Mediating Presence

Immersive Experience Design Workbook for UX Designers, Filmmakers, Artists, and Content Creators

Peter (Zak) Zakrzewski
and David Tamés

A Focal Press Book

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ROUTLEDGE

"Peter (Zak) Zakrzewski and David Tamés go beyond the hype to deliver a long-overdue critical and robust methodology for creating a 'better human+computer ecosystem.' Comprehensive, well-researched, and drawn from practical experience, this is not only a 'how to' make but a 'how to think about' book that helps practitioners to deeply leverage the full range of expressive affordances offered by immersive tech."

Celia Pearce, *Professor of Game Design, XR and game designer and author of* PLAYFRAMES *and* Communities of Play

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Mediating Presence: Immersive Experience Design Workbook for UX Designers, Filmmakers, Artists, and Content Creators provides the foundation for a broader understanding of the impact of XR as the next medium. The methods presented draw from a wide range of disciplines and professional practice to provide a practical guide to design methods, production techniques, best practices, and terminology that provides an effective road map for developing immersive experiences using augmented reality, virtual reality, augmented virtuality, and other emerging immersive media forms.

In this book, media designers Peter (Zak) Zakrzewski and David Tamés present a comprehensive framework for XR media experience design (XRXD) that will allow UX designers, filmmakers, artists, and content creators to connect their audiences to rich, multimodal, immersive experiences for entertainment, learning, creating, and healing. This book guides the reader through a 12+1-step design-based model for creating XR experiences. Each step is accompanied by specific media design methods expressly created for or adapted to XR content creation. The theoretical concepts and methods covered address the specific context and meaning aspects of the XR media environments being created.

Peter (Zak) Zakrzewski is a design strategist, researcher, and design and innovation coach who advocates for applying transformative design thinking and participatory design methods to the creation of media, experiences, and social change. He is an assistant professor of communication and visual arts at Thompson Rivers University. He is a former creative director of the emerging technologies conference EmTech at MIT. He is a recipient of the MIT President's Citation Award for his research, design, and strategy work for the MIT Enterprise Forum.

David Tamés is a media maker working in traditional and immersive media forms. His creative practice focuses on media co-creation and immersive media production. David recently completed an MIT Open Documentary Lab Fellowship, conducting research for this book. He is a teaching professor in the Department of Art + Design at Northeastern University with a joint appointment in communication studies. David is on the board of directors of Filmmaker's Collaborative and serves on the advisory board of MedVR. David has produced award-winning short films and recently co-directed and co-produced *Reality's Fugue: Genesis*, a virtual reality experience that provides a new take on the Genesis origin story to suggest how we create a shared world.

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Routledge
Taylor & Francis Group
NEW YORK AND LONDON

First published 2025
by Routledge
605 Third Avenue, New York, NY 10158

and by Routledge
4 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN

Routledge is an imprint of the Taylor & Francis Group, an informa business

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ISBN: 978-1-032-58084-5 (hbk)
ISBN: 978-1-032-58083-8 (pbk)
ISBN: 978-1-003-44246-2 (ebk)

DOI: 10.4324/9781003442462

Typeset in Times New Roman
by Apex CoVantage, LLC

Access the Support Materials: https://xrxdesign.com

Peter's Dedication
I dedicate this book to the students in my immersive media class at Thompson Rivers University. You are the future of extended reality, and extended reality is your future.

David's Dedication
I dedicate this book to Jan Kubasiewicz and Gunta Kaza, designers who taught me to think of design as experience and to embrace theory as illuminating what is implicit in creative practice.

Research for this book was conducted during an MIT Open Doc Lab Fellowship 2021–22 and 2024; special thanks to the fellows, faculty, and staff for their support and encouragement, especially William Uricchio.

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Contents

Acknowledgments

We thank Daniel Kershaw, Danielle Zarfati, and Alyss Barraza at Focal Press for their support during the production of this book. We express our gratitude to Kimberly Husband and Kate Fornadel for their assistance with the copyediting of the final manuscript. We would like to thank all of the people in the XR community who generously shared their experiences with us to expand our understanding of this new and rapidly evolving medium: Zev Berman, Christopher Boulton, Danger Donaghy, Bernard Francois, Rus Gant, Sofie Hodara, Jeffrey Jacobson, Oscar Keyes, Eileen McGivney, Vittorio Netti, Patrick Nugent, Steven Max Patterson, Celia Pearce, Nicolas Robbe, Mandy Rose, Mark Sivak, Graham Roberts, J. J. Ruscella, and Jamal Thorne.

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Introduction

Engulfed in Flames: The Most Persuasive Medium in History

It was a cool and windy but otherwise inauspicious day in 1990 when David walked into the San Francisco Museum of Modern Art (SFMoMA) to see a new media exhibition.[1] Little did he know at the time that the show he was about to experience would be remembered as a landmark event that symbolically marked the birth of an imperative for a new-media art movement. Perhaps more importantly to our story here, it also became a formative experience that shaped David's fascination with the transformative potential of immersive media.[2] Strolling through the exhibition with no specific idea of what to expect, David came upon Jim Campbell's installation titled *Hallucination*. He was caught in the gaze of a black-and-white surveillance camera and saw himself on a large rear-projection video monitor. Just as he was about to turn to a friend to wonder out loud what this was all about, he witnessed himself being engulfed by flames. David watched the electronic reflection of his digital self burn up in vivid color. The accompanying sound of a crackling fire heightened the eerie sensation. This was no ordinary museum experience. The immersive out-of-body quality was accompanied by a distinct awareness of the artifice of what was happening. As David stared at the monitor, a woman appeared in the video reflection. Sometimes, she observed the environment passively. Other times, she would interact with it. Seeing another person seemingly enter the exhibit, David turned, expecting to see a real person behind him, only to realize that figure was an apparition in the virtual world. This uncanny sensation triggered a mild sense of anxiety followed by a philosophical inquiry: What was going on here regarding observable reality? This was 1990, a world in which e-mail was the killer app. The closest even the most adventurous techno geek got to the magic of the world of shared information was the disconnected text-based terminal screens.[3] Personal computers of the day only provided a tiny window onto the data stored on their own hard drives. They were devices used primarily for word processing, spreadsheets, e-mail, or simple graphical applications for those lucky enough to own a Macintosh or a Unix workstation. In this prehistoric context, *Hallucination* dramatically signaled how far computational media could and had to go and how it would expand our understanding of what it meant to participate in computationally mediated experiences.

DOI: 10.4324/9781003442462-1

The exhibit curator, Robert Riley, wrote that his "measure of art" was "seduction" manifested when the audience became "absolutely convinced by the authority of a work" to believe that "this is the way things are." Riley suggested that profoundly moving immersive content could become "the ultimate exchange of humanity, wisdom, and intellect that we have."[4] A work like *Hallucination* stood out because it moved beyond the confines of the installation and media artworks seen before and into a realm that dissolved the boundary between a participant's subjective experience and a computational environment. Campbell's piece achieved a high level of engagement by embedding the participant in the work as both an actor and an observer interconnected in the production process. Presence was enabled by a novel computational component that performed the image processing required to composite the flames onto the moving bodies of the spectators. The piece went beyond the mechanical interface expected from museum exhibits. Gallery visitors who wandered into the space became immersed in the virtual world created by the artist. In a moment of epiphany, David saw how this new art form would use software as a medium and data as material. In the fire of *Hallucination*, he saw the possible future of immersive computational media. Notions of the computer as a medium, our connection with computational objects, and new-media art, as both substrate and form, came to David in that single moment of combustion. The reverberations of experiencing *Hallucination* revealed to him that it would be just a matter of time before personal computers would collectively transport us into what we know today as extended reality (XR). In the mid-2020s, we acknowledge that the technology is not quite ready for mass adoption of XR beyond VR gaming and specialized applications; but we also argue that the time is now for content creators to not only get ready for those soon-to-come technological developments but to start co-creating a richer and more humane immersive media. What a time it is to be alive for this massive media revolution not just as a witness but as an active participant.

Dreaming of Better Human+Computer Ecology

Peter's immersive conversion occurred during his doctoral research, eventually culminating in the book *Designing XR: A Rhetorical Design Perspective for the Ecology of Human+Computer Systems*. Over the course of five years, Peter had an opportunity to observe the new domain slowly but steadily emerging from experimentation in the areas of ubiquitous computing, wearable devices, artificial intelligence (AI), the Internet of Things IoT (IoT), and dedicated augmented reality (AR) and virtual reality (VR) technologies. Since the early days of computation, the interaction between humans and computers has become increasingly intimate. In the span of six decades or so, we have gone from room-size computers operated by engineers in white lab coats to everyday people pointing, clicking, and typing on their personal devices to kids walking around with smartphones, calling and texting their friends by touching responsive screens. With the rapid co-mingling of AI, XR, IoT, and robotics, the emergence of immersive human+computer (H+C) intelligence augmenting systems seemed like an inevitable conclusion.

