CURATING MULTISENSORY EXPERIENCES:

THE POSSIBILITIES OF IMMERSIVE EXHIBITIONS

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A thesis presented to OCAD University
in partial fulfillment of the requirements for the degree of
Master of Fine Art
in
CRITICISM AND CURATORIAL PRACTICE

Toronto, Ontario, Canada

2021

ABSTRACT

Curating Multisensory Experiences: The Possibilities of Immersive Exhibitions
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Master of Fine Arts in Criticism and Curatorial Practice, OCAD University, 2021

The immersive exhibition is a specialized exhibition genre flourishing in the 21st century. It creates illusions of time and space by applying multisensory display methods to envelop visitors in a three-dimensional virtual world. The enhanced sense of presence facilitates public engagement. Not only have immersive exhibitions transformed audience experience, they have triggered discussions on the evolution of the museum and how curators can productively incorporate new technology. Based on interdisciplinary theory and the case studies of Grande Experiences (Melbourne) and teamLab (Tokyo), this thesis addresses issues around defining, developing, and curating immersive exhibitions. I discuss the genre's operation from three perspectives: managing the physical space by using nonlinear thematic frameworks and dynamic displays; curating audiences' subjective immersive experience by applying natural sensory interactions, mediator-based interactions, and collaborative participation; and identifying multisensory stimulation as immersive exhibitions' critical attribute. These aspects hold possibilities for implementation in all museum contexts. The purpose of this thesis is to offer curators and exhibition creators practical guidelines on reshaping existing displays and collections with immersive design and technology. Immersive exhibitions encourage museums to rethink the possibilities for enabling and diversifying connections between art, technology, and the public in the digital era.

ACKNOWLEDGEMENTS

My first expression of gratitude must go to my primary advisor, Dr. Jim Drobnick, for his patience, conscientiousness, and immense knowledge. He guided my research field and direction, edited each draft, and clarified all my questions during the writing process. This thesis would not have been possible without his continuous support, guidance, and encouragement. Thanks to my secondary advisor, Dr. Andrea Fatona, for helping me at the very start to choose and refine the theme of this project and offering me thoughtful suggestions to inspire my critical thinking.

I would like to thank my thesis committee member, Dr. Selmin Kara, for her encouragement and insightful comments. My sincere thanks also go to our Program Director, Dr. Keith Bresnahan, and Program Coordinator Julian Higuerey Nunez for their tireless support of our cohort during this tough pandemic time. Thanks to my Criticism and Curatorial Practices colleagues for the wonderful learning experiences we shared in the first academic year. I hope they will all have a bright future.

Lastly, I want to thank my partner for his continuous support during these two years, without whom my academic pursuit would not be conceivable. Thanks to my parents, who gave me understanding when I decided to live and study in a new country far away from home. Thanks for their constant love throughout my life.

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1. INTRODUCTION

The immersive exhibition is a specialized exhibition genre flourishing in the 21st century. It creates illusions of time and space by applying multisensory display methods to envelope visitors in a three-dimensional virtual world. The enhanced sense of presence facilitates public engagement. One of the most revolutionary features of immersive exhibition is its potentiality to accommodate multiple senses. While there are five basic senses (sight, smell, taste, hearing, and touch), two sub-basic senses (vestibular[1], proprioception[2]), and many other additional senses (e.g., chronognosis[3], nociception[4], cardioception[5], hygroreception[6], and thermoception[7]) that collectively facilitate human perception and understanding of the surrounding environment, why has only one sense – sight – become so predominant in the exhibition design? The glass cabinet tradition is the most implicit endorsement of the ocularcentric model of knowledge and knowing. Philosopher Friedrich Nietzsche has advocated for anti-ocularcentrism and argued the traditional dominant eye dictated that "the active and interpretative powers are to be suppressed" (1997: 87). This suppression also led to the overall impoverishment of the display environments and visitors' experiences.

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[1] The vestibular system is a kinesthetic sense that explains the body's perception of gravity, movement, and balance.
[2] The sense of the relative position of the body in space.
[3] The sense of time passing.
[4] The sense of pain.
[5] The sense of activities of the heart.
[6] The ability to detect changes in the moisture content of the environment.
[7] The sense of temperature.

Consequently, this thesis introduces the concept of "multisensory experience" as a specific entry point to investigate immersive exhibitions. Besides, given the previous relevant studies often focus on digital technology but ignored the effect of curatorial strategies and the theoretical framework that grounds immersive design and implementation, this thesis adopts an interdisciplinary perspective that integrates curatorial practice, new media, phenomenology, scenography, psychology, cognitive neuroscience, and sensory studies to examine the relationships between the curated immersive environment and the stimulated multisensory experience. Accordingly, this thesis begins with the developing of a definition, an evolutionary history, a theoretical foundation, and typical case studies of the immersive exhibition. It ends with a comprehensive discussion on curatorial and technological approaches that can manage objective immersive environments and subjective immersive experiences. In short, this thesis attempts to address what types of curatorial approaches are suitable for immersive exhibitions that allow participants to engage more multisensorially. What kinds of technologies and media can generate or enhance immersive environments and multisensory experiences? What and how many senses can be stimulated? The purpose is to offer exhibition practitioners practical guidance on reframing collections and reshaping current exhibitions with immersive designs and technologies; furthermore, I seek to encourage them to reconsider the possibilities of immersive exhibitions for facilitating and diversifying links between art, technology, and the public in the digital era.

1.1 DEFINING IMMERSIVE EXHIBITIONS

Immersion, in the mid-15th century, meant "plunging or dipping into"; later in the 1640s, it signified "absorption in some interests or situation" (Lukas 2012: 4). Philosopher Martin Heidegger (1962) used the German word *Dasein* to represent the state that humans are immersed in the world and claimed the world is immersive and equally inescapable. The notion was then refined to an immersive psychological state, *flow,* which psychologist Mihaly Csikszentmihalyi referred to as an optimal experience comprising "the holistic sensation that people feel when they act with total involvement" (1975; 1990: 36). Virtual reality scholars Carol Manetta and Richard Blade (1995: 37) described immersion as observers' emotional responses to become part of the virtual world. Digital media theorist and designer Janet Murray (1997) further conceptualized it as a metaphorical concept of "transportation." Known as the philosopher of cyberspace, Michael Heim (1998) proposed immersion as a sensory feeling of transporting to another place and is one of the three essential components that affects virtual experiences[8]. As compelling as these interpretations are, they tend to address immersion as a mental or emotional reflection without considering the influence of the body.

The definition of immersion can be extended to the bodily reaction of the digital-driven virtual world by considering real-time perception or awareness of the position and movement of the body and sensory data inside a computer-generated environment of proprioception (Slater & Wilbur 1997). Over the past decade, elucidations of immersion respectively highlighted the psychological, emotional, and sensory factors (e.g., Mitchell 2010: 99; Lukas 2012: 4; Yuan

[8] Another two are interaction and information.

2020: 10), physical interactions (e.g., Kitson et al. 2018: 1354), and virtual or fictional environments (e.g., Ryan 2015: 73). Sensory factors, due to the emergence of immersive exhibitions, have been particularly stressed most recently. As new media artist Melissa Aguilar (2020: 90) indicates, the immersive exhibition actively involves multiple senses besides sight; it adapts to the dynamic architectural space, makes the viewer a part of the work, and generates interactivity and intimacy while delivering information and participatory emotional responses. However, there is still no consensus on immersive exhibition's definition because of its varied manifestations, limited examples, and insufficient research.

Two things need to be recognized before defining an immersive exhibition. First, *immersive* is not equivalent to *virtual*. Although they have boundary-blurring features that simulate the real world, *virtual* tries to achieve "real" by imitating reality, focusing on providing a high level of "ideal real" through rebuilding the surrounding environment. However, *immersive* comprises a synthesis of being multisensory, participatory, emotional, and entertaining while highlighting human factors such as making people feel part of the space or using the human body as the main perceiving interface. Second, when engaging with an immersive exhibition, the perceptual process is bodily and psychological, people intuitively respond to the surrounding world rather than rely on a scientific explanation or analytical reflection. In short, the state of immersion does not mean forgetting the real since people can always catch the fake moment no matter how vivid and realistic the world is constructed. So the purpose of immersive design is not to create an absolute reality but to re-create a simulated world to activate the audiences' intuitive multisensory perceptions and echo their previous experiences. Therefore, an immersive

exhibition is a curated art space where audiences can fully engage through embodied interactions and multisensory perceptions of the designed environment that mirror their established experiences and knowledge while simultaneously generating new experiences and knowledge. The newly added elements – embodied interactions and multisensory perceptions, especially the distinction and emphasis on the existing and new experiences and knowledge, are important aspects that this thesis seeks to explore.

