users can move within the virtual location using their personal devices through common input devices such as a keyboard or mouse (Bellani et al., 2011). This desktop technology is more accessible, less costly and less susceptible to possible cases of cybersickness. Technological advancements have also allowed VR technology to advance in terms of sensory experiences (Guttentag, 2010). For instance, technology recreating sounds, sensations and smells is being expanded into 4DX cinemas worldwide. There have also been several experiments with VR to treat post-traumatic stress disorder in troops by utilising a display capable of releasing eight different scents associated with the Iraq War (Brewin, 2007; Pair et al., 2006).

The use of sensory experiences and visual learning through virtual reality has major implications for people with autism. Virtual reality has already been used in an educational manner and with therapeutic purposes for people with ASD. Recent review studies on virtual reality for children with ASD discovered it contributes to the enhancement of social and emotional abilities, as well as ordinary daily tasks (Bravou et al., 2022). However, the effect of information and communication technologies (ICT), including virtual reality, on social communication abilities of people with autism has been discussed in academic literature and has many opposing arguments. Criticism of using ICT for people with autism mainly encompasses the argument of making a sometimes already socially isolated person less likely to interact with others (Rajendran, 2013). There are several opposing arguments to this statement. Firstly, there is no evidence that the use of ICTs intensifies possible social communication deficits amongst people with ASD. Secondly, ICT, including virtual environments, often facilitate direct or indirect interaction with others in different ways from in-person interactions (Rajendran, 2013). Virtual environments are often better suited for educational purposes than physical environments for people with ASD because they offer the possibility to remove uncomfortable stimuli from the environmental context (Bellani et al., 2011). Visual and auditory inputs can be personalised and controlled beforehand, allowing them to complete tasks without distractions from extraneous inputs. Furthermore, virtual environments can allow individuals with ASD to repeat tasks without the boredom usually associated with task repetition by human instructors (Parsons et al., 2004). DaCosta & Kinsell (2022) further express the benefit of 'chunk information' within the realm of virtual reality. The general sentiment is that material should be organised into small and comprehensible units or 'chunks' of information to avoid cognitive load challenges, something that some individuals with autism often struggle with (DaCosta & Kinsell, 2022). The possibility of cybersickness when using HMDs amongst people with autism has also been researched. Glaser et al. (2022) provide preliminary evidence that HMDs are considered acceptable and comfortable by individuals with ASD, however individual differences in terms of hyperreactivity to external stimuli could possibly lead to more severe cases of cybersickness (Glaser et al., 2022). VR being used as an intervention tool for ASD behaviour and skills hangs relatively close with the medical view of disabilities. The social model, however, asks the question of how society could use this affinity for virtual reality to increase accessibility for people with autism

and adapt itself for their benefit. Thus, the use of virtual reality has implications for cultural heritage sites, a sector traditionally less accessible for people with autism.

2.4.1. Virtual Heritage

Virtual heritage encompasses the use of computer-based interactive technologies to create virtual representations of cultural heritage sites and artefacts (Stone & Ojika, 2000). It involves the use of computer-generated graphics, multimedia, and interactive tools to simulate, reconstruct, and showcase heritage resources in a virtual environment that can be accessed and explored (Cecotti, 2022). It wasn't until the 2000s that technological advancements and the widespread availability of the internet made these more immersive virtual experiences possible. One of the first virtual environment platforms was Google Maps[1]. Launched in 2004, it allowed users to explore and navigate different locations around the world through satellite images which usually get updated annually. This platform completely revolutionised how we perceive environments by providing users with a more interactive and visual experience of various destinations. In 2007, Second Life[2], a virtual world where users can create so-called 'avatars' and explore this virtual environment, gained popularity as a virtual tourism destination for cultural heritage sites (Guttentag, 2010). This platform allowed people to explore replicas of real-life locations and heritage sites as if they were physically there (Sanchez-Vives & Slater, 2005).

Over the past decade, several companies have created VR experiences for popular heritage destinations, allowing users to experience places such as Machu Picchu, the Colosseum and the Great Barrier Reef. However, many cultural heritage specialists have also shown resistance to the idea of heritage sites and objects being limited to a virtual environment. (Loddo et al., 2021). Whilst experimenting with virtual reality for vulnerable physical literature collections, Loddo et al. (2021) state that "many cultural heritage specialists resist the idea of a mediaeval manuscript being confined to a plastic container, placed in a high rack and retrieved only by an automated system" (p. 3). Paladini et al. (2019) further state that virtual heritage is limited because it "lacks rendering in the same level of details of high resolution photography"

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[1] *Google Maps* (11.81.1502). (2004). [Software].
[2] Rosedale, P. (2007). Second Life [Software]. In *Linden Lab*. https://SecondLife.com

(p. 931) but modern VR technology provides more accurate images with each passing year due to continuous technological advancements.

Despite some hurdles, virtual heritage has nevertheless been identified as showing great potential in terms of offering enhanced educational opportunities and heritage experiences, especially for people with disabilities. One of the main lines of thought within recent VR literature is that VR could be used to enhance the heritage experience by creating a combination of the physical and the virtual commonly referred to as mixed reality (Sussmann & Vanhegan, 2000). Buhalis & Karatay (2022) researched the attitudes of Generation Z towards the use of mixed reality (MR) in cultural heritage tourism. They concluded that participants believe that cultural heritage experiences can benefit from immersive technology and that cultural heritage sites should consider how to use MR to enhance consumer experiences (Buhalis & Karatay. 2022). Consequently, the use of virtual humans at cultural heritage sites has been increasingly researched over the past decade. Sylaiou and Fidas (2022) state that the use of virtual humans could 'foster visitors by providing meaningful connections with cultural treasures in exhilarating and informative ways that may acknowledge the specificity and demand of the user' (p. 18). Moreover, Marconcini (2018) states that virtual heritage can provide 'a richer experience for everyone, fostering social participation and communities' involvement in heritage conservation' (p. 6).

Whilst virtual heritage is still a relatively new concept, it is relevant to research the consequences this technology can have on the concept of accessibility. Researchers' ability to explore virtual recreations of various locations, as demonstrated by Sundstedt et al. (2004), indicates the general improvement in 'accessibility' that VR offers to researchers, the general heritage audience and people with autism (Guttentag, 2010). The increased access offered by VR is demonstrated by several exhibitions, such as the Myin-Pya-Gu temple in Bagan, Myanmar (Paladini et al., 2019) (Fig. 2). Furthermore, when a VR program is made available over the Internet, it can allow wider access to the virtual site in addition to providing virtual access to locations that would not otherwise be accessible (Guttentag, 2010). Thus, VR offers the opportunity to enhance the experience of cultural heritage sites and contribute in an educational manner, including for individuals with autism.

Figure 2. Virtual reality experience of Myin-Pya-Gu Temple in Bagan from Paladini et al. (2019)

2.5. Theoretical framework

Constantinou, Loizides & Ioannou (2016) state that through the integration of technology in cultural heritage, a path can be created to widen the experience to approach more individualised needs. This thesis builds upon the conceptual model of Iftikhar et al. (2022), by analysing the factors and constraints that contribute to the perceived usefulness and ease of use of virtual reality (Fig. 3). Despite its relevance, Iftikhar et al.'s model provides a generalised approach for all disabilities. Therefore, an in-depth qualitative research to analyse attitudes towards and (possible) benefits of virtual reality for a specific type of disability is needed. Thus, this research aims to investigate how virtual reality can contribute to the accessibility of cultural heritage for people with autism spectrum disorder (ASD). By adopting a theoretical framework that acknowledges the complexity of disability, organisations can develop more effective accessibility policies and practices that prioritise the needs and experiences of people with disabilities. Furthermore, the social model of disability serves as a theoretical underpinning. The social model of disability is a perspective on disability that suggests that it is not the individual's impairment or condition that is the primary cause of their disability, but rather the barriers and limitations that are created by society (Shakespeare, 2010). This model sees disability as a social construct rather than a medical or individual problem. The social model recognizes that people

with disabilities face barriers and discrimination in society, which can prevent them from fully participating in society on an equal basis with others (Shakespeare, 2010). These barriers can be physical, such as buildings and transportation that are not accessible, or attitudinal, such as negative attitudes and stereotypes towards people with disabilities. According to the social model, removing these barriers and creating a more inclusive and accessible society is essential for achieving true equality for people with disabilities (Shakespeare, 2010). This includes providing reasonable accommodations, such as sign language interpreters, accessible technology, and flexible work arrangements, as well as changing attitudes and perceptions towards people with disabilities. For people with autism, who often struggle with overcrowded spaces, hyperreactivity to sensory inputs and fear of uncertainty, the use of virtual reality could possibly contribute to the accessibility of cultural heritage sites.

3. Method

The method aims to bridge the above theoretical framework and the empirical results. Firstly, the choice in research design and approach are explained. Next, the selection of example cases used within the research are established. Furthermore, there is a description of the method for data collection. Following this, the data analysis process is elucidated and codes are identified. Finally, the ethical considerations and constraints within the methodology are discussed.

4.1. Research Design

This research aims to analyse the role virtual reality can play in improving the accessibility of cultural heritage to people with autism spectrum disorder. Due to the complex and delicate nature of this aim, this research takes on a phenomenological approach, one of the two intellectual traditions within interpretivism (Saunders et al., 2012). Interpretivism is often used by researchers who oppose the reduction of real-world insights to a set of law-like generalisations contended by positivism. According to Saunders et al. (2012), the phenomenological approach refers to the study of how people make meaning of their surroundings. Humans are constantly analysing the social world around us and others whom we

engage with in symbolic interactionism, which leads to alterations in our own meanings and actions. This phenomenological approach puts a lot of emphasis on "social actors". According to Johnson and Clark (2006), researchers must be conscious of the ethical decisions that are made through the research strategy selection because this will have a significant influence on the comprehension of what is being researched. The phenomenological approach allows for focusing on the participants' views and experiences. It further requires an empathetic stance, which is critical to interpretivism theory (Saunders et al., 2012). The main challenge of phenomenology is to attempt to see the world from the perspective of the participants. Therefore, axiology, or the philosophical brand that studies judgements about value also plays a part in research design selection. Both the philosophical strategy and the data collection method used are a reflection of values (Saunders et al., 2012). For this research, high value is placed on human interaction with the participants, leading to data collection through in-depth interviews as opposed to anonymous surveys.