When the *Spacewar!*-playing computational media pioneers like Stewart Brand dreamed of putting the "funky hands" of everyday people on the emerging computer technology to "do tricks for funky heads," they did not imagine that the gift of personal computing was going to come with a baggage of mental health and other wellness issues (Scott, 2015, p. 103). Personal computers have expanded our ability to perform creative work and accomplish cognitive tasks more efficiently. Mobile devices gave us the first taste of spatial computing, allowing us to be informed, entertained, and connected on the go. Yet spending hours in a head-forward posture with eyes fixed on our screens has created generations of people whose bodies are chronically tight and sore to the point of creating a pain epidemic. The more "natural" user interfaces of XR can solve many of the problems associated with the graphical user interface (GUI) paradigm by adapting to their human users, but they will come with their own challenges. Our embodied minds have a language of their own. Our nervous system sets the landscape for all of our experiences. The stories that define our lives by reminding us who we are and how we see the world we live in are built on the platform of our biology. No medium in the history of humanity ever had the potential to reach deeper into the human nervous system than the emerging medium of XR. As our symbiosis with computers grows more and more intimate, we need to make sure that our computational media can truly complement rather than hijack our neurology. We need the next medium to respect the embodied nature of the human experience in the physical and social worlds.

We believe that there is a need to make the next computational medium not just more human centered but more humane. The unique design affordances of immersive media make XR experience design (XRXD) a fundamental building block of the new chapter in our relationship with computers. The complex and the sensitive nature of building H+C systems requires XR system designers to engage in ecological thinking that can restore the power balance between human users and increasingly advanced and complex computer systems. The immersive experience design we describe in this book offers users an opportunity to engage in augmented imagination by means of immersive transportation that provides access to context-relevant information in the key areas of understanding the self, others, and the environment. It can lead to a truly immersive and multimodal access to advanced computation that supports and promotes physical and mental well-being.

XR: A New Media-Making Paradigm

Philosopher of science Thomas Kuhn in his influential book titled *The Structure of Scientific Revolutions* defined paradigms as "universally recognized scientific achievements that, for a time, provide model problems and solutions for a community of researchers" (Kuhn, 1996). Paradigms describe what phenomena are to be observed and scrutinized, what kinds of questions are supposed to be asked and probed, and how these questions are to be structured. A field's paradigm provides the members of a community of inquiry with a set of problems, a philosophical stance, and a set of rules on how to look at these problems and how to address them. The human–computer interaction (HCI) field is a paradigm dedicated to the problems associated with the rise of personal computing since the 1970s. HCI researchers made a number of contributions applicable to a generation of computers that were operated by human users interacting with a device via the device-centered windows, icons, menus, and pointers (WIMP) style of interaction that predominantly addressed the visual sensory channel. Graphical user interfaces using WIMP made great strides toward multimodality from the interaction with punch cards, line printers, command lines, and machine language programming. Personal computer manufacturers gradually dedicated more hardware to the auditory channel. Improved chips allowed for faster, higher-resolution video display that encouraged media scholars and makers to think of computation as a medium. Mobile computing added the basic sense of touch to the human–computer interaction paradigm with taps and swipes. Yet the HCI paradigm remains fixated on interaction between human users and computing devices rather than on the creation of conditions conducive to immersive presence.

People who grasped the true potential of human+computer systems considered the "desktop metaphor" to be only a transitory state of human–computer interaction. One of the greatest challenges in the transition to immersive media is our ability to rethink the fundamental media making paradigms that are rooted in audiences looking at flat 2D screens. As immersive experience designers, we need to collectively reimagine how to create interactions centered around the body actively navigating 3D environments that become an active part of the user interface. Muriel Cooper, the founder of the Visible Language Workshop at the MIT Media Lab, transcended the GUI desktop paradigm by dreaming of *Information Landscapes*. Working with her students throughout the 1980s, armed with a Silicon Graphics Reality Engine $250,000 computer, Cooper undertook a series of projects that explored such topics as interactive calendars, infinite information zooms, typography in space, multiperspective data presentation, and personalized information galaxies in which information was organized and filtered in a dialogue between an algorithm and the reader (Maudet, 2017). Cooper and her team found their design inspiration not in a traditional two-dimensional, page- or screen-restricted graphic design but in three-dimensional forms of theater, performance art, and Bauhaus happenings. Their explorations illuminated five unique features of the computer enabled information landscapes: (1) three-dimensionality of (2) multimodal media spaces, temporally navigated by (3) actively participating audience members within (4) nonlinear time frames through (5) multiple access points not directly controlled by the designers.[5]

One of the major premises behind this book is our argument that moving from HCI to immersive media making will require a major paradigm shift. The approaching wider adoption of XR as the newest communication medium will bring the society at large and XR media-making community into a new domain of artificially designed immersive sociotechnical systems that far surpass the complexity of the era of personal computing. This book describes why humane-centered XR experience design will matter a great deal to this brave new world. It outlines how the new paradigm is qualitatively different from HCI design. It also lays out a framework of how to go about creating meaningful immersive experiences. The still-emerging XR technologies have already substantially expanded the range and control over objective stimuli available to XR designers. XR content creators can engage in multimodal composition that lays the foundation for subjectively experienced cognitive and emotional states of immersive presence—a close coupling of advanced computation and the human nervous system. XR media offer media makers five unique areas of opportunities and challenges that make immersive experience design unique. (1) The XR continuum from augmented (AR) to mixed (MR) and virtual reality (VR) is the first type of media in history to allow its makers to engage in computational-based world-making that allows its audiences to enter synthetic experiences that appear real to the human nervous system. (2) XR content makers accomplish immersivity by practicing multimodal composition based on designing for the eight sensory channels.[6] (3) XR systems are moving us toward the world of human+computer immersion in which computers, unlike their predecessors, use sensors and artificial intelligence (AI) to adapt to the human users rather than forcing them to learn how to navigate the newest version of the underlying operating system. XR environments can offer users unprecedented bio and neuro feedback, hence giving design teams an opportunity to customize XR experiences and even elicit meaningful behavioral change. (4) Based on advances in computational social science and social physics, XR media systems can be expressly built for enhancing collective intelligence. (5) Immersive media systems can be designed for collective action and purposeful emergence within the ecologically balanced socio-technical systems that offer humane intelligence augmentation. We will expand on all of these points throughout the book.

The Future of Content Creation

Hollywood movies like *Minority Report*, *Ready Player One*, and *The Matrix* have introduced many of the concepts associated with extended reality (XR) into popular culture. XR technologies have steadily become cheaper, higher in quality, and more widely available to both enterprises and consumers. Billions of people can experience mobile AR on their phones to navigate physical places using the Google Maps app or to play *Pokémon GO*. Head-mounted displays such as Meta's Quest and HTC Vive allow gamers of all ages to immerse themselves in VR worlds of popular games such as *Beat Saber*. *XR* today is an umbrella term for three related but qualitatively different forms of media. Virtual reality applications require the audience to use headsets and other hardware to become fully immersed in computer-simulated worlds. VR hardware generates realistic stimuli that engage all five external senses of vision, audition, olfaction, somatosensation, and even gustation to create immersive virtual worlds. Augmented reality (AR) applications rely on devices such as mobile phones, tablets, or headsets to overlay digital data over real-world environments. Mobile AR apps are already familiar to those who might have used the IKEA Place app. Mixed reality falls somewhere in between VR and AR. MR hardware allows users to switch between and blend real and virtual environments where physical and digital elements can interact in real time. Some examples of MR headsets are Microsoft's HoloLens 2, Meta Quest Pro 3, and Apple Vision Pro. MR users can see their surroundings as in AR but mixed with interactive 3D objects as in VR.

Up to now, we have been consuming flat media, which we usually view from the third-person perspective. Immersive media will not just give us a front-row seat; it will place us in the middle of the action. XR is an invitation to climb into the world of data and become part of the immersive information system we refer to as the XRI world. In this new world, instead of watching digital content, we will become immersed in spatially presented experiences that surround us with a richness of virtual presence. When we eventually collectively enter the XRI world, we will immerse ourselves into an environment designed to act upon us as much or more than we can act upon it (Rosenberg, 2022). The fundamental shift predicated on the unique conditions of XR media will dramatically change how we access digital information and how it affects us. The first phase of the transition into XR will continue to be mobile friendly. VR experiences such as VRChat, *Fortnite*, and Roblox can be accessed on TV screens, tablets, web browsers, and mobile phones. But as Unity CEO John Riccitiello argues, the currently popular apps and games like Instagram and *Grand Theft Auto* that rely on touch screens and physical controllers will translate poorly to the multimodal world of XR (Wingfield, 2021). Immersive media will eventually compel media designers to reinvent the way their products are offered in the world of XR media in the same way that the invention of sound changed moviemaking. As the technologies mature, the ability to provide natural-language and gestural interfaces will define immersive experiences.

The youngest generation of media audiences regularly spends time in virtual spaces such as *Horizon Worlds*, *Fortnite*, *Minecraft*, and *Roblox*. Megabrands like Nike and Gucci are following this audience, staging events and product launches in these emerging virtual spaces. XR applications are already improving the effectiveness and efficiency of education and skills training, enhancing customer experience, and raising productivity in areas from product design and prototyping to assembly to equipment service, sales, and marketing. The wide rollout of 5G networks will enable the deep integration of XR technologies into every aspect of our lives, transforming how our society learns, shops, and makes critical decisions. Educators are using a VR platform, Engage, to allow their students to build virtual geothermal stations on the ocean floors. The architects who designed Hong Kong International Airport used the XR simulation engine Unity to create fully functional models of the facility, including changes in passenger volume and airplanes that responded to weather and air traffic conditions. Unity is currently being used by nongaming customers such as Volkswagen AG to develop virtual experiences to train employees. We believe that imaginative media makers working with XR technologies will open new frontiers that are hard to imagine today. Opening up immersive media to more creative minds and hands is the motivation behind creating this book. That said, a variety of XR applications are already quietly making social and economic impact. We believe that XR media will disrupt all areas of media making, but here are a few examples of changes already taking place in such areas as entertainment and gaming, marketing and advertising, e-commerce and retail, healthcare, education, and travel and tourism.