1.2 HISTORY OF IMMERSIVE EXHIBITIONS

From a broad historical perspective, creating a simulated environment and the quest for sensory-rich experiences are some of the oldest continuous traditions known to art history. In the 17th-century Baroque era, Catholic churches emphasized dramatic architectural structures and elements, such as illusionistic ceiling paintings, strategically-placed mirrors, monumental sculptural assemblies, and serpentine columns, all to provide 3D theatrical effects designed to awe and immerse the viewer. In the late 19th century, Claude Monet envisioned a circular installation of monumental paintings that would envelop the viewer in a panoramic expanse of water, flora, and sky. This primitive idea of immersion matched with an early argument about virtual reality – that it is panoramic rather than limited to a narrow field (Slater & Wilbur 1997). Monet materialized the panoramic idea in the form of large-scale panels known as the *Water Lilies* series (1896-1920), which can be seen as the precursor of today's classic type of immersive exhibition that digitally displays paintings with giant screens and projectors.

However, in general, immersive exhibitions are the product of modern technology that highlights the human-cyber-art relationship. The history of immersive exhibition should be written from the point when pioneer artists began to incorporate digital media and interactive technologies into their practices and then evolved into complex, three-dimensional spatial systems called immersive environments. As computer scientists Mel Slater and Sylvia Wilbur (1997) commented, people have become more and more intertwined with computers; immersive technologies supply people with new places to inhabit and share, determining people's very sense data and resulting in new bodies and new powers.

During the 1960s, early media artists began to utilize limited programming and computational tools to conduct a series of immersion experiments by staging art events called Happenings. Artist Allan Kaprow coined the term, which usually refers to a combination of installation and performance art. It was one of the participatory media arts at the time that emphasized the organic connection between art and environment, artists and audiences, and helped put new media developments into context (Wardrip-Fruin & Montfort, eds. 2003).

Immersive exhibitions became a part of popular culture with such projects as haunted houses in the 1970s, when Disney's Haunted Mansion theme park ride and Knott's Berry Farm's Knott's Scary Farm Events became prominent attractions. Such a design prototype – an immersive darkened environment to evoke fear in passing audiences – set a model for some of today's immersive exhibitions that are mainly for entertainment, such as the US art collective Meow Wolf's immersive art experiences. Their mixed-use practice – combining art installations,

audiovisual effects, live actors, and storytelling – can be seen as models to enrich modern curatorial design's repertoire to produce immersive environments and experiences.

The development of the Internet, the Web and virtual reality in the 1990s has changed nearly every aspect of modern life, fueling the development of immersive technology and the corresponding immersive experiments. In 1995, Char Davies showed her "fully immersive" interactive work *Osmose* (1994-95) at the Ricco-Maresca Gallery in New York. She used a stereoscopic head-mounted display, three-dimensionally localized interactive sound, and an embodying interface driven by the user's breath and balance to enable audiences to enter into a never experienced world. It highlighted abstract sensory experiences rather than realistic visuals and interactions, and aimed to facilitate a unique "perception of consciousness – a feeling of disembodiment and embodiment at same time" (Davies 1998). This practice experimentally extended immersion's viability and scope.

With the prominence of installation art since the late 20th century, installation artists gradually incorporated new media into their practices to produce interactive installations and immersive virtual reality artworks that center on the audiences' entire sensory experiences. Computer artists who have been endeavoring to discover the possibility of transforming physical space into virtual and futuristic environments facilitated this process. It is a significant advance that changed the conventional experience of visiting an art space from viewing from a distance to entering into and being part of the context. As sensory studies scholar Jim Drobnick (2016: 196) argued, the principal mechanism for installation art's effectiveness and increasing prevalence in the art world derives from an engagement with, and foregrounding of, the senses. Digital artist

Bonnie Mitchell (2010: 106) proposed that immersive installations that respond to the human body satisfy the viewer's inherent desire to escape physical reality and become part of the art experience itself. These statements suit immersive exhibitions, which stimulate senses beyond sight, highlighting self-consciousness and presence while using the body as the interface.

Since the beginning of the 21st century, with the continuing progress of digital technologies, there is a burgeoning interest in the design of immersive environments and the construction of interactive communication between customers and services. "Immersive" has become a buzzword, and the design and production of immersive works have gradually grown into a profitable industry that involves diverse fields such as entertainment, retail, education, and art museums. A significant number of immersive exhibition-focused companies and museums emerged in the past two decades worldwide. They revolutionized audiences' single-sensed experiences in the past hundreds of years when visiting museums while also raising debates on museum evolution and how curators need to tackle the challenges of new technologies in the digital age.

To sum up, every technological advancement provides new possibilities to create immersive environments and experiences. As media theorist Marshall McLuhan (1994) stated, the effects of technology do not occur at the level of opinions or concepts, but alter sense ratios or patterns of perception. Therefore, immersive exhibitions accomplish several outcomes: they facilitate a hybrid art of human (body and senses) and technology; they exemplify the public's growing interest in more diverse and participatory experiences; and they testify to the increase in the development of digital technologies and market demand.

2. LITERATURE REVIEW

To ascertain the starting point of my study, I will survey the existing research literature pertinent to immersive exhibitions. In general, most academic attention focuses on audiences' sensory experiences and immersive technologies in the museum context, encompassing subthemes that cover the immersive exhibition's definitions, theoretical foundations, impacts, practices, and values.

Studies of the immersive environment usually begin with examining the dynamic relationship between the body, senses, and architectural space (e.g., Bloomer & Moore 1977; Pallasmaa 2005; Spence 2020). They address theories such as *body-image* or *body spatiality* to highlight an unstable three-dimensional boundary between the inside personal space and the outside extra-personal space, while heading closer to my topic when considering how to gradually push this boundary to achieve a state of immersion. As architect Joy Malnar argued, "The point of immersing people within an environment is to activate the full range of the senses" (2017: 146).

In the past decade, attention to audiences' "full range of the senses" significantly increased. Research shows that, besides viewing, audiences' experiences also included senses of hearing (Voegelin 2013; Riches et al. 2017), smell (Drobnick 2013; McMillan 2020), touch (Verbeek 2012; Bacci & Pavani 2013; Levent & McRainey 2013; Gadoua 2015), taste (Davis 2012; Clintberg 2012; Mihalache 2013), presence (Fisher 2012; Aardalen & Steier 2020), and coherently in their overall experiences (Bitgood et al. 1990; Harvey et al. 1998; Gilbert 2000,

2002; Lorentz 2006; Dancsteop et al. 2015; Park 2020; Yuan 2020). In general, audiences' collaborative engagements, physical interactions, and stimulation of sensorial channels play crucial roles in the degree of their perceptive experiences and sensitivity to the designed immersion. Moreover, the development of cognitive neuroscience deepened the recognition of how senses interact and affect people's perceptual process (Stein & Meredith 1993; Calvert et al. eds. 2004; Stein 2012; Bruno & Pavani 2018; DeSalle 2018; Sathian & Ramachandran eds. 2020). As a result, "multisensory" (Drobnick & Fisher 2012; Levent & Pascual-Leone eds. 2013; Drobnick 2016; Brigante 2019; Lestyan 2019; Velasco & Obrist 2020; Wang 2020) and "intersensory" (Harley et al. 2016) gradually become new entry points to investigate curatorial practices, museum engagement, and audience research. Besides the sensorial aspect, there were also voices about the significant role of narratives, such as myth and storytelling, on enhancing immersive experience (Lorentz 2006: 94-121). Some studies even argued that immersive experiences evoke a richer extent of the feeling of "being there" than people present in a conventional place (Ward 2013; Aardalen & Steier 2020), which enhanced the intention to explore the distinctive capabilities of immersive exhibitions.

Scholars realized that interactive technology and new media had played crucial roles in museum exhibitions since the late 1980s (Thomas 2015: 119). The broad interest in immersive technologies began in the late 1990s when developers of video game and virtual reality systems started to extend their attention to the possibility of creating an immersive environment (e.g., Slater & Wilbur 1997; Heim 1998; Hillis 1999). Correspondingly, scholars defined some essential terms for immersive technologies and provided abundant possible theoretical supports

for practitioners to refer to, which greatly expanded the realm of implementation of immersive technologies since then (Manetta & Blade 1995). Comprehensive discussions on immersive technologies emerged in the past decade, involving broad fields such as narrative and context creation (Stogner 2011), computerized artistic practices (Mitchell 2011), entertainment and consumer space (Lukas 2012), digital humanity (Lugmayr & Teras 2015), cultural heritage (Bekele et al. 2018; Bekele & Champion 2019), and museum exhibition (Vaz et al. 2018; Aguilar 2020). Scholars also stressed that immersive technology provides sensory experiences through a combination of high quantity and quality real and digital information to the users (Slater 2009; Rodrigues et al. 2018; Bailey 2020; Velasco & Obrist 2020). Virtual art theorist Ayoung Suh and new media artist Jane Prophet (2018) further classified immersive technology into four categories depending on sensory stimuli – visual, auditory, haptic, and movement tracking. It is a meaningful attempt that scholars included multiple sensorial channels into the classification of immersive technology.

