Museums and Technologies of Presence

Edited by Maria Shehade and Theopisti Stylianou-Lambert

1 Presence, Museums, and Immersive Technologies

An Interdisciplinary Exploration

Maria Shehade and Theopisti Stylianou-Lambert

1 Presence, Museums, and Immersive Technologies

An Interdisciplinary Exploration

Maria Shehade and Theopisti Stylianou-Lambert

Introduction

The last few years have seen a rediscovery or re-articulation of the concept of *presence*, which has evolved into an important trend in the field of humanities. Starting out from related notions in philosophy, presence has become an object of study in a wide variety of fields: philosophy, literature, museum studies, architecture, computer science, art, and anthropology, to name a few. Despite the many cross-disciplinary endeavours to define what 'presence' is, however, it proves an elusive concept. Its exploration within different fields of academic enquiry has led to different conceptualisations of the term both across and within different disciplines. Although reconciling these concepts might be impossible and not particularly useful, certain lessons can be learned from exploring the concept through the prism of different disciplines.

Within the field of museum studies, presence has been associated with the type of experience that a visitor can have in a museum setting, in an attempt to find the balance between interpretation/meaning on the one hand, and embodiment and immersion in the museum space on the other. The rapid advancement of technological developments such as augmented, virtual, and mixed realities (AR, VR, and MR), holograms, projection mapping with immersive sound, and virtual museum spaces has greatly affected current practices in the museum sector. As a consequence, a set of new questions regarding the effects of these technologies on presence has been raised.

The increased interest in immersive experiences, identified as the *immersive turn* (Kidd, 2018), is grounded in broader discussions and developments in new museological conceptualisations, such as the *narrative turn* (in an attempt to diversify the voices represented in museum environments), the *affective turn* (in an attempt to explore potential empathetic responses of the visitors) and the *ludic turn* (in an attempt to incorporate play and game into museum learning activities) (Kidd, 2018). This increased focus on expanded narratives, affect, and new learning experiences is rooted in museums' desire to offer more multivocal, empathetic, and transformative experiences.

At the same time, when discussing the relation of technologies such as virtual, augmented, or extended reality to presence effects in museums, one

needs to turn to relevant discussions in computer science or psychology, discussions that open up a new stream of multidisciplinary exploration and, simultaneously, new ambiguity and terminological confusion.

This chapter brings together different discussions pertaining to presence to allow both a multidisciplinary approach to presence, which is currently lacking, and cross-fertilisation of this concept across disciplines. The chapter begins with an exploration of presence focusing on the dichotomy between presence effects and meaning effects; it then moves to a discussion of presence in museum environments with an emphasis on embodiment, affect, and atmosphere. The section after that turns to computer science to investigate how presence is defined and what its key components are; the chapter concludes with a discussion of the potential role of technologies as facilitators of presence in museums.

Presence and Meaning

Even though discussions relating to the concept of presence go back to ancient times,[1] it has recently evolved into an important trend in the humanities. The ways in which the past manifests itself in the present are the main concern of the philosophy of presence, which 'attempts to understand, or at least convey, the ways the past is literally with us in the present in significant and material ways' (Kleinberg, 2013, 1). Kleinberg forgoes theoretical interpretations of the past and focuses instead on tangible objects with the potential to bring us closer to the past: the philosophy of presence thus emphasises the material and the real while challenging current understandings of interpretation and constructed meaning.

In his seminal book, *Production of Presence: What Meaning Cannot Convey* (2004), literary theorist and philosopher Hans Ulrich Gumbrecht attempts to connect presence to the role of the humanities in the twenty-first century. Gumbrecht argues that nowadays the Western world adopts a *meaning culture* that favours interpretation, one based on a purely Cartesian logic. In a meaning culture, or a *culture of interpretation*, as Gumbrecht calls it, knowledge is produced by a subject whose standpoint is eccentric in relation to the world (ibid.), and this has led to an intellectual relativism that draws us away from the past. Gumbrecht (2004) believes that our meaning culture cannot possibly cover the full complexity of our existence and, like Kleinberg, emphasises the importance of material experience when consuming art and literature.

Gumbrecht makes a case for the development of concepts in the humanities that go beyond the layer of meaning to relate to the world in more complex, bodily, and space-related ways. For this reason, he introduces the concept of 'presence' and argues for a shift from *a meaning culture* to a *presence culture* (ibid.). The main dimension of a presence culture is space and, more specifically, the relationship between human bodies and the world around them.

According to Gumbrecht, presence is a 'state of being lost in focused intensity' (2004, 104) or a spatial interconnection of the world to the body

and the senses, which is juxtaposed with the connection between the world and the mind. As Becard notes, Gumbrecht's aim is to 'go against a tradition in philosophy and literary criticism in which everything that cannot be reduced to configurations of meaning is rejected' (2014, 31), and to focus instead on a more intuitive flow with what is presently at hand.

The work of Dutch philosopher of history, Runia, and his seminal paper on presence (2006a) also places the spotlight on objects. Runia developed a concept of presence based on how the past can be present in the now while offering useful perspectives on how we engage with historical objects. For Runia, presence refers to:

> 'being in touch'—either literally or figuratively— with people, things, events, and feelings that made you into the person you are. It is having a whisper of life breathed into what has become routine and clichéd—it is fully realizing things instead of just taking them for granted (2006a, 5).

Runia (2006a) criticises the obsession of historians with constructed narratives about the past, which he believes has led us away from – instead of closer to – the past.[2]

The discipline of history attempts to create a continuity through narratives, i.e., constructed meaning, to understand the past; in the same way, museums interpret the past and their objects through meaning and narratives. For Runia, however, presence is not created by narratives: presence is linked to discontinuity; we should therefore not focus on a time continuum created by constructed narratives but should instead engage in a historical reflection 'not on history as what is irremediably gone, but on history as ongoing process', which reflects on the present (2006b, 8). This process can have a strong impact on individual experiences of the past, and this applies equally in the museum context. Thus, in the museum context, objects not only serve a particular narrative but they allow the visitor to create new, personal meanings, either through multisensory experiences (Pye, 2007) or through other avenues of embodied interaction.