Entertainment and Gaming

The biggest promise of XR is the ability to deliver experiences that are not attainable in the physical world. In her book *Computers as Theatre* (1991), Brenda Laurel suggests that computational media experiences should be designed with the principles of theatrical storytelling, focusing on creating engaging, meaningful experiences for participants. Her framework has had a lasting influence on immersive experience design, especially in experiences in which narrative is crucial for participant engagement. This framework was elegantly realized in *Placeholder* (Laurel et al., 1994) created by Brenda Laurel, Rachel Strickland, and their team at Interval Research, which integrated virtual reality, spatial audio, and embodied interactivity to orchestrate a two-person immersive experience. Participants explored three distinct virtual environments—a cave, a waterfall, and hoodoo formations—based on real-world locations in Banff National Park as they embodied one of four archetypal animal avatars (Crow, Spider, Fish, and Snake) while moving objects and leaving "voice marks" that added narrative layers. Using "smart costumes," which altered participants' avatars, voices, and sensory perceptions based on their chosen animal, created unique embodied experiences (Laurel et al., 1994). *Placeholder* highlighted the potential of using immersive media's sensory and narrative affordances to orchestrate dynamic experiences emphasizing embodiment and interactivity over passive observation. *Placeholder* drew from anthropology, mythology, and psychology to demonstrate how virtual environments could evoke personal and collective stories, challenging conventional notions of storytelling. The use of spatial audio and symbolic avatars foreshadowed the current emphasis on mediated presence and sensory engagement in XR experience design and provides a reference point illustrating how immersive technologies can be applied to create emotionally resonant and intellectually stimulating virtual spaces focused on creating a sense of "being there," now recognized as central to XR experience media. Echoes of *Placeholder* can be felt in the multiuser interaction and asynchronous communication currently in *VRChat*. BeAnotherLab's *The Machine to Be Another* draws directly from *Placeholder's* emphasis on embodiment to explore empathy and learning with immersive media. Narrative VR experiences such as *Dear Angelica* and *The Under Presents* owe their nonlinear, exploratory storytelling structures to the foundational work demonstrated by *Placeholder*.

It comes as no surprise that gaming and entertainment currently constitute the number-one XR market segment worth billions of dollars. Gamers playing such games as *Half Life: Alyx*, *Horizon: Call of the Mountain*, and *Gran Turismo 7* have embraced XR technologies to immerse themselves in the virtual worlds that bring more visceral and exciting challenges, adventures, and exploration. Various flavors of *Fortnite* allow players to indulge their social side by cooperating to fight off zombie-like creatures, forming teams to defend castles, create new worlds, and compete to be the last person standing. When Anifa Mvuemba's Hanifa brand's New York Fashion Week runway show was canceled due to COVID-19, the designer transformed all of her garments into 3D images and fitted them onto avatars. The entire show became a virtual event streamed over Instagram

Live. Music and sports fans can now virtually experience live music and sporting events from the comfort of their VR and MR headsets. Electronic music pioneer Jean-Michel Jarre used the platform as a venue for his 2020 New Year's Eve event titled Welcome to the Other Side and for a concert titled Alone Together. Welcome to the Other Side was broadcast simultaneously across radio, television, and online platforms inside the virtual Notre Dame Cathedral. It attracted more than 75 million views.

Disney's 2019 *The Lion King* might be seen as a bridge between traditional and immersive forms of filmmaking. The movie was made possible by an experimental form of production that leveraged VR to shoot virtual sets along with traditional direction and analog camerawork. Filmmakers created a computer-generated virtual world and characters that could be walked through and filmed while wearing a VR headset. The process was akin to playing a video game aimed at creating a movie. During preproduction, *The Lion King*'s crew worked on master scenes using the industry-standard special effects Maya system. Using a custom-built asset management system, they translated the scenes into digital files compatible with the 3D game engine Unity. Key crew members, including director Jon Favreau, wore HTC Vive headsets to explore the virtual world as they walked through a physical set. Immersed in the VR environment, they could make creative decisions and discuss the camera placements, lenses, and locations of actors, sets, and props. The production team created 350 premade skies to make every shot uniquely fit the director's creative vision. Shooting in a 25-foot-square area called the Volume, Favreau and his crew moved a simulated camera around the stage to identify the best camera placements and movements. The chosen three-dimensional flight path of the camera was tracked inside the virtual world, allowing the team to record the master scenes in Unity. The virtual camera was designed to simulate the Arri Alexa 65 body and Panavision 70 Series cinema lenses to give the film a realistic documentary style reminiscent of an episode of the BBC's *Planet Earth* docuseries. The resulting 3D footage was delivered to the animators in London, who combined it with other assets and animations into the movie's final version. *The Lion King* will go down in cinema history as Hollywood's first, but most likely not the last, virtual production to show the creative potential of XR filmmaking (Giardina, 2019).

Less well-heeled content creators can conduct XR filmmaking experiments on platforms like VRChat, where their audiences can use sensors and haptic technologies to experience rather than just watch movies. A new breed of XR filmmakers is well exemplified by Joe Hunting, whose *We Met in Virtual Reality* documentary was shot entirely within the *VRChat* platform. The work examines immersive escapism during the days of the COVID-19 pandemic, showing a burgeoning cultural movement demonstrating the real power of immersive connection and digital intimacy. Hunting's subjects include such avatar performers as Jenny, who teaches American Sign Language (ASL) to classes of virtual students. Another avatar by the name DustBunny teaches virtual belly dancing. The film also follows two users named DragonHeart and IsYourBoi, who, despite living thousands of miles apart, have fallen in love on VRChat. Hunting's film is a testament to how VR platforms can offer users a chance to be free from social expectations associated with gender, sexual identity, or physical limitations by becoming animated entities or colorful anthropomorphic creatures (Daniels, 2022). Experimentation in immersive filmmaking has only just begun, so it is not wise to predict where it will take us. We know one thing, though. The next *Up* or *Star Wars* will not be told like the last one, with one exception: imaginatively presented stories which deeply resonate with audiences are not going away anytime soon.

Journalism

Nonny de la Peña created the new field of immersive journalism by integrating VR technologies with journalistic storytelling. Her work has demonstrated how immersive media can foster empathy and emotional engagement and contribute to a better understanding of social, political, and humanitarian issues. David remembers participating in de la Peña's *Project Syria* at the 2014 Sheffield Doc/Fest; at the time, it was his first encounter with VR journalism, and it left an indelible mark that is felt to this day. Participants are placed amid the Syrian civil war, bringing them directly into the realities of the conflict. *Project Syria* uses real audio and video footage combined with computer-generated imagery to recreate scenes of devastation and human suffering. Participants in VR headsets enter the room-scale VR experience, which begins in a bustling Syrian marketplace filled with the sounds and sights of vendors, children, and daily life. Suddenly, your walk through the marketplace is disrupted by the explosion of a bomb. You become a witness to the chaos, confusion, and cries for help. As the experience unfolds, you are then transported to a refugee camp to witness the struggles of displaced families, including children scavenging for resources and individuals coping with loss. Combining arresting visuals, spatial audio, and movement creates a beguiling sense of presence. Participants can look around, take in the devastation and human suffering, and form an emotional connection to the events portrayed in a manner that is not as easy to do with traditional media. *Project Syria* attempts to foster empathy and raise awareness of the refugee crisis by placing people amid harrowing scenes. The experience provides one of the most compelling examples of immersive journalism shifting participants from passive observers to active participants by proxy.

At the same time, the effectiveness of immersive media in communicating complex social issues remains an active area of debate and research. Regardless of the debates on whether virtual reality is or is not an empathy machine, Nonny de la Peña's work demonstrates that immersive media can be used for more than entertainment or escapism. XR experiences can invite people to engage with complex social realities and catalyze meaningful discussions. de la Peña's work, of which *Project Syria* is but one among many others, provides participants with a first-person perspective to enhance the emotional impact and has influenced subsequent immersive media projects focused on empathy-building and understanding complex social realities, such as *The Key* (Celine Tricart, 2019) and *We Live Here* (Rose Troche, 2020).

Media Art and Scientific Visualization

Osmose (1995) was the first virtual reality experience installed in a contemporary art museum. Char Davies, a co-founder of the 3D animation software company Softimage, created this work, deeply rooted in her interest in phenomenology and her background as a painter (McRobert, 2016). Participants fitted with a custom suit and headset navigated through a translucent, flowing environment populated by abstract forms and naturalistic imagery. They navigated the virtual space through a unique interface that responded to their breath and balance. This experimental form of natural interface encouraged participants to connect with their physical sensations in distinct contrast to the traditional computer interfaces available at the time. *Osmose* blurred the boundary between the participant's bodies and the virtual environment, inviting them to engage with immersive media as an extension of their inner and physical realities. Her work challenges conventional notions of space, perception, and interaction, highlighting the potential of immersive media as a vehicle for introspection, emotional resonance, and reembodiment, and her bio-responsive design influenced later developments in media art, natural user interfaces, and therapeutic uses of immersive media (McRobert, 2016). Char Davies's artistic vision provides the conceptual and experiential insights that prefigured and influenced the evolution of immersive media toward specialized and application-driven uses like scientific visualization like *BioVR*, bridging art and technology to expand how we engage with emotional and scientific complexities. While *Osmose* pioneered an artistic and meditative exploration of virtual environments, BioVR applies similar principles to scientific visualization, focusing on DNA, RNA, and protein structures. The ground broken by *Osmose* is evident in *BioVR's* embodied interaction, intuitive spatial exploration, and emphasis on natural input methods, allowing users to manipulate 3D molecular models with hand movements (Zhang et al., 2019).