From a broad perspective, the immersive exhibition is still a new and under-researched realm, especially when compared to other fields in curatorial studies. Curators and exhibition designers usually lack the knowledge of theoretical research findings, and are inexperienced with both the empirical practices of creating immersive environments and with managing audiences' multisensory experiences in art spaces. However, given the increasingly powerful impacts from digital technologies and the public's gradually awakened awareness and demands for more emotional, participatory, and sensory-rich experiences of museum visiting, scholars and exhibition practitioners have to face the challenge of immersive exhibition as an opportunity to

make alterations, satisfy the digital native[9], and explore more deeply the relationship between humans, technology, art, and space in an era of increasing virtuality.

Meanwhile, from an academic perspective, it is essential to distinguish between immersive and virtual, immersive and multisensory, and immersive and interactive, since most of the existing studies mix or obscure these concepts. In short, *immersive* does share and overlap some features with the other terms but has a broader context; from both connotative and practical perspectives, it incorporates and accommodates the others. Moreover, previous studies have often paid too much heed to digital technology but ignored the effect of curatorial strategies, let alone the theoretical framework that grounds curatorial designs and practices. As such, this thesis moves out from the literature review's previous findings to take up questions of how to curate immersive environments and stimulate multisensory experiences through an investigation into immersive exhibition's theoretical foundations, case studies, and internal operating systems.

3. METHODOLOGY

The research methods of this thesis have included the synthesis of immersive exhibitions' foundations by reading and responding to theoretical texts, two case studies based on online resources, and comprehensive discussion of immersive exhibitions' internal operating system to offer appropriate curatorial strategies and viable technological approaches.

[9] Digital Native is the person born during or after the general introduction of digital technologies and interacts with digital technology from an early age so has a greater understanding of its concepts.

This thesis draws from the interdisciplinary contexts of phenomenology, new media, scenography, psychology, cognitive neuroscience, and sensory studies. Phenomenology interprets the dynamic relationship between the human body, mind, and surrounding space. It reveals the nuance between the real and virtual world in people's perceptions and explains how people perceive curated sites of immersion through physical interaction, mental engagement, and multisensory stimulation. New media studies expound on the algorithmic manipulations, modular structures, automation, cultural transcoding, and data visualization features of new media art, which shed light on understanding the immersive exhibition's internal operating system. Scenography and environmental psychology inform strategies to design and construct immersive environments. Psychological flow explains why, through particular structuring, dynamic displays could produce immersion without digital technologies. Cognitive neuroscience and sensory studies help identify and analyze the multisensory attribute of immersive exhibitions. These theoretical foundations ground my next approach to analyze the case studies and make recommendations for further research.

The two chosen case studies, either contain distinctive features or are used to test and respond to key issues and suggest immersive exhibitions' ongoing potentials. The Melbourne-based art company Grande Experiences represents the classic model of immersive exhibitions using massive projectors, multichannel display screens, music, lighting, and sound effects to produce immersive environments. The Tokyo-based art collective teamLab conceptually connects human, art, and technology and experimentally pushes boundaries between artworks,

audiences, and exhibition spaces. It guides audiences to become multisensory perceivers and co-creators of exhibitions through dynamic digitized interactions.

The theory and case studies provide the basis for addressing three thematic areas of managing immersive environments, curating immersive experiences, and implementing multisensory stimulation. My conclusion will offer feasible advice to facilitate immersive exhibitions' development and production, ultimately identifying it as an alternative and adaptive exhibition type in the digital age.

4. THEORETICAL FOUNDATIONS OF IMMERSIVE EXHIBITIONS

Phenomenology serves as an essential foundation for immersive exhibitions' design and practice. By studying perception and consciousness, the importance of the body and senses can be foregrounded. First, phenomenology explains why people have different interpretations of things based on the relationship between the mind and things, or things as they appear in one's experience. Heidegger pointed out the significant differences between phenomenon, appearance, and semblance in his *Being and Time* (1962: 29-30). He explained the phenomenon of a thing "shows itself in itself"; the appearance of thing "announces itself through something which does show itself," which implies that the appearance must have a physical mediator – a phenomenon. Besides, the nuance between "show" and "announce" is something that "seems to be," which is semblance. Moreover, appearances and semblances exist beyond phenomena because of people's different abilities of perception, subjective experiences, and various forms of mediators that direct their perceptual processes. Thinking of the famous Rorschach Test, people have different

interpretations of the same inkblot image, which shows test-takers' distinctive conscious patterns of perceiving objects, shapes, and scenes as meaningful reflections of their experiences. In short, phenomenology can theoretically help people discern the real and virtual world, understand why people can utilize special mediators to design and construct simulated or mirrored worlds, and why people cannot distinguish reality and virtuality at times and so can feel immersed in a constructed world.

Second, phenomenology highlights the conditional intentionality that directs one's mind to perceive things. Intentionality is the aboutness, directedness, or reference of mind towards things. It is usually affected by various conditions such as the state and level of embodiment, physical skills, cultural and social context, language, and other social practices. Embodiment, which refers to the meaning-making process when the body and mind interact through embodied activities, plays an essential role in the perceptive process and directly guides intentionality. It emphasizes physical activities such as gaze, gesture, posture, expression, and movement, all realized by various interactions with the environment – since "the cognition is embodied through the body, and the body is always embedded in the environment" (Niedenthal et al. 2005). Thus, if we change the conditions of the thing or the way of interaction, the mental representation would self-adjust correspondingly. In other words, we can manipulate people's subjective emotions and experiences by controlling the conditions of the environment and interactions between it and the body.

Third, phenomenology emphasizes the effect of spatial relationships. Classical phenomenology features the concept of *dasein*. According to Heidegger, it means "a state of

being and signifies a spatial relationship – the relationship of being which two entities extended 'in' space have to each other with regard to their location in that space" (1962: 54). Such a concept suggests that equal attention should be paid to spatial relationships between people and exhibits and architectures in immersive exhibition practices.

Finally, when it comes to experience,[10] classical phenomenology usually focuses on subjective, practical, and social conditions; in contrast, modern phenomenology concentrates on the neural substrates and how conscious experience, mental representation, and intentionality are grounded in the brain activities. Maurice Merleau-ponty (2002: 3), for instance, argued for "the 'sensation' as a unit of experience." Modern phenomenology thus pays attention to characteristics of multiple senses. It re-manifests phenomenology's central argument about the perceptual structure. The perceptual structure is a computational system designed to make inferences about a physical environment's properties based on scenes. In this context, scenes are defined as information flowing from a physical environment into a computational system via sensory transduction. Thus the perceptual structure must incorporate input from at least one sensory organ, but perception can be enhanced by activating more sensory channels. Moreover, the perceptual structure and the decision-making process can be biological or artificial, which has a significant overlap with cognitive neuroscience, sensory studies, sensor design, natural scene statistics, and computer science. These theories support the idea of increasing the diversity

[10] The experience here contains many manifestations such as perception, thought, memory, imagination, emotion, desire, embodied action, social and linguistic activities.

and degree of immersion by activating more sensory channels through natural or technological means.

In summary, phenomenology helps examine the dynamic relationships between the body, mind, and surrounding world. It promotes a theoretical understanding of the real and virtual world and further renders immersion as the "false" perception of the artificially constructed mirrored world. People's mental representations of things can be altered or re-created by changing conditions that affect intentionality, so audiences' subjective experiences can also be manipulated by setting environmental cues and designing various interactions. Additionally, enhancing audiences' awareness of spatial relationships and multisensory reactions while resonating with their established experiences conforms to phenomenological theories by strategically influencing the perceptual structure.

According to the above analysis, a four-layered design prototype suitable for planning and practicing immersive exhibitions can be generated. The first layer is the physical exhibition space. The second layer is the interior reconstructed settings and scenes. The third layer is natural sensory interactions such as gesture, voice recognition and motion capture. The fourth layer is mediator-based interactions that rely on particular devices such as touchscreens, headsets, or VR glasses. The first two layers mainly determine immersive environments, and in most cases, are unidirectional output and non-interactive. The other two layers primarily impact immersive experiences and activate more sensory channels by utilizing diverse interactions. Compared with traditional exhibitions, immersive exhibitions' advantages and potential come from the immeasurable affordance to enrich the first two layers and enhance the last two layers.

Besides phenomenology, immersive exhibitions' interdisciplinary theoretical foundations also involve relevant fields such as new media, scenography, psychology, cognitive neuroscience, and sensory studies. Their integrated potency influences immersive exhibitions' input and output mechanisms and effects.