Both Gumbrecht and Runia maintain that meaning is currently prioritised over presence, while interpretation is prioritised over material expressions of the past. In the museum sector, this can be seen in museological approaches and discussions that prioritise interpretation and narratives beyond an object's materiality. The dominance of curatorial texts and official *interpretations*, characterised by Hale as the 'tyranny of the text' (2012, 193), may create a mediating layer between the object and the visitor, overlooking the fact that objects are also present and thus can affect us in ways other than purely interpretative. As Söderqvist et al. argue, although:

> recent attempts to refigure the study of material culture towards non-meaning based modes of engagement suggest a loosening of the grip of

language and culture on museological discourse, the study of meaning and cultural context still remains the dominant mode of engaging with objects.

(Söderqvist et al., 2009, 434)

Nevertheless, it should be emphasised that presence is not the opposite of meaning, since both presence and meaning are dimensions of a museum experience. This is also acknowledged by Gumbrecht, who refers to an 'oscillation between presence effects and meaning effects', since 'presence phenomena always come as "presence effects" because they are necessarily surrounded by, wrapped into, and perhaps even mediated by clouds and cushions of meaning' (2004, 106–107). In a museum setting both presence and meaning co-exist and, in many cases, it would be impossible for meaning to be absent. Furthermore, museum visitors often reach meaning through multisensory and affective experiences and in the absence of pre-narrated interpretation. As a result, affective responses influence cognitive responses and vice versa. As Johnson explains, 'meaning becomes possible and takes the form it does through bodily perceptions, movements, emotions, and feelings' (2007, n.p.). Therefore, 'embodied understanding is not merely a conceptual/propositional activity of thought, but rather constitutes our most basic way of being in, and engaging with, our surroundings in a deep visceral manner' (Johnson, 2015, 1).

This more bodily and intuitive way of relating to the world seemingly comes in contrast with the concepts of interpretation and meaning — concepts prioritised in the nineteenth and twentieth centuries. What we can keep from this discussion, however, is that philosophy and museum studies of the twenty-first century are investigating new ways of meaning-making that are increasingly more sensory, embodied, immersive, and affective.

Museums and Presence: Embodiment, Affect, and Atmosphere

Gumbrecht's and Runia's discussion of presence echoes discussions in recent years in many disciplinary fields in humanities about the role of the body, discussions that have been described as 'the paradigm of embodiment' (Hale, 2012). This shift has its philosophical roots in Phenomenology, which considers the body as a pivotal aspect in our understanding of the world, since 'the body is seen as the vehicle of our "primordial encounter" with the world and the means by which we gain our basic "grip" on it' (ibid., 196). Different variations of this embodiment paradigm have also preoccupied museum studies, with relevant literature recently turning its attention more and more to the affective, sensory, embodied, and personal museum experience.

While some philosophers focused on the relationship of the human body to objects and the spaces around it, museum professionals have increasingly created affective and multisensory responses in museum spaces. For example, some museum scholars turn to what Andrea Witcomb coined the *pedagogy of feeling* (2015), referring to strategies that can engage the senses and produce

affective and embodied responses, along with cognitive ones. As Witcomb explains, the term describes:

> the ways in which some forms of contemporary exhibition practices stage affective encounters between viewer and viewed through the ways in which they use a range of devices to promote sensorial experiences that encourage introspective reflection on the part of visitors (2015, 322).

Other scholars emphasise the need for an orientation towards materiality, also known as *the material turn*, which emphasises the object's capacity to create an intimate relation to the past and to provide an emotional encounter in tandem with an educational encounter (Classen and Howes, 2006; Dudley, 2010; 2012). According to this line of thought, the material object is usually seen as an *object-information package*, a tool used for creating meaning, instead of an *object-subject interaction* (Dudley, 2010, 3).

Apart from the dynamics at play between the object and the visitor, other scholars have emphasised the importance of space as a pivotal aspect of the museum experience. As acknowledged in relevant literature, a visitor's experience may be influenced by 'elements of the physical context – the architecture, the objects on display, and the ambience' (Falk and Dierking, 2013, 29).[3]

To explore how space affects museum experience, scholars have employed space syntax[4] for analysing museum spaces and the movement of the visitor within the space (Hillier and Tzortzi, 2006; Tzortzi, 2017; see also Chapter 11 in this volume). These studies are based on the premise that space is not simply a background in human experience 'but an intrinsic aspect of it' (Hillier and Tzortzi, 2006, 283), one that can facilitate 'embodied spatial and social experience' (ibid., 282). From this perspective, when examining the physical context of the museum experience, we can imagine the visitor not simply as a viewer, looking at the space and the objects, but as a navigator, being in and experiencing the museum space (Tzortzi, 2017).

In this approach, the notion of atmosphere is central and can be linked to the aforementioned reference by Falk and Dierking on ambience. The discussion of atmosphere has appeared as a concern in museum studies (Crawley, 2012), but its definition proves a bit slippery. According to German philosopher Böhme, atmospheres 'fill the space with a certain tone of feeling, like a haze' (1993, 114), a mood that is 'in the air', an 'emotional tinge of space' (2017, 28), which 'takes possession of us like an alien power' (2017, 29). As anthropologist Tim Ingold explains, aesthetic atmospheres 'are not objective yet they inhere in the qualities of things; they are not subjective yet they belong to the sensing beings' (Ingold, 2015, 77).

In essence, Böhme places atmosphere in conjunction with space and presence, defining atmosphere as a 'mindful physical presence in space' (Böhme, 2013). Atmospheres can create affective impressions which, according to Böhme, are interlinked to the external effects of things (or objects). This takes us back to Walter Benjamin's aura conceptualisation (1968), according to

which every original work of art has an aura, an immaterial quality that cannot be reproduced. When translated into a museum setting, we could argue that visitors can 'absorb' or 'breathe in' this aura while perceiving the surrounding atmosphere in a bodily way. As explained by Böhme, 'aura is clearly something which flows forth spatially, almost something like a breath or haze – precisely an atmosphere' (1993, 117).

In the context of museums, the notion of atmosphere helps us understand the visceral and emotional responses of visitors in staged environments. As argued by Madsen, the notion of atmosphere 'stresses a need to study the visitor's experience as enmeshed in both material matters and social space' (2019, 233). Bjerregaard similarly views atmosphere as a way of generating an intensifying sense of presence in the present:

> while the use of atmospheric elements (sound, smell, visual backdrops) in exhibitions often aim to increase the experience of 'being there' […], I will hold that we may as well think of atmosphere as the generation of an intensified 'being here', a sense of presence (2015, 76).