The research design used is qualitative as such a design is linked to interpretive theory (Denzin & Lincoln, 2005). Semi-structured interviews were used as the data collection technique (Appendix A). Semi-structured interviews are considered one of the most effective methods for conducting qualitative research, including about autism spectrum disorder (ASD), due to their allowance to gain a deep understanding of the experiences and perspectives of individuals with ASD and their families. Through semi-structured interviews, which offer a balance between the flexibility of open-ended interviews and the structure of close-ended questionnaires, sensitive topics related to ASD can be explored, such as communication difficulties, anxiety and sensory processing (Lord et al., 2018). The format and flexibility of semi-structured interviews allows one to focus on specific topics whilst still allowing for participants to share their unique perspectives and experiences (Bryman, 2012). This is particularly effective for participants with ASD, which is characterised by presenting itself in different ways and impacting each individual differently. Furthermore, a semi-structured format enables the possibility to build trust with participants by creating a calm and relaxed environment, leading to more spontaneous answers. As a result, this approach can provide rich and detailed information that can help better understand the perspectives of individuals with ASD, and inform the development of support services that can be tailored to their specific needs. Furthermore, semi-structured interviews are effective due to the possibility to modify the language and complexity of the questions to match

the communication abilities of the participants, and to adjust the pace and duration of the interviews to accommodate their attention spans and sensory needs.

4.2. Research Approach

An inductive approach is used for this research. Induction is often used in qualitative research where the aim is to understand social phenomena from the perspective of participants (Saunders et al., 2012). Induction involves the process of collecting and analysing generalisable observations to generate new theories (Bryman, 2012, p. 26). Patterns and trends are observed within the data which are then often formulated into generalisations based on those observations. Inductive research is characterised by its flexibility and openness to new ideas, as the theory emerges from the data itself rather than being imposed on it (Bryman, 2012). Due to this, an inductive approach can be particularly useful in exploratory studies when little is known of a topic. The complex nature of autism spectrum disorder and its individualised experiences and needs require such an inductive approach. As there is very little known on the use of virtual reality for cultural heritage experiences for people with ASD, no inherent hypotheses can be formulated and it can be difficult to decide which questions to ask or which themes should be explored. With an inductive approach, it is possible to conduct an interview with an open mind and to gain insights into the experiences and perspectives of participants without forming preconceived ideas or hypotheses before data collection (Bryman, 2012).

4.3. Selection of Example Cases

In order to provide clarity of what exactly is being researched in terms of virtual reality for cultural heritage sites, two cases were used as examples within each interview. Considering virtual reality is such a broad spectrum, spanning many different techniques and technologies, two examples were chosen based on their technological differences and variety in terms of specific traits.

The first example chosen for this research is a desktop virtual environment of the National History Museum in London from the Google Arts and Culture platform[3]. Google Arts and Culture is a non-profit initiative partnering with cultural institutions on a global scale. It

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[3] *Google Arts and Culture. (2011). Google Inc. https://artsandculture.google.com/*

allows staff to upload virtual tours of the chosen cultural location, which in turn allows digital visitors to take a 360-degree virtual walk using Google's Street View technology (Burke et al., 2020). The content within Google Arts and Culture varies enormously in terms of scale. For example, the Musée d'Orsay consists of one Street View tour and 278 items, whereas the Natural History Museum in London consists of two Street View tours and over 298,000 items (Burke et al., 2020). Such virtual sites are used as digital twins for many different sectors including real estate, tourism, and architecture (Roman et al., 2022). Since the COVID-19 pandemic, it has been used within the tourism sector where it allows people to take virtual tours of both hotels and cultural sites from their computer (Roman et al., 2022). One of the most important features of this site is that participating in a virtual tour is both free and accessible from personal devices. This allowed for the participants to use their own computers and devices. With Google Street View technology, the viewer can use the trackpad or mouse from their device to move around the room within the physical space depicted on the screen. In the case of the Natural History Museum, the virtual tours starts in the large entrance hall named the Hintze hall, after which participants were free to move around wherever and however long they liked.

The second example used within the interviews is a more immersive virtual reality technology. Due to not being able to use the head-mounted display (HMDs) typically associated with immersive virtual reality, a smartphone app was chosen that attempts to replicate the use of the headsets. This technology differs from the previous one in that it provides a more interactive experience within the virtual environment. The choice of virtual app was given to the participants, after which they could choose which they would prefer based on sensory preferences and interests. The choice was given between 'Athens in VR'[4], which focuses on auditory aspects, and 'Memory Museum VR'[5], which focuses more on authentic visual aspects.

In order to gain more perspective on the participants' thoughts on accessibility initiatives at cultural heritage sites, an example of 'relaxed performance' was also briefly given, which the participants were able to give their opinion on. The relaxed 'Dawnosaurs' exhibit within the Natural History Museum in London was used as an example. The Dawnosaurs exhibition is a free, relaxed morning visit for children with neurodiverse conditions, including autism spectrum disorder and other sensory processing difficulties. Supported by autism-aware staff, the exhibit

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[4] *Athens in VR* (2.1). (2017). [Mobile App]. Lithodomos VR.

[5] *Memory Museum VR* (1.0). (2017). [Mobile App]. EON Reality.

lasts from 8:00 until 10:00, when the museum opens its doors to the general public. These relaxed morning initiatives have received mixed to positive feedback (B. Fletcher-Watson (2015).

4.4. Data Collection Techniques

Possible participants were contacted through a hybrid access strategy and asked whether they would be willing to participate in the research. A hybrid access strategy refers to a combination of traditional access and internet-mediated access (Saunders et al., 2012). Therefore, face-to-face interactions and computing technologies, in this case email, were used as mediums to gain access. These methods were selected based on their suitability with the intended research method and their effectiveness due to geographical dispersion. When using more intrusive forms of data collection, such as semi-structured interviews, a personal approach often provides for a greater connection with the participant leading to richer data (Saunders et al., 2012). The use of Johnson's (1975) three-stage strategy was implemented to achieve the required level of access. Access was thus developed incrementally. Firstly, requesting to conduct interviews. Secondly, scheduling interviews. Thirdly, receiving permission to audio-record the interviews.

In order to reduce the formality of the situation to provide more comfortability, interviews were sometimes referred to as conversations. Contacting the participants took place primarily at the beginning of April and continued until early May. The sample consisted mostly of existing connections but several new ones were developed as well through the use of snowball sampling, thus expanding the network of possible participants. The use of known contacts works especially well given the nature of the research question and the in-depth data collection strategy focusing on a small, purposively selected sample (Saunders et al., 2012). Due to the essence of the research and the personal experiences explored, a certain level of access was required in order to receive valuable information. Accessibility is also seen as a continuing process throughout the entirety of data collection. For this research, cognitive access was required. Next to connecting to the researcher's personal network, the autism community on Reddit was contacted through a gatekeeper. Okumus et al. (2007) state that gatekeepers 'provide and facilitate access for the researcher' (p. 10). The general autism subreddit was approved by the gatekeeper. Therefore, initial access was negotiated on a personal basis. After initial contact, the

gatekeeper allowed for an advertisement of the research to be made on the subreddit. No respondents replied, although several gave upvotes in support. This could be due to the time and energy required to give an interview, or once again lack of perceived credibility. Often, researchers can be in a weak position when opposite a gatekeeper, since researchers have limited bargaining resources beyond their academic respectability, which is mostly limited for a graduate student (Okumus et al., 2007). Therefore, in this case a 'false start' took place leading to a slight feeling of disappointment (Saunders et al., 2012).

Occasionally, through snowball sampling the possibility of participants still within the personal network but with a less personal relationship to the researcher were proposed. Due to this, several strategies were implemented in order to facilitate the gaining of the needed level of access. Firstly, a clear account of the purpose of the research and the access required was provided. Secondly, the usage of suitable language was implemented by reading a large amount of academic literature. Furthermore, making sure of familiarisation with the community before making contact was essential for this research. By doing this, the researcher can signal to the possible participant or gatekeeper that careful thought was put into the research which can justify the request to grant access to the community and their experiences (Saunders et al., 2012). Furthermore, the interviews were arranged at a convenient time for each of the participants. The researcher maintained a flexible and open schedule throughout the data collection process in order to allow participants to choose which date and time was most suitable for them. In the case of this research, interviews were typically scheduled within two weeks of the initial interview request. Moreover, providing a clear account of the research requirements was essential. Participants were informed beforehand what the research entailed and how the interview would be structured. Two participants in particular asked specifically for the interview guide beforehand to better prepare their answers. According to Okumus et al., (2007), building a relationship and creating a cooperative environment takes time. In the case of the majority of the participants, the relationship already existed thus providing a comfortable environment for interviews to take place.

Interviews lasted from April 10th until May 3rd. Two of the interviews were conducted in person, whilst the remaining seven interviews were conducted online using either Zoom, Microsoft Teams or Discord (2020). Apple Voice Memos and OBS Studio (2012) softwares were used to make audio recordings of the interviews, with explicit consent from the participants.

Following the interviews, transcripts of the recorded audio files were made using the Otter.ai software[6] for interviews conducted in English. Interviews conducted in Dutch or in an English/Dutch hybrid were transcribed using Microsoft Word.

4.5. Data Analysis

In this research, a thematic analysis was used to analyse the data collected through the semi-structured interviews with the participants. Thematic analysis is widely used for analysing qualitative data by identifying patterns or themes within the data. The thematic analysis comprises several steps. Firstly, initial codes were generated. After the initial coding follows an analysis by searching for and defining themes within the data. The analysis process thus involves the identification of recurring and common themes, topics and patterns within the interview data, which are then organised in such a way to reach conclusions.

An attempt to use the AI Coding Beta application from Atlas.ti[7] was initially made to generate codes from the interview transcripts. However, due to technical difficulties, codes were eventually generated manually. A large number of codes were initially created, leading to a need to summarise and condense data (Saunders et al., 2012, p. 456). From those initial codes, several were selected based on their frequency within the transcripts and data was sorted into categories. Concluding themes and codes included lack of accessibility, hyperreactivity to sensory inputs, customisation, uncertainty, preparation, isolation, heterogeneity and co-creation.

4.6. Ethical Considerations

Bryman (2012) states that ethical considerations cannot be ignored, "as they relate directly to the integrity of a piece of research and of the disciplines that are involved" (p. 129). According to Diener & Crandall (1978) as cited in Bryman (2012), discussions regarding ethical standards and breaches in social research can be categorised into four specific themes. These are: harm to participants, lack of informed consent, invasion of privacy, and deception. The

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[6] Liang, S., & Fu, Y. (2016). *Otter.ai* (3.27.0) [Software]. AISense. https://otter.ai/

[7] Muhr, T. (1993). *ATLAS.ti* (23.1.2) [Software]. https://www.atlasti.com

researcher took several measures to ensure that there was no harm to the participants throughout the research process. Due to the nature of this research, unstructured methods which are sensitive to the social context of the study were used (Spencer et al., 2003). The researcher obtained informed consent from each participant before the start of the interview process. Informed consent was achieved by explaining the research fully and meaningfully both before and at the beginning of the interviews. Signed consent forms were used to establish the consent given by participants. Furthermore, the researcher ensured that the questions from the interviews were non-invasive and respectful of the participant's privacy. Participants were given the option to remain anonymous and were reminded before the interview and at the beginning of the interview that they always have the possibility to refuse to answer a question they feel is too personal. It is important to mention that the sample consists of participants from within the researcher's personal network. Due to this, the interviews felt relaxed and comfortable as the majority of participants are people that the researcher knows on a personal level. Furthermore, the researcher provided the opportunity for participants to withdraw from the research at any given time without consequences. Moreover, the researcher maintained confidentiality by keeping the identity of participants anonymous if they so wished, and ensuring that data and recordings from the interviews is stored securely and privately. Finally, there was consent from each individual participant, thus the concept of 'deception' is not relevant. To conclude, the researcher used these methods to ensure that there was no harm to the participants throughout the research process.