Branding, Marketing, and Advertising

The XR world is already seeing a rise in a new breed of designers and architects focused on creating virtual places for immersive spatial experiences populated by AI bots, customized avatars donning digital fashion, objects, and accessories. Working for clients such as McDonald's, *Vogue*, and the Utah Jazz, design consultancies such as Polycount have been trailblazing this type of design since 2001. For the Qatar World Cup 2022, Polycount collaborated with the Swiss luxury watchmaker Hublot to transform a virtual stadium designed by MEIS Studio into a fully realized metaverse environment for soccer fans. Hublot's official Qatar World Cup 2022 watch became "the central design element for the virtual stadium" (Polycount, 2022). The virtual build included "15 Hublot brand ambassadors stationed around the pitch, each holding a specially designed ball and room for ninety-thousand virtual fans" (2022). The Hublot Loves Football Stadium was opened to the public on a social VR and live event platform, *Spatial*, which has more than 800,000 monthly visitors. The experience is available to fans via desktop, mobile, and Oculus. In another project, Polycount partnered with fashion designer Humberto Leon and IW Group to design a metaverse space celebrating the Lunar New Year. The Hall of Zodiacs exhibit, sponsored by McDonald's, was hosted on *Spatial* and *AltspaceVR*. It featured a spatial experience that allowed the visitors to explore the twelve Chinese zodiac animals. The animals were each placed in front of banners describing the years when their particular attributes became dominant. Visitors accessing the Hall of Zodiacs received personalized horoscope readings based on the year and month of their birth and the associated zodiac animal. The campaign was cross-promoted on Asian television news channels and through traditional gifts distributed at McDonald's stores.

E-Commerce and Retail

XR can contribute to both online and offline shopping experiences. Customers visiting brick-and-mortar stores can quickly and easily learn about products on display without seeking assistance from store staff. Mobile AR–enabled devices can recognize barcodes and text on the labels to provide shoppers with information about product features, ingredients, reviews, and promotions. Retailers can use the same features to assist their employees in inventory control. They can also offer personalized discounts to customers based on shopping pattern data. Product returns are estimated to cost online retailers hundreds of billions of dollars annually. In the realm of both e-commerce and traditional retailing, this can be reduced by letting shoppers virtually interact with the digital twins of the products before buying. XR technologies, rather than forcing consumers to imagine how the products will look and feel, can let the users experience the product firsthand. For brick-and-mortar giants like Macy's whose home goods and furniture product catalog features much bulkier offerings than Amazon, returns are a necessary but quite costly evil. To combat the problem, the company launched an experimental "try before you buy" program in 2019 using AR technology that allowed in-store shoppers to design and furnish their own virtual room mock-ups on iPad stations. Customers could step into virtual spaces to look around the room in 3D. A traditional furniture area in a retail store can take up thousands of square feet of retail space and cost about half a million dollars to build. The experimental space only took up 500 square feet and cost less than $50,000 to build (Boland, 2019), providing a glimpse of the potential for XR in retail sales.

Healthcare

There are multiple areas in which XR technologies combined with biosensors, machine learning, and predictive analytics can contribute to healthcare. These areas include mental well-being, physiotherapy, improved diagnostics, telesurgery, and education for both medical professionals and patients. Medical imaging technologies like magnetic resonance imaging (MRI) and CT scans can give medical staff 3D representations of the patients' bodies that offer a much greater level of detail than traditional 2D imaging. People like Jeffrey Jacobson, the XR Lead of

Immersive Design Systems at Boston Children's Hospital, are reenvisioning the future of medical training with XR tools like the HoloLens. Jacobson and his team developed an AR pharmacy training module using simulated needles and drug vials in addition to actual sterile cleaning supplies to assist in teaching the pharmacy personnel the fundamentals of aseptic technique for sterile compounding. The system allows up to four students to simultaneously train with the supervision of a senior pharmacy educator to decrease the amount of time needed to complete initial competency training from a full day to just 40 minutes. The system has significantly improved the pass module rates in competency tests to 90%.

Education

XR-based learning experiences are expected to grow in influence in education at all levels from elementary to high school to university and corporate and professional training. A study conducted by the National Training Laboratory found that VR-based learning modules have a retention rate of 75% compared to 5% for the lecture-style learning experiences and 10% for reading (Carlton, 2017). XR can also dramatically reduce the cost of training while providing educators with a lot of useful data on the learners' progress. Field trips have traditionally been powerful learning experiences for students of all ages, but tightening school budgets combined with the rising transportation costs and complexity of logistics have reduced these experiential learning opportunities. With a comparatively lower cost, schools can now use the spectrum of XR technologies to give their students immersive experiences that will positively impact their learning. AR technology allows students to get additional information about what they see. One of the main benefits of VR simulations is that they allow learners to make critical errors and experience real consequences within a safe environment. VR modules can enable students to explore complex scientific topics in unprecedented detail by manipulating 3D models of molecules. They can use multisensory engagement to experience what it would be like moving in outer space or performing a surgery on virtual patients. German car parts manufacturer Bosch uses the Oculus Rift headset to take its 10,000-strong army of service technicians on three-dimensional tours of the inner workings of various car parts to enhance the technicians' understanding of the functioning of direct-injection and braking technologies.

The Workplace

The gaming industry's success in popularizing VR technologies has now paved the way for the integration of XR in professional settings. Immersive media can effectively reconnect a hybrid workforce and remote employees in a more collaborative, immersive environment. Virtual workspaces enable remote and hybrid teams to collaborate, communicate, and increase productivity without a need for expensive and time-consuming travel. Immersive workspaces can also foster creativity by encouraging willingness to take risks and enabling inexpensive experimentation in a safe environment. Hyundai Motors supports its numerous teams engaging in multiple rounds of design feedback through its world's largest VR design evaluation facility, allowing 20 designers, engineers, and key stakeholders to collaborate simultaneously on a car design in a virtual environment. The setup combines high-performance Nvidia GPU-powered systems with VR headsets to let the teams modify the virtual car's colors, shapes, textures, and parts in real time. Design teams can view high-fidelity renderings of the car's interior to understand better what the car buyer may experience at the dealership. Designers can also place cars in real-world backgrounds to better assess every facet of the design.

XR brings unprecedented opportunities for on-the-job training in healthcare, manufacturing, technical support, and service industries to help employees learn hands-on and in the field. AR-based training can provide employees with practical experience in a realistic environment without the need for expensive physical equipment or facilities. Six Flags Amusement Park trains up to 40,000 seasonal employees using a custom-designed AR training module that allows trainees to interact with virtual customers. The immersive training module uses tablets rather than expensive cash registers to let the new employees test their point-of-sale (POS) system skills under simulated stress and to help them understand typical scenarios they will experience while on the job. The immersive program has improved employee training and scaled up training while cutting costs for the park.

Travel and Tourism

The COVID-19 pandemic had a devastating effect on tourism, but it also prompted creative travel operators to apply XR technologies to offer novel stay-at-home travel experiences. There are four ways in which XR can benefit both the consumers and the travel industry.

Virtual travel offers consumers the opportunity to travel the world safely while saving money and reducing environmental impact. Virtual travel allows visitors to experience destinations that are remote or need to be preserved from traffic. For instance, the *Patagonia VR* experience available from Meta's app store lets users explore Argentina's Monte Fitzroy mountain landmark and the neighboring remote glacial lake Laguna Sucia, both of which are hard to reach in real life. Virtual hotel tours let the operators of hotels and upscale resorts show off their stunning locations and world-class amenities to prospective visitors in immersive detail before they book. XR can also help travelers to immersively test drive different trips and excursions available at their chosen destinations. Mobile AR apps can help travelers with navigation. *Google Maps* now incorporates an AR feature called Live View for those who are navigating unfamiliar locations on foot. The feature is available on all ARCore and ARKit-enabled mobile devices for any locations where Google already has the Street View option. Live View overlays big arrows and easy-to-follow directions onto the user's screen over the street view, clearly showing them where to walk and turn (Marr, 2021).

Designing XR Media, and Why It Matters to You as a Media Maker

Media scholar Henry Jenkins summed up an insight concerning media disruption caused by networked computers by articulating a concept of media convergence. According to Jenkins, convergence goes beyond a mere technological change to create deeper social, cultural, and industrial transformation. The first stage of convergence brought all forms of content from print to photography, recorded music, and cinema into the world of ones and zeros. Web 2.0 added broadcasting and long-distance telephony to the mix of mediation available over the Internet. Mobile devices allowed audiences all over the world to access digital media on the go. This technological shift allowed media makers to integrate content and to widely disseminate it through multiple access points and platforms. Media audiences developed novel media habits and protocols, moving freely between platforms while consuming content, sharing content, and most importantly, developing an expectation of participation from likes, comments, and full-blown fan related content posted on social media channels. This cultural convergence linked media audiences, their communities, and media producers in ways that inspired new forms of creativity. Jenkins likened the product of convergence culture to traditional folk culture in which songs, gossip, and stories were transmitted freely throughout the community.

