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Virtual Actualities:

Technology, Museums, and Immersion

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Culture and Performance

by

Francesca Albrezzi

2019

ABSTRACT OF THE DISSERTATION

Virtual Actualities:

Technology, Museums, and Immersion

by

Francesca Albrezzi

Doctor of Philosophy in Culture and Performance

University of California, Los Angeles, 2019

Allen Fraleigh Roberts, Chair

In this dissertation, I build discussions around the use of digital technologies in association with art and art historical contexts to ask greater cultural heritage questions regarding humanity's relationship with digital technology. My work reflects on the emergence of digital humanities as a field in response to the experimentation and incorporation of digital methods, with an emphasis on extended reality (XR) technologies, for conducting humanities research in relation to arts and culture-based organizations. I investigate the advantages and disadvantages digital tools bring to the field of Art History today. In particular, the project focuses on modes of publishing, display, and information-capture in museums and archives that illustrate a break from "traditional"[1] models. In doing so, I argue that digital modalities provide a distinctly different

[1] Cultural Studies scholarship of the 1970's and 1980's conducted by Raymond Williams, Catherine Bell, Clifford Geertz, and Victor Turner, among others, redefined understandings of the term "traditional," as a notion that is no longer fixed, but an iterative performance that

paradigm for epistemologies of art and culture. Extending previous research in museum studies and media studies, I address a selection of the latest technological interventions within museum and cultural heritage contexts that operate within a spectrum of immersive modalities and use extended reality technologies. The dissertation brings together many humanities disciplines to investigate how sharing XR within a museum both disrupts and complements the time-tested benefits of object-centered methods of display, representation, and education.

The phase "virtual actualities" within the title of the dissertation signals changes in practice that are being brought about as digital technologies, and particularly XR, become incorporated into fields of arts and culture. "Actualities" connote the practical matters associated with producing, presenting, and preserving digitally immersive materials in the contexts of gallery, library, archive, and museum (GLAM) organizations. "Reality" in turn is reserved for the qualities perceived when discussing the characteristics that define 3D and XR production. At the fore in addressing new topics in museum practices and by conducting new experimentation through the application of immersive technologies, this dissertation can offer new information for digital art history, cultural heritage, and museum studies. The aggregation of examples throughout the dissertation aims to provide a survey of the field of XR in its current state within GLAM settings in order to offer insight and guidance for future development and implementation.

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attempts to recreate an event or process based on collective memory. In this instance, I use the term "traditional" to refer to non-digital methods connected with the practice of visual studies and established lineages of practices within the discipline.

The dissertation of Francesca Albrezzi is approved.

David Delgado Shorter

Johanna R. Drucker

Steven Franklin Anderson

Allen Fraleigh Roberts, Committee Chair

University of California, Los Angeles

2019

For my partner, John.

Thank you for the unending amount of love, support, patience, and snacks.

In loving memory of Mary (Polly) Nooter Roberts and Norman Hollyn.

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ACKNOWLEDGEMENTS

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I am grateful for the opportunity to complete my degree at UCLA, and I want to thank my department, World Arts and Cultures/Dance (WACD), for their support. In this regard, I would like to acknowledge our previous Chairs, Angelia Leung and Lionel Popkin, and our current Chair, Dan Froot, for their tireless efforts to lead such a unique and special department. To the faculty of WACD, thank you for sharing your incredible work and expertise. It has been a pleasure to learn from you. To my fellow WACD colleagues, it has been a pleasure to learn with you. Thank you to the entire department's staff: Lynn Tatum, Tiffany Long, Hayley Safonov, Megan Taylor, Marcia Argolo, Arsenio Apillanes, Erica Angarano, Mark Goebel, Ginger Holguin, and Will O'Loughlen for answering every question, supporting every project and performance, and sending out countless reminders for deadlines and events – you make all the difference.

In addition, I am truly grateful to have received the following support over these many years: Graduate Division CTR Funding 2019, Kress Foundation/ CAA Fellow (2018), CS3DP Scholarship (2018), UC HRI Grant Recipient (2017-2018), HASTAC Scholar (2016-2018), Faculty Women's Club Scholarship (2016-2017), Philip & Aida Siff Fellowship (2016-2017), Registration Fee Grant (2016-2017), WACD Scholarship 2015-2016, Teruko Kubota Memorial Award (2015-2016 & 2012-2013), Kress Travel Grant (2015, 2014, 2012), WACD Scholarship (2014-2015 & 2013-2014), Dean's General Scholarship (2013-2014), Kress Foundation Grant (2012-2013), Graduate Division Fellowship (2012-2013). I could not have completed this work without the opportunities each one of these honors, grants, and awards have afforded me.

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Outside of UCLA, I am grateful to the College Art Association for the support and the opportunity to serve on the education committee. I feel fortunate to work alongside so many inspiring people while helping to build and promote Art History Teaching Resources (AHTR). Your comradery and friendship remind me why I started this PhD process and why I love Art History. Additionally, I want to thank all those I have met through the Community Standards for 3D Preservation (CS3DP) group. It is a privilege to be involved within producing such important work with brilliant people. Parts of Chapter 8 were co-authored with members of the CS3DP "access" group. Finally, to the Getty Research Institute and Foundation for the lasting friendships and support over these many years.

Personally, I want to thank all my friends and family for their unwavering patience as I have completed this process. We have much to catch up on, and I am looking forward to it. I want to especially thank my parents, Steve Albrezzi and Trish Johnson, for telling me to follow my bliss and seeing me through my goals, especially this past year. It has made all the difference and our family is stronger because of it. Thank you to my grandparents, Mollie Albrezzi (Nana) and George and Dorothy Johnson (Pop-pop and Babba), for prioritizing education, making sure I had the best experiences, and loving me just the way I am. You set the best examples, and I have always wanted to make you proud. A special thanks to my aunts Mary B. Johnson, Fran Baker, Beth Albrezzi, and Susan Chervenic, for helping teach me what it is to be a woman in this world. The special moments we have shared have shaped me greatly. To Nicolle and Lawrence Townsend, thank you for the invaluable support, encouragement, and wisdom – you have helped

keep me grounded and motivated. I am continually inspired by Elizabeth, Eva, and Eden Glover, the true Digitals. It has been an honor to watch you grow and learn from you. Thanks for keeping me “hip” with the latest tech and for being your wonderful, caring, kind, beautiful selves. To the best poodle I know, Dante, thanks for the endless kisses and cuddles when I needed it most. Finally, to my loving partner John Glover, thank you for being my rock and my light at the end of every tunnel. We made it through, and I could not imagine sharing this part of the journey with anyone else. I am looking forward to what adventures come next for us.

FRANCESCA ALBREZZI

| Curriculum Vitae | | albrezzi.com |

EDUCATION

PhD in Culture and Performance **Degree expected June 2019**

University of California, Los Angeles

Dissertation Title: "Virtual Actualities: Technology, Museums, and Immersion"

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PROFESSIONAL EXPERIENCE

Curatorial Assistant, California African American Museum (May 2017 – October 2017)

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Technical Director, The Dancer-Citizen Live 2018: MOVING THE MAP (February 2017 – June 2017)

Technical Director, *Throwing Face*, UCLA (February 2017 – June 2017)

Technical Director, *Refugee Re/Enactments*, UCLA (February 2017 – June 2017)

Guest Curator, National Taiwan Museum of Fine Arts (July 2016 – November 2017)

Research Assistant, The Getty Research Institute (August 2011 – June 2015)

Editorial Assistant, The Getty Research Institute (February 2011 – August 2011)

Paralegal, Gary M. Gilbert & Associates, P.C. (September 2009 – June 2010)

Curator, Smith College Museum of Art (September 2008 – May 2009)

Smithsonian Researcher, National Museum of American History (September 2007 – December 2007)

Membership Department Staffer, Los Angeles County Museum of Art (May 2007 – June, 2007)

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- Projects: VSim Repository, Archive, and Platform; Digital Humanities Seminar Series; “Humanistic Infrastructures” book project; “Digital Art History: 101” Online Textbook; “Beyond the Digitized Slide Library” summer institutes; Wiki for Indigenous Languages project

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UCLA Research Symposium, UCLA, May 29, 2019	(Presenter)
UCLA GIS Day 2018, UCLA, November 14, 2018	(Presenter)
Alternative Research-Focused Jobs in Academia, UCLA, March 20, 2018	(Host)
Creating Reality Hackathon, University of Southern California, March 12-15, 2018	(Participant)
How To Build A Website Workshop, UCLA, February 13, 2018	(Presenter and Host)
Community Standards for 3D Data Preservation (CS3DP), Washington University, February 2018	(Poster)
Requirements for Advanced Research Cyberinfrastructure, UCLA, October 2017	(Panelist)
360 Day, Occidental College, September 22, 2017	(Keynote Presenter)
DH Infrastructure Symposium, UCLA, CA, 2016 and 2017	(Presenter and Participant)
PNC Annual Conference and Joint Meetings, Getty Center, August 2016	(Poster Competition Winner)
Beyond the Digitized Slide Library Summer Institutes, UCLA, 2014 & 2015	(Presenter and Coordinator)
College Art Association Annual Conference, 2019, 2018, 2016, 2014, 2013	(Presenter and Participant)
Digital Art History Lab, Getty Research Institute, March 5th-7th, 2013	(Presenter and Coordinator)
International Terminology Working Group, Getty Research Institute, 2011 & 2013	(Coordinator)
DAH: Challenges, Tools & Practical Solutions, University of Málaga, September 2011	(Coordinator)

Social Media Strategist and Contributing Editor for Art History Teaching Resources	(May 2018 - Present)
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Part I:

Introduction and Foundation

As technologies have become our tools, prosthetics, and companions, the art world and artists have been questioning and incorporating their continued and varied uses. From American dancer and inventor Loie Fuller's illusory performances at the turn of the 20th century to Alejandro G. Inarritu's 2017 virtual reality installation on immigration *Carne y Arena* at LACMA, work at the intersection of art, ontology, and virtual world building has been generated by innovators and artists to captivate and immerse audiences. In this dissertation, I build discussions around the use of digital technologies in association with art and art historical contexts to ask greater cultural heritage questions regarding humanity's relationship with digital technology. My work reflects on the emergence of digital humanities as a field in response to the experimentation and incorporation of digital methods, with an emphasis on extended reality (XR) technologies, for conducting humanities research in relation to arts and culture-based organizations.[1]

Within media that embody elements of "reality," like photography or film, semiotic understandings can become confused; the observer may perceive an object or experience and fill in a context. Additionally, audiences may be unaware of the cultural kaleidoscope through which the material is being filtered. Reality, after André Breton's Surrealist Manifesto of the 1920s, could never again be seen as simple or continuous, described empirically or through induction (Brenton 2012). While film and photography changed crucial aspects of culture in the modern era such as criminology, science, politics, and art, today's digital technologies are creating global connections, allowing for major steps in societal progress. As film and media scholar Steven F. Anderson notes, "Spaces both public and private that are *not* awash in wireless data seem like an

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[1] Extended reality (XR) refers to any technology that blends virtual and real environemnts. This includes Virtual Reality (VR), Augmented Reality (AR), Augmented Virtuality (AV), and Mixed Reality (MR). The concept of XR will be discussed in greater detail in subsequent chapters.

impoverished exception rather than the rule" (Anderson 2017). With the invention and wide acceptance of the Internet and the World Wide Web, the world experienced a new ontology and epistemology in a very similar way. Folklorist Simon J. Bronner once noted the artist's ability to use the materials of today's Western, twenty-first century, hegemonic culture to express unofficial social commentaries (Bronner 1986: 218). My work seeks to demonstrate that digital technology is not our savior nor our downfall, but a way of exploring key concepts of humanity.

In this project, I investigate the advantages and disadvantages digital tools bring to the field of Art History today. In particular, the project focuses on modes of publishing, display, and information-capture in museums and archives that illustrate a break from "traditional" models.[2] In doing so, I argue that digital modalities provide a distinctly different paradigm for epistemologies of art and culture. Extending previous research in museum studies and media studies, I address a selection of the latest technological interventions within museum and cultural heritage contexts that operate within a spectrum of immersive modalities and use extended reality technologies. The dissertation brings together many humanities disciplines to investigate how sharing XR within a museum both disrupts and complements the time-tested benefits of object-centered methods of display, representation, and education.

The concept of immersion plays an essential role within the dissertation, from deep involvement to suspension of disbelief. I utilize examples in each chapter to reflect how current practices are being challenged and reshaped by the introduction of XR technologies within

[2] Cultural Studies scholarship of the 1970's and 1980's conducted by Raymond Williams, Catherine Bell, Clifford Geertz, and Victor Turner, among others, redefined understandings of the term "traditional," as a notion that is no longer fixed, but an iterative performance that attempts to recreate an event or process based on collective memory. In this instance, I use the term "traditional" to refer to non-digital methods connected with the practice of visual studies and established lineages of practices within the discipline.

museum studies. These technologies have grown to a point of sophistication in which the virtual and the actual will create rivaling realities, both offering profound experiences for learning. While institutes of art and culture have been offering greater access to collections and archives through digital databases, there is a shifting interest to provide a remote public with an online experience that can communicate on an historical level, through factual data dissemination, and simultaneous shape both collective and personal memories through meaningful remote encounters with digital facsimiles and a rich level of related information.

The phase "virtual actualities" within the title of the dissertation signals changes in practice that are being brought about as digital technologies, and particularly XR, become incorporated into fields of arts and culture.[3] "Actualities" connote the practical matters associated with producing, presenting, and preserving digitally immersive materials in the contexts of gallery, library, archive, and museum (GLAM) organizations. "Reality" in turn is reserved for the qualities perceived when discussing the characteristics that define 3D and XR production. At the fore in addressing new topics in museum practices and by conducting new experimentation through the application of immersive technologies, this dissertation can offer new information for digital art history, cultural heritage, and museum studies. The aggregation of examples throughout the dissertation aims to provide a loose survey of the field of XR in its current state within GLAM settings in order to offer insight and guidance for future development and implementation.

[3] Admittedly, the phrase is a playful and productive contradiction. Much of the work discussed within the dissertation is at odds with previous modes of operation for GLAM institutions. Thus, "virtual actualities" also acknowledges the many differences XR technologies introduce to the fields of arts and culture and their various settings.

In my efforts to describe current challenges and opportunities in implementing XR into museum and cultural heritage spaces, this dissertation is organized into three parts, each with varying topics and methodologies. Part I reveals the motivation for the study, the methods of research, and the theoretical discourses employed to evaluate platforms, projects, exhibitions and other examples of digital technologies from the field. Part II focuses on the use of digital and XR in publication, display, and information-capture, encompassing areas of preservation and pedagogy. In Part III, the project culminates in a set of best practice guidelines for the field as expressed through a "Checklist" model for application in arts and cultural heritage arenas. Each section discusses digital technologies from current practice in GLAM settings situated within praxis contexts, approaching the descriptive analyses with differing methodological tactics.

Part I, "Introduction and Foundations," is divided into four chapters: "On Digital Humanist as Bricoleur: Methods, Methodology, and Motivations;" "On Digital Humanities and Digital Art History;" "On Museums in the Digital Age;" and "On Ways of Seeing and Technologies of Vision." In Chapter One, "On Digital Humanist as Bricoleur: Methods, Methodology, and Motivations, I offer some personal background and current context to demonstrate my motivations for undertaking this research project. I refer to the experiences I have garnered professionally and in the areas of academia which have informed my scholarly approach and critical perspective. Additionally, I describe the research methods I have employed through my course of study. In Chapter Two, "On Digital Humanities and Digital Art History," I articulate how the application of digital humanities within the field of visual studies, often referred to as Digital Art History, bears discipline-specific concerns for the digitally processing and presentation of object-based sources. Throughout the chapter, I rely on Johanna Drucker's use of the term “capta” (captured) as a touchstone for understanding “data” as always interpreted or translated in our attempt to communicate about the world around us (Drucker 2011).

Chapter Three, “On Museums in the Digital Age,” addresses key issues in the museum’s adoption of digital technology, merging ideas from practitioners such as Susan Vogel, Mieke Bal, Barbara Kirchenblatt-Gimlett, Mary Nooter Roberts, and Tony Bennett. In doing so, I situate the museum’s cultural authority within political, social, and cultural discourses of representation and display. Chapter Four, “On Ways of Seeing and Technologies of Vision,” merges ideas from Katherine Hayles, Donna Haraway, Anne Friedberg, Sean Cubitt, Jonathan Crary, and Tara McPherson to begin to form a new humanistic vocabulary around XR technology. As a medium, XR is not only visual. The combination of technology often employs several of the other senses culminating in an experience. As such, developing a language for communicating about the sensorial nature of the work moves the field forward in a necessary way. Within Part I, Chapters Two, Three, and Four provide a foundational perspective on the fields of Digital Humanities and Digital Art History, Museum and Curatorial Studies, and ways of seeing and technologies of vision as understood through Media Studies, and Culture and Performance Studies. The summary overviews offered in these chapters are intended to demonstrate to the reader a variety of useful basic concepts by largely well-known scholars in their respective fields to lay groundwork from which the topics of part II (digital publication, XR displays, and pedagogical and preservation concerns) can be understood. Together, the chapters in Part I lay the foundations for the main body of the dissertation.

Part II, “Discussions of the Digital and XR in modes of Publication, Display, and Information Capture for the Arts and Culture Fields,” focuses on paradigm shifts in three central areas of epistemologies. In Chapter Five, “For Publication: Past, Present, and Possible Futures for the Fields of Arts and Culture," I examine the frameworks of process and presentation as arts and culture-based scholarship move from traditional print publishing workflows to digital dissemination, focusing on specific platforms and projects. By investigating current publishing practices for digital scholarly catalogs, collections, exhibitions, and monographs, I lay groundwork for considering 360 panoramic technology, augmented reality, and virtual reality "publications" that are reaching new audiences and causing museum professionals to reassess the very notion of publication. Chapter Six, "For Display: Challenges and Opportunities in Contemporary Exhibition Practice for XR Work," details changes exhibition designers and curators are facing when sharing digital immersive artistic productions. Drawing from examples in the field, I propose new standards of display for XR experiences within exhibition settings. Chapter Seven, "For Posterity and Pedagogy: Using 3D Models and 360 Capture to Preserve Exhibitions and Teach Museum Studies," offers insight into issues of access and discovery through my personal experiments with technology in the field to document exhibitions, interviews with two professionals incorporating XR into learning environments, and current XR exhibition projects. The application of XR within museum settings can provide context in preserving and sharing exhibition work with future generations. The three chapters of Part II demonstrate the need and propose solutions for developing methods and standards for practices in GLAM organizations when implementing XR for the purposes of publication, display, and information capture.

In Part III "Conclusion," I summarize my findings, offer a set of best practice guidelines for current implementations, and suggest next steps for the field to support artists, scholars, and cultural heritage institutions. Chapter Eight "XR Implementation Checklist: Recommendations for Implementing XR into Arts and Culture Settings," synthesizes my findings and provides a model for implementing XR technologies into arts-and-culture-based educational environments, with special attention to accessibility, usability, and inclusion. Intended as a practical outcome, the best practice recommendations provide new practitioners a place to start, a method for building up, and a way to evaluate the application of XR technologies and platforms into various uses within the arts and cultures fields. Looking ahead, the conclusion makes an effort to tackle the current actualities practitioners are facing in order to realize a more equitable and inclusive future within arts-and-culture-based outreach when incorporating digital technologies.

The dissertation contributes to GLAM institutional practices by bridging professional and academic concerns regarding digitally immersive technologies. Valuing the new array of practices generated by those who participate in XR production and presentation, I advocate for their inclusion within media and art historical studies. The dissertation presents extensive examples to form a broad overview of current uses of digital immersive technologies within arts and cultural heritage settings. I foreground current issues in XR implementation, engaging sociopolitical and cultural discourses in order to document and improve current practices in digital publication, display, and information capture for arts and culture-based content.

Chapter 1: On Digital Humanist as Bricoleur: Methods, Methodology, and Motivations

The bricoleur, as traditionally understood through the metaphor developed by the structural anthropologist Levi-Strauss, makes use of available media in sometimes unexpected ways to build, mend, and/or maintain a construction (Edgar and Sedgwick 1999: 48)[4] In the context of cultural theory, bricolage involves the appropriation of elements from the dominant culture which are utilized or transformed to subvert it (ibid). The bricoleur embodies the artist, the engineer, and the pragmatic problem solver. Bricolage represents a reflexive and responsive approach to work—a method of careful consideration and deliberation with room for inspiration and play.

Today's digital humanists are bricoleurs. The combination of computational methods and humanistic inquiry results in a productive tension which highlights the values and limitations that define their modalities. Donna Haraway describes and uses the same type of tension in her Cyborg myth, a liminal being (Haraway 2001: 291). My motivation for including what is typically interpreted as theoretical scholarship within my method/methodology section is to bring a social feminist perspective to bear on mixed method practice. The combination of qualitative and quantitative methods in addition to the combination of theory and practice (or praxis) is a task that has the potential to result in a Haraway Cyborg, capable of shedding its hegemonic lineage for radical progress (Haraway 2001: 293). Under the bricolage method, the Haraway Cyborg has served as a litmus test for assessing the radical potential of the work throughout the

[4] In his own words, Levi-Strauss wrote "In its old sense the [French] verb *bricoler* applied to ball games and billiards, to hunting, shooting, and riding. It was… always used with reference to some extraneous movement: as ball rebounding, a dog straying or a horse swerving from its direct course to avoid an obstacle. And in our time the bricoleur is still someone who works with his hands and uses devious means" (Levi-Strauss 2010 [1966]: 16). For a greater discussion regarding Levi-Strauss sense and development of the term, see (Roberts 1996: 82-101).

various examples from the field I employ throughout the dissertation. Her works have provided a guide for considering the politics of organism-machine hybridity. Pairing interpretive modalities with exacting frameworks requires an iterative process; the DH bricoleur reflects upon project milestones to evaluate how recent work may have shifted the overall plan and reimagines next steps.[5] I employ a bricolage approach within my dissertation as the overarching method. Bricolage allows for my choice of methods to be project specific. As the format for my chapters centers around key examples or objects from the field, bricolage allows me to be fluid within my application of methods, serving the needs of the particular project, object, or experience in focus over the shifting terrain of the overall dissertation. At each stage, from gathering and selection of sources, to processing of the data and information, to interpretive frameworks that shape the final presentation, I have assessed if my application of methods, methodology, and theory are working toward my overall thesis which questions if digital tools introduce a paradigmatic shift for art history in terms of publishing, display, and information capture as specifically understood through and supported by my examples from the field. In this way I also build upon event-oriented methods in performance studies and other humanities fields (cf. Jackson 2005).

The DH bricolage method relates to Olga Goriunova's notion of a digital ontology—an ontology built on understanding the essence of how something is made and used (Goriunova 2016). The pursuit of the ontological, the quest to define something's nature of being, involves metaphysics and politics. Hayden White reminds us that the constructed narratives of dominant

[5] Within technical project management workflows, "iterative" does not mean simple repetition. whereas you imply change and growth in the unexpected but clever ways associated with the bricolage trope.

histories are written by those who are in power (White 1981).[6] So, while employing many Digital Art History and XR projects that are representative of the field, I have also utilized ones that I was involved in from start to finish in order to privilege the emic perspective. Through a set of autoethnographic methods and perspectives inspired by Heewon Chang, I can account for and expose the underlying decision-making processes within the constructions in those cases (Chang 2008: 43-59). From a practical standpoint, I had much of the data in hand already, which includes documents and digital files in the form of schedules, meeting notes, websites, publications, videos, and memories of conversations and events that occurred during my time on each project.

In this instance, I am a DH bricoleur searching for materials and gathering what I need from the world around me—that which is readily and reliably available. Either I control the primary resources, or they are publicly available, which was essential for me to move to the next phase of processing the data. Though I have collected data in a project-specific manner, my process and presentation prevent the information from being overly siloed. I foster connection among the examples throughout the dissertation and with theoretical discourses.

Since the project was born out of the experience I gained through my contributions to projects and experiments in the greater field of Digital Art History, I felt strongly drawn to bricolage as a nimble methodological approach which could support a critical and responsive engagement to the works (Yardley 2008). Pairing quantitative and qualitative methods, I form a praxis approach that has inevitably been presented with unexpected challenges.[7] Using a

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[6] Certainly not all histories are written by the powerful, for memory permits counter-histories to be proposed and acted upon; see Roberts and Roberts *Memory: Luba Art and the Making of History* (1996, Munich: Prestel, for the Museum for African Art, New York).