4.7. Constraints

One of the main constraints when researching the personal experiences and perspectives of people with autism spectrum disorder is the heterogeneity of the disorder. Every individual with autism is different and their autism affects them in different ways. Therefore, finding one specific solution is simply impossible. This thesis thus serves to provide recommendations based on the perspectives of participants interviewed. A larger sample including participants from different backgrounds, ages, and severity levels would provide more perspectives of the autism spectrum and higher quality results.

Participants stemming from the researcher's personal network will affect data collection in a positive way due to a higher level of openness. One participant stated that the reason she was so open throughout the interview is due to the long lasting friendship with the researcher which

led to her feeling comfortable throughout the interview and when answering questions. The researcher's own experience with a close family member on the spectrum also contributed to a high level of awareness surrounding autism, further contributing to more openness from participants.

The use of a virtual reality headset can cause so-called 'cybersickness', thus was not implemented for eight of the nine participants due to possible ethical issues. The single participant who did use a virtual reality headset had multiple years of experience using a headset for video gaming and thus owned one themselves and volunteered to use the headset when first approached for this research. Further research could possibly implement the use of a headset in a controlled environment in order to focus on the use of HMDs specifically and how it can contribute to cultural heritage accessibility.

The participant using the headset was facing away from the microphone for much of the VR session. The conversation was still clear but less so than if the interview were conducted towards the camera. For possible future research using HMDs, in-person data collection would be preferred.

The interviews occasionally gravitated towards a more informal setting than a formal one due to the personal relationship between the researcher and the majority of participants. Despite a comfortable setting being beneficial for such research, it occasionally skewed towards topics of conversation not academically relevant to the results. This was not interrupted during the interview as it contributed to the comfortability of the participant and relaxed environment of the interview.

Moreover, due to the limited time constraints, only a limited number of people could be interviewed for this research. A larger data sample would improve findings and provide for more individual perspectives and experiences regarding accessibility for people with ASD and the use of virtual reality for cultural heritage sites.

4. Results

This chapter aims to provide answers to the research question: how can virtual reality make cultural heritage sites more accessible for people with autism? Firstly, participants were asked about their experiences regarding accessibility to cultural heritage sites. Secondly, participants were questioned regarding their experience of and opinion on virtual reality. Participants were further asked to use two different virtual reality tours of cultural sites and were requested to provide their opinions and possible benefits and risks of the use of virtual tours for people with autism spectrum disorder. A visualisation of the results is illustrated below.
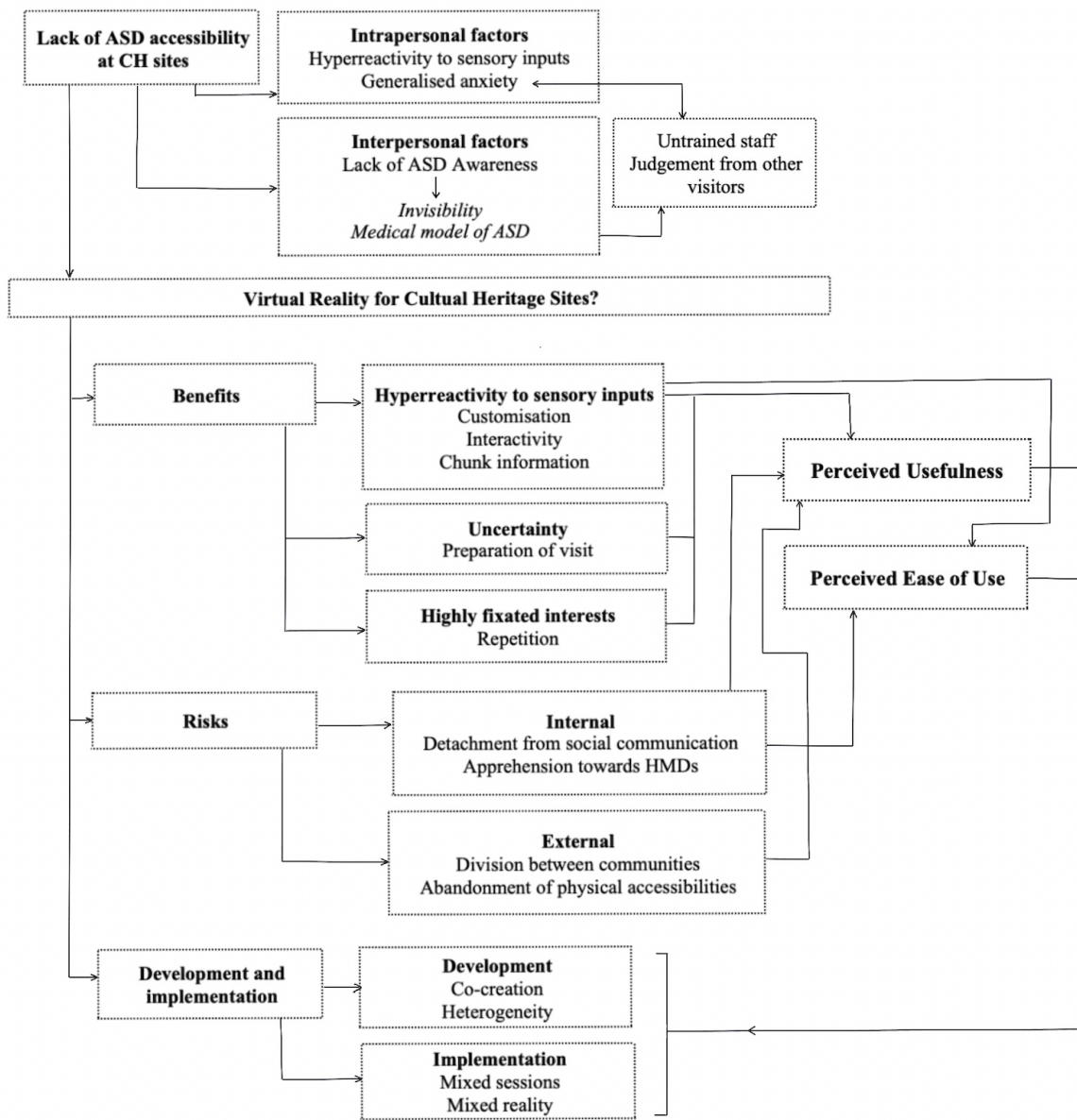

Fig 4. Visualisation of the Results Chapter

<u>Sample</u>

The sample consisted of nine participants, including six adults with autism spectrum disorder (ASD) and three parents, one with a young child with autism and two with children with more severe autism traits who are unable to conduct interviews themselves. Ages of participants ranged from 21 to 64. Of the participants with autism, two identified as female and four identified as male. The sole selection criteria was the participants' own or their child's official autism diagnosis. Participants were chosen in order to be more representative of the heterogeneity of the autism spectrum. Therefore, primary caregivers of young children with ASD and more severe forms of ASD were also interviewed and provided beneficial insights. In total, nine interviews took place, lasting on average 60-75 minutes.

<u>Geographical spread</u>

Within the final sample, six participants were located in Belgium, with the remaining three being from the Netherlands, the United Kingdom and the United States respectively. Due to the geographical variance of participants, most interviews took place online. Often, participants would comment on specific cultural heritage sites within their individual country or area and discuss accessibility to the site or their knowledge of particular initiatives undertaken by nearby heritage sites to improve accessibility for individuals with autism.

5.1. Lack of Accessibility

5.1.1. Hyperreactivity to sensory inputs

Interviews show that cultural heritage sites are indeed often not as accessible for people with autism spectrum disorder. This confirms literature by Magkafa & Newbutt (2018) regarding the lack of ASD accessibility. Several participants stated that due to their hyperreactivity to sensory inputs, heritage sites such as museums can often provide a stressful and anxiety-inducing environment. This hyperreactivity was identified by Lord et al. (2018) as one of the main defining traits of ASD. Participant one shared how heritage sites often come with loud noises, both of exhibitions and of crowds at the locations, which in combination with the environment are often difficult to process due to their auditory sensitivities. This is referred to as sensory

overload, when several external stimuli can be overwhelming for an individual, often leading to increased anxiety and possible 'meltdowns'. This hyperreactivity to sensory inputs varies from individual to individual and thus affects everyone differently. Several participants talked specifically about the difficulties experienced with auditory and visual sensitivities, such as loud, unexpected noises and changes in lighting throughout different rooms at the site. The occurrence of such an external stimulus was described by one participant as 'painful' and debilitating. For example, participant one stated how it is difficult for her to focus on a part of an exhibit when other visitors are talking around her.

P1: *"Sometimes in a museum exhibition there's a video on and it stresses me out, because I would just want to focus on the film and I would be surrounded by people talking. Same with reading signs, if there's a lot of people in that environment, and I'm trying to read, and then people are talking around me, that affects my sensors."*

Apart from auditory and visual sensitivities, participant six further mentioned that sensitivities in terms of food texture and the unwillingness of some heritage sites to accommodate such sensitivities can provide an unwelcome and stressful environment. The differences in reactivity to sensory inputs illustrates the heterogeneity of autism as emphasised by Georgiades et al. (2013). According to a significant number of participants, historically, hyperreactivity to sensory inputs has not often been taken into account by heritage sites and neurotypical visitors. Based on participant's experiences and in accordance with Magkafa & Newbutt (2018), heritage sites seemingly do not accommodate enough for these sensory difficulties to the point where several participants stated that they avoid attending heritage sites or have avoided attending them in the past.

Lack of rest areas

Furthermore, multiple participants stated that if sensory overload occurs, heritage sites often lack a physical rest area where people with autism could go in the case they feel overwhelmed. This falls in line with literature from B. Fletcher-Watson (2015) regarding suggestions for receiving visitors with autism in a theatre environment. Participant six, who has a

young daughter with autism, described how the lack of a specific rest area in heritage sites in the case of sensory overload contributes to an already stressful environment.

P6: *"I get that issue with my daughter at places like that. I wouldn't know where to go, where to stop, how to calm her because sometimes it's hard to find spots where you can just sit down and calm her, particularly if staff and other people don't understand."*

Participant six further expressed that in the case his daughter would start feeling overwhelmed, they would make a circle around her in a corner of the site in order to try and calm her down. Thus, in the physical space of cultural heritage sites, people with ASD often experience a lack of accessibility. From interviews it also seems that the inadequacy of understanding hyperreactivity to sensory inputs and lack of physical rest areas often circle back to a major lack of awareness surrounding autism spectrum disorder.