The trend of media convergence has not stopped. Extended reality might be the greatest hybrid of media technologies and protocols to date. XR is a blend of all forms of narrative media, gaming, apps, live events, and human–computer interaction. In our approach to immersive media, we are aligned with Laura Ermi and Frans Mäyrä's tripartite framework, which shows immersion as a product of three overlapping categories of sensory experiences, challenge-based (ludic) interactions, and imaginative (narrative) approaches. Within these three complementary domains, media makers can identify separate sources of rich opportunities to engage their diverse audiences. The multimodal composition familiar to user experience (UX) designers engages the audience on the deeply embodied sensory level. Immersive media projects also benefit from the lessons learned from the task-oriented software design and play-oriented game design traditions. XR applications can offer their users effective, efficient, engaging, error-tolerant, and easy-to-learn ways to accomplish life- and work-related tasks and challenging or relaxing play experiences. Finally, narrative immersion adds another dimension by drawing on the long and rich tradition of storytelling, books, and cinema.

The development of the early cinema offers a great parallel to immersive media. The medium started without a "language" of its own. Cinema pioneers such as Fritz Lang, Dziga Vertov, Elizaveta Svilova, Esfir Shub, Sergei Eisenstein, Alice Guy-Blaché, and F.W. Murnau had to invent new conventions that could help audiences to make meaning based on the series of flickering images projected on the walls of the makeshift movie theaters. The early masters who canonized this visual language told stories within the constraints of "silent" cinema. They had little choice but to engage in mostly visual storytelling.[7] Later filmmakers such as King Vidor, Alfred Hitchcock, Orson Welles, Akira Kurosawa, and Luchino Visconti used postsynchronous sound technology to immerse their audiences further by combining sight with sound. Since the 1960s, media makers have attempted to create a greater sense of immersion by experimenting with additional sensory channels and spatial dimensions. In the 1950s, Hollywood cinematographer Morton Heilig (1992) proposed that all the sensory intensity of life could be simulated with what he called "reality machines" (p. 240). Heilig saw what we now call virtual reality as a natural extension of cinema. He articulated a powerful vision of media makers controlling the multisensory stimulation that could provide audiences with an illusion and sensation of being present in virtual worlds. Heilig argued that "the cinema of the future would become the first art form" to present audiences with new worlds in "the full sensual vividness and dynamic vitality" of human consciousness (p. 239). He believed that the expanded form of media making would involve taste, touch, and smell in addition to sight and sound. Such multimodal cinema would be capable of dissolving the fourth wall of traditional movie theater performances to transport audiences into inhabitable virtual worlds he referred to as "experience theater" (p. 240). Heilig backed up his vision by inventing an arcade-style machine he appropriately named Sensorama. It was a mechanical device comprising a stereoscopic 3D color display, stereo-sound system, various fans, scent emitters, and a motional motorcycle chair. The immersive experience involved a motorcycle ride through Brooklyn. Participants experienced riding through the streets of a busy city, sitting on an imaginary motorcycle, while hearing the cars passing by, smelling petrol fumes and local pizza shops. Heilig's surrogate travel device did not find proper financial backing and did not become a popular success, but it influenced a generation of VR pioneers in the 1990s who sought to realize Heilig's vision of inhabitable movies using computers as a medium.

Another field advancing the multimodal language that has dominated media since the second part of the 19th century started with early magazine layouts for such publications as *Harper's* and *The Atlantic* and advertising for such iconic brands as Coca-Cola and Campbell's. The UX and UI canons behind such digital products as games, apps, and websites started from the tradition of communication design still frequently referred to as graphic design. Much of what has been taught in graphic design programs is based on the modernist canon established in Weimar Germany at such institutions as the Staatliches Bauhaus, known as the Bauhaus. The field further developed after WWII in Switzerland and the United States at such institutions as the Basel School of Design and the Institute of Design at the Illinois Institute of Technology, originally founded as the New Bauhaus. The graphic design field originally developed in an era when media technologies separated the senses to offer radio, film, and photography as distinctive forms of mediated communication. Various foundational figures in the field, such as Bruno Munari, stressed the visual aspect of communication to distinguish the predominantly print-based graphic design from discursive forms of communication such as literature. The emphasis on the visual aspect of communication design continued with the contribution designers made to the development of the graphical user interface (GUI). Since the days of the early personal computer, such as Apple's Macintosh, design has become the common denominator behind all computational media. More advanced forms of computational media offered expanded opportunities for the new generations of new media designers to evolve the field into more multisensory interaction and experience design. Today, UX/UI design is a well-developed field whose main focus on making advanced media technologies, such as mobile computing, more usable and accessible to the wider audience can greatly benefit the emerging multimodal XR medium.

Computer-as-a-medium has not only allowed media makers to think in terms of an added dimension of multimodal interaction, it has also allowed them to think in terms of systems. Two fields that simultaneously emerged from the personal computer era were digital games and software design. Both of these fields evolved around the concept of rule-based systems. The main task of both game and software design is to shape virtual play and work spaces by rules which allow the users maximum freedom while being easily internalized—two requirements that are essential to usability. Both gaming and UX/UI designers explicitly recognize the vital role users play in any type of interactive system. Like play, presence—the ultimate goal of immersive media design—cannot be coerced. Presence is a state that emerges from the audience members interacting with immersive systems. Traditional and digital games create powerful experiences because, like stories, they tap into some fundamental aspect of human nature. Play permeates all expressions of human culture. We grow up and learn to socialize by playing games. Digital games have captured the magic inherent in such activities separated by space and time as pre-Columbian ball playing and Chinese checkers. Gaming has evolved from consoles found in arcades, to Pong to Sega and Nintendo which were plugged into TV sets of suburban living rooms, to Sony PlayStation, PlayStation2, and the Microsoft X-Box. The medium has now expanded into highly social online and mobile gaming and VR games. Writing in an introduction to his 2001 book *Information Anxiety 2,* Richard Wurman predicted a "revolution" that will see gaming move from first-person shooters "to business gaming, problem solving and decision-making, vicarious travel, and ultimately to flying through information—perhaps all human knowledge" (Wurman, 2001, p. xxvii). He saw the potential of gaming to become a powerful tool for learning, strategic decision-making, and navigation of information. Whether gaming will become anything other than gaming, game designers have developed a language that cannot be ignored in any immersive media design. For this reason, the cross-platform game engine Unity has become one of the most popular authoring environments for AR and VR applications. From innovative user interfaces to experience design strategies, gaming has created a robust media design toolbox that is closer to Muriel Cooper's vision of spatial computing than GUI's flat desktop metaphor.

In the context of XR design, the convergence of media is much more than just the convergence of technologies; it is a convergence of methodologies. Bringing knowledge from a diverse set of immensely accomplished fields can shape immersive media experience design in ways that will only expand the media makers' creative potential. We see the merging of the methods, languages, and terminology from UX, game design, and narrative storytelling fields as the core challenge of developing a new immersive experience design (XRXD) paradigm. The tripartite cross-disciplinary approach combining the narrative, the challenge-based, and the multimodal sensory media-making traditions underpins the immersive media experience design framework we present in this book.

I Am the Camera: Immersion Is More Than Interaction

In contrast to the critique advanced by the opponents of rhetoric, we believe that in all forms of rhetorical communication, meaning is co-created between the media makers and the audience. Audiences always have to work hard to generate meaning out of a series of stimuli supplied by the medium. XR media makers, more than their filmmaking and design counterparts, need to embrace the fact that immersive content creation involves an act of co-creation. Each immersive media audience member becomes the co-director and the camera operator through their choice of gaze. The choices they make provide them with a unique perspective, path, and sequence through the immersive experience. This is why our approach to immersive experience design comes, first and foremost, not from the world of computer code but from neuroscience. It is based on the fundamental understanding that art or any aesthetic experience is only possible because the human brain actively constructs its own experiences. What our eyes, ears, and other sensory organs receive are not meaningful sights, sounds, and smells but “a barrage of light waves, chemicals, and changes in air pressure with no inherent significance” (Barrett, 2020, p. 65). Faced with an onslaught of ambiguous scraps of sense data, the brain, whose core task is to control the body to keep us alive and well, must figure out what to do next. The brain meets this challenge by drawing on a lifetime of past experiences, things that have happened to us personally and things that have happened to our ancestors. What we believe we see, hear, touch, taste, and smell is a combination of what is present in our physical environment and what is constructed by our brains (2020). When we recognize a human figure in a painting or on a screen, we understand what we see because of the memories of all human figures we have experienced that help our brains make sense of the represented abstract elements. Based on an intuitive grasp of this phenomenon, Marcel Duchamp argued that an artist is only responsible for 50% of the work necessary to create art. The remaining 50%, he suggested, was the domain of “the beholder’s share” (2020, p. 69). Immersion, like all experience, is the domain of conscious human meaning-making, which emerges from the active, co-creative process of constructing our private sentient experiences.