[7] Possibly a more contemporary version of the bricolage method is a "Comparative Studies" approach as proposed by Katherine Hayles (Hayles 2012: 7). Personally, through her approach

performative research method for multimodal scholarship recognizes the unpredictability of research and allows for a hybrid outcome that balances the needs of the content and form with the overall intention of the work (Weinstein and Weinstein 1991). Originally, the project was conceived as a digital document, one that would allow for adding digital assets and offer readers direct engagement via embedded or linked resources, while supplementing the experience with an interpretive layer which I would provide. However, due to restrictions on what can be submitted through the university's ProQuest system and additional concerns raised about the need for the document to signal "permanence" within its presentation, I redesigned the dissertation to fit within the requirements.[8]

In this version of the project, links to digital sources are placed in footnotes, and I have chosen to use very few of my images from the field. It is my intention to build on the work within the dissertation to present it in a more digital interactive format at a later time. In doing so, I would allow for the work I am investigating to be presented in a format that offers readers a better idea of the experiences I am discussing. Experiential technologies or extended reality (XR) technologies are proposing knowledge production through encounter and can create complicated notions of reality which challenge linear narratives and preservation practices. The operation of the technology becomes essential to understanding what XR experiences are and how they fit within our current systems for understanding objects and optical technologies. Additionally, there are forces outside of data that can impact XR technologies, as data is a representational

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the term loses some of its poetics, artistic intentions, and breadth that "bricolage" connotes to me.

[8] Digital publications are complicated, but several universities have already begun to allow them for dissertation projects. The limitations of a dissertation delivery system should not decrease the impact of production, especially through the arts. Universities will likely need to re-evaluate such systems to accommodate digital scholarly production on the graduate level.

reflection of the human identities involved in its creation. As a result of such considerations, I have turned to Olga Goriunova's work on digital ontologies and "double data" in applying a meta-reflexive perspective to my dissertation.

Origins and Motivations

The dissertation project is founded on my decade of work in museums. Serving in many roles, from publications intern to curator, I have witnessed firsthand the changes to workflows that digital technologies have instigated. Challenges to Art History and museum practice are coming from extended reality (XR) technologies, which my background has prepared me to study in depth. As an undergraduate, I majored in Art History and minored in American Studies, developing skills for close-looking, object analysis, and building historical and cultural contexts, which I apply throughout the dissertation. In addition, I began my foray into the museum world, starting as an administrative assistant in the office of the Director of the Smith College Museum of Art. I have held positions in museums that range from research to membership, marketing, and curation. These experiences have provided me with insights into the interworking and daily operations of museum and exhibition spaces.

I came to this dissertation after a four-year Research Assistant and Project Coordinator position in 2015, through which I reported to the head of the Digital Art History Department at the Getty Research Institute (GRI). There I had the chance to work on digital projects in various stages of production and to collaborate with scholars and professionals at different levels of technical skill and know-how. From my experience as interim project manager for the first version of the Getty Scholars' Workspace (TM), I became interested in developing digital tools, platforms, and projects that would allow art historians, archivists, and curators to reach audiences in new ways. I found that digital technologies had the power to contribute in new ways to the fields of arts and cultures.

My time at the Getty Research Institute (GRI) was particularly meaningful in shaping my perspectives. While working in the Department of Digital Art History at the GRI, I grew passionate about working with and preserving digital media, collaborating across disciplines, and managing and sharing scholarship through digital platforms. I was introduced to dialogs regarding the use of newly emerging platforms and the representational and operational concerns they entail. These and my early graduate school classes at UCLA with Allen F. and Mary Nooter (Polly) Roberts sparked my Master's thesis, "Visiting Digital Tombstones: Unearthing Questions of Digital Personhood, Commemoration, and Remembrance Processes." Central to my thinking were Alfred Gell's concepts of the art nexus and the distributed person, in combination with Sherry Turkle's studies of social and psychological connections among digital devices and users as frameworks for examining digital applications which are being incorporated by some users in processes of remembrance and mourning (Gell 1996 and 1998; Turkle 2005). In doing so, I began to grasp how bringing different scholarly fields (specifically Digital Humanities, Digital Art History, Museum and Curatorial Studies, Media Studies, and Culture and Performance Studies) together could create original understandings of today's technologies.

At the same time, I started my own digital arts consulting business and developed an interest in 360° photo and video capture. The technology had progressed to a degree that it was easily portable and more accessibly priced. I began to document exhibition spaces and performances using my 360° equipment and discovered I was able to capture greater spatial context, which helped situate the work in relation to the world around it. I became interested in the way 360° capture could add more relational information to the archive for study of performance and exhibitions.

In pursing my interest of the intersections of arts and technology, I received further training that has been essential to the project. I attained a graduate certificate in Digital Humanities (DH) from UCLA in 2018, after spending several years teaching and furthering my studies into the intersection of humanistic inquiry and computational methods. I met Dr. Lisa M. Snyder through the DH program and had the opportunity to serve as her lead content coordinator on a National Endowment for the Humanities (NEH) grant funding the development of a new version of VSim, a platform for presenting 3D models in teaching and research contexts, as well as assisting on an online archive of academically rigorous 3D models at the UCLA library. While working to build a content management platform and an online database, I regularly considered how to generate and manage metadata in a way that will promote a wide usership amongst teaching and research communities. I was also exposed to the challenges of presenting, sharing, and preserving 3D scholarship. My work in 360° capture and 3D through these various collaborations provided me with hands-on experiences in the field of XR.

My efforts in the field guided my investigations into how immersive technologies affect publishing, display, and information capture. Building on previous research in museum studies and media studies, I address some of the latest (as of spring 2019) technological interventions within museum and cultural heritage contexts. The dissertation closely examines how digital technology, specifically XR applications, reconfigures the relationship among museums, art historians, and interested audiences through multimodal scholarship and practice. Through this research, I aim to document and critique current processes and methods for XR implementation in order to contribute to new standards for presentation and display that emphasize accessibility, inclusivity, and usability for as many GLAM visitors as possible.

Organization and Overview

I have divided the dissertation into three parts. "Part I: Foundations" addresses the key perspectives in the fields of Digital Humanities, Digital Art History, Museum and Curatorial Studies, Media Studies, and Culture and Performance Studies. The short chapters of this section are meant to demonstrate a mastery of literature within each field and situate my point of view within the greater areas of study. I bring these discourses to bear on my topics in Part II, which is a set of chapters that discuss digital and XR in modes of publication, display, and information capture for arts and culture fields. Within them, I connect some of the literatures from Part I with additional articles, projects, and examples from the field to tailor my descriptions to the topic at hand. Finally, in Part III I conclude with recommendations through a "Checklist" to guide future work in XR display, teaching, and learning.[9]

Chapter Breakdown and Application of Methods

Chapters Two, Three, and Four are derived from reading lists I compiled to develop a broad understanding of discourses in Digital Humanities, Digital Art History, Museum and Curatorial Studies, Media Studies, and Culture and Performance Studies. The chapters are summaries of basic concepts and work by key authors that act together to provide readers with a

[9] While preservation is a concern through the dissertation, I am choosing not to offer specific guidance on preservation practice within the conclusion because I am currently working on a publication with the Community Standards for 3D Preservation group that will do so in great detail.

baseline perspective for the research presented in Part II of the dissertation. Presenting relevant critical thinker's works and popular concepts from each field with some historical framings, attention is drawn to the particular way these fields intersect when considering the presentation, teaching, and preservation of XR materials. Shorter and more presentational than analytical in style, they provide the reader with essential context, bringing together foundational components to form a perspective upon which the chapters of Part II can build.

Chapter 2

A general overview of Digital Humanities (DH) and Digital Art History (DAH) follows as an engagement of key issues to serve as a touchstone for the work offered in Part II of the dissertation. Criticisms of DAH are summarized and answered with specific examples, using a DH model of examining sources, processes, and presentation, drawing attention to their visual studies particularities. Distinctions between analog and digital modes through object-analysis argues for distinctive experience in digital environments. A central thesis is that reflexive digital projects can be beneficial to humanistic practice. Looking for intersections between cases developed in several literatures and my own work, the chapter interweaves my professional and research experiences with that of the greater field from roughly 2012, when Diane Zorich published her Kress Report, to the present.[10] An action-based approach results as my work-based observations are presented with regard to current scholarship.

[10] Diane Zorich produced a report for the Kress Foundation regarding the state of digital humanities centers and a community assessment in 2012 on the field of digital art history. In it, she encouraged a shift in strategy for institutional leadership to no longer focus on funding boutique digital projects, but rather foster training programs and long term, reproducible digital techniques, tools, and outcomes. For a copy of the report, see: http://www.kressfoundation.org/research/transitioning_to_a_digital_world/.

Chapter 3

Chapter Three addresses key issues in a museum's adoption of digital technology, merging ideas from curators and theorists including Susan Vogel (1991), Mieke Bal (1996), Barbara Kirchenblatt-Gimlett (1998), Mary Nooter Roberts (2008), and Tony Bennett (1996). In doing so, I highlight the museum's cultural authority to situate these institutions within political, social, and cultural discourses of representation and display. The groundwork for this chapter originated in classes at UCLA with Mary (Polly) Nooter Roberts and Miriam Posner on curating cultures, the exhibition complex, and museums in the digital age. The assignments in these classes prompted me to build exhibition proposals in collaboration with other students. The application of a praxis approach informed the understandings represented in this chapter and I carry those foundations into the work presented in Part II on publication, display, and information capture.

Chapter 4

Born of independent studies with UCLA Professor Steve F. Anderson, I developed a reading list on immersive technologies, media studies, and human and computer interactions. Dr. Anderson offered me a qualifying exam question that challenged me to develop my own vocabulary for my project, which became the basis for this chapter. A summary analysis of ideas in these fields lays out approaches to ways of seeing and technologies of vision to highlight key areas in respect to XR technologies. Of particular significance are Katherine Hayle's "Comparative Media Studies" (2012), Donna Haraway's concept of "Vision" (1998 [2002]), Anne Friedberg's investigation of the perspectival paradigm, Sean Cubitt's consideration of light within the formation of the object and subject relationship (2012), Johnathan Crary's notion of subjective vision (1990), and Tara McPherson's application of the lenticular to contextualize the social history of computational development in order to propose the term "Bubbled Lenticular Vision" to describe 360 photo and video capture (2012). I then connect my proposed term to cultural ontological theories, drawing from another reading list developed with Professor David D. Shorter, to develop discussions around immersive 360's use of phenomenology to produce an "embodied liveness."

<u>Chapter 5</u>

Publication provides for the communication of vital information and knowledge for educational and GLAM institutions and their public and scholars. Chapter Five describes the rapid transition in recent decades from analog to new forms of electronic publication in these settings. From my work in the Publications Department of the Getty Research Institute (GRI) in 2011, I transitioned to the GRI's Department of Digital Art History, and was fortunate to participate in the sea change that occurred in this area at a major GLAM institution. Through later projects at UCLA and independently, I furthered my understanding and experience through an action-based research method by working with evolving platforms and tools of digital publication. In investigating digital publishing for visual studies disciplines, issues that practitioners, institutions, and users are grappling with became evident by attending conferences, consortiums, and forums. An encompassing landscape results from publications, key events and gatherings, exhibitions, and other digital art history projects and websites that provides a foundational history for contemporary digital art history praxis.[11]

[11] Johanna Drucker provided a useful distinction for the field in 2013, separating digitized art history (use of digital images) from digital art history (curated digital catalogs, information visualizations, simulated environments, mapping, networks, etc.).

Platform and project analysis are explored, focusing on digital scholarly catalogs, collections, exhibitions, and monographs. Comparing tools used in virtual presentation to their print counterparts and each other, I highlight the opportunities and challenges digital publishing presents to arts-and-cultures-based content. Development of digital monograph initiatives is especially significant, through close readings of Scalar, Manifold, and Fulcrum platforms, to consider their presentation of visual studies material, particularly 3D or immersive content. An overview of new publication pipelines and workflows emerges as they are developed to handle new media content and publications. Hybrid formats receive attention as well, to examine an alternative of how publishers and authors can publish 3D scholarship. An object analysis of panoramic 360, augmented-reality, and virtual-reality examples demonstrates the challenge of evaluating of XR "publications" due to their aesthetics as experience and virtual objects.

Chapter 6

The sixth chapter will focus issues of display that confront those who are creating and curating XR encounters for a public audience. I apply the bricolage method in this instance in a very similar way to practice-based inquiry through curation (Gardiner, Bentkowska-Kafel, and Cashen 2009). Curation brings together objects in thematic, purposeful ways to add meaning and significance through contexts of grouping and juxtaposition, much in the same fashion as a bricoleur. In *HyperCities: Thick Mapping in Digital Humanities*, Todd Presner, David Shepard, Yoh Kawano similarly reflect on analogies of the *flaneur* of late-19th-century European arcades (Presner et. al. 2014: 23 28, 30, 31, 36, 55, 95, 109, 131). More than a strolling "dandy," they look to Walter Benjamin's reconception of the *flaneur* as a time traveler able to make the past "speak, […] come alive and come to light, and, thereby, resonate with the present. In this sense, the past must be conjured, awakened, and cared for" (ibid; Benjamin 1999: 476). Like the wanderings of a *flaneur*, my assembly within this chapter is not happenstance or aimless; it has been responsive to key observations and practical circumstances, while remaining open to inspiration and exploration of XR display.

Through a process of selection, placement, display, and design, XR exhibitions culminate in interactive and immersive environments for visitors to engage with identity, technology, performance, agency, and other matters of personal and collective importance. In examining encounters with XR as the primary sources, the impact of the roles of practitioners, the management of and communication with the public, the spatial concepts and requirement, and approaches to funding and partnerships are detailed. The observations also connect current articles from journalists and practitioners with scholarly phenomenological and identity-based discourses related to issues of display, representation, and embodiment.

Chapter 7

Implementation of XR within museum settings can benefit future generations by preserving and sharing exhibition work with greater access and virtually enhanced contexts. In Chapter Seven, I present findings from my personal experiments with technology in the field to document exhibitions for preservation and learning. The late UCLA Art History professor Arnold Rubin challenged understandings of art when he wrote about art as technology to stress the work objects perform – their efficacies, that is (Rubin and Pearlstone 1989: 11; cf. Gell 1989). Considering our digital tools and devices as folklore objects, or creative creations of quotidian life, presents an opportunity to highlight the scholar as a maker.[12] To argue for an understanding that reflects dynamic and mutually constitutive relationships between people and digital technologies, I engage with 360 photo and video technology to create immersive experiences for GLAM (gallery, library, archive, museum) audiences.[13] With these technologies, we can preserve environments and performances in ways that capture artworks and audiences, allowing new methods and models for reflecting on dynamic exchanges between the two. Bricolage allows for methods to be project-specific in order to serve content and intellectual missions.

Additionally, qualitative interviews provide a way to compare and build from expertise of others working in the field and implementing XR in classroom settings. My first interviewee was Dr. Kristina Golubiewski-Davis, Director of the Digital Scholarship Commons at the UC Santa Cruz University Library who has approximately fifteen years of experience working with digital tools from a humanities perspective. I met Dr. Golubiewski-Davis through our shared work with the Community Standards for 3D Preservation (CS3DP) group, where we are addressing issues of long-term preservation, management, metadata, copyright, and access for 3D content. As part of her many responsibilities, Dr. Golubiewski-Davis runs an equipment loan program through which students and professors can rent 360° cameras and compatible mobile phones. A librarian's viewpoint on the facilitation of digital tools within the visual studies classroom is

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[12] As an amateur painter and filmmaker, bricolage resonates with me on a personal level. In artistic practice, form reveals itself through a process of creation and revision, remaining a dynamic process of balancing intention and inspiration.

[13] I won my earliest film award at the age of eleven. I have participated in two summer programs at the USC School of Cinematic Arts and learned the craft from the angles of writer, producer, cinematographer, actor, director, and designer. My use of the medium within the dissertation and examination of what it affords GLAM institutions stems from personal practice as well as intellectual interest.

valuable, given the central role libraries play in education. Likewise, Steven Sato, Director of Technology at Rolling Hills Country Day School, offers his perspective on what types of XR implementation is being undertaken in elementary and junior high education. I met Steven through the Immersive EdTech Meet-Ups he arranges every month. From those gatherings, I have additionally learned about how high school programs are also introducing digitally immersive tools and skills in education.

Supplemental information regarding other immersive programs, techniques, and practices to further express the issues facing digitally immersive museum educational strategies provides support to these experiences in the field. Such perspectives include frameworks for object-centered learning, distant/online learning, immersive learning, and digital humanities in promoting discovery, access, usability, and inclusion within arts and culture-based education. By discussing the modes of learning that XR can engage for students, I argue that investing in immersive documentation of exhibition spaces prototypes a spatial- and design-oriented epistemology for museum and curatorial studies. These XR contributions promote discussions about the significance of museum placement of artworks in a physical installation in visually-oriented and interactive ways.

Chapter Seven is further informed by my seven years of teaching in higher education within the department of World Arts and Cultures/ Dance and the Digital Humanities Program at UCLA and professional service. From my time as a HASTAC Scholar from 2016-2018 to my current role working as a Research and Instructional Technology Consultant (RITC) in Humanities Technology at UCLA, I have gained experience in helping others implement digital technologies into their classrooms. As a Contributing Editor for Art History Teaching Resources and a College Art Association Educational Committee Member, I regularly support and share online educational resources and build community around the scholarship of teaching and learning in art history. Additionally, I have developed digital tools, such as The Getty Scholars' Workspace™ for conducting collaborative arts research and preservation, and an online digital art history textbook as a resource for scholars and professors looking to get started in the field as part of a Getty Foundation grant. Finally, I have served for two years on my department's student-led Professional Development Committee, lending my knowledge of digital applications to help with career training and building amongst my colleagues. These experiences have served as motivation for the inclusion of a chapter that addresses educational concerns when implementing XR technologies into teaching and learning practices.

Conclusion

Digital environments and the arts in varied configurations require different criteria for assessment. Bricolage depends on expertise with many different kinds of tools and techniques. Once learned, the various methods and models of production are at one's disposal to tackle work as it presents itself. The digital humanist pulls from a range of quantitative and qualitative modes in service of research questions and needs. People often confuse assemblage and bricolage; however, it is essential to understand their distinct meanings. Unlike assemblage, through which objects are brought together but retain what they were on their own, bricolage transforms different items through amalgamation into something with new meaning and purpose. Through case studies, aspects of thematic content, historic context, intent of an artist, physical space, and varied immersive experience of the viewer can be addressed as constituting new opportunities rather than as summations of their parts.

This dissertation addresses a spectrum of immersive experience within GLAM organizations as offered by technologies such as virtual reality, augmented reality, and 360 photo and video capture. To achieve this goal, consideration is given to digital immersive tools in publishing, display, and information capture for arts and culture content. Believing that digital modalities provide a distinctly different paradigm for epistemologies of art and culture that offer greater contextualized understandings than "traditional" modes, I have conducted interviews, performed archival research bridging different disciplines, attended conferences and gatherings in the field, and performed by own experiments with digitally immersive content to represent exhibitions spaces in a virtual way. With these three areas of research and the resulting analysis, I situate my project at an intersection of Digital Humanities, Digital Art History, Museum and Curatorial Studies, Media Studies, and Culture and Performance Studies. Bridging among these fields permits investigation of current (as of 2019) use of XR technologies in museum and cultural heritage practices in valuable ways.

Chapter 2: On Digital Humanities and Digital Art History

The history of Digital Humanities is well-documented (Grudin 2011, Nelson 1973, Paul 2015, Gold and Klein 2016, Svensson 2010, Bentkowska-Kafel 2015), but the productive tension that results from combining computational methods with humanistic inquiry continues to break new ground. The development of Digital Humanities to address the use of digital and computational methods for humanities research and publication renegotiates the standard practices of research methods and publication outcomes. The sources, processes, and presentation decisions that define a digital humanities project require specific parameters and functionalities depending on the subject matter and methods applied. Many have written about the specific concerns for Digital Art History work (Bentkowska-Kafel 2006, Baca et. al. 2013, Klinke & Surkemper 2015, Klinke & Surkemper 2016, Klinke et. al. 2018), as material and image-based data present a different set of challenges for analysis and presentation than text-based humanities data. As such, some remain concerned over losing criticality and humanistic application in utilizing computational/ data metric technologies for art historical research. In this chapter, I establish that to debate interpretation, one must begin at the level of Johanna Drucker's "capta," where any intervention to communicate about the world is an interpretive act, including data collection and visualization (Drucker 2011). Such a process starts with addressing the components that make up a particular digital humanities project.

Most digital humanities projects can be examined at the levels of primary source material, process, and presentation. Every project begins with material that was likely not born as data, but existed as something else: a sculpture, a journal, a sheet of music, a region of land, a moment in time. At this level, the DH project is understood by considering the core materials at the basis of research. Primary sources form the foundations of the DH project. From these sources, information is harvested to form a data sheet that can be processed in a variety of ways. Processing includes the way the data is formatted – the ontology[14] of the dataset. It also includes how the data is massaged, cleaned, or manipulated to be run through programs to transform it into information that is relevant to the project's research questions. The results may be data visualizations, maps, timelines, network graphs, 3D renderings and the like (Posner 2015: Slide 11). The tools used to process any such data have their own biases, strengths, and weaknesses. Understanding the selection of tools for processing data will be critical to the analysis of the DH project. Finally, choices that go into presentation can be assessed on two levels: the information architecture and the user interface (UI) design. Information architecture controls where information is placed and how information is connected across the platform. User interface design addresses the overall form and function of the presented material. Often, the information architecture and UI are limited, based on the choice of a content management system (CMS). The CMS is a user platform that serves as an intermediary between file storage and content presentation. CMS's operate via a templating system that utilizes WYSIWYG (What You See Is What You Get) design to help streamline publishing to the Web, so that not every component of the website needs to be coded by hand. Today, CMS's are designed for various kinds of Web publishing, such as blogging (Wordpress) or collection management (Omeka).

By examining a project based on the choices made across the elements of sources, processes, and presentation, we can understand data as "already interpreted." Next, I will demonstrate the implementation of common digital practices that support rigor and humanistic

[14] Ontology in philosophical study addresses the metaphysical nature of being. However, in library and information science, the term refers specifically to organization and categorization of information by which that information is delimited, properties are assigned to the content, and relationships between the information is described through the system as it is constructed. I am referring to this application of the term here.

inquiry and are “normalizing” Digital Art History and its place within Art History, as represented by its continued and increasing presence at significant gatherings like the College Art Association Annual Conference. To further support these assertions, I will reference art historians and art historical projects that engage with digital tools critically. Finally, I will lay out what is at risk if Art History does not adapt and adopt digital methods. The chapter is meant to lay the ground work for considering the ways digital methods are allowing for different forms of humanistic inquiry for art historical research and scholarship that will enhance and diversify the field. Broadening methods for artistic and cultural study can improve representation and foster connections with contemporary discourses concerning identity politics. Digital Art History projects expand the types of learning experience art history can offer. They also provide an opportunity for greater context to be introduced in the dissemination of materials in art history and cultural studies, as seen through online scholarly catalogs for exhibitions or digitally immersive tours of museum spaces. Ultimately, such initiatives will contribute to an assessment of current XR experimentation and application within art and cultural heritage studies and allow me to critique such work based on standards of assessment utilized within the Digital Humanities community.

Already Interpreted

Technodeterministic arguments can rob scholars of their agency and responsibility. I argue that while digital tools do have a purpose that is inherent in their creation – a motive behind their being – how we choose and employ them matters. In Drucker’s article “Humanities Approach to Graphical Display,” she cautions humanists who work with data from thinking about data as a given, suggesting the concept of “capta,” or captured, to emphasize an active, processual sense of how knowledge is constructed as opposed to any positivist notion of it simply "existing" sui generis (Drucker 2011, 2). Echoing Walter Benjamin's notion of translation, Drucker reminds us that there is no such thing as a natural representation of preexisting facts. The process of digitization makes evident that acts of interpretation happen at every level of art history, and to single out one area over another seems arbitrary (Drucker 2013: 8, 12). Every intervention is an act of interpretation, including computation, in other words.