New Media

Most examples of immersive exhibitions involve new media digital arts. New media has five principles: numerical representation, modularity, automation, variability, and cultural transcoding (Manovich 2002: 44, 49-65). Specifically, new media objects often have a similar modular structure, which determines the commonality of today's immersive exhibitions and the possibility to summarize their inner operational elements, modules, and strategies. Based on this modularity, it is possible to automate many operations and bring more flexibility to immersive exhibitions than traditional exhibition design, creation, installation, manipulation, and transport. Consequently, it allows new media objects to exist in various and potentially infinite versions. Lastly, new media aims to achieve cultural transcoding through technologies such as data visualization. It implies that new media treats its cultural and technological layers equally. This attribute is in line with immersive exhibitions and enables a high resilience in broadening its future potential. In short, understanding these principles can help explain what advantages of new media have been materialized in current immersive exhibitions and what aspects have been overlooked but can inspire new possibilities.

Scenography (Place Orientation)

Scenography is the collective practice of designing and crafting stage environments and atmospheres rooted in theatrical performance. Scenographer Pamela Howard (2002: 130) described it as "the seamless synthesis of space, text, research, art, actors, directors and spectators that contributes to an original creation." Scene works as a mediator that connects the environment (stage/setting) and the audience's perceptual experience. Anthropologist Kathleen Stewart (2014: 119) explained how this process is enacted by arguing that "scenes becoming worlds are singularities of rhythm and attachment. They require and initiate the kind of attention that both thinks through matter and accords it a life of its own." Scenographer Rachel Hann (2019) further proposed an idea of place orientation, seeing it as inclusive of haptic proxemics and orders of knowledge while also a mediator for spatial figuring.

The usage of place orientation seeks to guide the design and experience of the assemblage of space. Its inclusive traits determine its affordance to accommodate multisensory approaches. In the past decades, scenography and the place orientation theory have been taken out from their original theatre context and expanded into exhibition context, thus rendering museums and exhibition spaces as metaphorical stages (Lam 2014: 91). For example, place orientation strategies could utilize sound systems to control the audience's feeling; manage the direction and focuses of lighting systems to re-orientate the audience's attention and spatial dimensions of a place; and use the scent of unique props to re-create a specific historical period. Consequently, place orientation theory, as a spatial arrangement strategy that functions at both the physical environment and the on-site experience, conforms to consideration of the critical elements of the

internal operating system of immersive exhibitions, which can yield a huge potential in orientating and directing the audience in the exhibition space.

Environmental Psychology and Psychological Flow

Investigating human-environment interactions should also consider the psychological aspect. Environmental psychology is the study of how individuals interact with physical settings – how they experience and change the environment, and how their behaviors and experiences are changed by the environment (Ng et al. 2019: 308). For example, psychologist Stephen Bitgood (2011) studied visitors' behaviors in the exhibition context to see what types of exhibits visitors pay most attention to. He then pointed out that by arranging exhibits to lessen crowding and maximizing circulation can offer visitors better and more engaging experiences.

Psychologist Mihaly Csikszentmihalyi (1988) coined the term *flow* and referred to it as a psychological state in which people are fully absorbed and immersed in a feeling of energized focus when performing some activities, even resulting in a transformation in their sense of time and loss of reflective self-consciousness. Flow and immersion are related. Immersive experiences can be enhanced by pulling audiences' attention toward the environment and away from internal thoughts and feelings. Interactive components, multisensory stimulation, and dynamic display could also influence flow and immersion (Harvey et al. 1998). Furthermore, flow emphasizes a distorted mental sense of time. It implies that there are techniques to a design structure that would result in an immersive exhibition without digital technology but relying upon building a psychological landscape that encourages timelessness, such as a spatially

structured curatorial narrative. Psychosocial rehabilitation specialist Kendra Cherry (2021) also highlighted flow's additional characteristics, such as immediate feedback, doable tasks, and a balance between skill level and the challenge presented, which should also be considered when designing immersion-targeted activities in exhibitions.

Cognitive Neuroscience and Sensory Studies

The scientific breakthroughs in cognitive neuroscience enable more in-depth observations on immersion and multisensory experience in the context of museum exhibitions. Meanwhile, sensory studies turn sensory perception into a scholarly subject by focusing on its cultural and social connotations. Neuroscience posits that internal representations of reality, and thus predictions about experiences and the nature of such experiences themselves, are intrinsically multisensory (Pascual-Leone & Hamilton 2001). The brain is intrinsically plastic and dynamically changing to respond to changes in the environment, types of activity, and so forth (Pascual-Leone et al. 2005). Consequently, it is necessary to explore immersive exhibitions' potential in evoking audiences' multisensory experiences and the meaningful progress that it obtains in reshaping audiences' cognitive process and knowledge acquisition mode.

On the other hand, sensory studies evolved from delving into the five canonical senses to considering the historicizing and culturally-influenced shifts of the senses and how the restrictions on some senses have been gradually eliminated – a move called the "sensory turn" (Levent & Pascual-Leone 2013: xvii) or "sensual revolution" (Howes, ed. 2005: 1-7). This

progress inspires museum practitioners to feature more of the "restricted" senses in the exhibition context and prompts the emergence of immersive exhibitions.

To conclude, the factors of phenomenology-inspired design prototypes, new media principles, the place orientation mechanisms, environmental psychology, psychological flow, cognitive neuroscience, and sensory studies all merge to constitute a theoretical framework that grounds the construction of immersive environments and the management of immersive experiences.

5. CASE STUDIES

This section analyzes two examples of immersive exhibition production companies – Grande Experiences and teamLab, either containing distinctive characteristics to test and respond to key issues of the immersive exhibition this thesis features. The aim is to see whether their practices situate them on the theoretical armature outlined above and if there are gaps that could be filled to facilitate further research into and development of immersive exhibitions.

5.1 GRANDE EXPERIENCES

Grande Experiences is a Melbourne-based commercial art company specializing in the design, creation, production, and internationally display immersive art. For more than a decade, it has delivered over 200 immersive exhibitions across six continents. Its efforts moved from artifact-based to multimedia-based interactive exhibitions and developed to form the template of today's multisensory immersive experiences. In 2020, it changed its name from Grande Exhibitions to

Grande Experiences, reflecting its developing focus from solely enlivening the way to show art, culture, and science to fully integrating innovative narrative, digital technology, and interactive and multisensory immersion. This change also emphasized two aspects of the company's updated guiding principles – focusing on audiences' on-site experiences while bridging art and entertainment.

Grande Experiences' exhibitions can be classified into three types based on different ratios of three critical curatorial methods – artifact-based, multimedia-based, and on-site activities.

Type A: *Artifact-based interactive display, supplemented by multimedia-based immersive display*. Typical examples of artifact-based displays are *Leonardo da Vinci Collection* (2020) and *Planet Shark: Predator or Prey* (2016-). For example, the *Leonardo da Vinci Collection* (2020) consisted of replicas of da Vinci's world-renowned paintings and extant codices, restored models of his designs and inventions, and a SENSORY4 multimedia gallery that showed videos and moving-images about the life of this Renaissance master. The first two sections were artifact-based but encouraged on-site interactions by inviting audiences to touch and "try to use" the restored models. The SENSORY4 gallery is a revolutionary technical innovation that introduced a state-of-the-art multimedia technology – the SENSORY4 system. This system incorporates 360º large screens, high-definition projectors, and Dolby surround sound to show multichannel motion images and video footage, accompanying cinema-quality audio narrative and music to create an immersive multisensory space digitally. In brief, the curatorial strategies such as touchable exhibits and digital storytelling helped audiences better understand da Vinci's outstanding contributions to art and science, sparked their curiosity and creative thinking through

hands-on experiences, and improved the conventional glass-cabinet display method that used to show natural and historical exhibits.

Type B: *On-site interactive activities supplemented by multimedia-based immersive display*. A typical example of this type is *Alice – A Wonderland Adventure* (2017). *Alice*'s distinctive feature is live actor-led narration and activities (costumed storytelling and interactive games). The curatorial team created a well-scripted storyline to engage audiences. It presented a fantasy immersive environment that incorporated reconstructed iconic scenes from the original story, all-surface projections, and 3D and 2D theaters that showed digital and live performances. The whole exhibition acted as a digital storybook that drew the audiences "inside" the narrative. It paid tribute to the haunted house culture that became popular in the 1970s, challenged museum exhibitions' traditional text label-led narrative structure, while augmenting its educational and entertaining functions at the same time.