The conceptualisation of atmospheres as a response to the aesthetic stimuli of space may also be useful in understanding how atmospheres may be co-created or result from their influence on visitors, not just of space but also of the objects (and their auras) as well as the influence of other visitors. Presence is thus also linked to actions and interactions within space, as well as with co-presence with other people. This interconnection between the visitors and the objects and between the space and other visitors also echoes the conceptualisation of the museum 'as ritual' and 'as performance' (Duncan, 1995).

The notion of atmosphere, and the relation of visitors to the museum space, has also been discussed in literature from a visitor studies perspective, with ambient conditions recognised as an important factor in museum experiences. As noted in a visitor study by Packer, the visitors 'offered general comments about the "atmosphere" or ambience, and specifically identified elements such as lighting, space, temperature and noise' (2008, 40).

All the above point towards the importance of reconsidering the museum experience through the lens of presence, and also atmosphere, and creating a balance with meaning:

> while presence and atmosphere may not be all there is to exhibition making, we need at least to think of it seriously as part of the dynamics of museum experience. And while we easily may legitimate the meaning making of museum display, we still need to account for the role played by presence effects.
>
> (Bjerregaard, 2015, 77)

We may think of the museum experience as an enmeshed nexus of meaning and presence, of interpretation and bodily experience, of cognitive and

sensorial entanglement. If one of these aspects is missing, then the experience becomes incomplete, affecting our 'proximity' with the past. As explained by Finnish geographer Granö's (1997) 'proximity' concept, to understand a landscape we should move beyond the simplification of maps and grasp the landscape's immediate presence through its full complexity, which also involves the senses, sounds, tactile elements, smells, etc.[5] The same can be argued for museums and our attempts to move beyond the layers of inter-pretation and engage with our bodies and senses.

This section explored the ways museums have responded to the concept of presence by focusing on material, embodied, and affective ways of experi-encing the museum space. Immersive technologies and the creation of virtual museum experiences, however, have expanded and problematised museums' relationship with the concept of presence. Before discussing the inter-connection of presence, museums, and technology, it is important to turn to computer science literature to explore how presence has been discussed in relation to new technological developments.

Computer Science and Presence: Determinants, Immersion, and Types

Presence has extensively preoccupied relevant literature in computer science – much more than in museum studies — because of the development of VR technologies and digital humans. The term, however, has introduced much ambiguity, controversy, and confusion, with computer scientists developing many different definitions of the term (for an overview of different defini-tions, refer to Skarbez et al., 2017; Felton and Jackson, 2021; Lombard and Jones, 2015). As stressed by Waterworth et al.:

> terminological and other confusions about what comprises presence, and what does not, have impeded progress in the field. At the current time, no unifying theory of presence is possible, because the word "presence" is being used differently by different researchers (2015, 36).

Apart from the abundance of terminological variations for presence, in many cases scholars use the term for discussing different underlying concepts (Slater, 2003). As a result, many of the available definitions of presence from the field of computer science are overlapping or even contradicting (for a further discussion of these terminological ambiguities, refer to Slater, 2003; Lee, 2004; Lombard and Jones, 2015; Felton and Jackson, 2021).

Presence has its roots in *telepresence*, a concept introduced in the 1980s by computer scientist Marvin Minsky (1980), in the context of teleoperation, to describe a system that allows its operator to feel the sense of being trans-ported to a remote workplace while controlling a machine or robot located at that space. His conceptualisation of telepresence was particularly useful for dangerous or hazardous tasks and for the concept of a remote-controlled economy. During the 1990s, this concept was further developed in the context

of VR technology, and instead of signifying the feeling of presence in another physical space, it was associated with the sense of being in a virtual environment.

Since then presence has been defined in many ways: as 'the subjective experience of being in one place or environment, even when one is physically situated in another' (Witmer and Singer, 1998, 225); as 'the perceptual illusion of non-mediation' (Lombard and Ditton, 1997, 2), or as the 'psychological state of "being there" mediated by an environment that engages our senses, captures our attention, and fosters our active involvement' (Witmer et al., 2005, 298), just to name a few.

In other cases, many variations of the term focus on different aspects of the phenomenon. For example, Slater and Usoh focus on the psychological underpinnings of our beliefs and define presence as 'the (suspension of dis-)belief that [we] are in a world other than where [our] real bodies are located' (1993, 221), while Lee focuses on things within the virtual world, defining presence as 'a psychological state in which virtual (para-authentic or artificial) objects are experienced as actual objects in either sensory or non-sensory ways' (2004, 27).

The International Society for Presence Research has defined presence as:

> a psychological state or subjective perception in which even though part or all of an individual's current experience is generated by and/or filtered through human-made technology, part or all of the individual's perception fails to accurately acknowledge the role of the technology in the experience (2000, n.p.).

Nevertheless, presence has been characterised as a 'state of consciousness' which could be produced not just by VR but also while reading books, watching movies, or even through religious experiences (Felton and Jackson 2021, 2). To distinguish it from the feeling of being transported to a virtual environment, some scholars use the term 'virtual presence' to signify presence in a computer-mediated environment. Virtual presence has been characterised as the 'most important psychological phenomenon in VR technology' (ibid.).

To decipher presence and the underlying processes that lead to its production, many conceptual models were produced (for an overview of such models, refer to Skarbez et al., 2017). One of the most well-known conceptual frameworks on presence was produced by Slater (2009), who believes presence comprises *place illusion* and *plausibility illusion*. Place illusion refers to 'the illusion of being in the place depicted in the VR ("being there") in spite of the sure knowledge that this is not the case', while plausibility illusion refers to 'the illusion that events in the VR are actually occurring, that what is perceived is happening […], in spite of the knowledge that the events are digitally generated and nothing […] is actually happening in reality' (Slater et al., 2022, 2). According to Slater et al., when these illusions co-exist, 'people tend to respond realistically to situations and events in the VR' (ibid., 3).

In other existing models of presence conceptualisation, scholars placed an emphasis on other parameters. In the model of Weber et al. presence combines the feeling of *being there* and *perceived realism*, that is 'the user's individual judgment of the degree of realism of a virtual world' (2021, 4). Whereas in the Wirth et al. model (2007) presence combines the sense of self-location (the sense of being physically located in the displayed environment) and the perceived possibilities to act (within the mediated space).