Drucker also explains how visualizations can reify misinformation. If we pursue computational methods, it is our responsibility as humanists to make evident to greater communities the where's, how's, and why's of those interventions as much as possible (Drucker 2011). In her talk and article titled, "Against Digital Art History," Claire Bishop spoke and wrote critically of the field, stating that "computational metrics can help aggregate data and indicate patterns, but they struggle to explain causality, which in the humanities is always a question of interpretation" (Bishop 2015: 5 and 2017). However, as users, creators, and data capturers, we shape the argument in the choice of media and the way in which it is used. Those who chose to participate in digital art-historical practice should be evaluated for the application of their tools and selection of their data, with the same rigor as applied to non-digital forms of scholarship. The lessons learned from Lev Manovich's cultural analytics projects have not fallen on deaf ears (Ushizima et. al. 2012).[15] As Nuria Rodriquez Ortega and Thomas Gaehtgens note in their 2013 articles for the *Visual Resources Journal* special double issue on Digital Art History, scholars must practice accountability by asking with every digital art historical endeavor how the digital

[15] Such cultural analytics projects use algorithms and image-detection software to arrange digital images based on visually and computationally identifiable data. Utilizing these methods on images of art results in a comparison of digital images, not a comparison of the works themselves. Early critiques of cultural analytics methods expressed concerned regarding the risk of conflating the two.

method is contributing in new and critical ways that advance the values of art history. As bricoleurs, DAH practitioners will hone and expand their craft and its application over time. Matthew K. Gold and Lauren F. Klein reflect upon Rosalind Krauss's musings on a confounding new earthwork in their introduction to the *Debates in the Digital Humanities 2016*. In this time of cross-discipline inquiry and analysis, they ruminate that "standing before the landscape of digital humanities and contemplating the present contours of the field, we find ourselves at a similar moment of simultaneous knowing and unknowing, rootedness and dislocation" (Gold and Klein 2016: xiv). With such examples in mind, ours is clearly a time to explore what digital art history can be.

Establishing a Baseline in the Recognition of Digital Art History Practice

Bishop cites Johanna Drucker's 2013 article "Is There a 'Digital' Art History?" to suggest that the field of Digital Art History is not producing work that has changed the foundation of art history. Understanding the stakes as posited by Drucker, several Digital Art History Institutes were funded by the National Endowment for the Humanities and the Getty Foundation and organized by Harvard, George Mason University, and UCLA to help encourage digital art history exploration and spread best practices starting in 2014.[16] In addition, the College Art Association (CAA) had begun to offer their own version of The Humanities and Technology Camp (THATCamp) prior to the annual conference to "address a growing level of methodological experimentation and questioning as digital tools were shifting in the field of art

[16] See footnote 1 in Elli Doulkaridou's article for additional examples and articles regarding the surge of support for digital art history practice (Doulkaridou 2015: 80).

history" (Albrezzi 2016).[17] Based on two summer institutes held at UCLA in 2014 and 2015, an online textbook was compiled to serve as a basic guide for digital art history covering fundamental skills as well as critical approaches to digital practice. *Digital Art History 101: A Basic Guide to Digital Art History* was intended for beginners in the field. Each chapter contains readings, resources, tutorials, digital tools, and projects to provide foundational knowledge regarding data collection and curation, project management, information visualizations, mapping, modeling, and pedagogy (Albrezzi et al. 2016). The carefully structured resource intends to foster connections between critical concepts, hands-on work, and key examples in order to promote the production of work with well-structured data and useful standards that considers "the epistemological implications of data-driven analysis and spatio-temporal representations" (ibid).

CAA has since ceased its THATCamp because the interest in digital art history has grown so prominent it has rightfully taken a seat (or set of panels) at the conference. As evidenced in the various outcomes from digital art history summer institutes, the field has begun to establish standards with which to critique digital art historical scholarship, from the selection of sources to the methods utilized to process the data and final presentation of a project. In 2016, I wrote a report regarding some of the programmatic changes I was seeing at the annual College Art Association Conference that signaled a growing acceptance of the practice of Digital Art History (Albrezzi 2016). Additionally, CAA came out with a number of guidelines relating to digital practice, including fair use and the evaluation of digital scholarship for tenure.[18]

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17 The first CAA THATCamp was held in 2013. Two others were held in 2014 and 2015 respectively.

18 CAA first released a brief entitled *Copyright, Permissions, and Fair Use among Visual Artists and the Academic and Museum Visual Arts Communities: An Issues Report* in 2014, and later a more encompassing set of recommendations in 2015, *Code of Best Practices in Fair Use for the*

Spearheaded by a series of CAA presidents who fostered their own practices of digital scholarship, starting with Paul B. Jaskot in 2008, DAH has gained increasing traction as an applied method within the discipline.[19] As digital methods are brought into the mainstream, it is the responsibility of the art historical community to assess and critique the design and application of data-driven projects, which begins with an understanding of the computational tools.

While creating a paradigm for DAH has taken time and will continue to transform in bricolage-fashion as practitioners respond to an expanding digital toolset, progress is being made to provide objective analysis in a way that subjective interpretation cannot. Even Erwin Panofsky, an art historian whose work on iconography was influential during the early twentieth century, as Elli Doulkaridou suggests, conceded there are practical aspects to interpretation that require more than just the use of a well-trained eye (Doulkaridou 2015: 68). In support of reflexive scholarship informed by bricolage, several characteristics have surfaced to define the difficult balancing act of digital art history including the disruptive use of big data, an influx of data access for selection, recognizing interpretation through working with digital tools, and exposure of the process through which knowledge is acquired and/or produced.

Visual Arts. The reports and further details can be found at: http://www.collegeart.org/programs/caa-fair-use/. In January 2016, CAA published *Guidelines for the Evaluation of Digital Scholarship in Art and Architectural History*, as funded by the Mellon Foundation and carried out by the CAA Task Force to Develop Guidelines for Evaluating Digital Art and Architectural History for Promotion and Tenure. As with the previous reports, it is available on the CAA website at: http://www.collegeart.org/pdf/evaluating-digital-scholarship-in-art-and-architectural-history.pdf

[19] The record of CAA presidents can be found at: http://www.collegeart.org/about/board-of-directors/presidents. It should be noted that CAA can make suggestions, but faculty in particular Art History departments are under no obligation to follow any such recommendations.

<u>Big Data</u>

Big data represents a change for Art History that has been built up incrementally over time. The ability to calculate beyond what is humanly possible in pursuit of humanistic inquiry was prompted by work of Fr. Roberto Busa and has been cited as a founding moment of what has become known as digital humanities.[20] In Busa's case, creating a searchable index for Thomas Aquinas' corpora of writings came before textual analysis, but the availability of big data has grown to a point where we can, and do, as Alan Liu describes: work backward from data to identify research questions (Liu 2013). It should be noted that working backwards from data to questions preceded Big Data and has been a temptation for scholarly projects that progress from available data sets regardless of their size. Empiricists in humanistic social sciences have made the point for a century or so, as did Victor Turner, for example (Turner 2017). One should not bring models and assumptions to research. Instead research is born out of observation of people and cultural productions, which guides the researcher to understand a topic, object, process through applicable methods.

With the use of large datasets such as those offered through resources like the Getty Provenance Index, we are now able to investigate vast questions that might otherwise be impossible to consider. Analysis of big data can point us in the direction of a pattern that we already suspected was there, serving as further validation, or make us aware of outliers that are worthy of consideration. The interpretive work does not rest on the spreadsheet alone in digital art history, but it can help us find new areas of study through methods like data faceted

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[20] Busa's index represents just one possible origin myth for DH and although he got help from IBM, the computational linguistic project was beyond what was humanly possible even at that time. Busa started his study of Thomas Aquinas and the project without having computation in mind, but both he and Thomas Watson, Sr., founder of the IBM Corporation, seized on an opportunity for cross-promotion and development.

searching, which allows for data to be called based on applied criteria and arranged in new ways to visualize the data with different emphasis (Drucker 2013: 8).

For example, Anne Helmreich and Pamela Fletcher co-authored “Local/Global: Mapping Nineteenth-Century London’s Art Market,” for the online journal *Nineteenth-Century Art Worldwide* (Fletcher and Helmreich 2012). Through the use of network analysis, they examined the crucial role commercial art galleries played in London’s art market, bolstering artistic transactions and transmissions. Awarded the ARIAH Prize for Online Publishing in 2015, the mapping of the network in terms of “geographical distribution and movement over time and in relation to other types of spaces; namely, exhibition societies, artists' residences, museums, and other retail venues” demonstrated that the London art market was much more central to the commerce of art and exchange of artistic thought than had previously been realized (Fletcher and Helmreich 2012). In addition, Helmreich and Fletcher’s work is a strong example of transparent digital methods and reflexive methodology echoed in other digital art history projects such as the Gugelmann Galaxy project which ostensibly began with a two-day hackathon in February 2015 at the Swiss National Library in Berne (Bernhard 2016: 96).

While the Gugelmann Collection of Schweizer Kleinmeister was available online at that time through Wikimedia Commons, users could only see what was available by scrolling through thumbnails of the drawings and paintings listed alphabetically by the surname of authors (ibid: 97). The goal of the project became finding a way to present a useful overview of the 2300-plus collection for productive browsing and search. The team settled on four measures by which to sort the collection: two attributes extracted from machine learning data and two from human generated data. The criteria for comparison derived from computer vision algorithms were “color” and “composition” and the two based on textual information were “technique” and "description." The decisions regarding the new sorting and curatorial concepts for collection access were made over a marathon weekend by the team which included an art historian along with PhD students studying Computer Aided Architectural Design in Zurich. Team member Mathias Bernhard detailed the methodologies the team employed in the classification process. Through their tailoring of the metadata, the Gugelmann Galaxy project team was able to generate a more precise model that acknowledged the idiosyncrasies of their data and allowed for great flexibility for users. The initial result from the hackathon was a 3D desktop application of a "cosmos of free floating images" that users can search by the four criteria to select an image which will be displayed in proximity with its eight most similar items from the collection (ibid: 105). Mathias Bernhard also continued to work on the project to make it more immersive using the game-design platform Unity; he eventually created a version online at www.mathiasbernhard.ch/gugelmann to give users even greater access (ibid: 108).

The combination approach demonstrates an acknowledgement of critiques of positivist methods, but also provides a plan for tapering the effects through close monitoring of and adjustments to the algorithm. Computers are not capable of the complex and independent thought required for identification of technique. However, there is promise in programming a machine to identify color using things like hex code ranges. Admittedly, the Gugelmann project "does not assume an indefensible set of categories but relies on a gradual statistical correlation" to find connections across the collection (ibid: 108). Through close and repetitive interaction with computer models, Bernhard asserts, we can teach computational models ways of interpretation—not seeking "perfection" in search returns but providing insight into our personal positioning to the collection information (ibid: 109). While big data may be authoritative in appearance, Alan Liu's "N + 1: A Plea for Cross-Domain Data in the Digital Humanities" concedes that big data analytics can be “messy” and “glitchy,” and so it remains “profoundly interesting what human observers find meaningful vs noisy” in their search for connections and significance (Liu 2016: 560). For this reason, the model of bricolage maps to DAH practice as scholars bridge together digital applications and critical art historical study to create more nuance within interpretation when forming meta-perspectives of histories from large data sets.

Data Selection and Access

While I joined in many art historians’ skepticism of Lev Manovich’s distant viewing of color analysis[21] and K. Benders use of the term subjective “beauty” as if it were quantifiable, I believe their work holds value because such experimentation pushes boundaries of current art historical practice. By testing the boundaries, members of the discipline actively shape it. Currently, methods such as spectrography lead the scientific ways for comparing colors of physical work. As a matter of technical development, conditions under which we can digitally capture and compare color across works of art may be in our future, but color is by no means an absolute, and is determined by cultural and other criteria, which makes this a fraught pursuit. Abby Smith’s extensive writing on preservation lauds the ability and availability of digital information with its “power to transform the very nature of inquiry” (Smith 2004 :7). What is not certain is how diverse the art history data will be that is readily available and if it will be preserved in a persistent manner for computation and review.

[21] By using image detection software and algorithms, one of the key issues for art historians was that the color Manovich analyzed is in the digital file, not the object, and the project risked conflating the two. This meant that when pointing the image analysis software at a corpus of Mark Rothko or Piet Modrian digital facsimiles, conclusions regarding visual characteristics can only be deduced regarding the digital images, not the physical artworks. For more details regarding this example, see: http://lab.culturalanalytics.info/2016/04/mondrian-vs-rothko.html.

We must remain cautious of preoccupation with digital tools as novel presentations of scholarship, skeptical of visualizations that may mask silences in the data, and vigilant about using virtual methods when truly appropriate and necessary to achieve project goals; but I also believe that the pursuit of digital art history and open access offers the field a valuable way forward. Many museums and cultural heritage institutions have spent time and money to create the infrastructure and workflows needed to release collections data, including the Getty, the Met, the Tate, and the Carnegie Museum of Art. The Getty has also released their Getty Vocabularies as linked open data, encouraging standard usages across datasets. However, the Western biases inherent in these collections and institutions have been slow to change, so inevitably, data flooding the field is mostly Western. Eurocentrism is connected with histories of art history and museum practice, but the work of scholars and practitioners such as Susan Vogel, Mary Nooter Roberts, and Barbara Kirshenblatt-Gimblett have guided museum and exhibition efforts to greater cultural understandings regarding the collection and display of non-Western art. This criticality will need to be translated into digital art historical practice, starting with the creation of data sets similar to the one Bishop proposes for African artifacts (Bishop 2015: 4). Projects like the Virtual Asian American Art Museum Project (VAAAMP)[22] begin to fill the need for a more diverse practice of digital art history, and the larger field of digital humanities may be able to offer helpful examples for this endeavor.

Miriam Posner's article, "What's Next: The Radical, Unrealized Potential of Digital Humanities," enumerates many crucial issues involving gender, race, time and uncertainty in data models that need to be addressed. She also discusses examples of a changing landscape of Digital Humanities (Posner 2016). For instance, she cites the work of Stanford's Elijah Meeks

[22] See: http://scalar.usc.edu/works/vaaamp/roger-shimomura.

and Karl Grossner involving Topotime as an advance in the broader depiction of time in data modeling, as well as David Kim's work on a Native American collection of photographs by Edward S. Curtis in which he "turned the data visualization back around, focusing scrutiny on Curtis himself and the Western imperial ideology that he represented" (ibid: 34, 37).[23] While the gathering of sources across archives for the project is no different from other studies through which decolonization is a goal, the digital presentation and gallery views allow more examples to be featured in the Scalar platform with greater visual impact, which would be exorbitantly expensive to achieve in a print publication. I suggest that all the above-mentioned projects indicate growth of humanist exploration, flexing digital mediums to portray nuance within data. In the end, open data and open source tools will continue to contribute to which types of digital art history are produced and so we must continue to demand the creation, release, and use of diverse and descriptive data.

Tools and Interpretation

Tools make us think.[24] The process of taking the messy world and formulating it into an organized dataset challenges our own inherent biases and forces us to recognize and confront them head on. When utilizing TEI, for example, adding tags requires us to face the limitations of categorization and often make interpretive decisions. Imagine one were building a Web resource

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[23] The title of Elijah Meeks and Karl Grossner's project alludes to the word topos, which means place, as well as representing uncertainty in regards to time. For more about the project's origins, see: http://dh.stanford.edu/topotime/about.html. See also, Performing Archive: Edward S. Curtis + 'the vanishing race' at https://scalar.me/anvc/showcase/performing-archive-edward-s-curtis-the-vanishing-race/.

[24] This section was partially inspired by the DH seminar "How Tools Think" held at UCLA: http://dhbasecamp.humanities.ucla.edu/dhseminars/how-tools-think/. Methods shape perspectives and scholarship in profound ways, which this section seeks to draw attention to.

using Renaissance Art documents. If one were to markup "Leonardo Da Vinci" within a transcribed inventory, one could choose to label him a painter, engineer, inventor, and/or artist which would in turn affect search results for the future user. In this case, the markup process asks us to think about both our own knowledge structures and those of the people that will be utilizing the resource.

Likewise, through the process of 3D modeling, scholars come to a greater spatial understanding by identifying replicable details and non-replicable one, as in the case of Diane Favro and Bernie Frischer's Digital Roman Forum[25] project or Lisa Snyder's reconstruction model of the 1893 World's Columbian Exposition.[26] Using historical texts, positivist measuring methods, and photographs to rebuild lost sites, projects like these can draw our attention to areas that are under-documented or lack documentation at all. In these cases, modeling can help us know what we do not know. Careful reconstruction enables scholars to identify where gaps in knowledge are and use creative solutions to indicate uncertainty within models, such as placing "Lorem ipsum" text on section of buildings where researchers know text had been but cannot tell what was written from photographs.[27]

Katherine Hayles writes about the growing divide between media and print, drawing distinctions among close, hyper-, and machine reading, changing workflows for scholarly production, and the forms of interpretive outcomes (Hayles 2012: 5, 11). Her approach to

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[25] This project has gone through other iterations; it was originally created at UCLA. The archived website can be found at: http://wayback.archive-it.org/7877/20160919152126/http://dlib.etc.ucla.edu/projects/Forum//.

[26] More information on Lisa Snyder's ongoing project can be found at: http://www.ust.ucla.edu/ustweb/Projects/columbian_expo.htm.

[27] Lorem Ipsum is a set of jumbled, nonsensical Latin text that is used as a placeholder within digital designs.

comparative media studies suggests alternatives to the dichotomy that Bishop sets up between close and distant reading/vision. Hayles describes how reading changes from print to digital and consider the educational benefits and drawbacks. In digital, rhizomatic reading and learning are more accepted. Work is undertaken more collaboratively in digital formats and forms of inquiry are more media-rich. An art historical example of such a hybrid approach might look like the Empire Exhibition website.[28] An online resource regarding Scotland's 1938 international exposition, the site combines oral history videos with people who attended the exhibition, video interviews with architectural and cultural historians, audio clips regarding the exhibition from the time period, archival photos and ephemera, an interactive map of the park as it was, interactive 3D models of nearly every building that was part of the original exposition, and concise contextualizing text. The various media combine to give a more holistic learning experience of a massive architectural if fleeting feat. Whether it is to support the production or presentation of research, digital tools offer the visual arts opportunities to delve into the intricacies of the representation of knowledge in many forms and to distinctive ends.

Preservation of Practice and Exposing the Scholarly Process

While some scholars may be convinced that the methods of digital art history are incapable of achieving the nuance of analysis and interpretation that is essential to humanistic production, I would argue that projects like the *Vincent Van Gogh: The Letters* or *Pietro Mellini's Inventory in Verse, 1681: A Digital Facsimile with Translation and Commentary* make even more evident the interpretive acts of art historical work. As projects that employ similar approaches by providing interactive transcriptions, translations, and annotations of art historical

[28] The Empire Exhibition website can be found at: http://empireexhibition.com/.

documents (in the one case Vincent van Gogh's correspondence and in the other a Roman noble family's art inventory written in verse), they each expose the process of interpretation.[29] By sharing varied opinions and points of view in direct relationship with the digital object, the projects attempt to be more transparent about the scholarly process. While some edited volumes bring opposing viewpoints together within succession, the use of digital annotations make that disjuncture more immediately evident to readers. Exposing the scholarly process counteracts the obfuscation brought on by computational work. As demonstrated by the inventive designs within Drucker's article, "Humanities Approaches to Graphical Display," representing inexactitude can be difficult, but is a critical component of the humanities field that we must seek to honor in the application of digital methods (Drucker 2011: 17-19). Likewise, recognizing digital humanists as bricoleurs highlights their creativity in producing digital materials to expand humanistic understandings.

To examine more closely how this is done within the Mellini project (often referred to as "Digital Mellini"), the annotations went beyond simply contextualizing references within the transcriptions and translations by additional historical content.[30] The project was envisioned as a foray into "using the Web as an innovative and productive way to develop discipline-specific research tools and to present and publish scholarly, authoritative work" (Baca, 2013). At the heart of the endeavor is a document authored by Pietro Mellini in 1681. Written in historic

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[29] See http://vangoghletters.org/vg/ and http://getty.edu/research/mellini/.

[30] I served as research assistant and project coordinator for the Digital Mellini Project for four years until it was published in 2015. While on a research visit to Los Angeles in 2009, Dr. Nuria Rodríguez Ortega, Professor and Chair of the Art History Department at the University of Málaga, uncovered a unique unpublished 17th century manuscript in the Getty Research Institute's Special Collections. Beginning as a collaboration between Ortega and Dr. Murtha Baca, a scholar of Renaissance and Baroque Italian art and literature and the head of Digital Art History at the Getty Research Institute (GRI), the pioneering "Digital Mellini" project was formed.

Italian, the manuscript, entitled “Relatione delle pitture migliori di Casa Mellini,” is a rhyming inventory of the best paintings and drawings from his family’s collection in Rome. In the introduction, the work addresses itself to Cardinal Savo Mellini, Pietro’s brother who was papal nuncio in Spain at the time; however, the purpose of the document remains unclear. Jorge Fernandez-Santos Ortiz-Iribas has written about another inventory also produced by Pietro Mellini regarding the collection in the Palazzo del Rosario completed in a more standard prose format the year before (1680), which is currently preserved in the family archive of Giovanni Crescenzi Serlupi Mellini in Rome (Baca 2009: 161). Two differences are worth noting between these two inventories: the first being that the 1680 inventory lists one hundred and forty-three distinct works, while the 1681 poem is a selection of the ninety-five “best” overall; the second is its poetic form and aesthetic evaluation of the paintings in the collection, which is a fanciful deviation from the standard details recorded for works in family collections at the time as exhibited by the 1680 inventory.

The document’s status as both a conventional inventory and a poetic text allows for a reading across the disciplines of art history, literature, and cultural studies. Therefore, as Baca and Ortega suggest, “the manuscript provides crucial primary evidence for art historians, as well as other humanities and interdisciplinary scholars who focus on provenance research, collecting patterns and habits, the social construction of taste, textual analysis of historical documents, and transfers of cultural capital” (Baca, 2013). In an attempt to allow for these multiple readings to coexist openly, and in the spirit of a network analysis approach, a project team of technologists and subject experts came together to construct an online content management system.

Using digital tools, the scholars set out to answer questions regarding the documents purpose, its intended audience, the reason for its “hybrid” form. The art historians also sought to uncover what the document could reveal about the artistic literature of the 17th century. Conducting a terminological/linguistic study of the critical vocabulary in a work that is not a "treatise" per se revealed more nuanced information about collecting and the role of art in Mellini's time. The project also allowed for the examination of the role of words played in the development of visual culture, through comparing the descriptions of the artworks in the 1681 poem and the conventional inventory done in 1680. With these research questions and goals in mind, the project team set out to build an online workspace to incorporate and house a transcription and a set of translations (Spanish and English) with multi-author annotations, a searchable database bibliography, and space for a concordance, image gallery, and artists list, each containing specific comments and notations and all linked into overarching essays.[31]

Within the manuscript sections, the four scholars who participated in the project were invited to respond to one another's interpretations. The layering of commentary demonstrated subtle differences among the perspectives of each of the scholars as they translated the poetic meaning and old Italian language of the inventory. In addition, a customized labeling system was designed for "List of Artworks," serving as a color-coded key to indicate to users the nuances within difficult provenance (best) guesswork when tracing the histories of artworks (Baca et al. 2015).

In my own work I have produced a 3D recreation of an exhibition I co-curated for the Taiwan National Museum of Fine Art and an annotated panoramic tour of another exhibition I helped to mount within UCLA's Young Research Library Special Collections.[32] Pictures and

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[31] The Spanish translation was later dropped from the final project publication.