5.1.2. Lack of awareness

From the interviews, it seems clear that a lack of awareness surrounding autism plays a part in the lack of accessibility at cultural heritage sites. Participant three stated that autism is not often discussed within society and that has led to a misunderstanding about ASD by many neurotypical people. This contradicts literature by Dillenburger et al. (2013), who stated that there is a high level (80%) of autism awareness amongst the general population. According to a significant number of participants, both neurotypical visitors and staff are often not as understanding as they could be of ASD challenges and needs.

Invisibility

Several participants expressed that this lack of awareness is partly due to the invisibility of autism, as emphasised by Yalon-Chamovitz (2009) when discussing the lack of accessibility for invisible disabilities. It is often not visibly noticeable that a person has autism and participants expressed that due to this invisibility, receiving help from staff is less likely than for a person with a visible disability. Participant one stated how this lack of help can cause a feeling of isolation, especially when she was a child:

P1: *"People assume if you're visibly disabled, that you need that support, and that guidance and that help. Whereas if you're autistic, for example, people can't tell that I'm autistic. So they're not going to help us, they're not going to give me that support. When I know, especially when I was younger, I needed that support".*

Medical model of autism

Apart from invisibility, participants expressed that another possible contributor to the lack of awareness is due to the medical model of disabilities as mentioned by Shakespeare (2010). Looking at autism purely from a medical standpoint risks ignorance regarding the perspectives of individuals with ASD. Participant five stated that more empathy and open-mindedness towards disabilities and autism in particular, would already make a huge difference:

P5: *"I definitely know people (with autism) who do think autism is a disability, and they experience it that way. And of course, that's completely normal. That's an important experience to listen to as well. It's just the way it's medicalized. It's kind of weird, because if people are just slightly more open minded and slightly more empathetic, ironically, there will just be less problems."*

This open-mindedness and empathetic stance is more reflective of the social model of disabilities. Therefore, the medical model, despite often being used in literature, may be affecting the awareness and consequent accessibility for people with autism in a negative way, confirming criticism of the medical model by Shakespeare (2010).

Untrained staff and judgement from other visitors

Interviews show that this lack of awareness, contributed to by the invisibility and the medical model, often leads to a lack of help from staff members and judgement from other visitors at heritage sites. B. Fletcher-Watson (2015) lists the training of staff to recognise autism as one of the recommendations for sites receiving visitors with autism so that appropriate help can be provided if necessary. Participant five states that she often fears getting lost in large

spaces, and the knowledge that if she starts feeling anxious and will likely not be helped by staff only contributes to that increased feeling of generalised anxiety and uneasiness.

P5: *"One of my biggest anxieties around things like that is just getting lost and people being extremely unhelpful when I get lost. … So, anxiety like that often isn't 'I'm autistic and I need predictability' but more that I know my needs will not be taken into account by the people around me. Therefore, I have to prepare everything in advance. And if I'm not prepared, and I get in trouble, I will not be helped. I don't know if I will be in pain in five minutes. Because, again, the sensories coming in can be really painful. And if you know from experience that people will not understand me, it will not help me when I'm in pain. They will maybe scold me for being in pain, so, of course, you're going to be super anxious about that stuff."*

Furthermore, it was also expressed that lack of awareness often leads to judgement from other visitors at heritage sites leading to a heightened feeling of unwelcomeness. This corroborates with literature from Elkin (2015) and Broach et al. (2003) as cited in B. Fletcher-Watson (2015) about individuals with autism often feeling unwelcome during leisure activities and being seen as potential 'disruptors' for other visitors. Participant six described how a 'meltdown' from sensory overload is often faced with judgement due to the incomprehension of staff and other visitors. Participant two expressed this judgement particularly occurs if a meltdown happens whilst standing in line or when part of a guided tour. Neurotypical visitors are thus frequently not understanding of a person with autism who may start feeling overwhelmed or react in a different way than a neurotypical person would. This subsequent judgement often makes a heritage experience more stressful and anxiety-inducing for individuals on the spectrum.

Therefore, based on respondents' experiences, cultural heritage sites are often not as accessible for people with autism spectrum disorder than for neurotypical people. Hyperreactivity to sensory inputs and the lack of rest areas in such sites can make heritage site visits distressing and overwhelming for people with autism. Furthermore, due to the general lack of awareness surrounding autism, contributed to by the invisibility and the medical model of disabilities, judgement from other visitors as well as the lack of proper aid from untrained staff members can occur which only contributes to the feeling of generalised anxiety and uneasiness

often felt at heritage sites. B. Fletcher-Watson's (2015) recommendations of paying attention to sensitivities, rest areas, and training of employees were all supported during interviews. These three recommendations should thus be reflected in the accessibility strategies of cultural heritage sites worldwide. In doing so, cultural heritage sites have the possibility to increase accessibility for people with disabilities, including those with invisible disabilities.

5.2. Existing initiatives

In order to gain a more thorough understanding on how participants perceive the lack of accessibility at heritage sites, existing ASD accessibility initiatives were discussed. Despite the still ongoing lack of accessibility at heritage sites for autism spectrum disorder, several participants expressed that over the last few years more initiatives have come forward in an attempt to increase this accessibility. Participants were asked about their knowledge or experiences with recent existing initiatives from heritage sites targeted towards receiving visitors with autism. Two main examples were brought up throughout the interviews.

5.2.1. Relaxed visits

Firstly, the concept of relaxed visits, as examined by B. Fletcher-Watson (2015), was discussed. The 'Dawnosaurs' exhibit in the Natural History Museum in London was discussed as an example. Overall, participants seemed to have mixed reactions regarding the concept of relaxed visits. Participants two and three stated the possible benefits of relaxed visits, especially for individuals with autism who might struggle more with large crowds due to hyperreactivity:

P2 *"If you just had this window of time, less people, less stress and staff who are well trained, who will be a little more relaxed with you, maybe a few more physical barriers, cutting down on the explanations, all of these things could be helpful."*

According to this participant, relaxed visits provide an opportunity for people with autism to experience cultural heritage sites without feeling overwhelmed. However, multiple participants expressed some criticisms about this initiative. Three participants applauded the general concept but criticised the inflexibility of the time slot given to the 'Dawnosaurs' exhibition. This relaxed

visit takes place from 8 to 10 o'clock for one day on a weekly basis. One participant expressed that such an early visit could be difficult for families living further away or with parents that have to work. Participant four further stated that they find it 'unfair' that only two hours a week are provided specifically for visitors with autism whilst neurotypical visitors have the entire rest of the week to attend the exhibit. Participant seven, who has a very specific sleep routine, stated that a relaxed visit only open from 8 to 10 o'clock for a single day a week is not an option for them and thus is not sufficient enough for an accessibility initiative. However, a significant number of respondents praised the implementation of staff being trained specifically to be aware of autism in its many forms.

P4: *"I think it is a really good initiative that they also really focus on adding experienced autism aware facilitators, that's excellent. My only criticism would be, and I like that it's 'Dawnosaurs' because dawn and dinosaurs, but if it opens at eight o'clock, that means you'd have to get your child up at about six o'clock to be there on time."*

Several participants also mentioned how a relaxed visit specifically targeted at people with ASD could possibly cause a division between visitors with autism and neurotypical visitors. Having a relaxed visit specifically for visitors with autism but inaccessible for neurotypical visitors could have an impact on the awareness of the latter surrounding ASD due to separation, contributing to the existing lack of accessibility mentioned above. Therefore, according to participants the concept of 'relaxed visits' could be a good initiative but is not as well thought out as it could be.

5.2.2. Sunflower lanyards

A second accessibility initiative which was mentioned during the interviews is that of the sunflower lanyards. These lanyards were introduced to 'discreetly' indicate to staff that a visitor has an invisible disability and help, such as being given priority in a long waiting line, might be needed. Despite being an initiative to highlight the invisibility of ASD, participants also generally had mixed opinions regarding the concept of lanyards, resonating with literature by Pritchard (2021). Participant one affirmed that the lanyards were a good initiative when they were first introduced, but now are not sufficient anymore, stating that they have become

overused, also by people without hidden disabilities, to the point of saturation leading to them occasionally even being ignored. Three participants expressed their scepticism towards the use of such lanyards as the fear of being judged by people around them, another extension of the general lack of awareness surrounding autism.

P3: *"Giving them a lanyard I think is a bit much. If that were to happen to me, if they gave me something solely because I have autism, I would feel discriminated against. I feel like the best solution is they should just know what autism is."*

Another participant stated that the consequent change in behaviour towards his daughter, the initial intention of the lanyards, is not ideal as he doesn't want her to be treated differently than other children. He also emphasised that the use of signs such as the sunflower lanyards contributes to a larger divide between neurodivergent people and neurotypical people.

5.2.3. Initiatives for adults

According to respondents, another criticism of existing initiatives is the target audience of mostly children, aligning with literature by Howlin & Moss (2012). Although the intention of improving accessibility for children with autism is absolutely necessary and incredibly important, some participants stated that they wish such initiatives would also be directed towards adults with ASD. Due to the recency of actions such as the relaxed visits, there was a lack of initiatives when participants were children themselves. Six respondents stated that they struggle with hyperreactivity to sensory inputs less as an adult than as a child due to the increased exposure to less accessible environments throughout the years. Interviews show that the lack of these initiatives when participants were children led to them becoming more desensitised as adults, but some adults still struggle with hyperreactivity and uncertainty and the amount of initiatives for adults with autism seems to be severely lacking. This resonates with literature by Howlin & Moss (2012).

P5: *"[As a child], that's really when I could use all those things, but what if you aren't a child? It's something people often forget, autistic children grow up, and you don't see as many initiatives when you're 18. Autistic children become autistic adults."*

Thus, the implementation of initiatives for children with autism is a very positive step forward, but existing initiatives should be more thought out and become available to adults who may benefit from similar initiatives as well. Interviews thus show that existing initiatives, such as relaxed visits and lanyards are not entirely sufficient and more could be done to increase accessibility for individuals with autism of all ages.

5.3. Virtual Heritage for Individuals with ASD

Attitudes towards virtual reality

With mixed reactions for existing ASD accessibility initiatives, the possibility of virtual reality for cultural heritage sites was discussed with participants. In general, the use of virtual reality for people with autism who want and/or need to use it, was received positively. Multiple participants stated their belief that incorporating such technologies could increase accessibility tremendously. Participant two stated their believed benefits of virtual reality, particularly for children with autism but also for all visitors.

P2: *"Children with ASD can often be a little hyper. So they need to be able to walk around a lot of them at their own pace. And at a lot of places, that's not an option. You're standing in a group, the tour guides are slow,... And to me, when you mentioned virtual reality, I thought, if you can do your own tour, that is helpful, not just for kids with autism, but also to people in general. I do see a place for this in the future and how it can increase accessibility."*

Participant six stated that his daughter would be excited about the idea of using virtual reality technology in order to visit heritage sites she is particularly enthusiastic about and that the interactivity of such virtual tours could be beneficial. Several participants also self-identified as visual learners and emphasised the benefits of virtual reality for other people who share the same

affinity for visual processing and computer-based tasks, confirming statements from Magkafa & Newbutt (2018).