Type C: *A completely multimedia-based immersive display that stimulates enhanced multisensory and immersive experiences*. Typical examples are *Van Gogh Alive* (2014-)*, Monet & Friends – Life, Light & Colour* (2020), and *Digital Nights* (2020). This type relies on advanced digital technologies – such as multichannel display screens, all-surface projection, and digitally controlled surround sounds – to construct an immersive environment that activates a collective sense of space, presence, movement, sight, hearing, smell, and touch. All of Grande Experiences' high-tech display systems can be efficiently installed to suit any space conditions, making its digitized immersive environment unique and more commercially competitive. This

module facilitates reshaping traditional exhibitions into their immersive versions, even compatible with outdoor environments as *Digital Nights.*[11]

5.2 TEAMLAB

The Tokyo-based art collective teamLab is currently the world's most influential digital immersive exhibition production company. Since being established in 2001, it has expanded from a group of five persons into a team of 500, composed of experts from diverse professional fields of art, animation, computer science, engineering, mathematics, and architecture. TeamLab designs exhibitions that engage the audience's body and senses in innovative ways across various physically and digitally enhanced environments. The core of its works involves new media art. It is an art form that uses digital medium and human-computer interfaces to produce unique and non-repeatable artistic presentations. The nature of the Internet and computer science determines new media art's incredible strength in energizing interconnectivity, interactivity, non-linearity, and multisensory activation. TeamLab's projects embody these features and implement them through boundary-pushing and co-creative curatorial approaches.

On the one hand, teamLab's projects conceptually push the boundaries between art, nature, technology, and humans. TeamLab provides a prototype that uses digital technologies to expand artistic presentations, conversely, demonstrates the potential of displaying technology with

[11] Digital Nights is an outdoor digital storytelling experience using cutting-edge multisensory technologies, accompanied by food trucks, pop-up bars, and community artists' live performances.

digitized art. Not only does it pursue multisensory and interactive immersion, but each exhibition creates a perfect integration of art and technology, virtuality and reality, emotion and perception. For example, *Interactive Magnetic Field Theater* (2016) immersed audiences in a computer-generated digital world filled with floating projections. The whole space digitally imitated the forces of magnetism that are usually invisible to the naked eye. Audiences can touch the floating projections representing the earth, aurora, and free electrons to see magnetic forces depicted through light.

Nature is teamLab's favorite curatorial theme. Technology plays a vital role in augmenting people's perceptual sensitivity and interest in nature. Through the form of digital installation, nature can be turned into a living art without harming it, and audiences can perceive the dynamic continuity and hidden beauty of nature that they do not usually experience in real life. In *Graffiti Nature – Mountains and Valleys* (2016), audiences draw and color creatures by themselves, then scan the drawings and project them onto 360° surrounding screens. Consequently, they can find their self-made creatures come to life and thus able to be interacted with, such as the animal move when they "senses" people approaching. The synchronous scan and projection techniques inspire the audience's collaborative creativity and empathy toward nature and art.

Moreover, teamLab usually incorporates real plants and animals in their exhibition settings, allowing them to "live" together with digitized creatures in virtual environments. In *Living Things of Flowers, Symbiotic Lives in the Botanical Garden* (2018), real plants were positioned in the exhibit room, simulating a realistic botanical garden. Computer-generated and holographic projected animals "lived" symbiotically with the plants; digital flowers "grew" on plants and the

audience as they passed by, then bloomed, scattered, and faded away. All creatures in this space, no matter whether they were real plants, humans, or virtual animals and flowers, belonged to a single constructed ecosystem that re-enacted the dynamic interactions of the real world, such as animals "dying" (disappearing) when audiences collided or trod on them too many times. The entire exhibition integrated the natural environment with digital projections, real-time interactions, environmental odors, and sound effects, transforming the ecosystem's dynamic processes into an immersive art.

TeamLab's digital projects also highlight the close connection between nature and humans; sometimes, the reciprocal sensory interactions can be realized without digital technology but only rely on unique curatorial designs. For instance, teamLab used 2300 real flowers to create a human-nature interactive space *Floating Flower Garden* (2015). Bouquets were hung in the exhibit room and continued to grow and bloom. Their smell, color, shape, and size changed over time. Audiences could touch and smell the flowers, and their movements caused bouquets to rise up and down, thereby leaving enough space for people to perambulate. Flowers were accorded the same sensation as humans, as if they were sensing each other.

On the other hand, teamLab's exhibitions experimentally connect artworks, audiences, and exhibition spaces. Digital art allows the body to be immersed in the artwork more than ever before because of the possibility to stimulate multiple senses. Take *Crows Are Chased and the Chasing Crows Are Destined to be Chased as Well, Transcending Space – Floating Nest* (2018) as an example. It used all-surface projections to construct a 360°, 3D environment. The exhibition space became an artwork itself, allowing audiences to enter into it and become a part

of it. The digitally created crows "flew" around the space while leaving trails of light in their paths and thus created spatial calligraphy. The crows chased each other in turn, and when they crashed into one another or a member of the audience, they shattered and turned into digital flowers. Audiences were able to lay on a giant floating nest hanging in the center of the exhibit space to experience the work, which intensely augmented the "spatial immersion."

Correspondingly, audiences' instinctive or guided interactions can impact digital artworks. The boundary between audiences and artworks becomes vaguer when the audience's role expands from solely a viewer to a co-creator. For example, in *The Infinite Crystal Universe* (2015-18), the creation team borrowed the art concept of "pointillism," using countless small, distinct, and colorful LED light points to construct a three-dimensional light universe. Audiences used smartphones to select their favorite elements and changed the light points' shape and color by dragging the elements and releasing them into space to create their unique crystal universe. Each element influenced other elements and was influenced again by audiences' behaviors, making it a forever evolving artwork.

Traditional exhibitions often abandon collaborative experiences since people usually feel uncomfortable when they encounter crowding in exhibitions. However, the positivity of coexistence and cooperation can be materialized by turning collaborative behaviors that favor personal activities into common behaviors in visitor experiences. In *Flowers Bloom on People* (2017), the whole installation was just a dark room before audiences appeared. When people entered and stood still, digital virtual flowers began to "blossom" on their bodies and spread out below their feet. When they moved, flowers began to "wither" and faded away, imitating the

flower's natural growth cycle. When two people approached, the projected flowers were connected, overlaid, and blended into one. Audiences perceived each other's presence in an art space more sensitively than normal.

The boundary between artworks can also be crossed in teamLab's exhibitions. Artworks are usually materialized based on unique ideas and concepts in the artists' minds, and boundaries appear during this process. In a white cube exhibition, artworks are isolated from each other and distinguished by attached labels. However, digital artworks can transcend this boundary, making elements from one work virtually influence and interact with the others in the display space. For instance, teamLab's permanent museum *Borderless* is well-known as a museum without a map. It allows the audience to enter the artwork, artworks to move out of the room, and artworks to communicate with each other. When one digital artwork shifted out of its original location by "flying" into another room, it may meet, affect, or sometimes blend with the others. Every single artwork does not have a consistent form and usually transcends narrowly-defined room constraints to occupy the entire space. This model challenges the conventional utilization of the exhibition space. For audiences, they become immersed in an unbounded and infinitely changeable environment. It is a unique experience that traditional exhibitions cannot offer, demonstrating a superconscious level of interaction and immersion. It is also a vivid example to illustrate immersive exhibitions' broad definition.

In general, teamLab opens a new space for new media art and pushes immersive and multisensory experiences to new levels, from the logic and concept of the creation process to the

exhibition of its final form, providing a new set of strategies and models that have inspired some key arguments of this thesis.

5.3 ANALYSIS

Grande Experiences' three exhibition types reflect its three developmental phases of creating immersion – from enriching exhibits' display methods to variegating on-site interactive activities, to reconstructing multisensory and immersive environments via advanced digital technologies. The touchable exhibits, digital and live storytelling, and costumed performances are their archetypal curatorial design and practice innovations. The mobile and easily installed multimedia device set gains both artistic and commercial success based on its originality and compatibility. The massive multichannel screens and all-surfaces projections, high-quality lighting and sound effects, equipped with environmental odors and motion sensors, establish a pioneering and widely spread experimental paradigm of immersive exhibitions.

If Grande Experiences successfully denatured the museum audience from a viewer to a multisensory experiencer, the experimental model established by teamLab further evaporated boundaries between the audience and the exhibits, spaces, and every other visitor. It progresses the perceiving, engaging, and understanding processes from passive to active, static to dynamic, independent to collaborative. Combined with fun and suspense, the experience reaches a subconscious state of immersion through digitally enhanced interaction and co-creation, transforming the audience from a docile consumer to an active co-creator. The exhibition itself functions as a live digital art studio; members of audiences are artists who are bodily,

psychologically, and logically immersing themselves. Besides, most of these immersive projects transcend the fixed exhibition space's limitation, allowing the audience to "enter" into the artwork and then enable the artwork to move around the exhibit space. Moreover, their thematic frameworks are nonlinear and concept-centric, emphasizing on-site co-creation and instantaneous change. This model better demonstrates the advantage of new media art on triggering inner interconnectivity and interactivity, and the character of psychological flow affords immediate feedback through doable tasks while keeping a balance between skill level and the presented challenge. Lastly, from the technology perspective, teamLab's immersive installations present more heterogeneity than the projector-and-screen model that Grande Experiences practices. This imagery was not pre-recorded video clips or projections on the loop; instead, the system rendered every change in real-time based on custom-designed computer programs, coupled with augmented techniques such as mixed reality, motion sensors, gesture capture, shadows cast, and holography.