[32] I presented an augmented reality draft of the in-process model at Forum 1 of the Community Standards for 3D Preservation group. For more information on that poster session, the model, and the exhibition, see: http://albrezzi.com/hbct.html.

articles offer a limited perspective of the exhibition process. Through the immersive model, I aim to provide users with a greater understanding of the challenges curators face when putting together an exhibition. I also hope to further contextualize the materials by embedding video interviews with artists and longer wall labels than would ordinarily be deemed suitable for a gallery setting, much like the goals of the project from the Getty's Online Scholarly Catalogue Initiative (OSCI).[33]

Not all digital art history presents itself as obviously statistical. My work may not look like a data visualization, but my methods still make an argument about the importance of contextual information. The photographic 360 documentations of events or exhibition, for instance, are still capta (Drucker 2011: 1-8). Decisions are still being made about where to place the camera within the space and what annotations I should add to the panoramic image, as would be true in an analog documentation project as well. However, when those images are placed within a platform that allows non-linear "reading" and is annotated with supplemental collections material and textual scholarship, the visualization of the data becomes a digital object. Each of these decisions is part of my interpretation of the works and how I believe the works should be analyzed, presented, and preserved for posterity. The immersive feature adds an interactive element that gives the illusion of agency to the viewer's interest. An immersive method encourages willful, active engagement as opposed to passive viewing. By shifting the framework of seeing - and exposing the framework itself in cases - to one in which the user must choose to view or hide annotations or click to see an artist interview, I extend the Brechtian concept *Verfremdungseffekt* or the "distancing effect," to a participatory level through which a user is not

[33] The final report for OSCI "Museum Catalogues for the Digital Age" was recently released and makes a compelling case for continued digital art history work. See: http://www.getty.edu/publications/osci-report/.

a simply a viewer, but rather an engager of interpretative scaffolding (Brooker 1994, 185-200). Unlike footnotes, which are relegated to the bottom or back of a document, these annotations live directly within the visualization, heightening their importance to the reader. The design indicates a perception of the annotations as not afterthoughts or asides, but essential information with which to engage.

What Is At Risk

What is at risk if we do not adopt new methods? President Obama famously offended the discipline when he suggested that Art History was not a very "useful" degree (Jaschik 2014). Do we risk dying out if we do not adapt and adopt new technological methods? Visual culture is a defining aspect of humanity and so I cannot imagine that it would ever disappear completely from academia or the humanities. The incorporation of digital methods into art history, however, has offered Art History greater funding opportunities and increased the discipline's "visibility" amongst the humanities. Some of the key challenges to the long-term establishment of digital methods in Art History as identified by Benjamin Zweig, including "funding, sustainability, archiving, copyright, technological obsolescence, documentation, tenure consideration, peer evaluation" have begun to be addressed by organizations who lead the field (Zweig 2015: 46). In January 2016, CAA published "Guidelines for the Evaluation of Digital Scholarship in Art and Architectural History" to weigh in on peer review and tenure concerns, as previously mentioned.[34] Scholars and practitioners like Abby Smith Rumsey and Brewster Kahle have been searching for the answers to questions regarding digital preservation, copyright, and

[34] See: http://www.collegeart.org/pdf/evaluating-digital-scholarship-in-art-and-architectural-history.pdf.

sustainability, not just for the field of digital art history, but for the entire digital user community (Smith 2004; Smith Rumsey 2016).

Moving forward, we should avoid the false dichotomy of art history and digital art history. Anna Bentkowska-Kafel sets a tone of productive pragmatism in her article "Debating Digital Art History." While she acknowledges the fears of the "death rattle," she shows that digital art history is stronger when it is incorporated into the larger canon (Bentkowska-Kafel 2015: 51, 58). She suggests that the use of the distinctive term "digital" will eventually no longer be needed (ibid: 59). Like Bentkowska-Kafel, I see no need to abandon current working practices. Learning through objects and visual resources will persist and there is no reason more long-standing modes of art historical analysis and scholarship cannot continue. In fact, they should continue and inform the use of our digital methods. As bricoleurs will know, we do not need to exclude knowledges of the past to make room of the methods of today (Hayles 2012).

A significant challenge the discipline facing now is how can academics' work move at and through the speed of technology? The production of new technologies is motivated by necessity and financial capital. These consumer-driven values can produce technology that may, at first, seem incongruous with the methods, ethics, and beliefs of academic institutions and scholars. Keeping pace with technology becomes the responsibility of academics in related fields in order make humanistic assessments and form critical analysis of digital tools (hopefully prior to widespread institutional and/or cultural adoption in order to prevent any unfortunate missteps). Without rigorous questioning, Art History risks incorporating technology that does not reflect its scholarly ideals. The breakneck speed at which digital technologies have been making advancements does not allow adequate time for implementation and critical reflection. Academics strain to keep apace with the growing number of hardwares and softwares being introduced. More time is needed for scholars and researchers to become familiar with and making productive use of technologies and platforms before new versions are released.

Moreover, the expense can make experimentation cost-prohibitive, and while more tech companies are offering special rates for educational and academic users, the issue of dependence on proprietary technology can bring years' worth of work to a shocking halt, as in the case of the Hypercities project, which made use of a Google mapping platform that the company decided to stop supporting.[35] Additionally, quite often the time it takes a group of scholars to find funding, master or build a digital tool or resources, engage with the product to investigate a research question, share findings with the larger community through publication and/or presentation, and provide the field with chances to explore the new resource and understand the significance of its contributions, new technology has already been introduced and is already beginning to render the project's methods out-of-date. The issues of obsolescence should not be conflated with technological innovation. Ultimately, the question is what aspects of digital work are sustainable? Further development of in-depth guides for determining the most productive ratio of money, time, and resources for DAH projects will benefit the field's future assessments of what to pursue and how best to do so for long-term development.

Art History for Whom?

There are other audiences besides academia to consider. Institutions essential to Art History such as museums have publics with varying degrees of familiarity and understandings to acknowledge. For example, the *Lightbox* developed by Harvard's metaLAB is an installation that

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[35] The archived information on the Hypercities project can be found at: http://www.hypercities.com/.

displays the collections at the Harvard Art Museums through an object map (Battles and Maizels 2016: 335). Wireless controllers allow visitors to select objects from an imposing grid of thumbnails, which become enlarged to show a large photograph of the object selected along with the metadata record (ibid). The interactive database display emphasizes the constructed nature of museum collections that are "always in the making" (ibid: 337). The addition of digital tools into arts education offers alternative ways for people of all ages to connect with the resources of museums, especially for schools that may not be in an area where major art institutions are present.

Returning to the example of the Digital Mellini project, user levels were embedded within the architecture of the site. The user interface was designed specifically with three user types in mind: a general browser with no prior knowledge of the topic or field, an interested party such as a student of art history with a foundational understanding of art history, and a super-user or expert in early Roman art collections who is searching for in-depth research. Discovery levels were added, like the reveal-and-hide features within the List of Artworks section, so as not to overwhelm a more general user. Digital Art History projects can reach broader audiences, not just due to their presence online, but through their designs.

Many scholars, like Michael Tymkiw, have considered underserved communities like the visually impaired, proposing haptic technologies and 3D printing to increase outreach.[36] Digital publications may also provide a way to lighten the burden of young scholars regarding the securing of reproduction rights to print images within their publications, which in the past have

[36] Michael Tymkiw presented a paper entitled "Digitally Reactivating Museums for Expanded Disability Access" during CAA's 2016 Annual Conference. See my report regarding the conference: https://www.hastac.org/blogs/francesca-albrezzi/2016/11/18/report-104th-annual-caa-conference.

been prohibitively expensive. CAA has produced a *Code for Best Practices in Fair Use in the Visual Arts* to encourage scholars to understand their rights when it comes to the use of digital images and help advocate for broader use of the fair use policy (Aufderheide and Jaszi 2015). With the proliferation of images using Creative Commons licenses through sites like Wikimedia Commons, subscription-based repositories such as Artstor are less needed. Overall, DAH can foster collaboration, both within and outside of Art History proper. We have begun to break away from the "Saint Augustine syndrome," through which scholars spend years working mostly alone in an ascetic-like commitment to their specific research, opting for a more interdisciplinary and collaborative community (Baca 2013).

Digital tools may force scholars out of their comfort zones, but the innovations pose substantial changes to the study and preservation of art. A recent article from the Getty Iris discussed "5 Cutting Edge Innovations in Art History Tech" (Clifford and Waldorf 2017). From VR, AR, and MR, to motion capture and machine learning, technology fields are turning their focuses to the arts. Tilt Brush, an application that is like an advance version of Microsoft Paint but for a virtual immersive environment, now has an Artist in Residence program, and companies like Next Art and VRScout are teaming up to put on digital art shows.[37] The technology is also not just being used for art making: Google Arts and Culture has been building its database of 360 and 3D reconstructions of museums worldwide, with nearly a thousand virtual tours currently available on their site that harness digital immersive technology to share spaces where art histories live. Digital art history is not simply about what has been art or art

[37] To see the details of the program and past artists in residence, see: https://www.tiltbrush.com/air/artists/.

history, but is also about what art history will be, digital and otherwise. The interpretation of digital art will require an understanding of digital methods and media.

<u>Digitized Art History Leading Digital Art History</u>

As a field, we can also not overlook or underestimate digitization, as the digitized forms the basis of the digital. Digitization is the process whereby analog information is translated into a digital form, "stored" within digital file formats, so that it can be "read" by computational devices. Digitization is not simply about preservation. Generally, the act of preservation focuses on preventing deterioration or the loss of significant properties of objects in physical worlds. More specifically, digital preservation refers to activities that help to ensure continued access to digital materials for as long as possible.[38] These methods seek to prevent loss of digital information from medium failures and hardware/software obsolescence. In fact, digitized files can degrade over time just like material objects in a process known as "bit rot" (Klerk 2018: 7-

[38] Archivists are well aware of the problems regarding digital preservation. Technologies can "preserve" culture only if we can "preserve" those technologies. For example, one can only see what is on a floppy disk if one has a working operating system and the hardware to do so. While library and information sciences are forming coalitions to address such concerns, there is currently little evidence for sustainability or longevity in terms of digital media broadly. It will take major, long-term, human-resource and financial investment to produce new cataloging systems, storage space, and efforts in forward migration and emulation to avoid digital files from becoming obsolete. Vint Cerf and others have warned that we are living in a "digital dark age," where all information of the era will ultimately be lost due to digital preservation challenges (Ghosh 2015; Wernick 2018). However, initiatives like the Internet Archive (https://archive.org/) and its Wayback Machine (https://archive.org/web/) are examples of fairly effective digital preservation efforts. Most objects, virtual and physical, ultimately are not preserved. Many artists, like the late Carolee Shneemann, produce more work than archives can afford to maintain. Jorge Luis Borges in his essay "On Exactitude in Science" illustrates the absurdity of attempting to preserve "everything" (Borges 1999: 160). Throughout this dissertation, my belief that digital technology can assist in preserving culture comes from my understanding that redundant efforts may help increase an item's chances through allowing alternative means of access.

8). Additionally, digital file formats can be "lossless" (preserving the data that was generated by the instrument that produced it) or "lossy" (losing captured metadata often in favor of compression for a smaller file size) (Hoffman 2017: 3). Lossless files are typically preferred for preservation, with caveats depending on storage capacities and institutional preservation missions. Ultimately, digitization is what I would call a work of visual ekphrasis, translating physical objects into digitally readable data.[39]

Digitized art history has laid the groundwork in many ways for the type of work that is essential to the practice of digital art history. Community archives show how one can use tools of the dominant power structure to redefine them. For example, the South Asian American Digital Archive (SAADA) or the International Museum of Women (IMOW) serve their respective communities without the need of physical locations (Long and King 2011). These online archives lead the way for projects that bring collections together virtually because they might not ever be able to do so physically. The model often provides communities with opportunities to self-represent through establishing new terms for categorization as described by Brown and Nicholas when discussing Canadian First Nations and Māori heritage concerns (Brown and Nicholas 2012). Digital art history, following in the footsteps of digitized art history, can enable communities to represent collections in their own displays and with their own words. It may also bring forth materials from archives and share them with communities that might not otherwise have access due to logistical issues or handling concerns due to the delicate physical status of the object in archival storage (Caswell 2014).

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[39] Steve Anderson writes in depth about how the visual characteristics of objects are transferred into computationally defined files (Anderson 2017).

Continuing to move away from proprietary technology or forming more long-term collaborative relationships with technologists, and embracing open data and open source formats, standards, and technology will encourage a broader range of digital art history projects. Forays into what it will look like include the Getty's linked open data initiative and the Getty Scholars' Workspace, allowing scholars access to authoritative standardized data as well as a toolset for sharing, comparing, and annotating text and images including a digital light table. Additionally, using thesauri such as the Getty Vocabularies for forming content specific taxonomies can allow digital project teams to reconcile standards with diversity. Scholars across the disciplines of anthropology, cultural heritage, library science, law, and art are also coming together to form groups like International Image Interoperability Framework (IIIF) community and the Community Standards for 3D Preservation (CS3DP) group to address the difficulties of storage, metadata, copyright, preservation, and access for 3D, gaming, and XR objects, applications, and environments. The standards that groups such as these are setting will define future scholarship and how we share, store, and cite virtual works.

Conclusion

Combining the digital with the humanities forms a tension that is generative and iterative. Thus, digital humanities produce work that is often reflexive. The issue of the ever-imperfect fit (round peg square hole problem) that results from the combination of positivist tools with the pursuit of humanistic interpretive nuances forces us to answer why and how those tools fall short or do not work for humanistic data and understandings. By attempting to answer these questions, we further our understandings of the operation of the two forms. In the particular case of art history, the field has shown perseverance in the response to Diane Zorich's 2012 Kress Report, which expressed concern that the discipline was falling out of pace with society. Today, digital art history has foundational standards from which to build and case studies to point to even greater multimodal humanistic projects in the works (Baca and Helmreich 2017). These examples and precedents will be critical in guiding those researchers working on the forefront of bringing new technologies, such as XR, into the practice of the field today.

Chapter 3: On Museums in the Digital Age: Technology, Museums, and Memory

Museums serve as a central authority and site for the experience of art and culture through objects. As such, museums have adapted to changes within society and the cultural material production they collect and display. In this chapter, I provide a summary of key perspectives in the transition of museums into the digital age. Performing as both cultural repositories and contact zones, I situate the museum within political and social discourses. First, I discuss the items that make museums what they are - the objects - and highlight historical shifts in representation. Next, I discuss how digital objects and interventions within museum and cultural heritage spaces have disrupted notions of the material and challenged archival, curatorial, and exhibition practice. Finally, I offer insight into the politics at play for sites of such cultural authority. As I will discuss in Chapter Six, museums and art spaces serve as leading access points for XR work. My goal is to emphasize the position of power museums and cultural heritage centers hold in order to situate my understanding of XR display within these authoritative arenas.

Objects are physical manifestations of intention. They hold many meanings and serve a variety of purposes. “Artifact” is a word that has colonial connotations in relation to materiality and the value we place on physical objects. Historically, this word was employed to differentiate between types of objects in museums. Objects out of the Western world that were specifically created for aesthetic pleasure were considered art.[40] In contrast, during colonialism, “artifacts”

[40] This distinction was weaponized in South Africa to the extent that it was built into museum architecture. In Durban, for instance, the large municipal museum had natural history and Indigenous South African works mixed on the second and third floors, while Euro-South African works were in the “art museum” on the fourth and highest floor, touting their supposed “superiority.”

were brought back and eventually placed within museums to educate a Western public on other parts of the world.

When speaking about her experience as a curator, Susan Vogel writes that "almost nothing displayed in museums was made to be seen in them," emphasizing the intervention aspect of museum and curatorial work that brings objects created outside of the institution's walls into an exhibitionary complex (Vogel 1991: 191). Grouped together, artifacts take on new meanings. She suggests that "An art exhibition can be construed as an unwitting collaboration between a curator and the artist(s) represented, with the former having by far the most active and influential role," due to the interpretive nature of curator's job (ibid). The way in which knowledge is presented is part of the overall power structures that shape societies. Curators often become bridge builders working within hegemonic structures and translating histories for the masses, and their epistemological frameworks have the power to shape ideologies and norms for the general public that wander their halls.

In a 2017 seminar, Andrew Prescott, Professor of Digital Humanities at the University of Glasgow, spoke of the importance of curators in shaping and disseminating culture (Albrezzi 2017). In previous centuries, the term "keeper" was used, rather than curator, as it still is at the British Museum. As taught by the late Professor Mary (Polly) Nooter Roberts in her Curating Cultures course for the Department of World Arts and Cultures/Dance at UCLA, the term "curator" is from the Latin "curare," which means to "take care of" but also holds the connotation of "to cure." Implied within the terminology is the notion that objects of culture and history require protection and that the public is to experience those objects in determined doses, like medicine, for their own betterment. As the modern museum emerged from the combination of the Western display techniques of the gallery and the curiosity cabinet, some still struggle with the propagation of hegemonic norms (Karp and Lavine 2014). A central concern for this dissertation is to consider if immersive technologies can change the types of publics that engage with museums or if they will only reiterate the discomfort that some constituencies already feel when engaging with cultural institutions that claim cultural authority that they do not perceive to be that of their own communities.

When discussing objects, material and materiality play a central role. Early definitions contain associations with the notions of "form" and "content," from Kant's assessment of formal properties, to Hegel's distinction from the spirit and Marx's distillation as a result from production (Hong 2003:1-4; Caygill 1995: 288-289; Hegel 1998: 69-90; Marx 1973: 109-111). From there, theories became more expansive and inclusive to the point at which Heidegger defines a thing as "something that is not nothing." Heidegger is not incorrect, but the definition is so broad that it encapsulates everything – which is the point. Materiality became understood as something that does not just define the physical, but the intangible as well.

In addressing digital objects, or material that is immaterial, "materiality" best articulates the "thingness" of the object's properties, even if it does not have a physical existence (Hong 2003: 1-4). For example, when considering the Smithsonian's 3D objects,[41] user reactions range from the object losing emotional power in the experience to the object gaining cultural power due to greater access. We must question: what is it we are actually preserving? When you see a telegram in special collections, you are viewing the item itself. When looking at the 3D version of the telegram, one observes the technological framework as well as the characteristics of the object, and that encounter becomes altered by the digitally mediated experience. Particularly with 3D modelled examples, we know that video gaming aesthetics color the encounter.

[41] The website for the Smithsonian's repository of 3D object is: https://3d.si.edu/.

Especially with young people, due to their exposure to gameplay, the user expectation affects how they experience the object in the virtual environment (Ito 2010: 50-59; 195-242).

In addition, when museums digitize an object, time operating on the object could be lost. If an item is digitized at the time it was created, as opposed to after time has operated on it, the work may become very different. One example would be paintings of the Old Masters who worked with varnish. As the years went on, the varnish turned darker and darker. The aesthetic of the Old Master painters changed for those who went to see the works in museum spaces. The colors are different now than what the artists originally intended, but that is in fact part of the history, materiality, and understanding of the work (Roberts 1994).[42]

Many scholars in museum studies have expressed concern as technology replaces the object within the museum. When it first opened in Washington, D.C., the core exhibition at the National Museum of the American Indian (NMAI) raised many questions for curators and exhibition practitioners due to the emphasis on technical displays and fewer objects than what was deemed typical for a museum. In this regard, Gwyneira Isaac sought to "examine how electronic media is changing the ways the concept of the museum 'object' is understood both by curators and visitors" (Isaac 2008: 287). One major concern raised at the NMAI is that the technology might become the museum's primary rather than an epiphenomenal object. The choice to implement video and audio not only served to emphasize oral traditions of many of the tribes represented in the opening exhibition, it also emphasized Indigenous peoples rather than objects (ibid: 292). An exhibition of objects and texts would not appropriately serve the community that is the foundation of the collection and the stated purpose of the Smithsonian's

[42] See the Getty Conservation Institute's "Research into Practice" Initiative for examples of the practical and ethical challenges art conservators face: https://www.getty.edu/conservation/our_projects/education/research/.

new museum. In attempting to find the best way to translate cultural ways to a greater public, the museum opted to put oral traditions on display. The difficulty would be the equivalent to displaying music or sound; visuality is not a primary component of the medium. The result was an opening exhibition with few objects and many screens, leaving many to wonder: how can there be a museum without objects? Due to visitor feedback, the NMAI has made adjustments over the years to incorporate more objects into displays in order to adapt to particular publics' expectations (ibid). The early days of the NMAI shine a light on issues of ownership and display that museums navigate when curating exhibitions of non-Western cultures or objects prior to the 19th century. The original intent of a technology-heavy display technique demonstrated a critical response to the problematic false dichotomy of art and artifact, but digital media comes with its own set of visual and material values and connotations, which need to be carefully managed and navigated (ibid: 297).

Andrea Shea discusses her interviews with several professionals in the museum industry today who are grappling with the challenges that new technologies present for them. While some say technology can bring together artists and patrons, others worry if people will even use the apps, which are expensive to produce and maintain (Shea 2015). Her conversation with Don Undeen, Founding Manager of the Maker Hub at Georgetown University and Founder and former Senior Manager of the MediaLab at the Metropolitan Museum of Art, suggests a compromise in moving forward through the digital humanities, where the combination of cultural content and technology furthers study in new ways while keeping museums and their artifacts essential to those discussions (ibid).

How does one then identify the key characteristic and features that make a museum what it is (Dillenberg 2011: 9-10)? What are the elements that have helped to shape our cultural understandings of these spaces, both large and small, vast and esoteric? Geoffrey Lewis discusses the etymology of the word "museum," citing that the Greek origins as "the seat of the Muses," bestowing a responsibility to contemplation and inspiration for spaces by that title that hold and share objects (Lewis 2019: 1).[43] Museums are places with objects and information on display, and whose mission often involves preservation of those items and histories. Visitor-focused, museums have historically been designated spaces where people come to learn about art and culture in a curated way.[44] Because of this selective characteristic, there is often an assumption of scarcity—that what you are being offered at a museum is a rare experience bolstered by oft-evident elitism. Within a museum, there are different notions of what constitutes value. The items in collections have worth outside of capitalist commodification systems and their display is often for the educational benefit of society. Whether the collection(s) housed by the museum have an overall theme or, if the institution seeks to be "encyclopedic," as it can never be for obvious reasons, a relationship of authority is negotiated between artifacts, visitors, and the museum itself (Posner et. al 2017).[45]

Mieke Bal addresses the long history of ownership and museums (Bal 1996: 202). If curators are working with collections outside of their own culture, how do they avoid cultural imperialism (ibid: 203)? Adopting a semiotic view of the museum, Bal analyzes the

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[43] Additionally, my late mentor Mary (Polly) Nooter Roberts often remarked in her class "Curating Cultures" that among the Muses was Mnemosyne, goddess of memory, highlighting the institution's importance for cultural preservation and authority regarding objects and their histories.

[44] The application of curatorial authority still varies widely. For a greater discussion, see Longair, Sarah. 2015. "Cultures of Curating: The Limits of Authority." *Museum History Journal*, 8:1, 1-7, DOI: 10.1179/1936981614Z.00000000043.

[45] Part of this sentence was co-authored with Professor Miriam Posner and my classmates with her class "Museums and the Digital Age" as part of an exercise in which we collaboratively defined terms. Here, I draw from our definition of "museum."

constructions of meaning around objects, specifically the difference between art and artifact, recalling Susan Vogel's pioneering consideration of the same distinction (ibid: 204; Vogel 1988). Recognizing that the distinction between "an ethnographic and art museum is itself an ideological fallacy" based on etic and emic perspectives on objects, Bal sets out to form a "new museology" that is a combination of critical anthropology and discursive analysis (ibid: 205).[46] She argues that in art, metaphor is used to express a connection to a larger context (ibid: 206). For example, a portrait of a woman can speak to understandings of beauty. Synecdoche operates similarly, allowing an object to stand in for another whole. However, in the case of artifacts, their cultural background becomes a metaphor for the "essence" of an entire culture (ibid), thus leading to stereotyping and the politics of degradation.

Barbara Kirshenblatt-Gimlett argues that it is this synecdochal burden which causes objects from cultures outside of the West to be labeled as "ethnographic" (Kirschenblat-Gimlett 1998: 387). The snapshot effect of "art as excerpt" essentializes rather than contextualizes (ibid: 388). What is excised becomes part of a process that forms cultural identity from an outsider's perspective. Kirshenblatt-Gimlett distinguishes the ethnographic object as ethnographic fragment to emphasize its detached nature, physically separated from its home environment, and to describe the process by which it becomes exoticized. Fragments are made, performed, and conceptualized as extractions from systems of thinking that are different from our own.