5.3.1. Example cases

In order to delve deeper into the possible use of virtual reality for accessibility of heritage sites, participants were shown two different virtual tours which showcase two different technologies. The first a desktop virtual tour, the second an immersive smartphone app replicating virtual reality headset technology. The first virtual tour shown, a desktop VE of the Natural History Museum in London was received mostly positively but the lack of immersion and the limited interactivity were main points for improvement. Furthermore, the quality of the tour was criticised as the visual quality was limited. Moreover, physical accessibility and knowledge accessibility within the virtual tour were mentioned as features to be improved due to the limited rooms available and the excess of information shown. Multiple participants stated that such technology could be incredibly beneficial to use as preparation for a visit. The second VE, an interactive smartphone app replicating the use of an HMD without the risk of cybersickness sometimes associated with headsets, was generally more preferred by participants due to the increased interactivity and level of immersion. Several participants stated that this virtual tour could be beneficial as a use of repetition, possibly for hyper fixated interests and praised its similarity to the use of an HMD. This enthusiasm regarding headsets, despite not being used in interviews, aligns with literature by Glaser et al. (2022). All participants reached a general agreement over how the use of a virtual tour could be beneficial to some people with autism and that the choice over which type of technology is used should be completely up to the user.

P5: *"The user themselves has to be the person who makes a choice to use either way. For things like these you can't get forced into using one or the other, like, going by or using VR. And that if you go live and things go wrong, you'll be blamed, because "why didn't you use the VR version?" or whatever. I'm super against that practice, because the choice has to be its user and not the person who's just trying to make things easier on them. But I can totally imagine people preferring the VR version over the real thing."*

Despite expressing that it could provide opportunities for people with autism who would need it and choose to use it, multiple participants stated that they would have benefitted from such a virtual tour as a child but now, mostly due to desensitisation over the years, would prefer to visit a physical site despite the risk of feeling overwhelmed because they have gotten 'used' to it. This further shows that the implementation of ASD accessibility initiatives is still a very new concept which did not exist when many participants were young children. Therefore, a significant portion of the sample advocates that providing the option to use both a virtual and physical tour should be implemented.

5.4. Benefits of virtual tours for people with ASD

Interviews show that several features of virtual reality technology could be beneficial for increasing accessibility to cultural heritage sites for people with autism. The implementation of these features contributes to the respondents' perceived usefulness of virtual heritage, expanding on Iftikhar et al.'s model (2022).

5.4.1. Customisation

One of the main benefits that participants mentioned was the possible ability to customise sensory inputs within a virtual reality tour. Interviews show that the ability to customise a virtual tour has major implications for individuals who have hyperreactivity to sensory inputs, one of the main ASD traits mentioned by Lord et al. (2018). According to participants, someone with auditory sensitivities could customise a tour to consist of no or low auditory components. Similarly, someone who gets distressed in large, noisy crowds, could use technology to visit a virtual site without surrounding strangers. Participant two mentioned how, especially with headsets, this could prove to be beneficial in order to prevent sensory overload:

P2: *"... With a headset, you are often blocking out a lot of extraneous noise in a museum and when they've got marble floors, they can get very loud and most autistic people have noise sensitivities. But if you have a very good headset, you are blocking out a lot of that. And also you're not getting the eye contact, you're not getting the discomfort of being around other people.*

These kids can just really focus on what they're supposed to be seeing. So you know, I think it has the benefit of not only presenting new information to them, but blocking out a lot of the overwhelming information. That stops them from possibly freaking out."

According to this participant, being able to block out unwelcome sensory inputs could allow for visitors with autism to fully focus on the heritage site, thus possibly increasing knowledge transfer and engagement with the site, resonating with literature by Freina & Canessa (2015). Therefore, the ability to adapt a virtual environment based on sensitivities to external sensory inputs could make a cultural heritage experience less anxiety-inducing and more enjoyable for an individual with autism, thereby increasing the conveyance of knowledge (Paladini et al., 2019). This contributes to participants' perceived usefulness of virtual heritage from Iftikhar et al. 's model (2022).

5.4.2. Chunk information

Three participants expressed how customisation could further benefit people with autism through the use of 'chunk information', confirming literature by DaCosta & Kinsell (2022). Chunk information refers to simply stating the most important pieces of information in units or 'chunks'. An overload of information could be too much for certain visitors to digest due to hyperreactivity, but providing the most important and necessary information could be educational without being overwhelming and thus increase knowledge accessibility. This could be implemented, for example, to a sign in a heritage site or within an audio guided tour. One participant, who has a son with autism, said:

P2: *"When it's just telling you some bare facts and minimum things, and you can adjust that to the level you want, even if it's a grown autistic person, what might be their functional level? Do you want the explanations to take a minute or less? Three to four minutes or 10 minutes? It can be so adjustable, and personalised, which it isn't now. And now we have a way of doing this."*

For this participant, being able to adjust the amount and complexity of information shown at heritage sites based on each individual's heterogeneous sensitivity level and attention span is a

major possible benefit of virtual reality and contributes to the perceived usefulness of virtual heritage (Iftikhar et al., 2022). Being able to adjust information on signs or tours in order to combat a feeling of overwhelmingness also has implications for people with intellectual disabilities, which is not synonymous with ASD but sometimes co-occur. However, Yalon-Chamovitz (2009) states that when asked to simplify information, service providers often turn towards solely adopting a child-like vocabulary and intonation. Therefore, chunk information could be extremely beneficial if it also offers an age-appropriate option in order to refrain from treating adult visitors as if they are children.

5.4.3. Interactivity

Furthermore, a significant number of participants expressed that the amount of increased interactivity from a virtual tour could prove beneficial for several people with autism. This reflects the overwhelming preference of the second example case of the interactive smartphone app over the virtual desktop tour of the Natural History Museum. A male participant with autism said:

P7: *"Interactivity is a big thing. And especially considering the way of transportation, you can teleport closer to things, you can click on it to get it closer, you can drag it to make it even closer, you can really go for all the details you're trying to see."*

A female participant further stated how the interactivity would have massive amounts of appeal and could increase engagement. This participant also mentioned that for virtual tours it could be possible to take a closer look at items and objects than in a physical site, which is often not allowed due to barriers or preservation risks, as illustrated by Loddo et al. (2021). Another male respondent, who has a four-year old daughter with autism, expressed that interactivity with virtual avatars, either tour guides or characters, would be very appealing to her and enhance the experience even more by increasing the level of engagement, resonating with literature by Freina & Canessa (2015). This also concurs with literature by Sylaiou and Fidas (2022) regarding the meaningful connections that can be created between visitors and cultural sites through the implementation of virtual humans based on demands from each user. Thus, the level of

interactivity that virtual reality could offer was mentioned by a significant number of participants as a notable asset for people with ASD, consequently contributing to the perceived level of usefulness (Iftikhar et al., 2022).

5.4.4. Preparation

From interviews, it seems that an additional benefit of virtual heritage is the possibility to prepare for a physical visit. Multiple participants concur with Lord et al. (2018) that a large number of people with autism struggle with the unpredictability of locations and being able to see the virtual site beforehand could be an advantageous option. One participant, who has a young daughter with autism, stated that this technology could also be beneficial for adults with young children with ASD by being able to see beforehand which rooms could provide a bit of rest and quiet if necessary. This participant further expressed how it could also help for the general planning of a visit:

P6: *"I think it's also interesting for the parents, because if you're going to do a physical visit, doing a visual visit first can help plan some things. I can check what my daughter really likes, know what she might want to see, maybe check some places where I could just stop if I need to."*

Another participant with autism agreed with the above statement and mentioned that if given the opportunity, he would often search up a location to make sure he knew the basic layout before visiting. He further stated that having such an understanding of the physical space beforehand would significantly reduce his anxiety. Therefore, from interviews it seems that virtual heritage could help decrease the anxiety often experienced by people with autism by reducing the uncertainty of a physical site by allowing users to explore the location virtually ahead of a planned visit.

5.4.5. Repetition

Furthermore, interviews show that virtual tours could be ideal as a use of repetition. Lord et al. (2018) listed the concept of repetition as often being very important for people with autism. This was confirmed by participant six, who described how his daughter will rewatch videos of

when she visited a location earlier that same day and the amount of enjoyment she gets out of it. He further expressed how the possibility of repeating a physical tour virtually could also be helpful in the case that the anxiety and stress from sensory overload cause his daughter to want to leave a heritage site before finishing the physical tour.

Love of repetition also hangs together with possible highly fixated interests of people with autism, as discussed by Lord et al. (2018). According to multiple participants, if a person with ASD has a strong attachment to a specific subject, location or experience and would like to repeat it, a virtual tour could provide a great opportunity to immerse themselves in their interest multiple times without having to physically revisit the site. One participant expressed that his daughter with autism has a strong attachment to the musical instrument museum in Brussels, and a virtual tour would allow her to visit the site at any given time from the comfort of her own home. Furthermore, virtual tours could also provide an opportunity for exploration by possibly finding new things to be interested in. A female respondent with autism said:

P1: *"Those little things can do so much for someone and especially for an ASD person, because they can be so particular about things. It can help them organise their routines, find new things that they're interested in"*

Therefore, according to participants, there could be many benefits of virtual reality for cultural heritage visits for people with autism. The ability to customise a virtual tour based on hyperreactivity to certain sensory inputs allows for people with autism to visit a physical site in a way that might make them more comfortable. The ability to implement chunk information and increase or decrease interactivity with the site based on sensory preferences could seemingly also have many benefits, including knowledge transfer and increased engagement. Furthermore, the ability to visit a site virtually before visiting in person could be beneficial for individuals who struggle with uncertainty and prefer adhering to strict routines. It also provides the possibility to skip rooms they might find intimidating after acquiring knowledge about the layout of a site. In addition, virtual tours offer the option of repetition, which could enhance the experience for individuals who have particular highly fixated interests and wish to visit the site multiple times. It could also be beneficial to individuals who wish to spend a longer amount of time at a site by allowing them to see it virtually instead of becoming overwhelmed by spending a long time at a

physical site.Therefore, virtual heritage could be beneficial for individuals with several common ASD traits identified by Lord et al. (2018) and consequently adds to the perceived usefulness of virtual reality mentioned in Iftikhar et al.'s model (2022).

5.5. Risks of virtual tours

However, participants also described certain apprehensions that could occur when using virtual tours for heritage sites. Several of these constraints affect the perceived ease of use and the perceived usefulness of virtual reality as illustrated by Iftikhar et al.'s model (2022).