However, combining with the analysis of theoretical foundations, some existing issues can be summarized to reference the next section's closing discussion:

1. *Activating more sensory channels*: Although Grande Experiences has finessed touch-friendly strategy and innovative SENSORY4/6 multimedia systems, some senses such as taste, balance, and proprioception have not been activated to reach a higher level of immersion. For example, Monet's water lilies and van Gogh's wheat field could have odors installed; food and drinks could be added to da Vinci's *Last Supper*; audiences could virtually experience the pain of being bitten by shark teeth or sense high moisture when they visit the shark's underwater world.

TeamLab performs relatively better in this regard, especially on the employment of spatial and ego presence and senses of movement and balance. But more delicate senses, such as time passing or changes of temperature and moisture, can also be activated, which would perfectly match teamLab's science- and nature-themed exhibitions.

2. *A more dynamic and nonlinear narrative*: Grande Experiences uses digital and live storytelling and re-enacted performances in their exhibitions; however, its curatorial narrative still retains the linear tradition, and its exhibitions still have themed showrooms and fixed visitors routes. All interactions and activities are well-designed and managed without unpredictable effects by distinctive human factors. The visitors' experiences are tightly scripted and routed given them little autonomy over their experience, resulting in single visits or the so-called social media visit. By contrast, teamLab's immersive exhibitions are usually nonlinear and concept-centric with synchronous interaction, co-creation, and feedback, consequently attracting more audience attention and participation. But teamLab could still improve by restructuring spatial narratives or setting up more environmental cues to inspire audiences' creative and affective responses. Like escape rooms and video games, the immersion state depends more on one's mental concentration rather than only on physical interaction.

3. *Spatial relationship and place orientation*: Grande Experiences' practice mostly focuses on the audience-exhibit relation. Still, teamLab expands such a concern to encompass audience-architecture and audience-audience connections – performing better on underlining the spatial relationship by dissolving spatial boundaries and inspiring collaborative activities. TeamLab's experimental practices also match the place orientation mechanism that informs how to fully

utilize the assemblage of space to activate inclusive sensory proxemics and information orders, while also allowing the audience's behavior to influence the output of the space.

4. *Exploring more potentials of new media art*: New media artworks constitute the vast majority of immersive exhibitions, so new media's properties determine exhibitions' controllability, variability, adaptability, and the essence of free artistic expressions, while also placing pros and cons on immersive exhibitions' design and final presentation. For example, new media art's modular structure may result in immersive exhibitions' humdrum similarity and repetitive imitation; yet, new media art's potential of translating intangible cultural meanings and social values into multisensorily perceivable art can be utilized to attract more diverse audience communities. Therefore, a systematic understanding and utilization of new media art's principles could inform the rational application of new media techniques in immersive exhibitions.

5. *Social value controversy*: Immersive exhibitions have significantly improved the conventional curatorial and display methods to adapt to the digital age. They also evoke controversy to question whether exhibitions should utilize museum's authoritative social functions to satisfy the public's entertaining mindsets and private companies' commercial interests. Both Grande Experiences's and teamLab's exhibitions have been criticized as market-driven experiences or Instagrammable shows. However, just as commercial galleries sell exhibited artists' artworks, there is nothing inappropriate with exhibition companies selling immersive experiences. Besides, teamLab's exhibitions create dazzling immersive spaces to attract audiences while also thinking highly of the output of concepts and values. It is also a

purpose of this thesis to suggest that people understand the immersive exhibition's internal operating system and principles before questioning its commercial model and social value.

6. DISCUSSION: THE INTERNAL OPERATING SYSTEM OF IMMERSIVE EXHIBITIONS

Each exhibition type has particular design needs, required expertise, and articulated communities but shares a similar process comprising three phases: development, design, and implementation. The development phase determines the exhibition's concept and purpose and formulates into the exhibition brief and interpretive plan; the design phase is the material realization of the plan; the implementation phase is the construction and installation of the exhibition project (Lord & Piacente eds. 2014). Many significant issues need to be considered and determined in the first development phase to provide the entire exhibition's infrastructure, such as the concept (core idea), purpose, resource plan, thematic framework, display methods, activities, and techniques. This thesis refers to such infrastructure as the internal operating system. According to previous case studies and other existing examples, the immersive exhibition's concept and core idea involve reframing and reinstalling classic artworks, historical artifacts, and collections, displaying digital new media artworks, and visualizing multisensory, invisible, oral, or written data, concepts, and stories. The purpose is to make more material exhibits and digital artworks accessible through innovative techniques as well as to introduce new ideas, findings, and technologies for engaging with audiences.

Immersive exhibitions have a relatively specialized and stable demand for staff resources based on its unique request for technological expertise and digital art's modular structure. For example, current immersive exhibitions are usually presented by professional companies with well-organized designers, producers, marketing and installation teams, and mature technological supports. Other aspects, such as thematic framework, display methods, on-site activities, and technologies, should be considered with an audience-centered attitude. Determining the interpretive plan is a critical task in the development phase. It is a "deliberate process for thinking about how to facilitate meaning and effective experience for visitors" (Brochu 2003). Therefore, the immersive exhibition's interpretative plan should aim to create the audience's immersive experience in the curated immersive environment. This section discusses curatorial strategies and technological supports that facilitate building immersive environments while enhancing audiences' immersive experiences, involving the thematic framework, dynamic displays, interactive activities, and multisensory stimulations.

6.1 MANAGING IMMERSIVE ENVIRONMENTS

In general, effectuating immersion through structuring exhibition environments needs to manage two aspects: the nonlinear thematic framework and dynamic non-interactive displays. Both offer more possibilities to accommodate diverse curatorial strategies that activate the sense of immersion.

Nonlinear Thematic Framework

The thematic framework demonstrates the relationship between themes and subthemes that help audiences make sense of vast amounts of data, curators organize and manage content, and designers make decisions about how the experience is arranged in physical space (Piacente 2014: 256). In short, the thematic framework is the structure of an exhibition and can be developed in a linear or nonlinear way. The linear structure often has a beginning and an end, with a fixed visitors' route, usually regarding a sequence of themes, topics, or chronology; the exhibition's effects and outcomes are thus anticipated and highly controlled. On the contrary, the nonlinear structure allows audiences to explore the entire exhibition non-sequentially. The linear structure is typically employed in collection-based, nature- and history-oriented exhibitions; the nonlinear structure embodies more advantages and flexibility in virtual and participatory exhibitions. In general, the nonlinear thematic framework provides audiences with multiple perspectives, diverse choices, dynamic environments, and more possibilities to develop their own subjective and creative responses.

As analyzed in my case studies, Grande Experiences' thematic frameworks retain the linear tradition with themed showrooms and settled layouts. Human factors play a minimal role in the exhibition phase. In contrast, teamLab applies conceptual and nonlinear thematic frameworks, presenting more dynamic environments and participatory performances. TeamLab meticulously considers human factors in its interpretative plans. Thus its final presentations always encourage multisensory engagement, collaborative creation, and spiritual satisfaction.

Dynamic Non-Interactive Displays

Dynamic displays without either physical interactions challenge curators and designers to think more intensely about creating immersion that relies upon architectural layout and environmental-stimulated display strategies, such as unique exhibit arrangements, visitor routes, signage, installations, reconstructed scenes, lighting, environmental odors, music, sound effects, performances, storytelling, historical re-enactment, and multichannel and all-surface projections. Although most of these display strategies are passive and unidirectional outputs, they can produce multisensory stimulations and deploy theoretical and practical potentials to generate immersive results. Practical strategies include:

1. *Managing spatial relationships*: Exhibit arrangement and layout design involve the spatial relationship between the audience, exhibits, and the environment, particularly considering the human factor. Conventional exhibitions usually organize the objects and displays strictly corresponding to the determinate storyline and graphic design (e.g., panels, labels, walls, partitions, screens) and, most of the time, have to conform to the established architectural and interior design elements (e.g., display cases, plinths, lighting, built structures). These factors may invisibly limit the creation of a dynamic display system required for immersive environments. However, exhibit arrangement and architectural design must also flexibly respond to anticipated audiences' demands rather than only serve the exhibits. As museologist Kali Tzortzi argued, the "structure of space and distribution of objects seem to work together so as to encourage local exploration, slow down visitors' paths, and delay the rhythm of perception" (2007: 072-8). For instance, pathways that direct audiences to exhibits can be of a wide variety. Straight lines, curves, or intersections produce different degrees of immersive experiences, giving the audience

decisions to be made. Moving paths can also be altered by directing audiences to go up and down in the exhibition space. For example, building a large slide in Grande Experiences' *Alice* exhibition imitated the rabbit hole that Alice fell through and induced audiences to become deeply immersed in the re-created wonderland. This strategy is similar to what can be found in theme parks, where slow-moving and low-gradient roller coaster tracks move visitors through an environment. The audience can rest and refresh their energy and become absorbed in the display and environment with more enthusiasm and entertainment. Besides, exhibits can also be laid out in rotation or suspension forms to create a sense of spatial immersion.