Bal purposes metonymy as a remedy for some of the drawbacks of metaphor and synecdoche, by remaining grounded in the indexical code of the work, rather than transcending it

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[46] The terms "etic" and "emic" are used in disciplines such as anthropology, ethnography, folklore studies, and the like to describe two viewpoints involved in fieldwork. "Emic" defines a perspective provided from someone who part of social group; an insider. This would be the perspective of the subject. "Etic" defines perspectives from those who are outside the community; an observer (Headland et. al. 1990).

(metaphor) or absorbing it (synecdoche) (Bal 1996: 212). She suggests that by focusing on frameworks we can arrive at an understanding through which museum is discourse and exhibitions are utterances within them, allowing the museum to be held accountable for its rhetoric (ibid: 214). However, Kirshenblatt-Gimlett offers distinctions between ethnographic objects that are purportedly displayed *in situ* as opposed to those shown *in context* (Kirschenblat-Gimlett 1998: 388-390). Objects shown in situ fall into the category of metonymic or mimetic displays that either isolate the object from its environment or attempt to recreate it. Objects shown in context utilize interpretive frameworks to provide a deeper understanding that situates them within their greater biographies (Kopytoff 1990). By acknowledging the life of objects, including their past that brought them to their present, museum practitioners can offer them a "renewed" life (Roberts 2008: 178).

On my second trip to the NMAI, I traveled to see the special annex offsite. The location was built to contain objects that had special needs. In some cases, tribal leaders had asked that certain objects not be shown due to their sacred status. When discussing her exhibition "Secrecy: African Art that Conceals and Reveals," Mary Nooter (Polly) Roberts explained how the dissemination of certain knowledges in other cultures is strictly regulated due to the understanding that knowledge is power and with it comes particular responsibility (ibid: 173). Certain objects used within rites were not meant to be experienced by outsiders for they may not be prepared to receive such knowledge that might cause them harm (Turner et. al. 2017). In other cases, NMAI items were housed within a separate warehouse because they required special treatment, such as being sung to or fed regularly because they are alive to the communities from which they have been taken yet to which they belong. The alternative space acknowledged that objects of the Indigenous communities of the Americas do not fit a one-size-fits-all museum model.

With recent technological advancements and adoptions by gallery, library, archive, and museum (GLAM) institutions, there are many new opportunities for curators to explore how to renew the life of objects in their new homes. A 2014 "Museums in the Digital Age" report states that the latest in museum trends includes "content diversification, immersive experiences, and sustainable and open spaces" (Arup 2014: 7). Influenced by the Maker movement, museums are looking to shift cultural expectations and foster collaborative curations to tell stories in new ways and appeal to people of all ages and backgrounds.[47] This is echoed by Maggie Burnette Stogner who defines and assesses the immersive storytelling that can happen in museums, stressing that such techniques "can connect visitors to different cultural experiences and to each other in meaningful ways" by allowing for personal life experience to help shape the story of each object (Stogner 2011: 9). These efforts harken back to the work Susan Vogel explored in her collaborative exhibition *Perspectives: Angles on African Art*, through which ten noted individuals from various backgrounds were asked to be cocurators and to pick objects based on their own criteria, then to discuss their choices and views. Their varied responses ranged from the scholarly to the emotional, yet in spite of their differences, "the cocurators were all concerned with the dichotomy between appreciation and understanding, form and meaning" (Vogel 1991: 194). In the effort to expand outreach, museums are broadening their target demographics to include the digital generation, aging populations, and working professionals

[47] The Maker movement is at the crossroads of Do-It-Yourself (DIY) creative production and hacking. Comprised of designers, investors, and tinkerers, Maker spaces foster collaboration and the use of digital platforms and fabrication for personalized manufacturing and creative production (Anderson 2017 [2013]).

through longer hours and more public spaces to help support and promote healthy and sustainable lifestyles.

The exhibitionary complex as broached by Cultural Studies scholar Tony Bennett calls into question modes of display complicated by incorporating digital forms of exhibition. Based on Michel Foucault's *Discipline and Punish: The Birth of the Prison*, Bennett draws parallels between the structures of the penitentiary and those of the museum, which share characteristics like panoptical authority, involvement with the state, control over representation, organizing bodies in space, and confinement (Foucault 1977; Bennett 1996: 76-82). However, the shift in focus for museums is from private to public, opposite to the direction of prisons, for artworks are typically donated by private citizens to be shared in public venues. More and more, that communal setting is extending into virtual space.

The exhibitionary complex is a network that turns time into space. In an attempt to be universally serving, such as in the example of so-called encyclopedic museums, the exhibitionary complex draws on the theater of memory and materializes knowledge acquired over time (Yates 1966). Bennett also uses the example of the arcade to highlight the technologies of details and how being in a space where one is aware of being monitored causes us to surveil our own behavior in accordance with hegemonic practices (Bennett 1996: 73-74). In addition, the city becomes visible through permanent displays of power and knowledge. Big museums are often government funded through entities like a Ministry of Culture, which play a role in the formation of the modern state. In this way, museums serve to legitimize the state and protect sovereignty. Through the exhibitionary complex, we become consumers of state-sanctioned art (Bennett 1996: 76). Bennett futher suggests that museum can diminish counter-hegemonic ideas; when objects are subsumed by museums and organized according to state-sanctioned ideas, they are bestowed with the status of recognized historical canon, meaning that their radical potential is defused (Posner et al. 2017).[48]

As bastions of public education, staff and trustees of GLAM organizations make decisions about what "the public" should know – with this latter term subject to class-based and other forms of social discrimination. For museums, such assertions of authority are manifested in selection processes by which institutions make decisions regarding what objects to display and how to display them. For this reason, practitioners such as Beth Twiss Houting, Mary Jane Taylor, and Susy Watts stress the importance of "Learning Theory in the Museum Setting," understanding that instructional strategies are communications in themselves. Educators can create lasting understandings through object-centered learning lesson plans applied during visits to museum collections.

Unfortunately, sometimes those lasting experiences are not always positive, as the objects present may not provide opportunities for visitors or students to feel resonance with what is on display, how it is displayed, or even the museum environment itself. For those who are socially and/or economically marginalized, museums can highlight their status within the state apparatus.[49] In fact, going to museums can cause a number of harmful experiences, such as alienation, lack of belonging, or being negatively singled out, as we can read "first-hand" in the

[48] Again, part of this sentence was co-authored with Professor Miriam Posner and my classmates with her class "Museums and the Digital Age" as part of an exercise in which we collaboratively defined terms. Here, I draw from our definition of "exhibitionary complex."

[49] For example, The Getty Center, fashioned out of glistening white stone, resides within the wealthiest corner of Los Angeles on top of a mountain. It is a place of distinct intimidation to those from parts of our deeply segregated city who may feel unwelcome there for many different reasons. Getty staff (and I as a former staff member) are painfully aware of such issues, and strive to overcome them through programs and various initiatives, such as the Getty Marrow Undergraduate Internship program (https://www.getty.edu/foundation/initiatives/current/mui/).

accounts shared within the online Tumblr resource "Visitors of Color."[50] In addition, differently-abled persons may experience barriers to learning within museum spaces. For example, those who are visually-impaired have often been neglected in visual arts spaces. Museum staffs have been working toward greater awareness to differences among visitors and are attempting to use new technologies in addressing some of these challenges. Through utilizing Alt text,[51] collections can be marked up with descriptions of objects, making online collections readable by softwares designed for the blind. While audio tours have been a great addition to many museum visitors, 3D printing technology, along with developments in haptic AR and VR, may offer alternative sensory experiences that would make the visual arts more accessible for those who lack the ability to see and yet who may enjoy experiencing objects through sensory means available to them.

Cultural institutions may seem innocuous to a general public, but withheld information can also be hurtful to visitors or entire under-represented communities because it sends a message that those histories essentially did not matter enough to be kept in the official records (Anderson 2016: 163-187).[52] Racism is a hegemonic force that comprises a range of practices, beliefs, customs, and phenomena that together have the effect of structurally oppressing one

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[50] The website URL is: http://visitorsofcolor.tumblr.com/.

[51] Short for "Alternate text," Alt text is a textual description that can be added to hypertext markup language (HTML) code for an image or "object" on a virtual page. In the event that the image cannot be displayed, or seen, the underlying code can indicate to the user the intention to have an item in place and what it was meant to represent. Screen reader programs, like JAWS, utilize this functionality to alert the user when a web page or document has a picture and to specify its subject matter.

[52] Museums have a long and complicated history with colonialism, which Benedict Anderson explores in depth. Colonialism is by no means over, despite the pretenses of "postcolonial" theory.

group (or some groups) and privileging another (Posner et. al. 2017).[53] Emphasizing how racism operates within museums, Artist Fred Wilson critically reframed the Maryland Historical Society collection in his exhibition "Mining the Museum" drawing attention to histories of colonialism and slavery and making audiences aware of the biased underpinnings that often shape cultural preservation and exhibition display (Ginsberg 2016). If knowledge is power, and museums are one of society's central holders of knowledge, then the exclusion of communities from those repositories can spotlight prejudices at work (Karp 2008). For this reason, most consider the destruction of a people's museums, libraries, or archives an act of terrorism, for so much of a culture's identity is understood and remembered through its objects. Taking away the materiality of the culture paves the way for the culture to be erased from memory. History and memory operate differently and have distinct qualities to them, as scholars like Pierre Nora, Mary (Polly) Nooter Roberts, and Allen F. Roberts have outlined in their work (Nora 1989; Roberts and Roberts 1996). History is always an incomplete reconstruction making it a problematic representation of past events (Roberts and Roberts 1996: 26). Memory is an embodied knowledge contacted through experience and can be dynamic in its existence (Roberts and Roberts 1996: 23). Memory is always in conflict with History as a hegemonic "record" and narrative creation may preserve and further certain perspectives while suppressing others. Exclusion from History can result in erasure and oblivescence for a culture, once no one is left with the memory to pass along the knowledge.

However, applied prejudices, such as racism, are also entangled with agency, and new methods such as community archiving and digital media offer ways to fight institutional

[53] Once again, part of this sentence was co-authored with Professor Miriam Posner and my classmates with her class "Museums and the Digital Age" as part of an exercise in which we collaborative define terms. Here, I draw from our definition of "racism."

oppression. Deidre Brown and George Nicholas have written on how some Indigenous communities have “employed digital technologies in the recording, reproduction, promotion and discussion of their cultural heritage” (Brown and Nicholas 2012: 307), demonstrating the reorganization of a collection from Western modes of categorization to a system that reflects the cultural understandings of the peoples who produced the objects. In discussing First Nations and Māori initiatives, Brown and Nicholas show how dynamic epistemological processes “can resist or creatively respond to the digitization and electronic dissemination of cultural ‘objects’” and fight against a Westernizing of their cultural knowledge (ibid).

Through my own research and scholarship, I have witnessed how institutional racism can be fought on an individual level by working on The George P. Johnson archive at UCLA. Johnson understood the racial dynamics of the United States well as a Black man who grew up in a White household. Through personal experience, he knew little was being done to preserve the creative productions of the Black community for historical purposes. He took it upon himself to ensure that history survived, building his seventy-one-box archive of Black film history over his lifetime. The collection’s presence within UCLA’s archive demonstrates that the exhibitionary complex is changing in response to new societal norms, through which display of these cultural objects are valued as much as any other within UCLA’s special collections. Digital tools offer additional ways in which we can fight against gaps within our collective understanding and representation of cultural history.

Several technical formats are beginning to stand out in new virtual relationships between museums and publics. The first is online companion websites. The Getty released its final report on the Online Scholarly Catalog Initiative in 2017, which sought to translate a long interpretive and contextualizing technique into a more nimble and interactive design through the use of digital methods. Digital tools are also being adopted to expose processes as elements notoriously absent from display, allowing curators and art historical to be up front about their interventions and interpretations (Roberts 1994). Projects like *Pietro Mellini's Inventory in Verse, 1681: A Digital Facsimile with Translation and Commentary*, the first born-digital publication from the Getty Research Institute, offer users the chance to see scholarly interpretation in action through the use of digital commentary (Baca 2015). The Steve Museum Project presented an opportunity for communities to create folksonomies to tag museum collections in their own words (Wyman 2006: 1, 5).[54] As previously mentioned, Harvard's metaLAB *Lightbox* installation displays the Harvard Art Museum collections through an object map that visitors can interact with to browse (Battles and Maizels 2016: 335). Digital tools can enhance arts education in rural areas by offering opportunities for remote access. For example, livestreaming, particularly with the use of 360° cameras that can capture the environment, allows museums to broadcast performances to a wider audience than can travel to their venue. In each of these cases, "the people themselves are the medium of ethnographic representation," which allows for self-definition and self-expression to take place (Kirshenblatt-Gimblett 1998: 388).

Museums have a history of immersive informational exchanges. From dioramas to panoramas and stereographs, museums have tackled the challenges of immersive objects and display (Crary 1990: 97-137). These histories and lessons are relevant to new XR technology and its use in documenting and sharing cultural events and objects. The technology's immersive effect continues a practice from the spheres of learning and display that transports those engaged, fostering deep connection by employing the senses. Within Part II of the dissertation, I examine

[54] "Folksonomies" is a term in library and information studies that refers to taxonomies that are user-generated, usually through the application of electronic tagging, to create categories for searching based on personalized knowledge.

the use of XR for cultural heritage preservation. By providing example projects, I argue for XR's potential to affect a culture's history and/or memory. In examining the effectiveness of XR technologies to provide a sense of the museum or exhibition experience in Part II of the dissertation, I form the basis of a "Good, Better, Best" model for implementation of these technology in the GLAM field. The goal of my work is to offer information on the benefits and challenges of using new immersive technology within museum environments, with a situated understanding of the institution as a whole.

<u>Chapter 4: On "Ways of Seeing" and "Technologies of Vision"</u>[55]

The adage "seeing is believing"[56] motivates much of today's XR work, as creators build experiences that utilize the science of vision to transport users through immersive sight, directional sound, and designed haptics. In these encounters with the actual, what we understand to be true, and the real, what we feel and sense to be true, can be confusing. XR technologies are used by many creators today to tap into the human sensorium to generate experiences that connect on a phenomenological level with users through visual, auditory, and haptic sensory stimuli. Tapping into the core of human experience and our most powerful methods of learning, XR tools have the potential to provide memorable encounters using virtual objects and environments. One key way to connect XR work with art histories is by exploring its connections with ways we understand the world of art through sight and theories surrounding the politics of points of view.

Working with various technologies, my research method is similar to Katherine Hayles's "Comparative Media Studies," because I do not limit scholarship to textual sources and production but instead investigate art historical and museum studies topics through a variety of digital media that best suit the content in focus and the mission of a given project (Hayles 2012: 7-10). Comparative Media Studies focuses on analysis across "texts," or modalities and methods of study, which further define the interpreted identity of the "text" and how it is being "read" or understood within the scholarly production. "Comparative Media Studies" loses some of the

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[55] The phrase "Ways of Seeing" is an homage to the class by the same name taught by Al and Polly Roberts at UCLA and "Technologies of Vision" is borrowed from the title of Steve F. Anderson's book *Technologies of Vision: The War Between Data and Images* (Anderson 2017).

[56] For a counterargument to the phrase, see: Roberts, Allen F. 1993. "Insight, or, Not seeing is believing." *Secrecy: African Art That Conceals and Reveals*. New York: Museum for African Art. 65-79.

poetics, artistic intention, and breadth that a term like "bricolage" connotes, where I implicate myself as "maker" and so more formally agentive (Yardley 2008: 6-9).[57] As a bricoleur, I acknowledge my role within the rhizomatic production of knowledge and therefore the inherently diverse, and perhaps even contradictory perspectives such an outlook connotes. The creation and use of humanistic data are at the core of Digital Humanities practice. Through Digital Humanities, I came to understand the inevitable tension that arises when using digital methods for humanistic inquiry. For my project, an underlying question within the dynamic exchange of digital tools and humanistic interpretation is how vision is affected by sensory immersion. The following literature review surveys key concepts and theories in discourses on ways of seeing and technologies of vision. I begin with cultural theorist Donna Haraway's work on the politics of vision. In the next section, I address ways of seeing through the work of art historian Anne Friedberg and film, media, and technology scholar Sean Cubitt. Next, I introduce some of Jonathan Crary's theories on the concept of "the subject" as understood through optics. Finally, I discuss the dynamics of the lenticular as applied by media theorist Tara McPherson, who layers histories of computing culture with understandings of digital applications. Building from one to another, the trajectory culminates in my proposal of the term "Bubbled Lenticular Vision" to describe mono- or stereoscopic immersive experiences. I conclude by connecting the previous discussion of discourses to Anthropology's ontological turn, finding additional context for understanding XR in notions of the encounter and epistemological production. In moving from media theories to anthropological perspectives, I broaden the discussion from methods of visuality to ways of understanding and knowing, introducing discourses regarding philosophical

[57] However, I do subscribe to her notion of technogenesis—that humans and technology are coevolving, and I would argue mutually constituting in the particular case of immersive technology (Hayles 2012: 10).

ontologies. These ontological connections emphasize that XR technologies work with senses beyond seeing, producing a range of experiences for users that offer additional systems for knowledge production and communication. In addressing just one of the many XR experiences available today, I am demonstrating the line of work that I will continue to pursue throughout the dissertation to develop a specific language for understanding the culture and aesthetics for XR art and cultural projects.

The act of distinguishing "vision" from "gaze," engages political discourses. In Donna Haraway's article "The Persistence of Vision," the gaze connotes an uneven power dynamic between the seer and the seen. Gaze also implies the privilege of privacy for the watcher and violation for the watched. Haraway posits the concept of "vision" to argue for agency and situated knowledge. The objectivity of vision applies to XR technologies in that the visual encounter is between a virtually perceived object or environment and the user. Politics remain connected to the creation and use of instruments of sight in terms of what and how they are making visible. In privileging the point-of-view (POV) perspective, two things occur: POV perspective replicates the gaze and reifies the subject.

Normative men (straight, White, able-bodied) in the United States, are privileged bearers of the "gaze."[58] Their "sight" or perspectives are privileged within society and representative of the hegemonic norm, which is also inscribed in the apparatus of cinema itself (Mulvey 1975). Various instruments offering different types of vision have become ubiquitous and seemingly omnipresent, particularly in Western quotidian culture. In order to commit to the scientific

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[58] Many other feminist scholars have addressed such issues, including, Kaja Silverman (1988 and 2005), Griselda Pollock (2008). Laura Mulvey's 1975 essay "Visual Pleasure and Narrative Cinema" is often credited with bringing the term "male gaze" into academic and eventually quotidian parlance.

standards of mobile positioning and detachment, Haraway acknowledges the identity politics problem in attempting to assume the standpoint of the subjugated in order to have the most powerful viewpoint (Haraway 1988: 680). Her solution is a "split and contradictory self" by which that positioning can be interrogated and held accountable (ibid: 681). Positioning then becomes essential to ground the knowledges gained through the imagery and instruments of vision. The battle for how to see can then begin.

The scaffolding that supports and accentuates sight in turn affects ways of seeing. In her book, *The Virtual Window: From Alberti to Microsoft* (2006), Anne Friedberg investigates the perspectival paradigm. She analyzes the window as an object, metaphor, and perceived reality. Friedberg starts with the first instances of the window in art when a painting was conceptualized as a medium that could mimic a way of looking out onto the world as if it were a vista. She builds from those origins to address various forms of mass media that redefine the modern world such as photography, cinema, television, and computing screens of innumerable kinds. In each case, windows position our perspective. While it seems that the frames that define contemporary mass media do the same, Friedberg argues otherwise, homing in on the differences in the design of the media, such as the ability to layer moving images in cinema or the graphical user interface of computers that allows for multiple windows on one screen. In doing so, she prizes the "complexity of technological development" (Friedberg 2006: 2, 4). For her, the choice of frame is as essential to our understanding of the work as the content within it. In her examination of the perspectival paradigm, Friedberg demonstrates that the virtual world's supply of multiple windows represents an ability to not just be "here and there, but also then and now" (ibid: 5). The computer screen breaks with a single image in a single frame method. The logic she proposes for visuality distinguishes that which is framed from the virtual.

Most relevant to my own work is Friedberg's exploration of the virtual. While glass windows produce a sense of demarcation that isolates the viewer, cinematic and televisual screens transport people in space and time through delimited vision (ibid: 138). Friedberg describes the virtual window as opaque—we do not see reality through it, like a glass window, but a framed virtuality (ibid). In defining "virtual," Friedberg looks to the work of Henri Bergson, who perceived the term as "an ontological distinction between the possible and the actual" (ibid: 141; Bergson (1910 [1889]) and 1990: 36-37). Existence is freed from physicality. Conscious perception actualizes the virtual. Memory is immateriality, only becoming matter within the present as a result of the agency of the subject (ibid: 142). The process of recall and description of the virtual is not unlike what is experienced today by VR headset users.

Additionally, XR technologies involve different levels of mediation. In Sean Cubitt's introduction to *The Practice of Light: A Genealogy of Visual Technologies from Print to Pixels*, he writes that "mediation is the ground of relationship" (Cubitt 2014: 2). For his work, light constructs the dichotomies of the world such as subject, the observer, and object, "the visible" (ibid; Merleau-Ponty 1968). Since light precedes the process, it is not until it is present that the relationships form between the two. Subject and object form in a dynamic way because light creates each one simultaneously in the process. In the case of virtual environments, mutual constitution comes not from light, but from the choice to engage or what Haraway calls "vision." Intentionality allows for us to see the work and for the work to be seen. The virtual environment does not exist for the user until the headset is in place. In the same vein, the environment can no longer be perceived when the headset is removed. This process for experiencing leads me to investigate the role of the subjective within the dynamic of the virtual experience.

We can additionally situate XR within the realm of technologies of vision through exploring their effects on the relationship between subject and object. Instead of focusing on the content or what frames it, Jonathan Crary, in *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century*, starts with the construction of the observer. Like Haraway, Crary insists vision is tied to hegemonic structures, but he also investigates connections to corporeality as well as histories of optical technologies. In Crary's argument, the observer became the basis of visual perception through the processes of Modernity (Crary 1990: 69).

Crary's focuses on two optical instruments, the stereoscope and phenakistiscope as demonstrative of the ideals of the Modern period along with photography, as all such optical technologies lead toward moving pictures and beyond. Such devices are based on the science of the eye and optical perception. Functionality depends on the mechanics of the body as much as that of the device. Both require interaction with the observer to become what they are. The phenakistiscope's illusory abilities of appearing to change static images into moving ones depend on the afterimage, which Crary describes as "the presence of sensation in the absence of stimuli," which demonstrates an independent form of vision that is divorced from the object and delivered from within the subject (ibid: 98). The phenakistiscope proves that the external referent and sensory perception are not only inextricably linked, but also dynamically constituted. Active seeing located within the body became a characteristic observation in the modern era, tying temporality to vision. The physiological *event* of an afterimage is then a "dynamic amalgamation of past and present" (ibid).[59]

In a second instance of new optical experimentation and resulting production of knowledge, Crary analyzes the stereoscope as an exceedingly popular form of mass culture,

[59] Noteworthy, this description of afterimage could easily serve as a definition for "memory."

usually labeled as "realist," but one that is in fact based on abstract models of vision — in this case, the binocular disparity of parallax.[60] Crary shares with the storied optical inventor Sir David Brewster that there is really no such thing as a stereoscopic image because it is actually an effect that is conjured based on the observer's experience of how the brain merges images as perceived by both eyes slightly distanced from each other (ibid: 122). In terms of representation, no other tool had ever come so close to conflating the real and the optical in the nineteenth century (ibid: 124). Turning to Marxism, Crary discusses how these devices seemingly render the human body a "cog" within the experience, relying on the observer's ability to transform parallel images into apparitions of a single scenes with depth and routinely replace one set of stereographic images with the next to reproduce the effect over and over (ibid: 131-132). Each time, the play of optical technologies based upon the parallax of human vision as processed by the brain permits outcomes that could be exceedingly important with regard to propaganda and "knowing the world" from very controlled perspectives (ibid; c.f. Poole 1997). The stereoscope arguably decenters the subjectivity of the body. By entering into and out of a stereoscopic experience, the body "sees" itself at work through the act of experience.