5.5.1. Possible detriment of social communication

One participant with autism stated the danger of using virtual tours constantly for large amounts of time instead of visiting sites in person, citing the possible risk of 'detaching from reality' and thus risks leading to heightened social communication deficits, identified by Lord et al. (2018) as one of the main common traits of people with ASD. This participant further stated that social interaction is a part of everyday life and thus a certain balance is needed between virtual visits and physical visits:

P1: "*I feel like it can also take us away from reality in general. And I find, especially with autism, being able to socially interact is something that's really important to develop. So putting myself in that situation is still important for me to do. Because that's just life, isn't it? We're not going to have virtual reality every second of the day. I definitely think it's something that most people should experience at least some point in their life and have the opportunity to choose, but then have a balance of virtual reality and physical reality.*"

The use of virtual reality as a cause of 'detachment from reality' and its possible effects on social communication has been researched in academic literature before. Such discourse often appears surrounding the topic of video games in particular (Fraser et al., 2023). Participant two, who has a son with autism, agreed with the above participant's quote regarding the risk of affecting social communication and further expressed that a certain time limit should be implemented. Participant one also stated that using virtual tours to completely replace physical tours could

contribute to a sense of isolation and be detrimental to someone's self confidence. It should be emphasised that this participant is referring to extreme cases where a large amount of time is spent using virtual reality in order to replace physical visits entirely. This argument reflects assertions made by several academics about risks of ICT for social communication of people with ASD as mentioned by Rajendran (2013). The possible effects of continual virtual reality use on an individual's social communication skills have not officially been identified or confirmed. Nevertheless, it is a point of concern for a large number of participants. Participant one further expressed how using virtual heritage as a way of promoting social engagement and participation instead of as an isolated experience is an unexplored opportunity and could be advantageous if implemented well. This aligns with literature by Marconcini (2018). Therefore, according to several participants, despite the possible benefits of virtual heritage for people with autism, it should be used in moderation in order to be the most beneficial for communicative behaviours of people with ASD (Lord et al., 2018). Instead, a balance between virtual heritage and physical visits could prove favourable.

5.5.2. Apprehension towards the use of a headset

Four participants mentioned another possible constraint being the initial apprehension of using a VR headset, particularly for children with autism. As a headset was not used in this research, most statements came from participants who already previously had experience using this technology in the past. Participant six expressed that extreme care is needed when using a headset for the first time, as a bad first experience due to hyperreactivity to certain sensory inputs can contribute to major anxiety surrounding the technology and prevent the will to try a headset on again, thereby affecting the perceived ease of use of VR mentioned in Iftikhar's model (2022).

P6: *"It can be scary at first until they get used to it. But if she develops some kind of apprehension, and she doesn't like it, it's going to be really hard to get her to like it. For instance, if she puts it on and it's uncomfortable, or something hurts or it's suddenly too loud, she will not want to touch it again. So the whole process of putting it on them and getting them to use it has to be very thought out. Not just put it on and that's it. It's very delicate. Same thing with*

visuals, making sure it's not scary, it's not too fast, it's not too loud. Because otherwise, she'll just be afraid of it. And then it will be hard to get her back on it.''

However, participant two stated that despite the possible initial apprehension, the increase in technology used by younger generations could perhaps make this easier. According to this participant, technological adeptness and increased inclination towards computer-based tasks could possibly make apprehension towards HMDs less intensive, which resonates with literature by Magkafa & Newbutt (2018) . If heritage sites plan on implementing the use of a headset for a virtual heritage tour, extreme care is needed during the first (and following) uses by a visitor with autism by making sure that sensory overload is prevented as much as possible when using a headset.

Cybersickness

Furthermore, multiple participants identified the possibility of cybersickness as one of the risks of using a head-mounted display to visit a heritage site, referred to by Bellani et al. (2011) as temporary symptoms such as nausea, headaches and dizziness when using the headset. A female participant with ASD stated that she has experienced nausea when using a headset in the past and thus would prefer not to use one for a virtual tour, thereby favouring the desktop virtual tour or interactive smartphone app without a headset instead. The possibility of cybersickness occurs for all people and is not limited to individuals with autism. It may, however, be possible that some people with ASD are more susceptible to cybersickness due to sensory overload and anxiety, aligning with literature by Glaser et al. (2022). Consequently, cybersickness could affect the perceived ease of use of virtual reality mentioned in Iftikhar's model (2022). Gradual exposure is currently a possible 'solution' to cybersickness but individuals who have had bad experiences with headsets in the past will perhaps not be willing to experience a headset again. This is something that heritage sites must take into account if they plan on implementing a virtual tour using VR headsets in particular.

5.5.3. Division between visitors with autism and neurotypical visitors

One of the main apprehensions from participants is the risk of virtual heritage creating a larger divide between visitors with autism and neurotypical visitors if these virtual tours are solely targeted towards people with ASD. Participant six, who has a daughter with autism, stated that he does not want it to solely target people on the autism spectrum because it could seemingly come from a negative place and thus contribute to the feeling of unwelcomeness described by Alberge (2019) and B. Fletcher-Watson (2015):

P6: *"I don't want places to start kind of putting kids with autism into one session and it feels like they want to put them there because they bother other people"*

For this participant, the notion of separating visitors with ASD and neurotypical visitors is sometimes due to heritage institutions seeing visitors with autism as potential 'disruptors' for other visitors, resonating with literature by B. Fletcher-Watson (2015). Furthermore, eight participants stated that separation between visitors with autism and neurotypical visitors could contribute more to the general lack of awareness surrounding ASD, resonating with literature by Huws and Jones (2010). Moreover, a divide between these two communities could hinder the shift from the medical model of disability to the social model due to lack of awareness and thus affect the perceived usefulness of virtual heritage tours (Iftikhar et al., 2022). Therefore, according to participants, solely targeting people with ASD for virtual heritage is not the preferable choice going forward and is a constraint that should be taken into account by heritage sites when looking to increase accessibility through virtual heritage.

5.5.4. Abandoning the accessibility of physical sites

From interviews, it seems that an additional possible risk is the discontinuation of increasing accessibility at physical heritage sites for people with autism if a virtual tour is implemented. It is not because a virtual tour could be beneficial for some people on the autism spectrum that the accessibility of the physical site should not be a priority anymore. As mentioned by multiple participants, physical heritage sites are still not as accessible as they should be and that will continue to be a problem until action is taken, resonating with literature

from Magkafa & Newbutt (2018), Alberge (2019) and B. Fletcher-Watson (2015). Thus, accessibility through virtual tours should not be at the detriment of no longer making physical sites accessible. This also links back to the possible risk of a larger division between neurodiverse people and neurotypical people and the perceived usefulness of virtual heritage. If virtual tours are made available and witness a good success rate, that does not mean that visitors with autism should be expected to always use virtual heritage and no longer visit physical sites. Affirming the article by Magkafa & Newbutt (2018), the lack of accessibility for people with autism spectrum disorder remains a major problem and should be prioritised, be it physically or virtually, or preferably, the option to offer accessibility through both.

P5: *"People don't really realise. There's certain results within web design. A lot of people assume that if you just make a separate site, all of these people will be happy. And that really directs their mindset. So I hope with VR, people won't think that if you just make a VR version, you don't have to make the real version accessible… I'm always kind of scared that abled people will suddenly assume that it's an available alternative and then they don't have to do anything else."*

Therefore, participants identified several constraints that could affect the perceived ease of use and the perceived usefulness of virtual heritage for people with autism spectrum disorder. Risks identified were the possible negative effects of virtual reality on communication behaviour, apprehension towards head-mounted displays, creating a divide between visitors with autism and neurotypical visitors, and the abandonment of increasing ASD accessibility at physical sites.

5.6. Development and implementation of virtual tours

With several possible benefits and risks, participants shared specific recommendations for heritage sites looking to develop and implement virtual heritage tours.

5.6.1. Co-creation

All participants mentioned the importance of co-creation when implementing a new initiative to increase accessibility for people with ASD. This confirms one of the

recommendations given in literature by B. Fletcher-Watson (2015). Often, such initiatives are thought out and implemented by neurotypical people who do not have the same experiences as people with autism. The discussion surrounding co-creation throughout interviews was broadened from people with autism to neurodivergent people being included from the beginning for initiatives that affect them. Even though neurotypical people may try, what they implement as observers may not be entirely reflective of the true wants and needs of neurodivergent people. Therefore, a team consisting of both neurotypical and neurodivergent people would be advantageous. One participant specifically stated that both perspectives are needed to make such an initiative realistic. This is reflective of S. Fletcher-Watson (2015) who encouraged co-creation by stating that 'this engaged design approach leads to higher quality product' (p. 87).

P1: *"If you're a team coming up with something you should actually incorporate a neurodivergent person into your team, to kind of create that contrast. Because of that contrast, I'm not saying that as a neurotypical person, you can't create stuff, but you kind of need both perspectives to make it realistic."*

Furthermore, participant five expressed how simply having good intentions and coming from a place of positive curiosity plays a major part in the success of co-creation and the subsequent accessibility initiative. Simply consulting people with ASD because of a legal requirement, is not sufficient enough to truly maximise co-creation. Making the effort to approach people and be open-minded to their experiences and suggestions can benefit the development and consequent implementation enormously. Therefore, positive curiosity also plays a role in the development of virtual heritage with the intent of making it more accessible for vulnerable communities.

P5: *"Everyone's different from you. If you want to make this truly accessible, you have to know not to simply do what the quantity guidelines say. You will have to actually go talk to people and look at those contradicting and very different needs."*

5.6.2. Heterogeneity

From interviews, the heterogeneity of autism spectrum disorder is another aspect heritage sites should take into account when developing virtual tours. This reflects literature from Georgiades et al. (2013) regarding the importance and lack of awareness surrounding the heterogeneity of the autism spectrum. Participant five described how using a one-size-fits-all approach would simply not work for this technology. The ability to adapt a virtual tour based on hyperreactivity to sensory inputs is seemingly one of the biggest possible benefits. Thus, an attempt to commoditise a virtual heritage tour by following a one-size-fits-all approach may not be received well. One participant with autism said:

P5: *"You could have clashing needs, one autistic person might need something that might be super overwhelming to someone else. If you did make a one-size-fits-all approach, neither of those people would probably be helped by that."*

However, participant nine described how targeting a larger group of people with a virtual heritage tour would be more advantageous than simply targeting people with ASD, linking back to the concept of division. Thus, a combination of a virtual tour that is available for the wider general public, yet still prioritises the heterogenous wants and needs of people with ASD with a customisable option would be the most beneficial way forward. This reflects literature from B. Fletcher-Watson (2015).