The Determinants of Presence

In computer science, the sense of being fully present in a virtual environment seems to be the measure of absolute success. And to aid technology experts in achieving this goal, the factors that affect presence need to be broken down and explained; perhaps for this reason a large number of presence studies focus on determining the factors that influence the user's sense of presence (for an overview of related factors refer to Skarbez et al., 2017). Through experimental studies of presence, factors relating to visual realism, display parameters, haptics, sound, content, and user characteristics have been found to affect the user's level of presence. Although many models have been created to categorise these factors (see Skarbez et al., 2017 for examples of such categorisations), Felton and Jackson (2021) provide a useful categorisation that builds on previous models and distinguishes presence determinants into external (relating to system features) and internal (relating to the user).

Based on this model, external determinants are separated into sensory determinants and content determinants. Sensory determinants include factors relating to the technical characteristics of the system: visual immersion (the degree to which the system obscures the user's vision of the real world); the display resolution and perception of depth; the display field-of-view; the frame update rate; head-tracking; real-world sensory distraction (coming from the physical environment), and the availability of multisensory cues (haptic, auditory, olfactory, gustatory). Content determinants include factors relating to the content presented by the system, such as the narrative, the possibility of social interaction within the system, the environmental realism, and the appearance of the virtual self (the user avatar).

On the other hand, Felton and Jackson (2021) separate internal determinants into psychological, demographic, and cultural factors. Psychological determinants include factors relating to the user's internal cognitive and psychological processes such as immersive tendency or dissociative tendency (the sense of detachment from the real world), trait absorption (the tendency to engage in a task), attention allocation, and other characteristics of the personality. Demographic factors include age and sex, while cultural determinants relate to the user's cultural background, values, and religious beliefs.

Many of the determinants discussed in literature relate to psychology and neuroscience, which indeed provide crucial contributions to the understanding of presence and its underlying psychological manifestations. In

relevant literature from the field of psychology, the notions of embodiment, self-presence, body ownership, and agency are important in understanding the phenomenon of presence (for a discussion of these terms, see deVignemont, 2020; 2011).

Although in computer science embodiment usually refers to the user representation through an avatar, in psychology it is defined differently. According to deVignemont, 'E is embodied if and only if some properties of E are processed in the same way as the properties of one's body' (2011, 84). Accordingly, body ownership refers to the feeling that a body is one's own and embodiment is a necessary condition for the creation of body ownership (ibid.). These terms also relate to self-presence, which refers to 'a psychological state in which virtual (para-authentic or artificial) self/selves are experienced in the actual self in either sensory or nonsensory ways' (Lee, 2004, 46). Finally, the notion of agency refers to 'the awareness of oneself as the cause of a particular action' (deVignemont, 2020, 85; for a discussion of these terms in relation to presence, refer to Chapter 3 in this volume).

Presence and Immersion

The concept of immersion is extensively discussed in relevant literature, and it has also caused confusion among scholars. In some cases, immersion is used interchangeably with presence, while in other cases their distinction is not clear, since immersion is used in a variety of ways. For example, Witmer and Singer consider immersion a subcomponent of presence, 'a psychological state characterised by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences' (1998, 227). Slater (2003), however, has clearly separated presence from immersion, with immersion referring to the technological capacity of the medium to remove the user from reality and presence referring to the subjective, psychological experience of feeling present in the mediated environment.[6]

This distinction also has implications for measuring the user's level of presence; if immersion is linked to the system's capacity, then it can be objectively measured through the sensorimotor contingencies of the system, and parameters such as the audio and video quality, the frame rate, the high-resolution displays, haptic feedback, etc. Thus, according to the quality and level of these parameters, systems can be classified as more or less immersive: 'the more that a system delivers displays (in all sensory modalities) and tracking that preserves fidelity in relation to their equivalent real-world sensory modalities, the more that it is "immersive"' (Slater, 2003,1). Therefore, according to this line of thought, although presence and immersion are related, they are distinct in nature. As Slater explains, 'presence is a human reaction to immersion. Given the same immersive system, different people may experience different levels of presence, and also different immersive systems may give rise to the same level of presence in different people' (ibid., 2).

Presence and immersion are also discussed in relevant literature in conjunction (and possibly in confusion) with engagement, involvement, interest, emotion, and empathetic responses. In an attempt to clarify this confusion, Slater (2003) introduced the distinction between form and content. According to Slater (2003), form relates to presence, i.e., the extent to which we feel present in an environment, irrespective of whether we feel interested, captivated, or emotionally engaged by what we see; content refers to our reactions to what we see, and whether we are interested, involved, or emotionally engaged. Thus, based on this distinction, one can feel present but not involved or interested if the content does not create this engagement and vice versa. The same applies to emotion, which can be considered another aspect of the experience, linked to content. As Slater (ibid.) emphasises, although parameters such as involvement or emotion can be used to test whether there is presence, they are nevertheless distinct in nature.

Types of Presence: Spatial, Social, Cultural

The different conceptualisations of presence have led to the creation of subcategories or variations of the term such as spatial presence, social presence, and cultural presence. These definitions are the result of the examination of different aspects or dimensions of presence, and they emphasise one aspect of presence or another.

Spatial presence emphasises the dimension of space and refers to the 'subjective sense that one is physically located within the perceived environment and subject to any physical consequences therein' (Felton and Jackson, 2021, 2). Other scholars refer to this as physical presence (Lee, 2004).

Social presence refers to 'the subjective experience of being present with a "real" person and having access to his or her thoughts and emotions' (Oh et al., 2018, 1). As Lombard and Jones (2015) emphasise, social presence may refer to other human entities or avatars, either in a virtual space or in a remote physical space, but it may also refer to reactions towards the machine (social responses to the medium itself). Though many scholars use social presence and co-presence interchangeably, Lee (2004) stresses how the two terms differ, since co-presence emphasises mutual awareness and interaction with other individuals, while social presence may also refer to one-way communication.

The expanding use of VR technologies in the heritage sector to recreate historic places that no longer exist or to better understand the past has led to the introduction of the term *cultural presence*. Apart from simply recreating a lost place, virtual reality applications in cultural heritage also place an emphasis on the accuracy and authenticity of the depicted place, the pedagogical aims of the application, the transmission of the social or other values of the objects in question, and the interaction of the user for active engagement.

Taking this into consideration, Pujol and Champion note that cultural presence 'combines the notion of "being there" with the communicational,

social, and contextual goals of heritage through the addition of symbolism, explicit expression of self-identity, and learning' (2012, 88). The term places an emphasis on other aspects important for cultural heritage apart from the reconstruction of a place – and which may not be so important in other applications. In this context, cultural presence has been linked to encouragement of 'empathy, interaction, and collaboration to enhance awareness and understanding of past or foreign cultures' and thus, in this case, presence 'is the means and "culture" is the goal' (ibid., 89).