Crary's theories and models of subjective vision provide the observer with unprecedented autonomy and productivity while simultaneously cultivating new forms of control and politically motivated standardizations for vision. Crary states that these technologies were rendered obsolete because they were "insufficiently 'phantasmagoric'" with regard to optical devices developed

[60] The literature on stereopsis I present could be deepened, given how important middle-class parlor culture was in Europe and the US through which, using stereoscopes, people could "visit" what was said to be "Africa," with all the problematic colonial politics so implied. People learned of the "need" for "civilization" through such devices. This chapter merely introduces a few key areas, but also highlights opportunities for future research development.

next as earliest prototypes of moving pictures – film, that is – were invented and deployed.[61] Novel in their use of optical illusion to create a feeling of depth, we have, however, seen updated iterations of stereoscopic technologies. From Jul 15, 2018–Apr 1, 2019, an exhibition at Los Angeles County Museum of Art (LACMA) entitled *3D: Double Vision* covered the history of 3D representation, providing evidence that the technology is not gone, just reimagined. Extended reality technologies today offer a spectrum of experiences on a reality-virtuality continuum, as proposed by Paul Milgram, and are arguably becoming effective enough to warrant a place within the mainstream (ibid: 132; Milgram 1994: 283).[62]

Objects, even virtual ones, do not exist "outside" of time and place. Their existence is tied to a particular set of circumstances, and such contexts are significant to our understandings of them. As Lisa Nakamura and Peter A Chow-White note, "no matter how 'digital' we become, the continuing problem of social inequality along racial lines persists," as well as inequities across genders, disabilities, and economic and social differences (Nakamura and White 2012: 1). To understand XR technologies, the historical background that led to their introduction into Westernized societies provides insight into their operation on both a practical and theoretical level. Tara McPherson posits that the significant work done in the 1960's in the development of

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[61] In this quote, Crary is quoting Theodor Adorno, who developed the term from Karl Marx to describe an illusory effect that takes on qualities of creating an alternative reality.

[62] Does where the experience happens matter? I think there may be a strong connection to be made between Friedberg's discussion of delineated virtuality and Crary's subjective observer in Kate Mondloch's notion of "screen subjects." In considering how visitors experience screen-based art in museums, she sees screens as both objects and "virtual windows," material and immaterial entities at the same time (Friedberg 2006: 7-12, 141-146, 254-257; Crary 1990: 67-97; Mondloch 2011). Mondloch also explores screen-mediated visuality from the perspective of screen art, focusing on modes of spectatorship to explore how contemporary viewing subjects are themselves defined by interactions with screens. To borrow a concept again from a different context, the experience might parallel in a secular fashion the concept of *darshan*—reciprocal site (Eck 2007).

nascent computer operating systems (particularly UNIX) is intertwined with momentous societal events in the US and worldwide involving race, cultural and political activity. She asserts that sociopolitical, historical, and cultural relationships between the two have not been explored sufficiently.[63] Since the digital realm has grown to impact the world so greatly in the decades since, McPherson calls for a more thorough examination of the decisions within the creation and use of digital tools that help to contribute to issues of inclusion and equity that cut across many dimensions of society, since computers, like any other object, become encoders of culture.[64] She places particular focus on the thinking of those pioneering scientists who developed their programs largely following nine core rules of UNIX philosophy (additional rules began to vary), and whose tools included "pipes, filters and hidden data" which allowed for great "modularity and the covert" (McPherson 2012: 28, 29). McPherson sees a correlation between the progression of these cyber advances to the deeply siloed departments at not just universities but within governments, corporations and cultural institutions in the US and worldwide. The result has lessened the impact of voices of color, gender, class, and political activism by a kind of divide and conquer (or at least isolate and diminish) approach by the power structures of these agencies. At the same time, communities of color and others deemed outside of mainstreams have been subjected to covert surveillance and other digitally enhanced forms of hegemony.

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[63] Thusly, McPherson's work is a critical intervention. Others scholars, such as Safiya Noble, Sarah Roberts, Miriam Posner, Ramesh Srinivasan, Michelle Caswell, Marisa Parham, Patrik Svensson, Thomas Mullaney, Shannon Mattern, Sara Hendren, Vendela Grundell, David M. Berry, Matt Ratto, Erin Rose Glass, Natalie Jeremijenko, Lilly Irani and Kate Elswit, have since built on this work and expanded into new areas of inquiry. Their work has reshaped the conversation into one that address the political, social, and cultural aspects of technology in the digital age. While I cannot address all of their work within this dissertation, I wish to acknowledge its contribution to my perspectives throughout this project.

[64] As an important aside, I want to acknowledge that laptops and other computers remain well beyond the reach of the majority of the world's population, yet the cell/mobile phone revolution has made at least certain digital resources available in otherwise extremely remote places.

McPherson defines these discriminatory practices using notions of the lenticular. Her use of the lenticular can apply to problematic modular logic as applied to technological development processes and forms of discrete vision (McPherson 2012: 24-25). To counteract discriminatory practices within technological development, McPherson urges digital humanists to become bridge builders and "develop common languages that link the study of code and culture" (ibid: 34). Heeding her call to develop scholarship "in a systemic manner," in my position as a DH bricoleur, I interweave discussions of XR technologies, artistic practices, and cultural and political discourses to develop socially and culturally conscious methods for XR implementation and assessment (ibid).

Additionally, McPherson's theories of the lenticular can be used to describe forms of discrete vision (McPherson 2012: 24-25). As opposed to the stereoscopic, where two images appear whole and dimensional when seen through the proper viewer, the lenticular is a design that gives the illusion of dimension through a fragmented structure (ibid: 25). Despite achieving a similar dimensional effect to the stereoscopic, the lenticular structure prevents the viewer from seeing the whole image at one time (ibid: 24). Instead, the viewer must either move the object or their own position in order to see the image appear and disappear in progression, allowing for the simultaneous perception of incompatible differences.[65] While the single camera lens privileges detachment through its delimited frame, the lenticular requires direct interaction. As one moves the object, one can observe a transformation. In their work on visual cultures of sub-Saharan Africa and the Indian Ocean region, Allen F. Roberts and Mary (Polly) Nooter Roberts noted an example of the lenticular as applied to devotional images of the Sufi Senegalese saint Sheikh

[65] Daguerreotypes required similar physical interaction, so there is a long – but often forgotten – history of such necessities.

Amadou Bamba (Roberts and Roberts 2008: 5). The Mourides, followers of Bamba, applied the optical technology to shift “from a portrait of Bamba to an image of ‘the Prophet as a boy,’” each “becoming” the other when laterally tilted, combining “cultural codes of communication” within the process (ibid: 7-8, citing Diane Umble 2003: 139).[66]

Similarly, in virtual environments, you move yourself, turning your head or body to explore the space. While virtual space is typically designed for you to experience 360 degrees, you can only experience a section at a time as you would in physical space. The immersive experience comes from the perceived continuity of space. Unlike the frame as described by Friedberg, there is an implication embedded within the mechanics of the lenticular that makes one aware that there is more to see (Friedberg 2006: 59-101). As Crary discusses, “the corporeal subjectivity of the observer[…]becomes the site on which an observer is possible,” as the human body is the active producer of the experience (Crary 1990: 69)

Feminist embodiment, Haraway argues, acknowledges orientations and affiliations communicated through semiotic fields (Haraway 1988: 682). Vision is always interpretive; observation can never be objective, and is usually intersubjective in complex ways. “Lenticular vision” serves as an apt metaphor for what extended reality technologies do. Admittedly, the analogy is limited, given that lenticulars can only shift back and forth between two or a very few images behind their lens-covered surfaces, or if constructed somewhat differently, they can fool the eye into perceiving three dimensions rather like stereographs of old. Lenticular opportunities do not “become,” then as XR works do, as much as they alternate or deepen.

[66] For a more thorough articulation of the lenticular as an optical technology and for several additional examples of lenticular artistic productions, see (Roberts and Roberts 2008: 8-10; Crary 1990: 8-19).

What may be called “Lenticular vision” operates differently across the spectrum of XR. In immersive VR, the headset closely replicates natural vision, so that as the user turns their head new areas of the scene appear. Additionally, VR often makes use of near-field rendering of sound, so that the audio reflects a perceived spatial distance and direction of a noise, which changes in relation to the user as they “move” through the virtual environment. Mixed reality applications encompass both augmented reality (AR) and augmented virtuality (AV). In AR, digital objects are layered onto a real environment, like in the popular Pokemon Go AR application which projected cartoons onto a windowed reality as seen through a mobile phone camera screen display. AV involves a live person or thing being layered into a virtual environment, through techniques like Chroma key compositing, also known as “green screening,” or motion capture. For AR, as one moves the device that layers realities, additional digital components are revealed to “share” perceived space. In the case of augmented virtuality (AV), the lenticular may be less obviously present. However, video games that utilize a POV perspective and motion capture for the characters within the game could be examples of the lenticular in connection with augment virtuality. Hybrid reality technologies provide a perceived environment that is mutually constituted at the moment of a situated subject’s engagement. When players share a video game experience, each perceive the virtual environment from their gaming-avatars perspective. While the environment is shared, the points of view are discrete. In the case of motion capture, the players see a lenticular perception of the motion data points. Actors attach sensors to their bodies, which record their movements as data points in space. Through post production, the captured corporeal information is translated for and rendered within virtual media. When one plays the videogame, the player does not see the actor, but a data driven version of their likeness.

Three dimensional environments allow users to access a limited depth within a virtual environment. However, the 360° photos and video footage that I have captured in galleries, libraries, archives, and museums (GLAM) spaces do not offer that same functionality. One's head or mouse can move a person around an image, but one cannot proceed into the environment being viewed. Sight without depth leaves the viewer with little efficacy, cultivating a touristic, distanced aesthetic and a feeling of stasis.

The sensation is reminiscent of one generated within the installation art work entitled "Don't Miss A Sec" by Monica Bonvicini that was placed just across from the Tate Museum in London in 2004. The piece constructed a bathroom out of one-way mirrors with a prison-style toilet on the inside. The patron using the facilities on the inside could see out, but no one from the outside could see in due to the reflective mirrored surface. While the installation has many layers ranging from Foucault's panopticon (1977) to Victorian ideals of privacy, for the purpose of my current work, I am interested in the resulting "bubbled" effect. Within the single bathroom stall, sensations of "mediated liveness" are triggered, as described by William Cusick, through which one can see the world while remaining somewhat removed from it, and in turn, one's outward gaze is not acknowledged or reciprocated (Cusick 2016).[67]

In 360° photographs and video, there is no evident "ontological cut" that a frame introduces to make one aware of the duel between reality and virtuality (Friedberg 2006: 5). The immersive feature of the medium dematerializes reality through hyperreality. In hyperreality, the conscious mind enters a suspended disbelief and is transported to a different environment. There, the mind is less able – or often, willing – to distinguish the simulation as such, as has been

[67] William Cusick, Professor at The New School in New York City School of Drama, used the term "mediated liveness" in his 2016 TEDxJerseyCity talk.

previously observed of the film subject's viewing position. In such a circular reality, or what I would propose to call "bubble reality," the limiting frame of virtual windows disappear, further enhancing the immersive sensation. Inside the bubble, as inside Bonvicini's installation near the Tate, one can see everything in the new environment, but similarly, one cannot interact with it, nor can it reciprocate interactions. Unless the camera is moved, the experience of the observer in the space is equivalent to that of a sit n' spin toy (or a stand and spin, as the case may be).

While viewers can still only see what is in front of them and must move their heads (or computer mouses) to experience more of the 360° photograph or video in a developing or unveiling fashion, a circular framework or Bubble Reality (BR) offers steps beyond lenticular technologies per se. Instead, BR presents a feedback loop, as the actor spins to view and review the scene again and again. By way of personal example, I created an annotated 360° tour of an exhibition entitled "The Industry of Uplift: Silent Race Film, The Lincoln Motion Picture Company and George P. Johnson" that was mounted in the Special Collection Reading Room at UCLA's Young Research Library. Within the experience, which lives online as part of a companion digital exhibition website, linked panoramic photographs eventually place the viewer back at the beginning of the tour so that it may begin again.[68] The paradoxical effect at least pushes against, and perhaps breaks, the modularity of the lenticular and of linear presentations more generally.

The virtual promotes promises of remote "embodied liveness." The delimiting sensation of the bubble, mimicking what sci-fi television writers might imagine dimensional "phasing" to be like, could give way to a productive "experiential curation" that allows GLAM institutions to

[68] To view the website and the tour, visit: https://dh150racefilmexhib.wixsite.com/theindustryofuplift/physical-exhibit-tour.

contextualize their rich repositories through bubbled vision.[69] With the growing ease and availability of applications, the demand for BR could be upon us sooner than most have imagined. In today's new media ecologies, a generational divide may limit initial scholarship and the embrace of VR and 360° capture, particularly in the case of institutions that are already taxed by the demands of evolving technologies. But as noted by Patricia G. Lange and Mizuko Ito in *Hanging Out, Messing Around and Geeking Out*, "Media theorists have argued for decades that media 'consumption' is not a passive act and that viewers and readers actively shape cultural meanings" (Ito and Lange 2010: 246). Their case studies support the argument that in our current moment of global participation, youth practices will define new terms in digital media production and networked media ecology, even as earlier technologies persist and/or are transformed to meet new circumstances (ibid: 14).

Virtual Immersive Media as a "Bubble of Lenticular Vision" encompasses a feminist perspective open to the idea of a relationship between users and technology that is mutually constituting and interactive (McPherson 2012; Haraway 1988). The bubbled-nature of the experience reminds the user of their situated position while still allowing for the suspension of disbelief producing a powerful immersive effect. Here, vision extends beyond the boundaries of sight and speaks also to ways of knowing. While immersive tech by no means dissolves the emic/etic divide completely, it can call attention to the dichotomy in a way that jars users to think more deeply about alternative perspectives.[70] The dichotomy between an outer reality and inner

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[69] Examples of "phasing" from *Star Trek: The Next Generation* appear in the episodes "The Next Phase" and "Time's Arrow." The *Star Trek: Voyager* television series episode "Deadlock" as well as a *Star Gate SG-1* episode "Arthur's Mantle," also use fictional science to speculate about alternative dimensions and realities.

[70] Used disciplines such as anthropology, ethnography, folklore studies, "emic" defines a perspective provided from someone who part of social group, an insider, and "etic" refers to perspectives from those who are outside the community, as an observer (Headland et. al. 1990).

consciousness is an essential discourse within the ontological turn of Anthropology, as expressed in *Key Debates in Anthropology,* and a central component within the immersive experience (Ingold 1996). Martin Buber created an opposition between the I-It and the I-You worlds in order to understand how individuals cultivate unhealthy objectifying mentalities (Buber 1958). He prescribed cultivating a harmonious existence through reciprocal encounters, though fleeting in experience, to live as responsible human beings. Putting forth a phenomenological theory, Buber asserted that people must aim not to experience the world but to encounter it through exchange. The more I-You moments one has, the more engaged he or she will be.[71] Additionally, scholars like Tim Ingold and Nurit Bird-David, when considering indigenous forms of ontology such as animism, narrow in on the concept of encounter (Ingold 1996, 2000, 2011; Bird-David 1999). [72] The process of bringing materials and things to life implies that one must have a meaningful interaction with them. Encounter defines all of these theories to some extent, and the focus becomes detecting where that encounter happens and identifying how one understands that encounter. Whatever the belief system (religious or not) may be, it contributes to or even becomes an ontology, shaping a person's nature of being in the world, their community, and their entire existence.

According to the sociologist Peter L. Berger, people inevitably build their own worlds because they are incomplete in their purpose at a biological level (Berger 2011: 4-5). Berger's

[71] I wonder if this is not unlike some other Eastern philosophies which are defined by core tenets of being present and harmonious with the universe (Ivanhoe et. al 2018). Rather than objectifying the world around us, we come to view ourselves as in it or part of it. Eastern concepts such as these were quite popular in Europe at the time that Buber's writing.

[72] The term "animism" is considered by some to have a patronizing and colonial connotation. I use it here since it is the term that Ingold and Bird-David use in their own work to discuss the efficacy and agency of persons, both human and non-human (Ingold 1996, 2000, 2011; Bird-David 1999).

phenomenological argument is that reality is socially constructed. If we consider Berger's premise that people create their own worlds because of an "instinctual" need, and the other authors I have previously mentioned have demonstrated that encounter is essential in shaping world building and what we do within that world, then we may contemplate the introduction of XR technologies as possibly contributing to growing digital ontologies and epistemologies (ibid). Arguments of phenomenology, particularly Buber's version, are at odds with the other descriptions of illusion in XR as discussed. One is engaged, the other is absorbed/oblivious. I bring these perspectives together to note that there can be slippage with XR experiences among a spectrum of engagement, believability, and entertainment. The human sensorium is highly individualized. Therefore, digitally immersive experiences, which rely on the body part as of the creation, will likely also be when it comes to their reception and use.[73] While warranting further study, the effectiveness of XR does not rely on a subject losing their boundaries and being totally absorbed in the illusion. Rather these are elements that can make up XR experiences.

Commercial statistics project VR to be a billion-dollar market, where every smart phone can operate in a VR mode and people will be participating in VR on a regular basis (Levola 2017: 6). Proving that these projections are more than just industry hype, UCLA produced a Virtual Reality Task Force Report released in February 2019. In Appendix B of the report, the task force provides a list of "major university virtual/augmented reality programs, centers, institutes, labs and projects" as of November 15, 2018 (Virtual Reality Task Force 2019: 53-67). The first part of the list is a survey of the centers and programs at the top thirty-three ranked national universities, according to *U.S. News*, where all but one school have resources dedicated

[73] While I claim no medical or scientific expertise, I feel we need to reserve judgement here for XR colleagues who are examining what effects media like VR can have on the brain for those who suffer paralysis or memory issues (Stone 2018; Reggente 2018).

to XR learning and research (ibid: 53-64). The report also includes additional pages of programs outside of the top thirty-three that the task force felt were worth noting and further demonstrate the range of institutions supporting XR within academic and scholarly circles (ibid: 64-47). Finally, the last section of Appendix B in the report provides a bibliography of recent publications that stress the growing significance and role of various XR technologies across different disciplines and fields of practice (ibid: 68-69) The full report makes a strong case against the argument that XR is a passing gimmick by discussing how XR offers new ways of encountering knowledge through an immersive experience that will reshape fields from education to training to medicine, and it ultimately advocates that an XR cross-disciplinary institute be established at UCLA to support long-term development.

There will inevitably be drawbacks or losses, too. As a form a mediated communication, technology can also have alienating effects. Sherry Turkle has expressed concerns in her latest books *Alone Together: Why We Expect More from Technology and Less from Each Other* and *Reclaiming Conversation: The Power of Talk in a Digital Age* about how technology is affecting people's relationships with one another, particularly in regard to younger generations who are often less oral or even textual (Turkle 2017 and 2016). Her alarm may ultimately be rendered moot. Turkle's call to conversation to stave off the negative effects of digitally mediated communications seems to be a mere stopgap measure and futile in the long term, when considering historian and philosopher Walter Ong's perspective in his work *Orality and Literacy: The Technologizing of the Word*.[74] Ong demonstrates that the shift from orality to

[74] Sherry Turkle's first book, *The Second Self: Computers and the Human Spirit* was published in 1984, just a few years prior to *Orality and Literacy: The Technologizing of the Word,* which was first published in 1989. Turkle has carried the mantle of Walter Ong's work through her field and expertise, producing valuable historical, sociological, and psychological data by tracking public reaction to personal computing devices over time (Ong 1989). For many scholars, Ong's work

literacy, which happened over centuries, was profound. We could be returning to a level of orality, as Ong suggests in his last chapter, as video chatting becomes more and more normalized after generations of television and telephone. Now we have companies developing personal artificial intelligences (PAIs) to act as our 3D virtual stand-ins in online environments.[75] It seems even more likely that we are shifting to a new way of visual communication.

The new direction of the latest technology does not privilege sound or writing but is primarily visual, computational, experience based. Steve Anderson's *Technologies of Vision: The War Between Data and Images* begins by describing the tyrannical reign of images across the twentieth century (Anderson 2017: 1). His central distinction is that today's images made with digital technology are no longer simply visual representation, but carry additional data that redefines our conception of visual culture. Anderson argues not for a digital divide between images and data, but an understanding of how and why they inform one another and do or do not connect in terms of histories and practices. In his third chapter, which provides a rich history of virtual reality, Anderson defines space in computational terms. For instrumented volumes, his concern is that they offer a troubling metaphor for lived spaces as being fundamentally indexable and therefore trackable. Environment and experience shape our perceptions of space—virtual, hybrid, immersive, and/or real. As XR technology finds its place within the growing web of digital media and method, we will learn to what degree it tilts the balance toward visual and experiential knowledge formation and transmission.

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has remained a touchstone for historical notions of technology, as demonstrated by Maaike Bleeker's reference to *Orality and Literacy: The Technologizing of the Word* in her introduction to *Transmission in Motion: The Technologizing of Dance* (Bleeker 2017: xix). I reference it here briefly to suggest yet another possible sociological shift in terms of the preferred method of knowledge consumption catalyzed by communications-based technological innovation.

[75] One such company is Project PAI (https://projectpai.com/) created by the startup ObEN (https://oben.me/).

Artistic and scholarly reflections on digital mediation can help us to better understand the changing ontology of digital device users. Additionally, artists are conceptualizing performance differently through the use of immersive technologies while affecting our understanding of human agency when theorizing artistic corporealities. Discussion of vision, ways of seeing, the subject, the lenticular, and bubbled reality form the basis for following chapters, such as how the normalization of digital immersive media can change museum and cultural pedagogical and preservation practices. In offering understanding through image-based immersive experiences, XR technologies have the potential to redefine our communication and knowledge consumption through moments of encounter within a growing digital world.

Part II:

Discussions on the Digital and XR in Modes of Publication, Display, and Information Capture for the Arts and Culture Fields

Chapter 5: For Publication: Past, Present, and Possible Futures for the Arts and Cultures Fields

Publishing is a creative product born out of preparation and dissemination communicated to a broad public. While publication has defined print media for centuries, the concept is closely tied to technical innovation and does not exclude media produced from advancements in technology, such as those since the Industrial Revolution including photography, film, and music.[76] While these media have challenged definitions and expectations of publication, electronic media in particular occupy a liminal space within the publishing realm, presenting challenges to characteristics that have defined publications, and fixed, linear, and definitive ones, in particular.

Though it may seem counterintuitive to start with publication, since it is usually the final piece within a project workflow, tackling publication first allows for a discussion of framework, process, and presentation (content selection, and assembly). Publication presents one of the biggest challenges facing digital art historical work, due to issues of accessibility, readability, producibility, and professional recognition. Digital publication offers the fields of art and humanities an opportunity to present content in ways that align more closely with humanistic inquiry. By allowing for the combination of modalities, expanding opportunities for access, and renegotiating the limitations of space and time, digital publishing has shifted the terrain of publication to include data presentation and reuse. Additionally, when digital methods are used in these ways, they evidence humanistic production of knowledge as interpretive and intersectional across disciplines, design, and cultures. Moving beyond the era of the ePub, which

[76] For more, see: https://www.britannica.com/topic/publishing; https://www.britannica.com/technology/information-processing; https://www2.archivists.org/glossary/terms/p/publication.

recreates the format of a book and the interactions that readers typically have with a printed text manuscript, digital publications have the ability to change their framework to reflect their content and their author's argument. By drawing attention to interface through thoughtful design, digital humanities work further embeds the argument in the structure and presentation of the content.

Steering the transformation of analog institutions with the adoption and integration of digital tools are a growing group of scholars and practitioners working at the intersection of the arts, humanities, and technology. Often operating under a position title such as "Digital Humanities Specialist," these individuals are typically expected to have a working knowledge of agile project management, humanistic scholarly production, data engineering, and computer programming. With large budgets and high expectations, these leaders in the field must balance a tricky equation between risk and reward. More often than not, trail-blazing is required as new territory is found or the familiar is made anew.

Much of the current progress in digital publishing involving immersive and 3D media is being made and exchanged through conferences and working groups. While not all-encompassing, I have compiled a list of events that is representative of the current attention being paid to addressing new frontiers of publishing within the digital era.