5.6.3. Mixed sessions

The general consensus of all interviews is that a virtual heritage tour should not solely be an option for people with ASD but should be available for everyone who chooses to use it. Despite seemingly being more beneficial to people with ASD than neurotypical people, implementing a virtual tour with people with ASD as the sole target audience would only contribute to a division between the two. Participant one expressed how having separate sessions could even contribute to a feeling of isolation, whereas the possibility of mixed sessions could explore the opportunity for social engagement. Having mixed sessions, where people with autism and neurotypical people can use virtual heritage together, could possibly not only be beneficial in

terms of social communication for some individuals with autism, it could also increase autism awareness for neurotypical people. This aligns with literature by Huws and Jones (2010) regarding interactions between people with and without a disability that can result in positive conceptualisation. Furthermore, participant five, who is diagnosed with autism, stated how making a virtual heritage tour solely for people with ASD to increase accessibility will paradoxically decrease accessibility by not allowing neurotypical people to use it. Therefore, having mixed sessions could contribute to an increase in autism awareness amongst neurotypical people which historically has been lacking, as stated by interview participants and confirming literature by Huws and Jones (2010) . Participant five further expressed how making something that's accessible for people with disabilities will almost always have benefits for non-disabled people too.

P1: *"There should be no divide. There's so many ways I know a neurodivergent person can feel isolated. And it feels like a catch-22 at a lot of times, because you do something to support them, but when you do that too much, you're taking them out of it again. I think it can be beneficial to both people with ASD and neurotypical people, because then they're also around neurodivergent people and then they can be more aware of it."*

5.6.4. Mixed reality

The possibility to combine a virtual and physical tour through mixed or augmented reality was also mentioned in several interviews. Mixed reality could provide the possible beneficial features of virtual reality whilst still allowing users to visit the physical site. The added visual aspects that accompany a mixed reality experience would therefore have positive effects for individuals who would benefit from visual learning and could enhance the interactivity of the experience. This could be advantageous in the sense that according to Magkafa & Newbutt (2018), people with autism are often great visual learners. This was further confirmed by multiple participants who either considered themselves or their child to be a visual learner. Furthermore, a mixed reality option could contribute positively to the experience of individuals who may struggle with sensory inputs or overwhelming information but still wish to see the site in person whilst feeling as comfortable as possible.

P6: *"I think lots of kids with autism need visual aid to really understand things. So sometimes museums, like for example, the Natural History Museum you just showed, it's very similar to Google Maps. But when you look at the signs, there are so many letters, it's not clear where to go, what to do, where to look. So with mixed reality, you can have arrows that say 'look here, now do this'. And you could have a picture graph of what to do. Virtual reality could be helpful, not just for showing things but for putting pictograms to show what they have to do with things."*

Buhalis & Karatay (2022) advocated the possibility of using mixed reality at heritage sites for a Gen Z audience with positive reactions from respondents. Thus, the use of mixed reality at heritage sites provides an interesting path for future research, for both audiences with ASD and audiences in general.

5. Conclusion and discussion

This research aimed to answer the question: *how can virtual reality contribute to the accessibility of cultural heritage sites for people with autism spectrum disorder (ASD)?* In order to analyse this question, semi-structured interviews took place with individuals with ASD and primary caregivers of individuals with ASD. This method allowed for an in-depth discussion about participants' experiences with accessibility at heritage sites and how these locations could improve how they receive visitors with autism. Firstly, the lack of accessibility at physical heritage sites for individuals with autism was discussed. Participants affirm literature by Magkafa & Newbutt (2018) by expressing how heritage sites often do not take into account several common ASD traits mentioned by Lord et al. (2018). The three most frequently discussed ones were hyperreactivity to sensory inputs, fear of uncertainty and highly fixated interests. In addition, untrained staff, judgement from other visitors and the lack of physical rest areas often contribute to the generalised anxiety frequently experienced by individuals with autism when visiting heritage sites. Participants further had some criticism of already existing

autism accessibility initiatives such as relaxed visits and the use of sunflower lanyards, including their frequency, content and the lack of initiatives targeted at adults with autism.

In order to answer the research question, the implications of virtual heritage for ASD accessibility were discussed. Interviews show that virtual reality could contribute to the accessibility of cultural heritage sites by allowing the adaptation and use of virtual sites based on three common ASD traits: hyperreactivity to sensory inputs, fear of uncertainty and highly fixated interests. These adaptations through virtual reality could seemingly create a safer and more predictable environment, confirming literature by S. Fletcher-Watson (2014). The ability to customise sensory inputs such as loud noises or lighting could be incredibly beneficial to individuals with autism who experience hyperreactivity and are prone to sensory overload. Customisation could also offer the possibility to modify the amount of information or the amount of interactivity as to not cause a feeling of overwhelmedness. The ability to visit a physical heritage site beforehand through virtual technology could also be beneficial to individuals who may struggle with the uncertainty of sites. This could also be advantageous to parents of children with ASD, in order to 'scout' a heritage site beforehand and identify places which could be used as a rest area if the need should arise. Furthermore, the possibility to repeat a visit multiple times, including after a physical visit has taken place, could be useful should the site contain, contribute to, or be a highly fixated interest of an individual with autism. These factors contribute to the perceived usefulness and ease of use of virtual reality (Iftikhar et al., 2022) and assist with increasing the level of physical and knowledge accessibility that individuals with autism often experience a lack of at heritage sites.

However, despite the positive implications of a virtual heritage tour for people with ASD, there are several constraints which could affect its usefulness and ease of use if not developed or implemented correctly. Firstly, participants agreed that a virtual tour should be used in moderation and a balance between virtual heritage and physical heritage should be practised. The effects of extensive technology use on social communication has been discussed in academic literature and has many opposing arguments, as illustrated by Rajendran (2013), but participants seemingly agree that constant extensive use instead of physical visits could possibly be detrimental to a person's confidence and contribute to a sense of isolation. Moreover, an apprehension towards the use of headsets could be caused by a negative experience due to sensory overload if the headset is not configured properly and requires the need to adapt to an

individual's sensory needs in a carefully thought out way. Despite this, the possible use of headsets was met with enthusiasm due to the increased interactivity and immersion they could offer, providing an interesting avenue for future research. Additionally, creating initiatives such as virtual tours, relaxed visits, etc. targeting solely people with ASD could possibly contribute to a divide between the autistic audience and the neurotypical audience. Mixed sessions were a popular option amongst participants and could be beneficial for both communities as they could also lead to an increase in ASD awareness for neurotypical people. Furthermore, the abandonment of increasing accessibility at physical sites if a virtual tour proves to be successful was identified as a possible risk.

Therefore, results show that virtual heritage should be implemented as an additional option to physical visits, whilst simultaneously improving the accessibility initiatives at the physical heritage sites. According to interviews, in order to avoid contributing to a divide between visitors with autism and neurotypical visitors, virtual heritage should be made available to a wide audience including neurodiverse and neurotypical visitors but focus on prioritising the needs and wants of people with ASD. In order to identify the accessibility needs and wants, there should be a strong emphasis on co-creation when developing a virtual heritage option by implementing a team consisting of individuals with ASD as well as neurotypical individuals. Making virtual heritage tours available for a wide audience which takes into account the heterogeneity of ASD accessibility needs could increase the awareness neurotypical visitors and staff have of autism, thus leading to a more positive conceptualisation of autism and less judgement from those without ASD, confirming literature by Huws and Jones (2010). This could consequently lead to a decrease in the level of anxiety and isolation sometimes experienced by autistic visitors.

The results of this research have societal implications. The importance of accessibility to cultural heritage sites was one of the main lines of discussion throughout interviews. These results highlight the importance of ensuring accessibility for all individuals, regardless of ability. Interviewees heavily emphasised that everyone should be able to experience cultural heritage in a way that feels comfortable to them. Using virtual heritage to make visits to cultural heritage sites more comfortable for individuals with autism is a reflection of the social model of disability and could contribute to an increase in cultural participation and engagement. Furthermore, making the general public more aware of ASD and its heterogeneity could contribute to the

feeling of comfort experienced and thus enhance cultural heritage experiences for individuals with autism who may face barriers accessing heritage sites.

Apart from conducting research with a larger sample in order to gain a greater understanding of the heterogeneity of ASD, future research is recommended to focus on analysing the full extent of knowledge transfer taking place within virtual heritage. Furthermore, the level of engagement between visitors and sites for virtual and physical sites could be analysed to indicate differences and possible avenues for mixed reality in terms of ASD accessibility could be researched. Additionally, more research could be done on how virtual reality could contribute to the accessibility of cultural heritage sites for other disabilities, thus further adapting the model from Iftikhar et al. (2022).

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Appendix A.

1. Interview Guide

Context: Cultural heritage sites such as museums or monuments are often not as accessible for people with autism as they are for neurotypical people: unpredictable, large crowds, loud noises, lights, smells, untrained staff

ASD and cultural heritage experiences
1. In your experience, how have your experiences been when visiting cultural heritage sites? (museums, historical monuments, etc.)

2. If you are comfortable sharing, how does your/your child's autism typically affect visits to a cultural heritage site?

3. In what ways do you typically try to cope with or manage feeling overwhelmed when visiting cultural heritage sites?

4. Do you believe these sites accommodate enough for people with autism?
5. Are you aware of any particular strategies or accommodations that cultural heritage sites have implemented to make them more accessible for individuals with autism?
   a. Dawnosaurs at the Natural History Museum, London
https://www.nhm.ac.uk/events/dawnosaurs.html
   b. What are your thoughts on relaxed visits for people with ASD or sensory processing difficulties?

Virtual reality

Context: Different forms: desktop vr such as google maps/street view, headsets → more immersive

Have you ever used virtual reality before?
6. Have you ever used virtual reality technology?

7. If yes, have you ever used it to experience a cultural heritage site? If so, can you describe your experience? (using a headset, instructions, sensations etc.)

Example Cases
8. What are your thoughts on this technology?
   a. General thoughts and comments
   b. Sensory inputs
   c. Immersion and interactivity
   d. Customisation

https://artsandculture.google.com/streetview/the-natural-history-museum-hintze-hall/yQHjHCm
SOMKyhQ?sv_lng=-0.17630020333149682&sv_lat=51.49614943214926&sv_h=320.96087100
78112&sv_p=11.888741123916844&sv_pid=xCOPaa20DC3Z4eRiKDUyew&sv_z=0.75526820
23476587

9. Would you use or have used this technology to visit cultural heritage sites at any point in your life?

10. Do you think these virtual reality technologies could help certain individuals with autism experience cultural heritage sites?
    a. Comparison of the two cases
    b. Customisation for sensory difficulties
    c. Lack of social aspect

11. Are there any specific features or aspects of virtual heritage sites that you feel are particularly beneficial or appealing for people with ASD when experiencing cultural heritage sites?

12. Would you prefer using either of these two technologies over visiting a cultural heritage site in person? Why or why not? How would you apply these technologies in everyday life?
    a. As a replacement
    b. Mixed reality

13. Can you think of any challenges or limitations of virtual reality technology when it comes to experiencing cultural heritage sites as an individual with autism? If so, could you describe them?

14. How important do you think it is for cultural heritage sites to make their sites more accessible for individuals with autism through innovative technology or otherwise?