Evaluating Presence

While museums are not particularly interested in evaluating visitors' sense of presence in their spaces, in computer sciences measuring whether a system is successful in simulating presence is crucial for evaluation and improvement. Measuring presence and evaluating the potential of a system to induce presence, however, has also proved a controversial issue in relevant literature, with scholars disagreeing on the best methods to measure presence. This type of measurement poses several challenges, with the most important pertaining to the subjective nature of presence. As emphasised by Slater (2009), presence is a qualia[7] and so it cannot be measured directly, but only through indirect assessments. Moreover, the visceral experience connected to presence makes it difficult to also express potential shifts in presence and to explore how different users experience different dimensions of presence (for an analysis of measurement challenges, refer to Slater et al., 2022).

Different scholars have adopted various indirect assessments of presence through questionnaires, behavioural, psychological, and neurological measures (for an overview of methods used, see Skarbez et al., 2017; Felton and Jackson, 2021). Questionnaires are the most common method used (usually after the immersive experience takes place), with the Witmer and Singer (1998) Presence Questionnaire and the Usoh et al. (2000) questionnaire being amongst the most widely used.

Behavioural measures record the user's responses to the VR experience, such as the adherence to social norms, based on the assumption that when users experience a high level of presence, they tend to react or behave in the virtual world as they would in the real world. Psychological measures record changes in the user's physiology, such as heart rate, body temperature, and skin conductance, under the assumption that changes in these measures are connected to the experienced level of presence. Neurological measures, which record the user's brain activity, are more rarely encountered in literature due to the operational and financial challenges of such studies.

Although these measurements can constitute a useful tool for exploring the user experience and sense of presence, they also have many limitations, which have been acknowledged in relevant studies (for a discussion of the limitations of each method, refer to Slater et al., 2022; Felton and Jackson, 2021). For example, questionnaires may impose certain conceptualisations of presence on

users or 'bring about the very feelings that it is supposed to measure' (Slater et al., 2022, 5); on the other hand, behavioural and psychological measures can be used only in cases where there is a predicted effect, one expected to cause a measurable arousal. These limitations, together with the uncertain validity of many of these measures, led some scholars to advocate the use of multiple measurements of presence (Felton and Jackson, 2021). Therefore, despite the existence of many studies and types of measurements, there is still no 'widely accepted and validated measure of virtual presence' (ibid., 3).

Immersive Technologies and the Quest for Presence in Museums

The rapid advancement of interactive and immersive technologies has greatly affected current practices in the museum sector, which has turned its attention to the potential of immersive experiences to try to tackle the many challenges the sector has faced in recent years. Consequently, this has also raised a set of new questions regarding the effects of these technologies on presence.

Museums are increasingly turning to immersive technologies to appeal to new and younger audiences, increase their visibility, and provide more engaging ways of participation. This increased interest in immersive experiences is based on the perceived advantages of emerging technologies in the sector.[8] In recent studies, immersive technologies such as VR have been acknowledged by museum professionals as offering a higher level of engagement with museum collections, which can lead to more powerful and memorable experiences, or as a tool for improving visitor perceptions of museums, attracting younger audiences, and as an effective learning tool (Shehade and Stylianou-Lambert, 2020a). The potential for enhanced learning outcomes is also emphasised in many studies (Ghouaiel et al., 2017), along with the ability of immersive storytelling to enhance the visitor experience, augment participation, or even provide multiple narratives (Kidd, 2019).

Although the application of immersive technologies in museum environments can expand the interpretation potential of the museum, it can also augment the aspect of the visitor experience that goes beyond meaning and interpretation, in the context of a realignment of museography from *object-centred* to *experience-centred design* (Parry, 2007, 81). We could argue that immersive technologies have the potential to move away from simply providing information to facilitating our sense of presence and embodiment and enriching our affective responses. Through immersive experiences, museums can transport visitors to other worlds, allowing deep and introspective engagement with museum objects and, in essence, with the past. Technology, therefore, can also have a strong effect on visitors' sense of presence through multisensory experiences, embodied interactions, and increased accessibility to the distant past.

The potential of immersive technologies and their subsequent effect on presence has also been acknowledged in relevant literature emphasising the ability of technologies to offer affective engagement and to evoke empathetic

responses from visitors (Gokcigdem, 2016) or their potential to effect beha-
vioural changes (Cohen and Heinecke, 2018). The ability of technology to
offer embodied and multisensory interactions beyond visual and textual
interpretation, including aural, haptic, and olfactory cues (Classen, 2017),
and to facilitate the engagement with difficult heritage and the transition of
museums into ethical spaces of empathy and affect (Stylianou-Lambert et al.,
2022), has also been emphasised.

The multisensory dimension of immersive museum experiences can also
open new avenues of accessibility in the museum space, affecting the sense of
presence for visitors with disabilities. The incorporation of sensory cues in the
museum experience can create an increased sense of embodiment for the
disabled body; those with disabilities can experience museum objects, works
of art, or the past in alternative ways that would otherwise be impossible for
them. This allows disabled visitors to feel present (and not detached) in the
museum space, to experience the presence of objects in more bodily ways, and
even access otherwise inaccessible places.

Nevertheless, as with any new technology, possibilities, and opportunities
come with challenges and dangers. Despite the large corpus of available litera-
ture on the advantages of technology for the overall visitor experience, however,
these challenges, and their implications for the museum experience, constitute an
understudied area, with relevant literature focused mostly on technical consid-
erations and aspects of their application (Cameron and Kenderdine, 2010).

Apart from the financial restrictions associated with the high cost of these
technologies, their incorporation into the museum space presents operational
challenges and other practical limitations associated with the specialised
equipment used and its effect on visitors. Museum professionals have also
raised concerns about the technology distracting visitors or disturbing the
exhibition flow — especially if these technologies are the only means of
interpretation — or about the social dimension of the experience (Shehade
and Stylianou-Lambert, 2020a).[9] Moreover, the wide use of 3D reconstruc-
tions for immersive environments raises concerns regarding the authenticity
and historical accuracy of these representations and underlines the need to
balance storytelling with the authenticity of these experiences.[10]

These challenges create new questions regarding our relationship with
museum objects and their surroundings, which in turn raises questions as to
whether or not technology can act as a distraction in museums, affecting the
visitors' sense of presence. The concerns regarding the effect of technologies
on objects and their authenticity echo Walter Benjamin's aura con-
ceptualisation, which is his assertion that a technological representation raises
issues of authenticity since it could redefine, alter, or even devalue the *aura* of
the original (Benjamin, 1968). Extending this line of thought to presence
discussions, one could argue that this could potentially affect our relation to
objects and their presence effects, since the aura of the original is lost; the
object takes a different 'form' and transforms into an element of the ex-
perience. Such representations may be seen as an additional stage in the life or

object biography of heritage, which does not affect its authenticity (see Shehade and Stylianou-Lambert, 2020b) or presence effect.