Furthermore, many particular artistic forms contain immanent potentials in taking advantage of the space. For example, installation art often occupies an entire display space, so audiences have to walk through to engage fully; hence, it is more likely to achieve environmental and attentional immersion. Also, installation art can evoke multiple senses based on its "material heterogeneity and dynamic dimensionality," using various raw materials and media as well as real space and physical context to construct "room-filling environments" (Drobnick 2016: 196-197). In particular, "the dimensionality of a spatial environment requires the use of a broader range of senses than just vision in order to navigate and comprehend" (Drobnick 2016: 198). In short, managing the spatial relationship in immersive exhibitions can facilitate dynamic non-interactive displays and multisensory stimulations to produce immersion.

2. *Scenographic and place orientation curatorial design*: Scenography, in one form or another, has been exercised in museum exhibitions since its origin in the late 18th century. As economists Joseph Pine II and James Gilmore argued, effective experience staging is prevalent in

almost any industry and applies just as much to the museum world (2007: 76); the notion of staging now becomes the core metaphor in the new exhibitionary paradigm (1999: 164). And the staging discussed here should not be confined to the concept of performances but a total theatrical expression of the whole space being encountered (Lam 2014: 2). Artistic director Zupanc Lotker (2015) studied the Prague Quadrennial from 1967 to 2015 and found that one approach that could confront established modes and exhibition display techniques was to transform the entire exhibition into scenographic installations; another trend was the incorporation of performers within the exhibition. In the context of immersive exhibitions, scenographic translation of the whole or some parts of the exhibition space could enhance the affective connection between audiences and space while inspiring audiences to develop richer imaginations to intensify spontaneous reactions. Possible implementations include placing exhibits "inside" reconstructed scenes, live performances, live storytelling, and costumed historical re-enactment. Scenography-inspired curatorial strategies can simplify the audiences' understanding and accelerate their imagining processes by visualizing or materializing contents; meanwhile, they can transmit affection, reappear the passing characters and stories, and stimulate multisensory perception. These techniques are especially suitable for historical, natural, and scientific exhibitions. Grande Experiences' immersive exhibitions (e.g., *Alice*, *da Vinci*) performed well in this regard. Another example is the *Crazy Kitchen* (1967-) at the Canada Science and Technology Museum, Ottawa. Curators reconstructed an interior scene of a rustic old-time kitchen with gingham curtains, checkerboard floor, and farmhouse furniture. The windows and all furniture were perpendicular to the floor, but the floor was tipped at a 12-degree

angle. When audiences entered the space, their two main organs for balance – eyes and ears – received and sent conflicting messages to the brain. The space seemed straight according to their eyes, but their inner ears sensed the tilt. With the squares and lines on the interior decorations, audiences felt intense dizziness, spatial distortion and immersion.

Place orientation theory further explains this directive function of setting spatial and environmental cues to guide and stimulate audiences' immersive experiences. For example, managing the direction and focus of lighting can re-orientate audiences' attention, movement, and spatial dimensions; using smoke and steam can create specific scenic atmospheres and make audiences feel like they are in a burning forest or underwater. These applications also respond to the view that designing environmental cues should consider multisensory factors and sensory cultures to build the harmonious what anthropologist David Howes calls the "sensescape" (2005: 143). However, curating to stimulate multisensory experience is not an easy task since senses themselves organize space and time and are contingent upon social identity and cultural understanding. It emphasizes the significance of considering human factors in curatorial planning again. In short, utilizing environmental cues to enhance multisensory immersion should balance perceptual stimulation and cultural heterogeneity of audience groups, especially when using particular odors, sound effects, religious songs, and cultural music.

3. *Non-interactive new media*: One typical example is the multichannel all-surface projections Grande Experiences employs. The shape of display screens, placement method (i.e., suspension, encirclement, dome and floor projection), and how many assistant mediums such as speakers and sensors have been supplied also influence the final output effects. Cutting-edge

techniques such as holography, digital dioramas, streaming media (simultaneously record and project), body tracking system, and media intelligence (reacting, performing, and changing display contents through real-time data streams), making non-interactive immersion embrace a vast potential by the developing multifarious technological interfaces.

6.2 CURATING IMMERSIVE EXPERIENCES

The objective immersive environments can be managed by appropriate curatorial strategies. However, immersive experiences highlight audiences' subjective feelings that depend upon individual capacities of perception and sensation while reflecting reciprocal and dynamic connections between embodied senses and curated environments. Scholars have studied interaction's function in shaping emerging experiences and found, on the one hand, users' emotions and subjective impression emerging through interaction; on the other hand, interaction can produce the temporal structure of a resulting experience such as challenge, risk, and resolution (Djajadiningrat et al. 2007; Dalsgaard 2008; Lenz et al. 2013). In other words, interactions can arouse more enhanced experiences than the passive and unidirectional impacts from immersive environments by activating subjective and two-way bodily and psychological reactions. Different forms and degrees of interactions lead to people's varied interpretations of reality and virtuality through. Therefore, this section discusses three types of interactions – natural sensory interaction, mediator-based interaction, and co-creation – based on different physical interfaces and psychological and cognitive mechanisms.

Natural Sensory Interactions

Natural sensory interactions refer to audiences' engagement with enhanced environments and exhibits as they are used to interact with everyday, real-life information, content, and media without complex human-computer interfaces and technological devices as mediators. The class of practical cases comprises gesture, voice and face recognition, speech and noise detectors, motion capture and tracking, heart rates sensors, eye tracking, and body temperature monitoring, involving the senses of sight, hearing, proprioception, vestibular (gravity, balance, movement), cardioception, and thermoception. For example, the London-based art collective Random International's interactive installation *Rain Room* (2012) allowed audiences to walk through a reconstructed "downpour" (with real water) without getting wet by detecting audiences' movements with motion sensors. The on-site experiences were familiar and real for the audiences, just like how they sense the natural rain in real-life, but were also novel and different since it felt like they were in a virtual world in which the raindrops could automatically sense their presence and avoid them. Such experimental practice illustrated that natural sensory interactions contribute to creating instinctive and implicit information-seeking and attention- and movement-oriented mechanisms, arousing multisensory immersion by imitating people's real-life perceptual experiences.

Mediator-based Interactions

As the name suggests, this type of interaction needs immersive technologies with specific input and output and various human-computer interfaces as mediators. Unlike natural sensory

interactions' familiarity and habitualness, mediator-based interactions stimulate and specifically train audiences' subjective initiative, sensory sensitivity, cognitive decision-making, intelligence problem-solving, and bodily activities. Examples of such mediators include monitor, keyboard, hand and foot mouse, trackball, light pen, joystick, pro pointer, workbench, touchscreen, headset, speaker, microphone, smartphone, wearable device, VR glasses, and HoloLens[12]; immersive-enhanced techniques include virtual reality (VR), augmented reality (AR), mixed reality (MR), spatial sounds, spatial mapping (3D reconstruction), free-floating, head-mounted displays (HMDs), and interactive game stations. In immersive exhibitions, mediator-based interactions should feature multimodal, multisensory, and multi-user availability through the utilization of mixed devices and techniques. This model performs well, particularly for displays regarding underwater, cosmic, and historical scenes, large objects and creatures, complex internal structures, cultural heritage and archaeological sites, and it is also beneficial to the vision-impaired or people with other disabilities.

Co-creations

Both natural sensory and mediator-based interactions afford multi-users to facilitate group behaviors and co-creations naturally. The psychological flow theory also supports that users' attention will be intensely concentrated during the co-creation process. Therefore, immersive

[12] Through the HoloLens, users can see a rectangular area in front of them, called the holographic frame, allowing users to see and interact with digital contents overlaid onto their surrounding real world.

experiences can be enhanced by building psychological landscapes that fertilize timelessness through doable collaborative tasks and immediate feedback. TeamLab's *Future Park* is just such an education-oriented atypical immersive exhibition project based on collaborative creativity and co-creation concepts. It allowed audiences to draw, scan, 3D project, and interact with their personally invented creatures in their co-created digitized exhibition space. The audiences were no longer just observers or participators but co-creators of the surrounding immersive world. Electronic artist Rafael Lozano-Hemmer's immersive installation *People on People* (2010) set floor-mounted projectors to cast shadows of audiences onto the wall and hanging projectors to project the real-time scene that happened in the exhibition hall onto the same wall. Audiences' casted shadows and live-streamed images intersected and overlaid one another so that they could interact with both themselves' and other people's "real" and "virtual" figures simultaneously, and consequently created a collective immersion in terms of psychological flow and sensory perception.