Ultimately, the XR’s success depends on us collectively answering the question: What sort of resonant experiences that are not possible today can immersive media make possible tomorrow? XRs future is not about the technological conditions of immersion but about what Sanchez-Vives and Mel Slater refer to as presence. They draw a clear distinction between presence and immersion, suggesting that immersion is a product of technology, while presence is an internal physiological and psychological state experienced by participants immersed in XR environments (Sanchez-Vives & Mel Slater, 2005). Presence is an emergent phenomenon, a product of immersive technology eliciting a subjective state in the user. The ability of

XR designers to create a sense of presence in the participant is the foundation of immersive transportation. A break-in-presence spells the breakdown of the virtual illusion. Glitches at the level of the physical and technological substrate, such as loss of tracking or bumping into objects in a physical environment, are detrimental to XR experiences.

One of the unique characteristics of XR is that it affects the human sensorimotor system in a way that prompts the brain to create internal psychological states that transport participants beyond the immediate physical environment and into the virtual world of digital media. Virtual reality researchers refer to the simulated sense of "being there" and "acting there" as presence. In the context of XR, presence can be understood as a form of visceral communication (Jerald, 2016). Virtualized presence can take many forms. We can experience mental and embodied presence or a social and emotional one, when virtual environments immersively mediate social interaction. Presence can be defined in at least two ways. One research perspective views presence as a subjective mental state in which a user "feels physically present within the computer-mediated environment" (Sanchez-Vives & Slater, 2005, p. 4). Researchers who consider reality to be formed through action rather than through mental filters define presence as the ability of the XR system to successfully support the participant's actions in the virtual environment (2005). Under this definition, the perceived reality of the user experience is relative to the functionality of digital objects and environments rather than their appearances (2005). While the focus of the experience-centered approach is on the creation of virtual environments that support the sense of "being there," the action-centered approach aims to create environments that support a targeted range of user actions and their agency to "act there."

Mel Slater argues that presence is based on two primary sensory illusions: the illusion of place and the illusion of plausibility. The place illusion addresses the question of location, while the plausibility illusion convinces the brain that whatever is happening is real. Technologically driven factors such as low-latency head tracking, accurate 1:1 body and eye tracking, and fast framerate lead the human perceptual system to believe that the person is present in a place other than their real physical location. A virtual world that accurately meets our expectations in the way it behaves and reacts to our actions makes us perceive the XR environment as being coherent in its construction (Bye, 2017).

The Wild West of XR Technology

There is no point hiding the fact that one of the greatest obstacles for media makers getting into XR is that the field resembles a Wild West when it comes to its technical standards. Developing XR experiences demands a solid understanding of the underlying immersive media technologies that can let the media makers develop a clear feasibility strategy to negotiate the fluidly changing landscape of a number of proprietary standards competing for market dominance. Currently, XR applications can be developed as mobile augmented reality (AR) apps for Android or iOS, VR/MR games and apps for Quest 3, Microsoft HoloLens, Apple Vision Pro, and other headsets. We can add to that a lineup of devices in the "smart glasses" category, which represents an AR-focused heads-up display (HUD) one can wear on one's face while walking on the street. These include Viture Pro XR, Rokid Max, Chamelo Music Shield, and Ray-Ban Meta Smart Glasses. There are also 360-degree video projection systems that record and play back in 360 degrees of azimuth and 180 degrees from nadir to zenith, viewable on flat displays or through spherical projections. There is simply no one way to immerse an audience in an XR experience at the moment. We cover the most important building blocks of immersive experience (XR) design to help media makers coming from outside of XR become more familiar and more comfortable with the most promising XR technologies.

The Rise of AI: Immersion Meets Our Digital Unconscious

XR lives in the shadow of another much more hyped technology. The rapid adoption rate of OpenAI's chat generative pretrained transformer (ChatGPT) app should convince even the most skeptical of us that the technological sea change we are living in the midst of is showing no signs of waning. ChatGPT reached its first one million users in only five days. It took such tech superstar start-ups as Instagram a whole month, Facebook ten months, and Netflix more than three years. General-purpose technologies such as the steam engine, the internet, and AI share a few common characteristics including continuous improvement, widespread proliferations, and complementary innovations. Watching the rapid advances in AI confirms that we are on the brink of another massive shift in human history. One thing is for certain: since the time of the Cognitive Revolution estimated to have occurred around 70,000 years ago, humanity has never faced an entity that can surpass our own powers of cognition. It is this artificial form of intelligence that XR will immerse its users in. The quietly-brewing-in-the-background extended reality revolution and AI are destined for each other. As they combine into a single domain, they will immerse the modern *Homo sapiens* in the world of hybrid human+computer (H+C) systems that go far beyond the old metaphor of human–computer interactions and into the domain of autonomous agents, chatbots, and virtual assistants. These intelligent conversational agents will be able to adapt to domain-specific scenarios and handle a variety of complex tasks through the application of open-source frameworks such as TaskWeaver. Natural language processing (NLP) and machine vision will become core technologies underpinning immersive experiences. From chatting bots to eye and hand tracking, AI will help shape immersive experiences, and XR will offer an immersive entrance point into the world of advanced computational media.

The combined world of XR, IoT, and robotics will be populated with all kinds of AI-based helpers capable of giving well-researched legal advice, translating between languages, offering mental health support, creating art, and writing code. With AI by its side, XR will take us from the age of information (Web 2.0) and into the age of knowledge. As good as this sounds, there is, as usual, when it comes to novel technology, one caveat. While knowledge might represent a higher level of consciousness, it still does not automatically rise to the level of wisdom, which is the ability to take purposeful and ecologically sound action in a complex and uncertain world.[8] The knowledge provided by AI systems might not hand us wisdom on a silver platter, but it can play a role in the process of making better decisions. Wearable AR devices will allow us access to mission-critical (yes, we mean shopping, but also things like navigating culturally rich urban environments and manufacturing-guided assembly) information while moving around the physical world with our heads up and our minds fully present. XRI world will replace typing commands with gesture and eye and voice commands fluently interpreted by AutoGen-powered agents as devoted to us as Mr. Carson was to the masters of Downton Abbey.

XRI immersion will be available at the shopping mall, the construction site, the street, and the classroom. The good news is that by using GPS-style systems, we will be able to navigate completely unfamiliar physical or cognitive environments. The downside of this cognitive offloading might be a gradual but pronounced change in the way that we process navigational information. People who follow GPS instructions do not form cognitive maps of their environments. This is poignantly illustrated by the case of the Ski-Doo–riding and GPS-dependent young generation of Inuit hunters in Northern Canada who are no longer able to follow oral directions using such references as wind direction, snowdrifts, memorably shaped rock, and the old Inuit place names that do not appear on maps. Traditional directions created by people traveling slowly and mindfully by dogsled while creating cognitive maps of the world around them mean nothing to the modern generation, which is used to moving fast by following clear-cut "turn left, turn right" GPS directions (Kemp, 2022). Finding the right balance between empowering users to explore unknown territories and depriving them of their natural ability to pay attention and form cognitive maps will be one of the many new challenges of XR immersion facing media designers.

AI technologies are also enabling creative professionals using AI to extend their skills and time to create magical 3D environments, objects, and code. Soon after the release of ChatGPT, Andrew Sibert, a lead product designer at gaming and mobile developer Backbone announced on X (Twitter) that he had been able to use the AI app to build a fully functional notes app in under an hour. The Swift-based app created by the ChatGPT's NLP interface only required minor debugging. OpenAI's generative image-making model, DALL-E, can create realistic art from a description given in natural language. OpenAI's Sam Altman suggests that the image-making app has crossed the critical threshold to produce photorealistic images that suggest a creative intelligence. DALL-E 2 makes an appearance of understanding meaningful cultural concepts well enough to combine images that elicit emotional responses from people viewing them. Altman described working with DALL-E to be akin to "talking to a colleague who's a graphic artist" (Heaven, 2022). The AI tools will not eliminate the role of designers and content creators from the process. Still, they will lower the price of entry and offer new efficiency and exploratory capabilities. Gaming, perhaps more than any other media so far, has taken advantage of the technologies forming the foundation of immersivity. AI is taking the nonplayer characters (NPCs) in digital games to the next level, allowing them to advance the narrative and enhance gameplay in surprising and rewarding ways.[9] NPCs can inspire all AI-powered digital objects that can go far beyond simple chatbots. Designers can express digital objects' infinite action potential by turning them into instigators of action, helpers, tutors, and advisors. We cover the application of Julien Greimas's Actantial Model to inspire the creative search for imaginative AI-based actants.

The Most Rhetorical Medium of All

Rhetoric has acquired a somewhat checkered reputation since the time of Plato. Even today, rhetoric can still be associated with duplicity, political blustering, and overdramatic posturing. Plato, who saw Sophists, the major proponents of rhetoric, as mortal enemies of his beloved teacher, Socrates, posed one of the earliest and most aggressive critiques of rhetoric. Brian Vickers (1989) argues that Plato's hostility to any form of oratory was motivated by his mistrust of the power it gave the sophisticated rhetors operating within the Athenian democracy whose social structure and the legal system jointly condemned Socrates to death. Once delegated to the study of style, rhetoric was resurrected in the 20th century by such communication scholars as I. A. Richards, Kenneth Burke, Chaim Perelman, Marshall McLuhan, and James Crosswhite to represent the communicative dimension that forms the basis of human coexistence. All forms of mediation and media making contain at least some element of persuasion. Media makers who narratively transport us into the imagined worlds of superheroes and supervillains implicitly persuade us to embrace the logic of the world not as it is but as it could be.