2. Interviewee Overview

Interviewee	Date	Gender	ASD/Parent	Location
P1	11/04/2023	F	ASD	United Kingdom
P2	12/04/2023	F	Parent	United States
P3	19/04/2023	M	ASD	Belgium
P4	20/04/2023	F	Parent	Belgium
P5	26/04/2023	M	ASD	Netherlands
P6	26/04/2023	F	ASD	Belgium
P7	27/04/2023	M	ASD	Belgium
P8	30/04//2023	M	Parent	Belgium
P9	03/05/2023	M	ASD	Belgium

Appendix B.

Figures
Figure 1.

Persistent deficits in social communication and social interaction across multiple contexts, as manifested by
- Deficits in social–emotional reciprocity (eg, abnormal social approach and failure of normal back-and-forth conversation; or reduced sharing of interests, emotions, or affect)
- Deficits in non-verbal communicative behaviours (eg, poorly integrated verbal and non-verbal communication, abnormalities in eye contact and body language, or deficits in understanding and use of gestures)
- Deficits in developing, maintaining, and understanding relationships (eg, difficulties adjusting behaviour to suit various social contexts; or difficulties in sharing imaginative play or making friends)

Restricted, repetitive patterns of behaviour, interests, or activities, as manifested by
- Stereotyped or repetitive motor movements, use of objects, or speech (eg, simple motor stereotypies, lining up toys, or flipping objects)
- Insistence on sameness, inflexible adherence to routines, or ritualised patterns of verbal and non-verbal behaviour (eg, extreme distress at small changes, difficulties with transitions, or rigid thinking patterns)

- Highly restricted, fixated interests that are abnormal in intensity or focus (eg, strong attachment to or preoccupation with unusual objects)
- Hyperreactivity or hyporeactivity to sensory input, or unusual interests in sensory aspects of the environment (eg, apparent indifference to pain or temperature, or adverse responses to specific sounds or textures)

Notes on diagnosis
- Individuals with a well established DSM-IV diagnosis of autistic disorder, Asperger syndrome, or pervasive developmental disorder not otherwise specified should be given the diagnosis of autism spectrum disorder
- Symptoms must be present in the early developmental period (but might not become fully manifest until social demands exceed limited capacities, or might be masked by learned strategies in later life)
- Individual must have social communication deficits (past or present) in each of the three areas defined above
- Individual must have two of the four restricted, repetitive patterns (past or present), as defined above
- Symptoms must cause clinically significant impairment in social, occupational, or other areas of current functioning

Fig. 1: Lord, C., Elsabbagh, M., Baird, G., Veenstra-Vanderweelde, J. (2018). Autism Spectrum Disorder.

Figure 2.

Fig. 2: Virtual reality experience of Myin-Pya-Gu Temple in Bagan from Paladini et al. (2019)
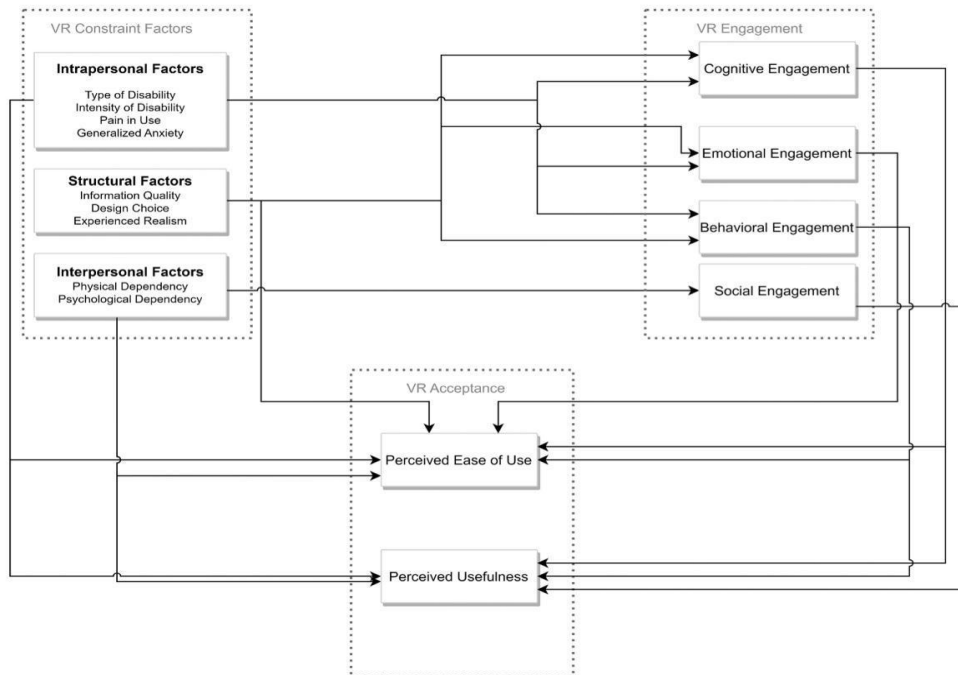
Figure 3.

Figure 1. Conceptual model of VR Tourism Acceptance for PwDs.

Fig. 3: Iftikhar et al. (2022). Conceptual model of VR Acceptance for PwDs.
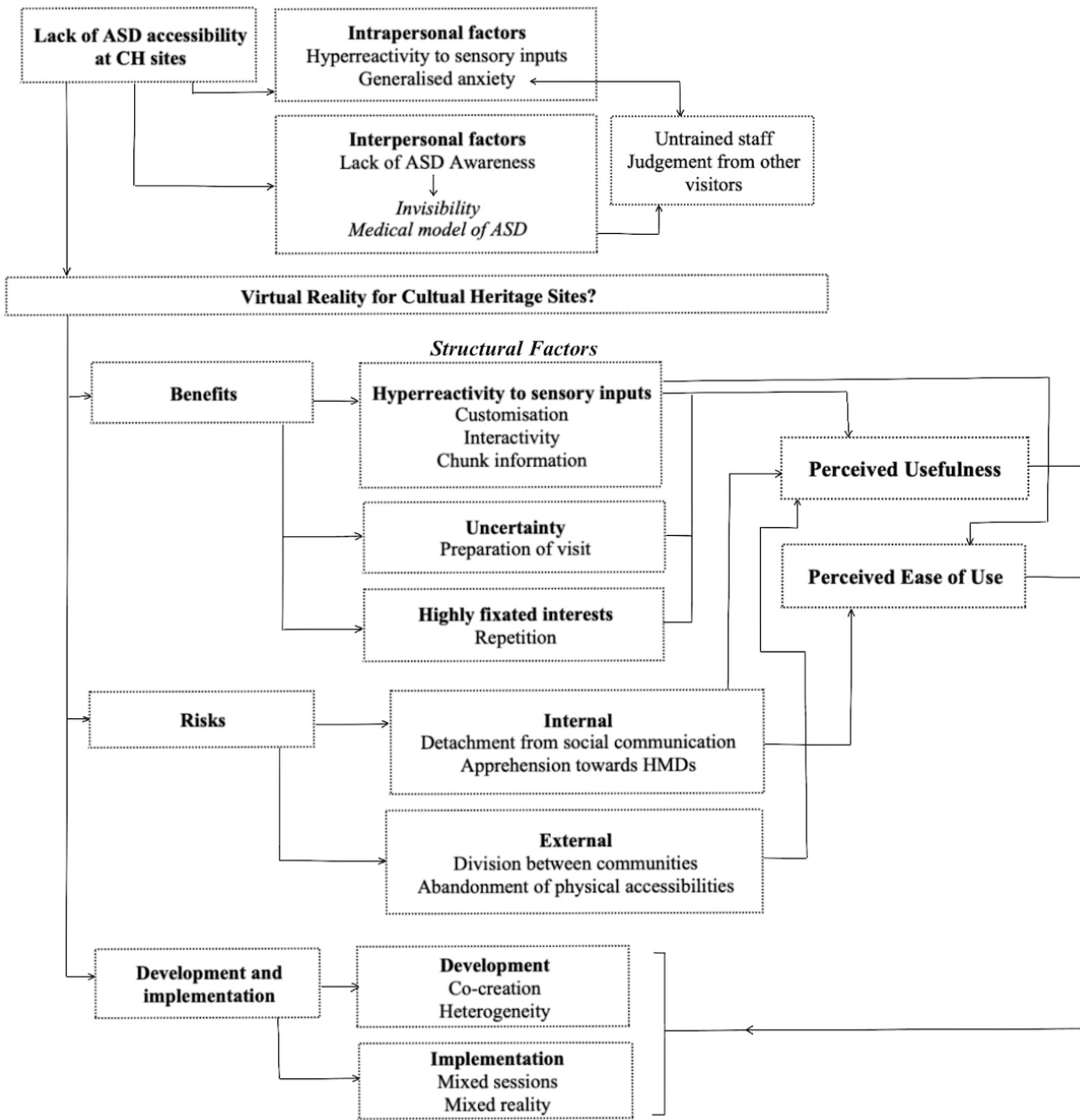
Figure 4.

Fig. 4: Visualisation of the Results Chapter

Figure 5.

Theme	Category	Code
Lack of accessibility	Intrapersonal factors: ASD	Hyperreactivity to sensory inputs
		Generalised anxiety
	Interpersonal factors: Lack of ASD awareness	Invisibility
		Medical model
	Heritage sites	Lack of rest areas
		Untrained staff
Virtual heritage benefits	Hyperreactivity to sensory inputs	Customisation
		Chunk information
		Interactivity
	Uncertainty (strict adherence to routines)	Preparation
	Highly fixated interests	Repetition
Virtual heritage risks	Internal	Possible detriment to communication behaviour
		Apprehension towards headsets
	External	Division between visitors
		Abandoning physical accessibility
Development and implementation	Development	Co-creation
		Heterogeneity
	Implementation	Mixed sessions
		Mixed reality

Fig. 5: Code book: Themes, Categories, Codes

Initial Codes: isolation, unhelpful staff, anxiety, made to feel like an inconvenience, heterogeneity, invisible, sunflower lanyard (existing initiatives and their mixed reactions), technological adeptness/proficiency of people with ASD, sensory processing, customization (choosing duration), detachment (social engagement), predictability, balance, division (catch-22), benefits for both neurodivergent and neurotypical people, co-creation, opportunity to explore hyper fixated interests, visual learning, cybersickness, accessibility of virtual tours (physical accessibility, information accessibility), preparation, quality of virtual tours, preservation, interactivity, mixed reality, ageing, lack of awareness (judgement), social anxiety, agoraphobia, beneficial as a child, chunk information, autism prevalence (then vs now, girls vs boys), mixed sessions, aversion towards headset at first, attention span, comfort zone, financial benefits for sites, desensitisation, repetition, enhancement, accessibility for family members, a virtual tour is not enough, one-size-fits-all approach, getting lost (anxiety), medical model of

disability, neurotypical language (intonation), clashing needs (heterogeneity), augmented reality, screentime