Co-creation is an often neglected activity by immersive exhibition curators and designers. Such neglect fails to recognize that people instinctively desire to preserve the sense of being in a space and the constant invariance of this sense. Co-creation performs better than independent interaction in both of these respects since the deeper immersed mental state of being in a space can be generated by perceiving and distinguishing other people's presences and actions. Comparing the above-mentioned examples *Rain Room* and *People on People*, the subtle difference between the independent-interactive immersion and co-creative immersion is that the former produces the virtual presence of a computer-generated environment; the latter stimulates

the ego presence that projecting self into a computer-mediated environment, and this ego presence has to exist with other people's presence.

6.3 THE MULTISENSORY NATURE OF IMMERSIVE EXHIBITIONS

Both immersive environments and immersive experiences should be multiuser-centered and effectively consider human factors, especially the mechanism of multisensory stimulations. The effect of immersive environments and the degree of immersive experiences, to a great extent, rely upon how many sensorial channels are stimulated during the dynamic and interactive visit process.

From a historical perspective, Aristotle developed the earliest systematic account of the senses' nature by identifying sight, hearing, smell, taste, and touch (Sorabji 1971, 1992; Keeley 2009). However, the Greek-originated philosophical tradition resulted in the belief of sight as the noblest and most dominant sense in the Western culture (Flynn 1993: 274). During the Renaissance, the five basic senses formed a hierarchical system of the highest, vision, to the lowest, touch (Pallasmaa 2005: 15-16). In the early 19th century, Hegel defined the beauty of art as "the sensuous semblance of the idea" and claimed art is "for the senses" (1920: 14-16). But the senses that Hegel valorized were still limited to sight and hearing, based on the premise that they did not alter or consume their objects. In this model, taste and smell were assigned a lower value and had little ability to serve as an organ of artistic enjoyment. As architectural historian Kent Bloomer commented, "by the end of (the) nineteenth century, almost of all aesthetic problems which dealt with three-dimensional forms were treated automatically as visual

problems" (1977: 29). However, scholars and artists have continuously challenged the hierarchical order of senses through investigations of the relationship between art, architecture, and senses. Historian Geoffrey Scott distinguished the mechanical, visual, and bodily measures-based feelings when people perceived architecture, which subverted the visual sense's many centuries dominative role (1954: 171, 173). After entering the information age, with the emergence of digital technologies and new media, "ocularcentrism" has been much challenged (Chandler & Munday 2011). For example, German sculptor Adolf von Hildebrand (1907) proposed that the true vision must be tangible, tactile, and based on the interplay of the senses. Cultural historian Hanna Järvinen (2006) argued that synaesthesia and kinaesthesia blur boundaries of the senses, and the artistic efforts could appeal to the recipient's sensory imagination as a whole.

Environmental psychologist James Jerome Gibson regarded the senses as active detecting systems that constantly seek out information from the environment and as perceptual systems that can obtain information about objects in the world without the intervention of an intellectual process (1966: 32). In his view, the senses are active, mobile, exploratory, and oriented with purpose and aggression in nature. Gibson then categorized the senses into five sensory systems of visual, auditory, taste-smell, basic-orienting, and haptic, instead of the five classical senses that Aristotle listed (Bloomer & Moore 1977: 33). Anthropologist Albert Soesman (1990) further distinguished twelve senses: vision, smell, taste, hearing, touch, balance, life sense, self-movement sense, temperature sense, language sense, conceptual sense, and ego sense. As anthropologist Ashley Montagu stated, "We in the Western world are beginning to discover our

neglected senses. This growing awareness represents something of an overdue insurgency against the painful deprivation of sensory experience we have suffered in our technologized world" (1986: XIII). Moreover, the senses are not merely perceptual organs or bodily responses, as Karl Marx (1964) argued; they are also "a powerful source of materials memories which are somatically carried by the body." That is to say, senses are also the unconscious knowledge of people's physical experiences, which deliver a historical account of how much experiences change and are transformed and affect subsequent experiences. Philosopher Henri Bergson concluded that "there is no perception which is not full of memories. With the immediate and present data of our senses, we mingle a thousand details out of our past experiences" (1988: 3). Therefore, multisensory stimulation discussed here simultaneously concerns generating new experiences, mirroring established experiences, and producing knowledge.

The exhibition space is an extension of nature into the human-made virtual realm. It should not be an isolated and single sense-dominated entity; it should direct people's attention and imitate our embodied experiences within broader horizons. Human neuroscience teaches that our internal representations of reality, thus the predictions we approach experiences with and the nature of such experiences themselves, are intrinsically multisensory (Pascual-Leone & Hamilton, 2001). People visit museums with their brains creating frameworks of expectations that determine what they perceive and influence their experiences, and they usually "feel more comfortable when their minds' model map onto their experiences" (Levent & Pascual-Leone 2013: xix). As psychologist Stephen Bitgood proposed, "if the visual stimuli in the exhibit are paired with other sensory inputs (sounds, smells, texture, temperature, etc.), greater immersion is

likely to be created" (1990: 290); moreover, there is "a high correlation between visitor ratings of 'feeling in the time and place' and multisensory stimulation" (Bitgood et al. 1990). Therefore, immersive exhibitions that adopt the nonlinear thematic framework, dynamic displays, diversified interactions, and collaboration intrinsically embody multisensory-stimulation potentials to enhance audiences' experiences and reshape their used cognitive process and knowledge acquisition mode when visiting museums.

To sum up, all curatorial and technological approaches that attempt to enhance immersion should communicate with multisensory stimulation. In other words, the effect of managed immersive environments and the degree of curated immersive experiences largely depend upon how many sensorial channels are stimulated. Thus, the possibilities for the future development of immersive exhibitions critically rely on the understanding and adaptations that exhibition practitioners will make to realize multisensory experiences.

7. CONCLUSION

Digital technologies and new media influence and will continue to alter the exhibition landscape radically through diverse human-computer interfaces. This trend compels exhibition practitioners to reflect on and challenge conventional curatorial concepts and strategies. The immersive exhibition, to a great extent, is the result of developments in digital technologies and new media art, and an experimental attempt to satisfy the public's growing demands for enhanced experiences of participation, education, and entertainment. Immersive exhibitions lend themselves well to concepts of audience-centered and participatory experience-enhanced

curatorial strategies based on its dynamic-display and multisensory-stimulation affordances. In particular, as the human-made virtual extension of the real world, immersive exhibitions break conventional exhibitions' visual-dominated shackles, holding considerable capacity and potential to stimulate multiple senses such as hearing, smell, touch, taste, balance, and proprioception simultaneously. Many large-scale art institutions have begun to support or seek cooperation with professional production teams to implement immersive exhibitions and multisensory translations of existing collections. It is a feasible way to drive the public to visit on-site to obtain unique engaged experiences, thereby providing these institutions with the possibility of continuing their relevance in the digital age.[13]

This thesis synthesizes phenomenology, scenography, psychology, new media, cognitive neuroscience, and sensory studies to construct a theoretical framework to analyze immersive exhibition cases, address existing issues, and fill research gaps. It aims to provide feasible guidelines for exhibition practitioners to employ immersive technologies and multisensory-stimulation strategies better. In short, this thesis found that the nonlinear thematic framework and dynamic non-interactive display can help manage visitor's spatial relationships, exercise scenographic and place orientation strategies, and utilize manifold new media technologies to construct immersive environments. Moreover, natural sensory interactions, mediator-based interactions, and co-creations can enhance immersive experiences by allowing audiences to engage multisensorially. Adapting these curatorial and technological approaches to the creation

[13] The subject of this thesis mainly involves large-scale institutions. Immersive exhibitions' impacts on small- and medium-scale institutions would be carried out in subsequent research.

of new exhibitions and the transformation of existing exhibitions yields constructive and systematic influences on appealing to a broad range of audiences and brings them unprecedented experiences.

As discussed throughout this thesis, it is crucial to recognize that digital information has changed people's habits by creating separate virtual worlds; digital culture continues to rise in significance and is likely to dominate all aspects of human lives eventually. In the near future, exhibition environments, exhibits, and audiences' experiences will become more virtualized and immersive to keep pace with technology. It is thus the responsibility of museum practitioners, especially curators who lead the field, to pay critical attention to the multisensory-stimulated immersive exhibition and regard it as a feasible model to adapt and respond to the contemporary digital era.

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