Jerome Bruner distinguished between two modes of ordering our experience and of structuring reality. Good stories and well-formed arguments can both be used as means for convincing others of our worldview, yet they convince in fundamentally different ways. Arguments use procedures for establishing formal and empirical truth. Stories draw their persuasive power by establishing not truth but verisimilitude or lifelikeness (Bruner, 1986, p. 11). Immersivity like narrative transports the audience into the world made by the media makers. One of the key premises of this book is that extended reality is a highly rhetorical medium, very likely more rhetorically potent than any other medium in history. This does not mean that XR must necessarily be manipulative. On the contrary, we who are collectively co-creating this new medium must make sure that it is not. Coercion and persuasion are two entirely different phenomena. As Peter argued in his previous book, ensuring the user's freedom within the context of immersive systems involves two components: "the existence of a set of genuine alternatives, and informed choice, which refers to the user's ability to choose their course of action" (Zakrzewski, 2022, p. 187). Rhetorical XR design is based on the willing participation of conscious human actors who are empowered "to make informed choices by selecting from the possible options of future actions" (p. 187). Immersive systems aiming to be persuasive rather than coercive must be designed to provide audiences with a wide array of choices for participation. User agency is a critical dimension of ecologically designed immersive systems. Despite the persuasive power of immersion, presence is not something that designers can create directly. While designers can manipulate the objective immersive stimuli to elicit target cognitive and emotional states, presence is a private and subjective state generated by the audience based on their life context and goals.

Co-Creating Humane XR: Your Mission, Should You Accept It

American historians Melvin Kranzberg and Carroll W. Pursell articulated a set of insights about technology. They saw technology not as a mysterious, alien entity but as a very human activity. They humorously suggested that invention was the mother of necessity. In other words, once people saw a technology they liked, they would increasingly find more uses for it until usage became a regular habit. They pointed out that while technology was deeply implicated in many social issues, the nontechnical factors involved in creating and adopting novel technologies were far more consequential than the technical ones (Kranzberg & Pursell, 1967). Media technologies do not develop in a vacuum. The human-made substrate of our material realities develops over time within specific social, cultural, and ideological contexts. Frequently, it has been the storytellers imagining the future who articulated the most powerfully resonant cultural imperatives our technologies eventually deliver to broader audiences. Science fiction writer Isaac Asimov gave us the "Three Laws of Robotics" in his 1942 short story *Runaround*. The laws were conceived as the organizing principle for his fictional robotic-based universe. Asimov also introduced us to the concept of autonomous vehicles with his "robot-brain cars." Philip K. Dick's *Minority Report* described, admittedly in quite unsettling ways, the idea of predictive analytics. The process of prescient storytelling, which Neal Stephenson refers to as "making shit up," has also given us the early vision of the metaverse (Robinson, 2017). Stephenson's *Snow Crash* not only painted a vivid picture of virtual reality but imbued it with such devices as avatars and digital currency. Enchanted objects have always played a unique role in fictional worlds, empowering characters to act in supernatural ways. Long before the cryptocurrency boom and blockchain technology, Stephenson's virtual currency represented a resonant vision of freedom and virtual value exchange in cyberspace. Adopting the Hindu concept of the "avatar," Stephenson used it to describe the digital twins of the metaverse and captured the possibility of virtual representation as a way toward flexible exploration of identity.

One of Kranzberg and Pursell's most astute observations was that any technology in and of itself was neither good nor bad, nor was it neutral. Technologies do not, by themselves, create dystopias or utopias. The human purpose and particular applications of technology make technology a critical component of social phenomena. At the moment when Web 2.0 and mobile app innovations have run their course, the future of XR is emerging from the present, powered up by the rich imaginative experiments conducted by immersive content creators who are not limited by yesterday's engineering boundaries. Immersive media innovators are leveraging XR's basic building blocks to envision novel ways to address core human needs, including expression of identity, socialization, exchange of value, storytelling, and co-experiencing the world of human creativity. While mainstream media commentators obsess over the vicissitudes of the corporately owned version of the metaverse, many other immersive experiments are bubbling up from the collective imaginations of XR content creators. For anyone looking closely, these emergent signals are coming from many directions. This new world is being built bottom up in a way Neri Oxman might refer to as a growth-not-assembly mode.

XR technologies offer immersive media makers unprecedented opportunities to push the boundaries of creativity in the new and unexplored area of designing for presence. Suggesting that XR will alter how humans relate to one another and the world around us is an understatement. XR applied to education can help to place students into navigable experiences that explore otherwise daunting abstract concepts. In medicine, it can assist medical professionals in visualizing patient data. AR can overlay digital information onto our physical spaces such as tourist destinations and retail stores to provide just-in-time information for all kinds of daily decision-making. But for all its incredible potential, by further blurring the physical and virtual boundaries, XR media can present a higher level of the potential risk to the users' well-being than its Web 2.0-era digital predecessor. Extending our symbiosis with advanced computation will face its fair share of potential hazards, including issues involving evidence-based reality, trust, power asymmetry, and mental health. In a report titled *Waking Up to a New Reality*, researchers at strategic consultancy Accenture outline three areas of risk associated with the wide adoption of XR: manipulation of data profoundly connected with personal identity, intimate behaviors, and thoughts; direct connections to not-yet-fully-understood human mental faculties and their perceptions of reality; and the irreversibility, opaqueness, and complexity of the distributed and decentralized advanced digital tools (Accenture Research, 2019).

We are only starting to grasp the implications and possibilities of manipulating the codes that underlie our societies' fundamental structures. Media scholar Marshall McLuhan poetically suggested that we effortlessly step into the media we consume as we step into a warm bath. Media environments are seductive by design. This is why they just feel right to the point that we do not think critically about the medium being the message. McLuhan asked us to think of media as complex and dynamically evolving systems. When Sherry Turkle cautioned us about computational media, arguing that the price for lowering the barrier of entry into computing for the masses by way of usability would lead to simulation without understanding, she addressed the issue of deep psychological effects media technologies can have on the users. She suggested that a societywide acceptance of taking things offered by computer systems at "(inter)face value" could have unintended consequences for the well-being of individuals and society as a whole (Turkle, 1997, p. 78). Social media examples we cover in what follows confirm the prescience of this prediction. As the computing medium grew more complex, the increasingly advanced software engineering was masked by the magic of UX design, making its simulations more and more opaque. A growing cadre of UX designers made the digital illusion appear real by blending the mastery of visual communication with key insights from cognitive science and neuroscience. Over the years, Silicon

Valley's digital disruptors have become increasingly skilled at seducing users to seamlessly adopt increasingly advanced computation into their everyday lives. The two parallel developments of the opaque complexity and the persuasive power of UX design have combined forces to spur the growing symbiosis of humans and computers, with the balance tipping toward those shaping and controlling the technology (Zakrzewski, 2022). We wrote this book based on the belief that the highly consequential task of creating the new immersive medium will be best accomplished through the participation of many creative individuals coming from diverse fields and perspectives. Our collective task as immersive experience designers is to make sure that our co-creation ends up benefiting all of its users.

The Structure and the Magic: Trusting the Process

While many of the specific software and hardware tools that are currently used in the XR field will undergo extensive transformation over the next few years of rapid development, the principles, process, and methods we discuss will remain valid for many generations of XR technologies. As VR pioneer Jaron Lanier argues, the most important question to ask about any novel technology is how it affects people. While we cover the technological feasibility in this book, we focus on the human experience first. Every novel technology offers media designers certain unique affordances that can shape the user experience in creative ways. This was true for film, radio, television, personal computers, and mobile phones. This is why this workbook is concerned primarily with form rather than the specific content. We leave the creative challenge of sharing meaningfully immersive experiences to the reader. What we present here is the comprehensive process that includes a suite of principles, methods, tools, and building blocks uniquely suited to creating XR content. We hope that the guidelines we propose, like grammatical syntax, while grounding the form of expression based on the realistic affordances of XR, will allow content creators near-infinite communication creativity in this new and exciting medium. The disciplined framework we propose will offer XR media makers a solid foundation of a clear and explicit strategy for their work. The magic in media design comes from the empathic co-creation between the designers and their audiences. The structure we propose aims to support the kind of magic that happens at the subjective moment of presence. By focusing on conceptual tools and methods enabling immediate exploration, we hope to encourage broader participation in the co-creation of the emerging XR medium. Our focus on immersive experience design highlights the critical importance of ensuring that the new XR medium is, above all, a humane one.

Seminal design theorist Herbert Simon suggested that every problem-solving effort must begin with creating an appropriate problem representation. With that in mind, Simon introduced the concept of a problem space within which the search for solutions can take place. The XRXD logic model we present in Section II outlines the 15 steps within the five areas of the XR media makers problem space. It is meant to help XR media makers to act strategically and purposefully by being able to focus on the particular features of immersive system design that are relevant to the context of their unique immersive experience. The model addresses the logical structure within the problem space by constructing a symbolic representation for particular classes of immersive system design problems. The outline of this book follows the phases and the steps of the model filling details at each progressive step. The theoretical concepts and methods covered in the following chapters address the specific context and meaning aspects of the XR media environments being created. The theater of the mind created by the human nervous system is the magical place within which all content creators operate. Before we enter the world of this immersive theater, let us discuss a structure for designing immersive experiences that fully explore all kinds of the magic that this wonderous new medium will allow.