On the other hand, concerns regarding the social dimension of immersive experiences have also been raised, since social interactions are a vital part of museum experiences, which may be hindered by immersive installations if they disregard these social dynamics (Hornecker and Ciolfi, 2019). Indeed, many immersive technologies, such as VR, are usually designed for a single user, hindering social interaction with other visitors. Although this can deeply immerse the user and make them feel present in a virtual environment, it can also detach them from the actual museum space and affect their sense of presence in relation to the objects and their co-presence with other visitors. The wide array of available immersive technologies, however, allows for the design of experiences that also provide for social interactions, either virtual through avatars or physical through the simultaneous view of the virtual and the physical space (as in AR or MR). Immersive installations that respect the social dynamics of the museum experience can allow, and in some cases even enhance, the sense of presence and co-presence in space, or the effect of social presence (as discussed in the previous section).

We, therefore, argue that this critical reflection on the uses of immersive technologies in museums is imperative and should focus both on the design of these experiences, based on the needs of the museum and its visitors, and on the constant evaluation of their effectiveness with regard to their meaning and presence effects. Moreover, the creation of embodied experiences that may also produce empathy or affective responses, poses several ethical considerations that should also be considered when designing such experiences. Although the ethical concerns associated with some technologies have been emphasised by certain scholars (Ramirez et al., 2021; Kidd and Rees, 2022), this remains an understudied area and is an important parameter that should be considered when designing immersive experiences in museums.

Conclusion

This chapter critically explores different approaches to the notion of presence as perceived by different disciplines to pinpoint the limitations and ambiguities in existing literature. Through this analysis, several challenges emerged which should be taken into consideration in future studies on presence.

First, many different disciplines examine the notion of presence, and the language describing what presence is and what its components are is quite diverse. As Slater emphasised:

> this confusion is hampering progress in the field. There can be no advancement simply because when people talk about presence they are often not talking about the same underlying concept at all. No one is 'right' or 'wrong' in this debate, they are simply not talking about the same things (2003, 1).

Although Slater was referring to terminological confusion about presence in the field of computer science, this is equally true amongst other disciplines.

Second, most studies on presence appear confined within the limits of their respective discipline, with truly multidisciplinary perspectives still being rather rare. As evident from the preceding analysis, each discipline views presence in very different ways: to capture the essence of presence, one must engage in a truly multidisciplinary reading of all of its manifestations. Especially in museum studies and visitor experience, relevant endeavours should examine presence perspectives from a variety of fields such as computer science, philosophy, and psychology.

This proposed multidisciplinarity will also benefit each discipline with new research avenues. For example, the effects of different types of presence discussed in computer science literature are underexplored in relevant discussions in museums. On the other hand, in the context of museums, it is not always necessary for immersive experiences to entirely remove stimuli of the real world, but visitors could benefit greatly from new types of multimodality, interaction, and a combination of these with the social element of the visit.

Third, the evaluation and measurement of presence are of paramount importance when discussing immersive experiences. This also creates a challenge as to how to find valid and accepted evaluation methods. Especially in museums, or in IT applications for museums, quantitative approaches cannot fully capture the breadth of the experience or presence effects, so qualitative or mixed methods might be more appropriate, encompassing as many parameters as possible. Finally, future research should also focus on the ethical implications created by such experiences and presence practices, as well as their limits.

The new technological developments and possibilities of immersive systems have certainly created new possibilities and opportunities for museums, which may constitute a useful testbed for exploring presence effects in conjunction with multisensory and embodied experiences for visitors. We argue that immersive technologies have the potential to enhance museum visitors' sense of presence via their embodiment capabilities and multisensory experiences that can generate empathy, historical presence, and a sense of personal growth.

However, more critical research is still needed to explore the impact of presence on museum visitors within the overall exploration of immersive experiences in museums, as well as the impact that presence-induced engagement and innovative narratives can produce. We offer this chapter as a theoretical basis for an interdisciplinary exploration of the concept of presence in museums and as a first step in this direction.

Acknowledgements

Notes

1 The word presence derives from the Latin words prae (before) and sens (I am), signifying that which is before me or immediately available at hand. In the history of philosophy, presence has been linked to truth, with Plato linking truth to speaking, which relates to presence and is unmediated, in contrast to mediated writing (Bencard, 2014).
2 This also echoes Ankersmit's argument that 'theory and meaning no longer travel in the same direction; meaning has now found a new and more promising traveling companion in experience' (2005, 2).
3 One of the most influential models attempting to map the museum experience is the Interactive Experience model (and its refinement through the Contextual Model of Learning) introduced by Falk and Dierking (1992; 2013). In this model, the museum experience is contextual and depends on the interplay between three overlapping contexts: the Personal, the Sociocultural, and the Physical Context. Apart from the visitor's interests, attitudes, and personal motivations for visiting, as well as prior knowledge, needs, beliefs, and expectations, the model places emphasis on two other aspects of the museum experience: the social interaction of visitors in the museum and in the museum building, its 'feel', and the interaction between physical objects in a museum space.
4 Space syntax refers to a theory of space which analyses the layout of spaces and buildings to explore how space and its design may affect people and their move-ment/use of the space.
5 For a discussion of proximity in museum exhibitions, refer to Mordhorst, 2009.
6 For an exploration of the correlation between presence and immersion, refer to Cummings and Bailenson, 2016.
7 In philosophy, quale (plural qualia), refers to an internal subjective experience, defined as 'a subjective and internal feeling elicited by sense perceptions' (Skarbez et al., 2017, 3).
8 See for example Erbay, 2019; Stogner, 2011
9 For a general overview of the limitations of VR technology in museums, refer to Shehade and Stylianou-Lambert, 2019.
10 For relevant discussions see Di Franco et al., 2018.

Reference List

Ankersmit, Franklin Rudolf. 2005. *Sublime Historical Experience*. Palo Alto: Stanford University Press.