Conference/Gathering Name	Website	Date(s)	Location	Hashtag
Alliance of Digital Humanities Organizations (ADHO)	http://www.adho.org/conference	1990-2020, annual conference	Varied	n/a
Advanced Challenges in Theory and Practice in 3D Modeling of Cultural Heritage Sites	https://web.archive.org/web/20161002172944/http://advancedchallenges.com/	June 22-28, 2015	University of Massachusetts Amherst	#neh3d
Advanced Challenges in Theory and Practice in 3D Modeling of Cultural Heritage Sites	https://web.archive.org/web/20161002172944/http://advancedchallenges.com/	June 20-23, 2016	University of California, Los Angeles	#neh3d
Technology & Storytelling: Animation, Special Effects, Virtual & Augmented Reality	https://noma.org/technology-storytelling-symposium-features-virtual-augmented-reality-demonstrations/	October 20, 2017	New Orleans Museum of Art	n/a
3D Imaging in Cultural Heritage	https://www.3dimaginginculturalheritage.org/	November 9-10, 2017	The British Museum	
Lib3DVR: Content Creation and Publishing	https://lib.vt.edu/research-learning/lib3dvr.html	March 1-2, 2018	Virginia Tech Executive Briefing	#lib3dvr

			Center Arlington, VA	
Lib3DVR: Visualization and Analysis	https://lib.vt.edu/research-learning/lib3dvr.html	June 13-15, 2018	Tom Love Innovation Hub, University of Oklahoma, Norman, OK	#lib3dvr
Lib3DVR: Repository Practice and Standards	https://lib.vt.edu/research-learning/lib3dvr.html	September 17-18, 2018	Big10 Conference Center, Rosemont, Illinois	#lib3dvr
Community Standards for 3D Preservation (CS3DP): Forum 1	http://gis.wustl.edu/dgs/cs3dp/	February 5-7, 2018	Washington University in St. Louis	#cs3dp
Community Standards for 3D Preservation (CS3DP): Forum 2	http://gis.wustl.edu/dgs/cs3dp/	August 13-15, 2018	University of Michigan in Ann Arbor	#cs3dp
Immersion in Museums: AR, VR, or Just Plain R?	https://www.aam-us.org/programs/center-for-the-future-of-museums/immersion-in-museums-ar-vr-or-just-plain-r/	September 5-6, 2018	Detroit Institute of Arts, Detroit, Michigan	n/a
Scholarship in 3D Digital Edition Publishing Cooperative/ NHPRC-Mellon Publishing Cooperative: Scholarship in 3D	https://www.archives.gov/nhprc/projects/depc/ucsantacruz	October 3-5, 2018	University of California, Los Angeles	n/a
panel on "Data-driven Virtual Environments" at MACAA (Mid-America College Art Association)	http://www.macaart.org/conference.html	October 4-5, 2018	University of Nebraska-Lincoln	n/a
Digital HERITAGE 2018: “New Realities: Authenticity & Automation in the Digital Age”	http://www.digitalheritage2018.org/	October 26-30, 2018	San Francisco, USA	n/a
Born to Be 3D: Digital Stewardship of Intrinsic 3D Data	https://www.loc.gov/preservation/digital/meetings/b2b3d/b2b3d2018.html	November 2, 2018	The Library of Congress, Washington, D.C.	#B2B3D
Virtual and Augmented Reality for the Digital Humanities Institute (V/AR-DHI)	https://sites.duke.edu/vardhi/	July 23-August 3, 2018	Duke University	#NEHVARDHI
Advanced Topics in Digital Art History: 3D and (Geo)Spatial Networks	https://sites.duke.edu/duke_arthist_3dgeo/	June 4-16, 2018	Venice International University	#DAHVenice2018
Immersive Learning Research Network (iLRN)	https://immersivelrn.org/ilrn2019/	June 23-27, 2019	New Cavendish Campus, University of Westminster, (DCDI College, London, UK	#iLRN

Table 1: A list of conferences and working groups researching the use of 3D and XR technologies for arts and culture research and learning

Current work being done through these conferences, consortia, and forums is forming what digital editions with 3D content will mean for the future of publication. These gatherings have also been looking closely at long-term preservation and reuse, to be discussed in more detail in a later chapter. Many of the understandings presented here were forged in discussions in which I have participated or have witnessed within such arenas.

The following chapter examines how traditional arts-publication formats have been transitioned to new digital standards. By using a method of platform and project analysis, functionalities of the tools used in virtual presentation are compared to their print counterparts and conventions, as well as to each other. In doing so, I will present the current landscape for digital arts publishing, both its opportunities for scholarly dissemination and the challenges that remain in terms of adoption and workflow. Secondly, ways that museums and cultural organizations are utilizing 360° panoramic technology, virtual reality, and augmented reality are presented, as they provide new perspectives and challenges to publication. Through immersive media analysis, I explore the blurred boundaries these forms offer art study and scholarship, arguing that there are opportunities for greater inclusion and contextual preservation through their use. Finally, a set of object analyses conclude the chapter, which address uses of proprietary technologies within scholarly arts publishing, focusing specifically on concerns for the presentation of 3D and immersive materials.

From Print to Digital

For art histories and visual arts, the most common digital publication types are online scholarly catalogs, digital collections, digital exhibitions, and digital monographs. By considering these various digital models, we may achieve an understanding of what "published" means for digital arts scholarship as it has been transferred from its print form to an Internet-based platform. Digital exhibitions are included in the discussion of publication, since physical exhibitions are sometimes counted toward tenure and other promotions as an equivalent to published works by arts-based departments. In each of the four cases, online scholarly catalogs, digital collections, digital exhibitions, and digital monographs, specific platforms and digital tools in use are highlighted.

For online scholarly catalogs, the Getty Foundation's final report for their Online Scholarly Catalog initiative and the resulting OSCI Tool Kit for producing digital catalogs for museum collections are summarized and described. Next, the trajectory of Omeka is presented as one of the leading digital collections platforms in relationship to growing digitization efforts by gallery, library, archive, and museum (GLAM) organizations. In the same section, digital exhibitions are addressed, as they are often closely linked to and a narrative presentation of digital collections. Finally, development of digital monograph initiatives is examined by looking at three platforms – Scalar, Manifold, and Fulcrum – to consider how they present visual studies material and address 3D or immersive content. Additionally, hybrid formats present publishers and authors an alternative way forward that place virtual objects at the center of publication, while new publication pipelines and workflows are being developed to handle new media content and publications.

Online Scholarly Catalogs

The Getty Foundation released a final report in 2017 regarding its Online Scholarly Catalog Initiative (OSCI).[77] Started in 2009, the Getty Foundation and Museum partnered with eight museums[78] in an endeavor to produce a multimedia, collections catalog. Addressing rising

[77] The report is available at: https://www.getty.edu/publications/osci-report/.

[78] The museums involved were: (1) the Art Institute of Chicago; (2) the Arthur M. Sackler and Freer Gallery of Art; (3) the Los Angeles County Museum of Art; (4) the National Gallery of

publishing costs and the popularity of online content, the institutions revisited a museum's mission dedicated to dissemination and access. The Getty initiative participants re-evaluated their products and workflows, updating where needed to include web publishing so that publics could access collections information from their digital devices. While the OSCI page on the Getty website claims the initiative was to help "museums make the transition from printed volumes to multimedia, web-based publications freely available to anyone with a computer, tablet, or smartphone," none of the institutions did away with traditional publishing methods. In truth, the working groups expanded and set standards for the types of digital publishing museums offer (Getty Foundation).

Director Deborah Marrow highlights the key challenges facing museum print publication catalogs in her introduction to the Getty report, including limited readership, costly production, which places limitations on the inclusion of content, and a process that is slow to update. Digital publications allow for wider audience participation, greater flexibility in terms of design, and interactive content with high resolution reproductions. The report also shares nine lessons learned: "1) Online publishing is authoritative; 2) Choose technology wisely; 3) Rightsize the project; 4) Make sure your content is ready; 5) Intellectual property is manageable; 6) Find ways to serve multiple audiences; 7) Design matters; 8) Get the right people and structure in place; 9) Think sustainably" (Getty Foundation 2017). These acknowledgements stress the importance of adhering to scholarly conventions of the discipline (e.g. citations, provenance, exhibition history) while adopting agile project workflows that promote iterative design processes and increase

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Art, Washington, D.C.; (5) the San Francisco Museum of Modern Art; (6) the Seattle Art Museum; (7) Tate; and (8) the Walker Art Center.

collaboration among diverse team members. Chapter Seven of this dissertation will discuss the use of digital exhibitions as popular assignments in the art history classroom.

Another key aspect to which the Getty document alludes is the rising importance of interoperability and the standards for work that are needed to support image-based resources. While Artstor and other early image repositories were essential to promoting new digital methods for art historical scholarship and learning, the model became unsustainable under the influence of the concept of open source and its communities. Many such image repositories, along with libraries, archives, special collections, and research institutions, came together to build the International Image Interoperability Framework (IIIF),[79] and to found the IIIF Consortium in 2015. With more than fifty institutional members worldwide, the group models certain values for the greater GLAM network: collaboration, shared standards, interoperable technology, and free public access, carrying forward the traditional missions of GLAM organizations into the digital era (IIIF).[80]

Ultimately, Getty findings suggest three approaches to online catalogs: stand-alone microsites as a customizable and flexible option that mimics the format and style of a typical museum catalog; Web content management systems making use of the current Web technology systems in place within the organization and repurposing them for catalog content; and The Museum System (TMS)/eMuseum publishing utilizing internal collection database systems and writing them to a public Web platform. As an example and template of the first approach, the

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[79] The IIIF website is: https://iiif.io.

[80] For more on what IIIF is now contributing to 3D digital objects, see Chapter Seven. It should be noted that many institutions ardently resist any such open-access initiatives, continuing nightmares for scholars hoping to publish pertinent illustrations from museum collections. For some museums, such income is essential to paying their bills (e.g. Belgium’s Royal Museum for Central Africa).

OSCI project also produced a digital tool kit to encourage other institutions to share more content online.[81] Within the report, options are evaluated, highlighting both the benefits and challenges of each one.

It is worth noting that the authors of the Getty assessment do not question whether the idea of the catalog needs to change or how often a general public or a specific readership is engaging these materials. How are these online catalogs being used? Would the public prefer an online digital catalog or a virtual tour of a permanently exhibited collection with annotations that are connected to a searchable database? With remaining concerns of cost, sustainability, discoverability, and usability, going back to the drawing board may be what is needed most and reassessing what "publication" means for the visual arts in the digital age.

Digital Collections and Exhibitions

The first photo was uploaded to the Web in 1992, and as computer and internet speeds increased over the next decade, digitization initiatives multiplied (Press 2016). While the commercial art field struggled in the late 1990s and early 2000s to understand how digital media could be effective within their market, as described by Pau Waelder in his 2016 article for the AC/E Digital Culture Annual Report, many libraries and archives slowly and successfully began to preserve and share their materials digitally (Waelder 2016: 36-40). Additionally, university departments with slide libraries began to digitize their collections and build local databases for

[81] The toolkit, built as a Drupal-based hybrid, is open source and available through Github, but it is no longer institutionally supported. I find the expectation that a set of interested community members will continue to shepherd an application forward to new iterations dubious and unrealistic. More likely, the code is available to be scavenged by those who feel they can make use of bits of it for other projects and the overall application passes on to eventually roam the digital graveyard with other abandoned works of code.

image storage. Artstor, a non-profit digital library service, collaborated across institutions to reduce redundant digitization efforts and produce an aggregate repository for scholarship, teaching, and learning. Today, while some GLAM institutions continue to build and share digital collections in-house, initiatives and institutions like Google Arts and Culture, Europeana, and Wikipedia have expanded access to digital collections online.

While there are many out-of-the-box, digital collections and digital exhibition builders currently available for classroom use, such as Google Arts and Culture Gallery Builder, that are great, Omeka was one of the first successful content-management systems and publishing platforms for digital collections. Items are the building blocks for Omeka's overall structure, which is ideal for object-centered learning. Each can have a file, file metadata, and item-related metadata attached. Items can be grouped in collections or contextualized through a narrative structure known as an exhibit.[82] The information structure and digital publication style of Omeka closely resemble that of analog archival and curation methods of preservation and display. The latest version of the free, open-source, web-publishing platform is called Omeka S and it is designed with archives, libraries, and special collections in mind. More robust and agile for institutional use, Omeka S takes a page from WordPress' playbook by allowing for multisite options. A new alternative to Omeka Classic and Omeka.net, Omeka S has additional standards built into its metadata field options, with Digital Public Library of America templates and linked open data import tools. Omeka's team was mindful of its community of users in the field of collections management and spent time finding out what they wanted before they built Omeka S.

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[82] As a personal aside, when referencing curated collections, I choose not to use the term exhibit due to its historical association with the Western representation of non-Western objects. To shun these colonial underpinnings, I prefer the term "exhibition" following the guidance of my late mentor, Mary "Polly" Nooter Roberts. However, in the current context, I will use "exhibit," as it is the terminology used within the Omeka content management system.

The detailed history of the overall project on their website demonstrates that attention to a user-base has been a critical marker for Omeka's success since its original launch in 2007 (Omeka). Libraries and archives have the onerous task of keeping up with latest information systems, and information technologists find themselves fielding requests from various disciplines, all with idiosyncratic wants and needs.

Digital Monograph

In response to shifts in technology, publisher and platform have combined in order to be more responsive to digital demands. The teams behind these publishing platforms challenge what digital scholarly publication can be. In 2016, for example, Donald J. Waters offered a state of the digital publishing field from his perspective as the senior program officer for Scholarly Communications at the Andrew W. Mellon Foundation, one of the premiere funding agencies for work in higher education and the arts. Through his team's support for those in the field looking to apply digital practices to scholarly publishing, Waters lists nine features that define a digital monograph: 1) searchable from the Web with interactive features and primary and secondary sources, 2) interoperable across various digital reader platforms and operating systems, 3) provide user analytics that are respectful to a reader's privacy, 4) preservation and upkeep of digital format, 5) viable and enduring economic model, 6) peer reviewed, 7) annotatable while remaining device agnostic, 8) eligible for academic accommodations and recognition, 9) publicized, shared, accessible and personally owned by readers (Waters 2016: 2).

While Waters lists thirteen different universities involved in research on digital publishing, alternative hybrids are also being explored, particularly in regards to visual arts content. Leading the way and growing in recognition are Scalar, Manifold, and Fulcrum. In the following sections, examples of digital art history and visual studies projects that have been produced from these platforms will be examined as they offer various levels of content immersion and interaction. Through an examination of frameworks for the presentation of scholarly interpretation, I consider how annotated models flip the emphasis to the object and environment, layering rigorous commentaries "on top," which therefore draw attention to "acts" of scholarship.

Scalar

Scalar, produced by the University of Southern California, was one of the first publishing platforms to question the notion of linear design for digital scholarly publication. With multimedia content in mind, Scalar makes use of computer sciences' modular thinking to enable pathways through bits of content that can be assembled and navigated based upon multiple connections and throughlines that the author selects. Like Omeka, Scalar established strong ties to its community of users. Through an Association for Computers and the Humanities microgrant, Alicia Peaker, Digital Scholarship Specialist at Bryn Mawr College, instigated the development of an exhibition plug-in for the Scalar platform in 2016. The template generated by her collaboration with Scalar became the Visual Path Layout now available in all Scalar books.[83] Peaker worked with Nathanael Roesch in consultation with curator Carrie Robbins to design two new layouts for Scalar, with the support of Scalar staff members Craig Dietrich, Curtis Fletcher, and Erik Loyer (Peaker).

[83] Read about the plugins develop on Alicia Peaker's website (http://aliciapeaker.org/?p=445) and find the open source code available on github at: https://github.com/peakera/set. View the template at: https://digitalscholarship.brynmawr.edu/scalar/scalar-exhibition-template/index.

The scrolling layout is a responsive design, meaning it is automatically scalable across different devices, and allows for page information to be stacked vertically and scroll over a background or set of backgrounds. The scrolling design became popular for mobile devices that use touch interfaces. Its replication as part of the exhibition template for the Scalar platform demonstrates an understanding that touch devices such as tablets and cellular phones are part of the art-seeing experience and culture today.

The “People” layout, while designed in part to give credit to those who created the digital experience, draws on archival and display conventions. Replicating a likeness to exhibition wall labels, the description default display provides a bolded title and a space for paragraph text below an image. When users hover their cursor over an image, navigational tabs are displayed, offering users to switch the display below the image to one of the four options: description, details, citations, or source. Like an artwork’s tombstone information in more “traditional” museum displays, the details tab provides an archival metadata display which draws on data standards such as Dublin Core and IPTC. Clicking citations sends one to an entirely new page that focuses on the single image object and location information for where one may find it referenced within the Scalar project. The more singular view provides a way to examine the part separate from the whole. What is implied but not openly stated about the People layout is that it is meant to create a format for displaying more than one image and bio. As a collection tool, it provides a layout to place multiple images and their texts within the same field of vision.

Finally, the source tab provides an individualized, nearly full-screen view of the image alone in a new browser tab. Additionally, Peaker’s template makes use of a gallery view that is labelled “exhibition checklist.” Upon hovering the cursor over an image in the collection, a tool-tip-like pop-up displays a short title or description of the item. Clicking on an image provides the same display as the citations tab within the People layout. Tagging these media items (a form of indexing) allows them to be reused and regrouped with other items in new configurations within different pages. The final section of the template is an abstract that clicks through to long form text. Within the template example, Peaker's team labels it "Exhibition History," but like the People layout, it can be used in a variety of ways, such as to publish exhibition catalogue articles.

Peaker's exhibition template is used within "The Tale of Genji: From Princesses to Pop,"[84] an online project that was curated by three Bryn Mawr students, Anna Moblard Meier, Nina Blomfield, and Sarah O'Connell, as a contextual companion to the special collections physical exhibition by the same name (Haartz 2017). Using the dropdown menu in the upper left of the page, users can find an overview of the content by clicking through the table of contents and using the arrows to the right of the text to drill deeper to see how the information is arranged. As it is not uncommon (and often good practice) to repeat important information in various places within a website, the table of contents navigation shows that the section entitled "The Genji Narrative" appears twice: once in Chapter Four Section Five and again as Chapter Five itself. Galleries, libraries, archives, and museums (or GLAM institutions) often struggle with deep Web issues due to the amount of rich content they share, and users have to click through many pages of the website before they find the information they are seeking. Because of Scalar's inherently modular design, important information can be repeated, as shown by this example, increasing a user's chances of finding it. However, the expanded and repetitive navigation can cause confusion. From my personal experience using Scalar and from discussing the Scalar

[84] The website for "The Tale of Genji: From Princesses to Pop," project can be found at: https://digitalscholarship.brynmawr.edu/scalar/tale-of-genji/index.

reading user-experience with others, users can become disoriented if they run into the same information on a different navigational path.

While the central piece of the physical exhibition was the restored six-fold, painted, golden screen by Kano Seisen'in Osanobu that depicts a scene from the fifth Chapter of the famous millennium-old novel of Murasaki Shikibu, the Scalar exhibition website takes the novel itself as its cornerstone (Meier et. al. 2017: “Restored Screen”). The exhibition checklist implies that all the items shown in the gallery view would be those from the exhibition, but the screen is not included in the set. It would be helpful to have an introduction above the gallery of images to orient visitors to the page. In clicking through the images, viewers can see to which of the five thematic groups the images belong: nature, seasons, poetry, the Genji narrative, or pop. The hyperlinked tags serve as another path of entry into those thematic pages. The project successfully demonstrates how visual content can be interwoven through textual scholarship to provide greater literary insight and historical context to the exhibition objects; however, it also makes evident the difficulties in producing scholarship digitally. There are several instances, like on the “Beauties Admiring the Blossoms” citation page, where filler text has not been edited out (Meier et. al. 2017: “Exhibition Checklist”). The virtual editorial process can be difficult to manage since the content is spread out over many pages. With greater interlinking of materials, digital project teams will need a more complex, detail-oriented editorial workflow -- something that Scalar is just now addressing in its version 2.5 release. The oversight of this filler text also indicates that it is possible to add item level descriptions to each of the images. Doing so would have made the project more exhibition-like, and users would have an experience similar to reading wall labels and/or the artwork’s tombstone information, in addition to exploring the overarching themes of the exhibition. One can surmise from exploration of the functionality, as evident by the placeholder text, that the students decided against its use for the project, possibly due to time limitations.

Nevertheless, Scalar's adoption of the exhibition plug-in acknowledges the validity of visual communication and argument, by which the answer is not necessarily a one for one, but rather an encounter turned communion with an object. In this Buberian sense, objects become the catalysts through which our thoughts percolate, jumping from synapse to synapse. When a reader becomes a viewer, a shift in agency allows for a deeper engagement with the content through the ignition of a personal thought process.

Slow-looking, as a technique common in the field of art history, requires the use of visual analysis skills in order to build a way of thinking.[85] The act of looking causes a thought process that deepens our understanding of a visual work, as formal properties guide our understanding within a cultural aesthetic system/framework. Then, through visual comparison across different works, additional assessments may be ventured regarding comparison of style and technique as developed by philosophers of art through the ages, from Giorgio Vasari to Heinrich Wölfflin (Vasari et. al. 2006; Wölfflin 2015). While most art historians today would agree that these purely aesthetic analysis methods leave much to be desired in terms of historical and political contextualization, I suspect they would acknowledge slow-looking and formal visual analysis continue to play critical roles in arts scholarship and argument. Additionally, visual works do not necessarily communicate in a linear narrative form. Their arguments unfold spatially, tactilely, and through a host of other experiential techniques. Object-oriented publishing becomes a

[85] For examples of how this technique often is utilized in an art history classroom, please see: http://arthistoryteachingresources.org/2015/10/puzzling-through-early-medieval-manuscripts-an-in-class-exercise/ and http://arthistoryteachingresources.org/2016/12/engaging-ap-art-history-students-at-louisvilles-speed-art-museum/.

method of involvement whereby readers/viewers experience the work for themselves and form their own opinions through individual reactions to a given work. While ekphrasis will remain an important scholarly practice, visual scholarship readers do not have to simply trust an author's analysis.[86] Scalar allows for a closer connection between visual media and argument by collapsing the virtual space between objects and text through interface design and allowing for more inherent qualities of digital media works to exist within a publication.

From 2005 to 2013, Vectors Journal (Vectors Journal: Introduction), explored how a digital publishing platform could better present scholarship by means of multimedia content. Vectors preceded Scalar and formed the intellectual foundation for the design of Scalar as a self-authoring platform. Most recently, with additional support from the National Endowment for the Humanities, Scalar released version 2.5. With a new editorial workflow, Scalar projects can now assign editors their own user roles with tailored permissions, allow for tracked changes and version control for all pages and media, and freeze publications in a final state to declare them an edition so that further edits will require producing a new edition (Alliance for Networking Visual Culture 2019). While the new Scalar documentation demonstrates how the added editorial workflow improves the copyediting process, it unfortunately does not include any peer-review tools where identifying information could be temporarily hidden to conduct a scholarly evaluation of the work with feedback (Scalar 2018).

Acknowledging the theoretical understandings developed in early media studies by scholars such as Marshall McLuhan who commented on the relationship between medium and communication, which he saw as inextricably linked, Scalar's suite of tools allows scholars to let

[86] The term "ekphrasis" describes the process whereby a visual work is "translated" via written description. An example would be a detailed description of a painting or poem that details the scenes of a short film.

media, like film, exist more fully within a textual publication (McLuhan 1997). While Scalar as a platform on the Web has successfully broken away from linear publication, its next steps will likely need to involve the incorporation of 360 and 3D objects and environments into publishing. Doing so would enable "readers" to inhabit or at least share in the content immersively, allowing for a more experiential connection with segments of XR work.

Manifold

Difficulties for projects that utilize digital tools are often due to a desire to customize design, tailoring it to the content of the project and its authors' vision, but ultimately leading to a complicated workflow. Nuanced and individualized digital project development has made it prohibitively difficult for leading academic publishers to get involved in formal publication and dissemination. Manifold, a platform developed at the University of Minnesota, seeks to address this problem by streamlining the digital publication process.[87] In partnering with Cast Iron Coding and the GC Digital Scholarship Lab, Manifold has maintained a digital humanities methodology throughout their development. Focusing on the needs of academic presses and on iterative and networked publishing with an open practice and open source ethos, the Manifold team has made its software available on GitHub, a public code repository, in addition to engaging with communities of scholars and readers through social media. While allowing for input from outside of the project team, the active Slack channel and blog have also been helpful in documenting the project's process as it has progressed.