Chapters at a Glance

Before moving to the specific theoretical underpinnings, process, and methods of XR media design, we lay the foundation for a broader understanding of the impact of XR as the next medium. We introduce the importance of immersivity as the next phase in human+computer symbiosis and our interpretation of the importance of this new medium in Section I: "What Is Immersive Media?" We introduce the concept of immersive experience design (XRXD) and discuss the design model in detail in Section II, titled "What Is XRXD?"

Section III, "Discovery and Pre-Suasion," starts to delve into the details of the XRXD model. The general concept of applying logic models to transformative design has its theoretical basis in the research on policy planning and evaluation in nongovernmental organizations and social enterprises. Logic models are conceptual tools that help to explicitly describe the proposed theory of change used to activate the intervention components such as program inputs, processes, and outcomes necessary to accomplish social change. The early version of the XRXD logic model was first introduced by Peter in his book *Designing XR*. We build and expand on the model and use it as a guiding set of simple rules to help designers identify key steps toward creating meaningful immersive experiences. The model comprises five major phases: (I) Discovery and Pre-Suasion, (II) Ideation and Inscription. (III) Planning and Building, (IV) Launching and Learning (From Play), and (V) Evaluating and Iterating.

Section III covering Phase I (Discovery and Pre-Suasion) of the model includes three chapters. In Chapter 1: "Vision and Purpose," we cover the why behind the project and outline some steps toward developing a strong project vision. This step in the model is focused on answering the following question: What do we want to accomplish with this project? What is our vision for the outcomes of this project? How will the audience be transformed by this XR media experience? In Chapter 2: "Understanding Your Audience," we highlight the importance of clarifying and developing a strategically empathic understanding of the intended audience. The chapter guides the reader through the process of discovering the micro insights about audience interests, goals, needs, and motivations. It also explores the fundamental desirability (people and culture) building block of persuasive media design.

This step is focused on answering the following questions: Who is the audience? What do we know about our audience and their media consumption needs? What themes might resonate with our audience? Chapter 3, titled "Developing Your Value Hypothesis," continues the audience identification theme with guidelines for the development of a well-defined value proposition for the core audience. It guides the reader through the process of answering the question: What value are we providing for our audience?

Section IV covers Phase II (Ideation and Inscription) of the model and includes three chapters describing the next three steps of the immersive experience creation process. Chapter 4, titled "Creating the Context Scenario," describes the process of leveraging narrative as a design tool. In this chapter, we help the reader answer such questions as: What will the immersive experience be like? How will the audience interact with the system? How can the XR system best respond to the user to support their goal (effectiveness) efficiently while being engaging, error tolerant, and easy to use? In Chapter 5: "Engineering the Magic: The Feasibility of Immersive Experiences," we introduce the XR technologies as the core building blocks of multimodal media composition. This chapter is aimed at helping the reader to estimate core competencies needed for the project, including internal and external resources, skills and processes, hardware, software, timelines, and budgets. The methods presented in the chapter guide media makers through a series of questions that test their leap-of-faith hypotheses about the project including (a) the availability of technologies to support the desired XR experience and (b) the team's core competence regarding the essential activities and processes needed. Chapter 6: "Building the Proof of Concept" describes the importance of testing the key leap-of-faith hypotheses covering the design teams' assumptions regarding the value provided to the audience, the feasibility/usability of the experience, and the scalability potential of the proposed project.

Section V covers Phase III (Planning and Building) of the model and includes three chapters describing the next three steps of the immersive experience creation process. Chapter 7: "Designing the System Prototype" delves into systems thinking theory and the process of applying these principles into the design of digital products. The chapter discusses systems design principles as applied in gaming and software design to give users a more rewarding experience. In Chapter 8, titled "Building the Functional System Prototype," we cover the basics of creating functional prototypes for immersive experience products. XR applications pose some of the most technologically complex challenges, and navigating them requires both a disciplined process and applied knowhow. In Chapter 9: "Playtesting the Prototype," we discuss the important stage of bringing the audience into the system. We also share some of the approaches to the evaluation of the initial user feedback.

Section VI (Launching and Learning) covers Phase IV of the model and includes three chapters describing the last three steps of the immersive experience creation process. Chapter 10: "Attracting the Audience" covers the various strategies for inviting the audience into the designer-inscribed XR system. Like any other digital product or media experience, XR applications need to attract core audiences to scale. We share some of the practices from such fields as gaming, software, and media marketing to outline the possibilities available to XR media makers in a way of attracting participants to their offering. In Chapter 11: "Immersing the Audience," we cover the important step of managing the audience entry into the immersive experience. We discuss the importance of incentives and shaping strategies. We also cover the relationship between such media design concepts as "System as Designed," "System as Encountered," and "System as Understood" by the participants. In Chapter 12: "Extending Play," we talk about building durable transmedia franchises by extending play beyond the original XR application. The focus of Chapter 12 is based on the research done by media scholar Henry Jenkins and his industry collaborators, Joshua Green and Sam Ford, who coined the term "spreadability." Extending play involves a process of successfully blending the key attributes of the XR media experience to appeal to motivations of particular user communities in a way that inspires them to embrace the XR media franchise and share content with others in their network.

In the final Section VII, "Iterating Immersive Systems," we discuss the truly unique opportunities afforded to XR media designers for auditing and evolving XR systems toward their intended function. The section returns to such areas of system design as designing the ecology of sociotechnical systems and optimizing XR systems for collective intelligence. The chapter also outlines Donella Meadows's concept of leverage points and her counterintuitive hierarchy of their respective effectiveness in transforming sociotechnical systems.

The proposed framework is offered not as a specific linear process but as a flexible, iterative set of simple yet essential principles that explicitly outline key activities involved in designing meaningful immersive experiences. The deliberately iterative approach of dealing with the uncertainty of proposing innovative solutions means that designers may cycle back and forth through all of the stages, pivoting back to earlier ones if necessary. The built-in hypothesis testing cycles allow immersive media design teams to move between thinking-to-build and building-to-think phases to pragmatically deal with the unavoidable challenge of facing uncertainty necessarily present in transformative design practice. We refer to our toolkit as the model-plus-tools approach to reflect the practical nature of complementing all of the steps of the logic model framework with appropriate conceptual tools and methods to guide the applied work of immersive media making. Now, let us explore immersive media experience design together.

Notes

1 The exhibition, curated by Robert Riley, included work by Bill Fontana, Doug Hall, Paul Kos, Tony Labat, Lynn Hershman, Chip Lord, Mickey McGowan, and Alan Rath. Lynn Hershman's *Deep Contact* also stood out, inviting me to touch an image of the guide who appeared on a touch sensitive computer screen, but since it involved actual touch, I found it less immersive. For some reason, touching the computer monitor made me all too aware of the surface tension between myself as participant and the guide as a virtual presence. Reference: Bay Area Media, exhibition, San Francisco Museum of Modern Art, March 15 to May 13, 1990.

2 Jim Campbell created the experience with a large-screen rear-projection video monitor, a video camera, custom image processing, custom electronics, two videodisk players,

and a Macintosh computer. He used *HyperCard* and a Macintosh simply as a sequencer; the heavy lifting had to be accomplished with custom electronics and image processing code. Reference: "Hallucination," JimCampbell.tv, https://new.jimcampbell.tv/portfolio/hallucination/ (accessed October 24, 2022).

3 Between 1989 and 1991, Tim Berners-Lee developed the first web browser at CERN, see Wikipedia contributors, "Tim Berners-Lee," *Wikipedia*, https://en.wikipedia.org/wiki/Tim_Berners-Lee (accessed October 24, 2022).

4 Robert Riley, "Voices Lecture Series," Gallery 400, program notes, University of Illinois at Chicago, January 14, 2002, www.uic.edu/aa/college/gallery400/02_spring2002/02_spring2002-v01.htm (accessed October 1, 2010, no longer available online).

5 All of these features will be explained in detail and elaborated on throughout the book.

6 We will discuss all of the channels and their submodalities in detail later in the book.

7 Silent cinema was never really silent. Since the early days of cinema exhibition, movies were accompanied by some form of music, typically a piano, and sometimes an entire orchestra in large movie houses. Dziga Vertov developed an elaborate score for his seminal *Man With a Movie Camera*. See "Music for Man with a Movie Camera," Silent Film Sound & Music Archive, www.sfsma.org/music-for-man-with-a-movie-camera/

8 For an excellent review of emerging unintended consequences of the application of AI to media and communication, see Melissa Heikkilä, "How AI-generated text is poisoning the internet," *MIT Technology Review*, December 20, 2022, www.technologyreview.com/2022/12/20/1065667/how-ai-generated-text-is-poisoning-the-internet/

9 Nonplayer characters (NPCs) are digital game characters not controlled by a player. The term originated in traditional tabletop role-playing games, such as Dungeons & Dragons, which applied it to characters controlled by the gamemaster. NPCs have a predetermined set of behaviors that can impact the narrative and gameplay. Early forms of NPCs were not necessarily a product of fully fledged AI.

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