Bencard, Adam. 2014. "Presence in the museum. On metonymies, discontinuity and history without stories". *Museum and Society* 12: 29–43.

Benjamin, Walter. 1968. "The Work of Art in the Age of Mechanical Reproduction". In *Illuminations*, W. Benjamin, 217–251. New York: Schocken Books.

Bjerregaard, Peter. 2015. "Dissolving objects: Museums, atmosphere and the creation of presence". *Emotion, Space and Society* 15: 74–81.

Böhme, Gernot. 1993. "Atmosphere as the fundamental concept of a new aesthetics". *Thesis Eleven* 36: 113–126.

Böhme, Gernot. 2013. "Atmosphere as mindful physical presence in space". *OASE Journal for Architecture* 91(21): 21–32.

Böhme, Gernot. 2017. *The Aesthetics of Atmospheres*. London and New York: Routledge.

Cameron, Fiona, and Kenderdine, Sarah (Eds). 2010. *Theorizing Digital Cultural Heritage: A Critical Discourse*. Cambridge, Massachusetts: The MIT Press.

Classen, Constance. 2017. *The Museum of the Senses: Experiencing Art and Collections*. London: Bloomsbury Academic.

Classen, Constance, and Howes, David. 2006. "The Museum as Sensescape: Western Sensibilities and Indigenous Artifacts". In *Sensible Objects: Colonialism, Museums and Material Culture*, edited by Elizabeth Edwards, Chris Gosden, Ruth Phillips, 199–222. Oxford and New York: Routledge.

Cohen, Orna, and Heinecke, Andreas. 2018. "Dialogue exhibitions: Putting transformative learning theory into practice". *Curator: The Museum Journal* 61(2): 269–283.

Crawley, Greer. 2012. "Staging Exhibitions: Atmospheres of Imagination". In *Museum Making: Narratives, Architectures, Exhibitions*, edited by Suzanne Macleod, Laura Hourston Hanks, Jonathan Hale, 33–41. London and New York: Routledge.

Cummings, James, and Bailenson, Jeremy. 2016. "How immersive is enough? A meta-analysis of the effect of immersive technology on user presence". *Media Psychology* 19(2): 272–309.

DeVignemont, Frédérique. 2011. "Embodiment, ownership and disownership". *Consciousness and Cognition* 20(1): 82–93.

DeVignemont, Frédérique. 2020. "Bodily Feelings: Presence, Agency, and Ownership". In *The Oxford Handbook of the Philosophy of Consciousness*, edited by Uriah Kriegel, 82–101. Oxford: Oxford University Press.

Di Franco, Paola, Fabrizio, Galeazzi, and Valentina, Vassallo (Eds). 2018. *Authenticity and Cultural Heritage in the Age of 3D Digital Reproductions*. Cambridge: McDonald Institute for Archaeological Research.

Dudley, Sandra (Ed). 2010. *Museum Materialities: Objects, Engagements, Interpretations*. London and New York: Routledge.

Dudley, Sandra. 2012. "Encountering a Chinese Horse: Engaging with the Thingness of Things". In *Museum Objects: Experiencing the Properties of Things*, edited by Sandra Dudley, 1–15. London and New York: Routledge.

Duncan, Carol. 1995. *Civilizing Rituals: Inside Public Art Museums*. London: Routledge.

Erbay, Mutlu. 2019. "The Importance of Using New Technology in Museums". In *Caring and Sharing: The Cultural Heritage Environment as an Agent for Change*, edited by Valentina Vasile, 325–335. Switzerland: Springer.

Falk, John, and Dierking, Lynn. 1992. *The Museum Experience*. Washington, DC: Whalesback Books.

Falk, John, and Dierking, Lynn. 2013. *The Museum Experience Revisited*. Walnut Creek, CA: Left Coast Press.

Felton, William, and Jackson, Russell. 2021. "Presence: A review". *International Journal of Human–Computer Interaction* 38(1): 1–18.

Ghouaiel, Nehla, Garbaya, Samir, Cieutat, Jean-Marc, and Jessel, Jean-Pierre. 2017. "Mobile augmented reality in museums: towards enhancing visitor's learning experience". *International Journal of Virtual Reality* 17(1): 21–31.

Gokcigdem, Elif (Ed). 2016. *Fostering Empathy through Museums*. Lanham, MD: Rowman & Littlefield.

Granö, Johannes Gabriel. 1997. *Pure Geography*. Baltimore: Johns Hopkins University Press.

Gumbrecht, Hans Ulrich. 2004. *Production of Presence: What Meaning Cannot Convey*. Stanford: Stanford University Press.

Hale, Jonathan. 2012. "Narrative Environments and the Paradigm of Embodiment". In *Museum Making: Narratives, Architectures, Exhibitions*, edited by Suzanne Macleod, Laura Hourston Hanks, and Jonathan Hale, 192–200. London and New York: Routledge.

Hillier, Bill, and Tzortzi, Kali. 2006. "Space Syntax: The Language of Museum Space". In *A Companion to Museum Studies*, edited by Sharon Macdonald, 282–301. UK: Blackwell Publishing.

Hornecker, Eva, and Ciolfi, Luigina. 2019. *Human-Computer Interactions in Museums*. Switzerland: Springer.

Ingold, Tim. 2015. *The Life of Lines*. New York: Routledge.

International Society for Presence Research. 2000. "An explication of presence". Accessed 23 February 2023. https://ispr.info/about-presence-2/about-presence/

Johnson, Mark. 2007. *The Meaning of the Body: Aesthetics of Human Understanding*. Chicago: The University of Chicago Press.

Johnson, Mark. 2015. "Embodied understanding". *Frontiers in Psychology* 6: 875.

Kidd, Jenny, and Rees, Arran. 2022. "A Museum of Deepfakes? Potentials and Pitfalls for Deep Learning Technologies". In *Emerging Technologies and Museums: Mediating Difficult Heritage*, edited by Theopisti Stylianou-Lambert, Alexandra Bounia, and Antigone Heraclidou, 218–232. UK: Berghman Books.

Kidd, Jenny. 2018. "Immersive heritage encounters". *The Museum Review* 3(1): 3–16.

Kidd, Jenny. 2019. *Critical Encounters with Immersive Storytelling*. UK: Routledge.

Kleinberg, Ethan. 2013. "Prologue", In *Presence: Philosophy, History, and Cultural Theory for the Twenty-First Century*, edited by Ranjan Ghosh and Ethan Kleinberg, 1–7. Ithaca and London: Cornell University Press.

Lee, Kwan Min. 2004. "Presence, explicated". *Communication Theory* 14(1): 27–50.

Lombard, Matthew, and Ditton, Theresa. 1997. "At the heart of it all: The concept of presence". *Journal of Computer-Mediated Communication* 3(2): 321.

Lombard, Matthew, and Jones, Matthew. 2015. "Defining Presence". In *Immersed in Media: Telepresence Theory, Measurement & Technology*, edited by Matthew Lombard, Frank Biocca, Jonathan Freeman, Wijnand Ijsselsteijn, and Rachel Schaevitz, 13–34. Dordrecht: Springer.

Madsen, Theis Vallø. 2019. "De-scripting a museum's presence and atmosphere: An exhibition experiment". *Museum and Society* 17(2): 229–247.

Minsky, Marvin. 1980. "Telepresence". *Omni*: 45–51.

Mordhorst, Camilla. 2009. "The power of presence: The 'Cradle to Grave' installation at the British Museum". *Museum and Society* 7(3):194–205.

Oh, Catherine, Bailenson, Jeremy N., and Welch, Gregory. 2018. "A systematic review of social presence: Definition, antecedents, and implications". *Frontiers in Robotics and AI* 5: 114.

Packer, Jan. 2008. "Beyond learning: Exploring visitors' perceptions of the value and benefits of museum experiences". *Curator: The Museum Journal* 51(1): 33–55.

Parry, Ross. 2007. *Recording the Museum: Digital Heritage and the Technologies of Change*. New York: Routledge.

Pujol, Laia, and Champion, Erik. 2012. "Evaluating presence in cultural heritage projects". *International Journal of Heritage Studies* 18(1): 83–102.

Pye, Elizabeth (Ed). 2007. *The Power of Touch: Handling Objects in Museum and Heritage Contexts*. California: Left Coast Press.

Ramirez, Erick, Elliott, Miles, and Milam, Per-Erik. 2021. "What it's like to be a _: Why it's (often) unethical to use VR as an empathy nudging tool". *Ethics and Information Technology* 23(3): 527–542.

Runia, Eelco. 2006a. "Presence". *History and Theory* 45: 1–29.

Runia, Eelco. 2006b. "Spots of time". *History and Theory* 45: 305–316.

Shehade, Maria, and Stylianou-Lambert, Theopisti. 2019. "The Future of Technology in Museums". In *The Future of Tradition in Museology: Materials for a Discussion*, edited by Kerstin Smeds, 153–158. Paris: ICOFOM.

Shehade, Maria, and Stylianou-Lambert, Theopisti. 2020a. "Virtual reality in museums: Exploring the experiences of museum professionals". *Applied Sciences* 10(11): 4031.

Shehade, Maria, and Stylianou-Lambert, Theopisti. 2020b. "Revisiting Authenticity in the Age of the Digital Transformation of Cultural Tourism". In *Cultural and Tourism Innovation in the Digital Era*, edited by Vicky Katsoni and Thanasis Spyriadis, 3–16. Switzerland: Springer.

Skarbez, Richard, Brooks, Frederick, and Whitton, Mary. 2017. "A survey of presence and related concepts". *ACM Computing Surveys* 50(6): 96.

Slater, Mel. 2003. "A note on presence terminology". *Presence Connect* 3(3): 1–5.

Slater, Mel. 2009. "Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments". *Philosophical Transactions of the Royal Society B: Biological Sciences* 364: 3549–3557.

Slater, Mel, and Usoh, Martin. 1993. "Representations systems, perceptual position, and presence in immersive virtual environments". *Presence* 2(3): 221–233.

Slater, Mel, Banakou, Domna, Porres, Alejandro, Vila, Jaime, Varela, Francisco, and Martínez, Ramon. 2022. "A separate reality: An update on place illusion and plausibility in virtual reality". *Frontiers in Virtual Reality* 3: 914392.

Stogner, Maggie. 2011. "The immersive cultural museum experience – creating context and story with new media technology". *The International Journal of the Inclusive Museum* 3(3): 117–130.

Stylianou-Lambert, Theopisti, Bounia, Alexandra, and Heraclidou, Antigone (Eds). 2022. *Emerging Technologies and Museums: Mediating Difficult Heritage*. UK: Berghman Books.

Söderqvist, Thomas, Bencard, Adam, and Mordhorst, Camilla. 2009. "Between meaning culture and presence effects: Contemporary biomedical objects as a challenge to museums". *Studies in History and Philosophy of Science* 40: 431–438.

Tzortzi, Kali. 2017. "Museum architectures for embodied experience". *Museum Management and Curatorship* 32(5): 491–508.

Usoh, Martin, Catena, Ernest, Arman, Sima, and Slater, Mel. 2000. "Using presence questionnaires in reality". *Presence* 9(5): 497–503.

Waterworth, John, Waterworth, Eva, Riva, Giuseppe, and Mantovani, Fabrizia. 2015. "Presence: Form, Content and Consciousness". In *Immersed in Media: Telepresence Theory, Measurement & Technology*, edited by Matthew Lombard, Frank Biocca, Jonathan Freeman, Wijnand Ijsselsteijn, , and Rachel Schaevitz, 35–58. Dordrecht: Springer.

Weber, Stefan, Weibel, David, and Mast, Fred. 2021. "How to get there when you are there already? Defining presence in virtual reality and the importance of perceived realism". *Frontiers in Psychology* 12: 628298.

Wirth, Werner, Hartmann, Tilo, Böcking, Saskia, Vorderer, Peter, Klimmt, Christoph, Schramm, Holger, and Saari, Timo. 2007. "A process model of the formation of spatial presence experiences". *Media Psychology* 9(3): 493–525.

Witcomb, Andrea. 2015. "Toward a Pedagogy of Feeling: Understanding How Museums Create a Space for Cross-Cultural Encounters". In *The International Handbooks of Museum Studies: Museum Theory*, edited by Kylie Message and Andrea Witcomb, 321–344. Chichester: Wiley-Blackwell.

Witmer, Bob, and Singer, Michael. 1998. "Measuring presence in virtual environments: A presence questionnaire". *Presence: Teleoperators and Virtual Environments* 7(3): 225–240.

Witmer, Bob, Christian, Jerome, and Michael, Singer. 2005. "The factor structure of the presence questionnaire". *Presence* 14(3): 298–312.