In a presentation at Brown University entitled "Manifold: Retooling the Monograph: The Manifold Scholarship Project," Douglas Armato discussed the academic politics of publishing

[87] See https://manifold.umn.edu/.

while Matthew Gold presented a preview of Manifold's interface and core features. Armato addressed why, despite advances in technology, publishing has remained so minimally digital. From his perspective, the problem lies in building truly networked scholarship — we must move beyond simply bringing the components from print publishing and digital tools together, to re-envision the process of scholarly publishing where infrastructure is shared, sources are linked, and texts are interactive, discoverable, and easily shareable. Manifold's design aspires to be a virtual environment to hold a project from its inception to its publication. While bold in spirit, this seems more likely how librarians and archivists would work. More often, scholarship is a messy business scribbled on napkins and copy-pasted in various word publishers and applications, transferred, lost and re-found, edited and started from scratch, numerous times. However, the effort to rethink the publication models has yielded necessary and beneficial strides for digital publishing.

Manifold's key tenets are derived from a series of experimentations in digital publishing that Armato and Gold discuss in their presentation. Quadrant was a precursor to Manifold, but instrumental in terms of its overall approach,[88] as an endeavor that brought publishers into scholar's research phases. The six-year initiative (2006-2012) funded by the Mellon Foundation was a partnership between Minnesota Press, the Institute of Advanced Study and faculty groups on and outside the University of Minnesota campus to foster a collaborative, interdisciplinary publishing model (University of Minnesota Press 2011). Armato notes in his presentation that the key difference was to change the aim and not see the work as just a publication, but to instead see it as a research project. One of the primary difficulties facing digital publishing with immersive virtual models is the expertise and understanding needed for the work to be peer

[88] See: http://www.quadrant.umn.edu/.

reviewed. The approach proposed by the Quadrant initiative attempted to address this issue by involving a publisher earlier on, when protocols and strategies for review might be better prepared and documented for outside readers. While Armato opines that Quadrant was not successful in its digital mission because scholars were concerned by the detachment of ancillary works in the experimental digital model, the collaboration between publishers and researchers was carried forward into future iterations where the work begins at the start of a project's lifespan. For Manifold, this looks like translating current editorial practices and workflows of presses into a digital content management system. To do so, the Manifold team has worked with presses to adapt manuscript guidelines, once tailored to print production, to the new environment of the Web. In updating and expanding guidelines, the Manifold team has given careful consideration to where changes to the workflow should happen so that digital layers may be introduced. Ultimately, they decided that it should remain quite late in the editorial process, after copy editing and editorial notes. A Manifold text is therefore ingested only after a full editorial process, maintaining a strict division between editorial and publication design.

A second influential model for Manifold was Forerunners: Ideas First (University of Minnesota Press 2019), an online series of e-texts with optional print-on-demand that allow authors to share works in progress and invite feedback in order to hone the work in anticipation of further development and publication. Forerunners acknowledges that serious intellectual efforts currently reside in side projects, blogs, keynote addresses, conferences papers, and the like. Debuted September 2014, there were nineteen Forerunners in print and six more in development at the time of Armato's presentation. As of January 2019, twenty-seven have been peer-reviewed and published. Operating on a twelve-week schedule designed for a quick turnaround, the series uses Creative Commons licensing and agile publishing technologies to produce rapid results (Brown University 2017). The publication model takes advantage of the immediacy of digital technology to focus on disseminating content to an academic community quickly, which Manifold has capitalized on.

Finally, *Debates in the Digital Humanities* served as a prototype for much of Manifold's approach to digital tools for online reading, bringing most of the core ingredients together (Gold 2016). The publication was disseminated in multiple forms -- a printed book, e-publication, and an interactive open access edition that enables what Gold calls "social reading," the highlighting of and commenting on the electronic text for logged in users. Additionally, the Website is open access, has hyperlinked references, and the platform code is on GitHub. As a dual edition, the publication is subjected to community open review, an editor's review, and press blind peer review. The shared responsibility of review subtly shifts the power dynamic of the publishing world, as a broader base of the academic community has an opportunity to weigh in on the scholarship's value.

While the appearance of publishers releasing control in this manner seems to chip away at the old adage of "publish or perish," by giving scholars a wider foundation for the evaluation of their work, the standard of rigor in publication will always be political to some degree. Through the peer-review publication process, disciplines can often reinforce a status-quo or hegemonic set of practices and ideas. The absence of an author or reviewer name does not change the fact that scholarship that does not utilize resources and methods typical to a discipline may not be published due to not adhering to discipline standards or conventions. The peer-review process operates to form and maintain a field's identity, and while that may shift over time, such shifts are often gradual in nature and can be a result of the "changing of the guard," when leaders who marshal the discipline retire.

Manifold's online system is searchable like a library catalog so readers can see what is in the platform. Using categories, Manifold allows readers to browse more specifically. Each text then has its own project landing page that provides context for the project's developmental stage and what type of project it is. Landing pages for the projects offer presses and authors ways to build and represent an identity for the work. A signature image can be posted along with social media platforms, and a hashtag can publicize the book and share latest news regarding the project. The recent activity section can be linked to a hashtag or twitter account, allowing for the display of most recent project related content. More importantly, there are links to read the Manifold edition and acquire the print edition. The expectation is that readers are more likely to order a print version once they have experienced the Web version and know for certain that the material is of interest and use to them. In this way, the Manifold team hopes to bolster print sales.

Major features/components of Manifold include an ingesting process to get materials into the platform. The Manifold team first focused on creating an ePub ingestion system, since most presses are familiar with this file type. The ePub file format allows for cascading style sheet (CSV) code to style the document consistently. In addition to the ePub format, Manifold allows four additional files types for ingestion: Markdown, HTML, Microsoft Word, and Google Docs. In his talk, Matthew Gold demonstrates how texts can be brought into Manifold using command line, where the text is ready to be annotated and highlighted (ibid). While presented as seemingly straightforward, the need for command line does create a learning curve and more of an intimidation factor than a WYSIWYG (what you see is what you get) interface. However, the completed Manifold platform does have a Publisher's Dashboard where ingesting texts can occur through a backend interface. Publishers are able to enter metadata regarding the text such as the names of authors and contributors, as well as other resources. Related information including use statistics and various reader analytics are also presented on the dashboard.

Additional resources can be associated with a project, such as other websites, movies, archival documents, maps, image collections and the like, which show up in the margins of the Manifold editions. While images that are central to the publication are displayed in situ with the text, resources can be clicked on from the sides of the pages to overlay related supplementary materials that would not be available in the print editions. Typically, resources of this nature might be referenced or shared in an appendix or a footnote. Manifold's interface increases their visibility, causing a more directly layered reading experience. The resources can also be grouped into collections. Reminiscent of the feature of the same name in Omeka, collections allow for certain resources to be displayed together. With this feature, Manifold recognizes the need to represent visual materials in direct relationship to one another and to the text.

There is a strong emphasis on reading in Manifold's design. In striving to better understand some people's preferences for reading on a web platform, Gold explains that looking at popular platforms like Medium, which have what he describes as a "clean" interface design, was instrumental to create the "look" of the platform. "Clean" is a term that is overused within the interface design field, but generally it implies a minimalist aesthetic of no more than two colors, typically white background and black text, and images inserted on occasion. Scrolling designs have become popular for online reading, since more and more people read on their smart devices like tablets or phones in which they are swiping up to move down the page. In response, Manifold's minimalism stresses ease of use and mobile friendliness through responsive web design.

Every project, once opened, allows readers the opportunity to annotate and highlight, which is then stored in the Manifold system. Employing underlining and highlighting, users can emphasize and annotate portions of the text if they are signed in. All subsequent readers share in the marked up version of the text. The process is known as social networked scholarship, and it brings the commentary regarding the text directly in response to it. Rather than an ancillary artifact, spaces for those discussions are built into the interface design. There was some difficulty in figuring out how to represent comments on resources, as Matthew Gold explained in his lecture. Does the comment belong on the book citation or image itself, or should it be placed in the text where the resource is utilized through a reference? Manifold's designers are thinking critically about how interface structures digital scholarship. *Debates in the Digital Humanities* (2016) served as a prototype for developing the Manifold reader interface. The ease with which one can change the contrast, font style, and font size allows for quick customization to make reading on a digital device more comfortable. However, for Manifold, more thought was given to annotations and highlights. Previously only available at the sentence level, users can now annotate individual words or parts of sentences. This presents a visual challenge if annotations become layered.[89]

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[89] The project team for Digital Mellini of which I was a member faced a similar challenge. Using the Getty Scholars' Workspace ™ prototype, scholars on the project were meant to mark up a transcription of an 1861 art inventory that was written in verse. In early testing, we realized that the plug-in we used for allowing comments on the text was not adept at handling multiple comments layered within a line. Visualizing of layered highlighting presents a difficult user experience (UX) and user interface (UI) challenge to developers. These moments when the humanistic need for nuance is essential often present the toughest design challenges for digital programming and presentation.

Texts are assigned a DOI, which provides them with a persistent Web address.[90] E-commerce methods are available for publishers who wish to put texts behind a paywall. Like the Amazon shopping model, Armato discusses the plans for a tool to suggest similar texts and a citation system for easy referencing in other scholarship (ibid). While mostly interested in publishers, the Manifold team is investigating ways to support scholars who wish to use Manifold for project work (ibid).

While digital is great for dissemination, there is often an inherent assumption that it is also good for the production of scholarly knowledge. Digital publishing is particularly important for visual studies disciplines, as it offers the opportunity to publish high-res color images, video, and the like, but with different limitations. A printed catalog would require a curator to select representative images from the collection to be featured. In digital form, financial overhead switches from the cost of printing to the cost of hosting. In the case of Manifold's annotation interface, the digital reader platform allows for direct interaction with authors and other readers. Arguments or key points that resonate with the field become apparent. Close reading (as opposed to distant reading) becomes documented discussion and built in commentary.[91]

How will these developments affect scholars producing long form critiques or dialogical responses? Could a commenter inadvertently usurp a scholar's long-form argument before publication? Will traditional forms of scholarship be able to keep pace with short form contributions to the field that platforms like Manifold are encouraging? How will shorter

[90] I say persistent rather than pertinent Web address because I want to curtail the notion that digital things are different from physical objects. Currently, the "shelf-life" of a digital object depends on storage and care in the same way physical objects need types of preservation and protection from the elements.

[91] See Franco Moretti's work on the subject of distant reading, such as *Graphs, Maps, and Trees* (2005).

contributions be measured within contexts of tenure and promotion? Likely, they will be seen as a form of professional service to the field, but would likely not be weighted like a publication with regard to original research. However, the ability to produce a pithy, insightful comment to disrupt another scholar's work is possible, and publishers will have to understand how and when to review referenced Manifold texts to make sure related scholarship is in line with the most recent form of the text and annotations.[92] However, Gold and Armato express the benefit of being able to receive feedback on early drafts when authors wish to expose the iterative process. Ultimately, digital publishing means more work for an author and publisher, but it enables the ethos of digital humanities to permeate a scholarly process from start to "finish." Many early digital humanities projects were self-contained websites, individually hosted as separate entities unto themselves. Manifold marries a more traditional publishing process with a digital humanities methodology by further exposing the intellectual process and levels of interpretation.

Additionally, Manifold's team is addressing the complex issue of referencing new media within scholarship. Gold uses the example of writing about video games and the possibility of embedding a game or part of a game within a Manifold text, with the support of fair use laws. At this point, the platform can accommodate anything that has an embed code from another platform. The concern here is the same as with those who use Scalar — if the source is not hosted locally, one must contend with the risk of breaking a link to content.

In the same vein, the expectation that digital publishers can guarantee the content experience across user devices is a very high standard to meet. In *Metagaming: Playing, Competing, Spectating, Cheating, Trading, Making, and Breaking Videogames*, Stephanie Boluk

[92] The situation may be reminiscent of the distinct downside of peer review, where anonymity permits some people to be harsh sometimes to the point of cruel in their assessments, which can be especially damaging to scholars early in their careers.

and Patrick LeMieux not only incorporate screenshots, game-play videos, and marketing materials into the center and margins of their argument, each Chapter is followed by a game that is available for download and play. As in Scalar, having the related materials embedded or a click away makes for an engaging read. However, in this case, readers may spend hours away from the text playing the game. With a full menu of options for the reader, consuming all the relevant information can become a labor. Only certain books, such as encyclopedias, dictionaries, or artist monographs are designed to be resource-rich, prizing entries over narrative in terms of style.

Within an online platform such as Manifold, publications often end up becoming both narrative and resource-heavy. Boluk and LeMieux's Manifold project has seventy-seven resources. Additionally, the text currently has 68 annotations and 522 highlights. While the annotations and highlights are not intrusive while scanning the text, they can diminish the flow of the argument if not relevant or engaging. Because a population is learning the socially networked technology in public, there are the occasional annotations that just read "test." With already so much clicking needed to navigate the various materials, and having the expectation of it being a worthwhile note, users could easily find themselves mildly annoyed. Conversely, toward the end of the section "Indie Game: The Movie, the Industry, the Genre," Zach Whalen leaves an annotation stating "This is so good," and the simple phrase of encouragement without stating any criteria of assessment is disarming (Boluk and LeMieux 2017). Using the socially networked tools for sharing enjoyment of the text has the potential to be powerfully disruptive within the rigorous culture of scholarship. Everyone benefits from hearing that they are doing good work. However, not all commenting may be governed by the Liz Lerman Critical Response

Process,[93] and annotations could be used to troll a scholar, possibly affecting tenure or promotion. Finally, annotations display the user who produced them within the annotation side bar, but highlighting does not credit a user. While one can track one's own highlights, if focus is being drawn to a certain part of the text, one may wish to know who placed the emphasis as it is shared.

Fulcrum

Fulcrum defines itself as a "community-based, open source publishing platform that helps publishers present the full richness of their authors' research outputs in a durable, discoverable, accessible and flexible form," according to its website.[94] Operating out of Michigan Publishing, Fulcrum partners closely with institutions and authors to present media rich publications that are flexible in their presentation, focusing closely on navigation of materials.[95] Like Manifold, Fulcrum has a public blog that makes the wider community aware of its latest developments and

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[93] The Critical Response Process (CRP) was developed by artist and educator Liz Lerman as a way to facilitate productive feedback for artists regarding their work while simultaneously governing the questions and opinions from the audience through a structured process to avoid notes that are unrelated to the artists intentions for the work. For more on CRP, see: (Lerman et. Al 2003).

[94] See: https://www.fulcrum.org/.

[95] Currently, Fulcrum offers three partnership models: 1) Single Title Hosting, 2) Hosted Publisher, 3) Hosted Collection. While long-term preservation is offered to all partners, hosted publisher and collection partners have access to a suite of services including "copyediting and proofreading, interior design and typesetting, cover design, e-book creation (EPUB, Kindle), accessibility upgrades, digitization and optical character recognition (OCR), print on demand, digital, and offset printing, print and e-book distribution, sales via branded shopping cart and Amazon" (Fulcrum n.d.).

serves as a historical road map for the project overall.[96] However, Fulcrum separates itself from Manifold and Scalar by paying special attention to accessibility as a core value of its user experience design, adhering to the latest Web Content Accessibility Guidelines (WCAG) Level 2 AA Standards and providing users information about known accessibility issues (Fulcrum 2018).

While Scalar and Manifold offer authors many options for page design and layout, Fulcrum carries such services forward to their readership as well, offering a variety of page layouts to choose from depending on the publication. In the case of *A Mid-Republican House from Gabii,* a side-by-side view is the default, but the reader can rearrange the components to best suit one's needs (Opitz et. al 2018). The Gabii project pairs a scholarly text of 251 digital pages with a linked archival database, a collection of visual media, and a 3D interactive reconstruction model to present findings from an archeological excavation of a Roman home built in the mid-Republican period.

Of the publishing platforms discussed in this chapter that are available for scholars to submit their work, Fulcrum is the only one currently hosting 3D content in direct relationship to the text using a Unity Web viewer. The Unity player can take a long time to load if there is not a strong internet connection; however, fair warning is provided to the user before opening the publication through a message on the publication's launch page. Readers have the ability to move about the model freely or use the scholarly text to direct them through hyperlinking to particular locations and view within the model.[97] Allowing the interpretive framework of the interactive model to connect to the textual argument through linking begins to bridge the distance

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[96] Scalar's Vectors Journal did have a blog at one point; however, the link on the site is no longer active. See https://www.fulcrum.org/blog/2016/06/30/year-one-report/ for Fulcrum's one-year report and plans for the second year of the project.

[97] This is done by through x,y,z coordinates to place the user in space and head, pitch, and roll (h,p,r) figures to bring about an exact orientation and view for the user.

between the two in a way that surpasses the embeddedness that is available in Scalar and Manifold due to its interactivity. While other 3D viewers allow for content to live within the model, like the Smithsonian 3D Tour Browser,[98] they do not have in mind the other features that Waters deemed necessary to consider the text a digital monograph (Waters 2016). An alternative approach to embedding the model within the text is to push for placing the text within the model.

Hybrids

Typically, the format of a publication aims to support the content within it, but annotated models reverse the framework of scholarship allowing for the object or environment to function in the primary role, relegating the interpretive scaffolding to a secondary layer, which more accurately reflects the scholarly process. When it comes to spatially-based research and scholarship, dimensional understandings can be bolstered through the use of 3D materials and viewers. I have come to understand the work that has been done in 3D modeling to represent and teach Architectural and Cultural History through assisting Lisa M. Snyder on her NEH grant to build an online repository and archive at the UCLA library for academically rigorous 3D models and improve the VSim prototype, a software designed for interaction and annotation of 3D models for research and pedagogy. In the VSim platform, which could be likened to PowerPoint for 3D models, the scholarship is attached to the object rather than the object being attached to the scholarship. A platform that can offer access to both sematic and semiotic webs of information can provide insight differently than narrative argument, and in turn it has different opportunities for reuse. Navigating through a virtual 3D building with illustrative evidence

[98] See: https://3d.si.edu/tour-browser.

marked, color-coded by thematically or by content type, interconnected through links, and searchable, offers readers a chance to "discover" the author's argument as it is manifested within the model and supporting documentation attached. The model serves as immediate evidentiary support and proof in a more fully formed that can then be interrogated by a reader in way that is not possible within a photograph or still-frame.

As Elaine Sullivan and Lisa M. Snyder explain in the *Journal of the Society of Architectural Historians*, the virtual object itself is an argument, echoing Johanna Drucker's notion that all data is "capta" (Sullivan and Snyder 2017: 467; Drucker 2010: 1, 17–19, 23–24, 33–38; Drucker 2011, 2) In models, unknown information is rendered distinctly visible. Within a written article, it often falls to an author's integrity to provide explanation of what is missing or omitted from their scholarship matched by review by peers to see that such assertions are valid. In 3D reconstruction, unknowns can be made visible in a powerful way that does not render them as prologue or footnote, and gives them equal weight and attention within the spatial argument. In the publication model in which text is primary, readers may assume that the author chose not to discuss something, was ignorant of such sources or subject matter, or may have been able to produce the argument without even giving the unknown consideration. In *Silencing the Past: Power and the Production of History*, Michel-Rolph Trouillot discusses how omissions in history can produce grave injustices (Trouillot 2015, 1-31). Due to hegemonic forces within society, those in power inevitably omit what they deem "unimportant" or not "noteworthy" vis-à-vis their own political purposes. Such "silences," as Trouillot aptly calls them, leave gaps within our historical and at-hand knowledge. Silences can be foregrounded within 3D modelling through visual representation or the lack thereof. In Lisa M. Snyder's ongoing 3D reconstruction project of the World's Columbian Exposition of 1893, she uses Lorem Ipsum[99] text to signal to her "readers" when she has not been able to locate signage or key building information. Representing the silences can go a long way to producing more equitable and socially conscious scholarship that acknowledges our blind spots.

While 3D viewers have come a long way in terms of how they can represent and grant readers access to layers of information while simultaneously granting dimensional interaction, authors may still feel the need to provide additional information within a more traditional article format. The notion of the hybrid I am engaging is based on the *Journal of the Society of Architectural Historians* publication "An Experiment in Publication and Peer Review of Interactive, Three-Dimensional Content" (Sullivan and Snyder, 2017). The publication is a hybrid because its model and article are related, yet can stand on their own and operate as publications separately from one another. The article points readers via a link to where they can find the published annotated, geotemporal model of Karnak, an ancient Egyptian temple complex. Independently, the article proposes a set of requirements for peer-reviewing a 3D model for publication based upon the process for producing the *Digital Karnak* project. First, the models had to be built. Because of the temporal element to the project, several models were produced for certain buildings which were added to, subtracted from, moved, or destroyed over time. Sullivan and Snyder had to develop and keep track of these changes across all the models in the Karnak complex over centuries of data. Secondly, VSim, a prototype software still in production at the time, needed to be able to produce the desired functionality for the presentation of the model for publication. VSim is designed with narrative and embedded resources features.

[99] "Lorem Ipsum" is a set of jumbled, nonsensical Latin text that is used as a placeholder within digital designs.

The Narrative Editor made it possible for Sullivan and Snyder to create slide shows of the temple complex that could lead the reader through the model in a planned manner, with text and image annotations as needed. The Embedded Resources feature allowed for commentary to be added to the model in a non-narrative manner.

"Local" Embedded Resources are site-specific, accessible only when the reader is within a set range. Embedded Resources can also be "global," remaining accessible to readers wherever they are within the model. In each instance, authors can set the point of view represented as head, pitch, and roll coordinates, as well as location represented by x, y, and z axis coordinates. Unlike the narrative feature, Embedded Resources can contain file types, from word documents to PDFs. Adding these argumentative and interpretive layers were the third and fourth step in the process for Sullivan and Snyder's teams. These were also the elements that needed to be reviewed for peer-reviewed publication. Sullivan and Snyder list both technical and procedural challenges for a 3D peer-review process (2017: 369-371). They establish a state of the field that is not quite ready for 3D publication due to the need for clearer standards for managing and citing 3D data, greater interoperability across 3D viewing platforms, and better publication pipelines that provide guidance for authors, reviewers, and publishers on manageable workflows and points of intervention for feedback and adjustments. One of Sullivan and Snyder's key points is that little can be done to adjust the platform or presentation, particularly once the content is in place, due to the immense effort, time, and funds that would need to go into making substantive changes.

Viewer landscape in cultural heritage remains one of the central battlegrounds for confronting requirements for discovery, access, and reuse. In terms of 3D objects, following standards that promote interoperability is a viable strategy for ensuring long-term access and preservation of this material, because this enables reuse of the 3D material across any number of open-source or commercial players. The IIIF 3D community has begun an assessment of available viewers and is collecting data points and identifying software features noting which viewers support the IIIF manifest, are connected to a 3D library, and whether they are open-source or commercial. Plans for interoperability of 3D scenes/environments are not as mature and were highlighted as a point of discussion for the Community Standards for 3D Preservation (CS3DP) community forums held in 2018. While these technical and publishing pipeline issues are outstanding, hybrid publications could offer the field a chance to continue to acknowledge the important humanistic 3D work that is being done.

Nevertheless, a dedicated group of scholars, archivists, librarians, and technologists are exploring viewer options and features as a way of creating a model of scholarly publication that makes use of applications that can annotate and add interactive elements to 3D models. In February 2018, the Mellon Foundation and the National Historical Publications and Records Commission (NHPRC) announced a set of digital publication grant winners (Mellon Foundation 2018). This included "Scholarship in 3D: A Proposal for a Digital Edition Publishing Cooperative" led by Elaine Sullivan, Angel David Nieves, and Lisa Snyder (Apartheid Heritages 2018). I had the opportunity to attend some of the cooperative's meetings that were held at UCLA in February 2019. The group, comprised of publishers, technologists, and scholars working in 3D for humanities research, are looking to develop their own set of content types, similar to Waters's nine features, to address questions of long-term access and preservation for publishing humanistic 3D scholarship. Snyder noted in her white paper for the NEH Digital Humanities Implementation Grant (#HD-50164-14) for VSim that "the 3D community has matured, and begun considering 3D scholarship in the same vein as more traditional academic pursuits. This maturation is evidenced by the sheer number of grants and groups working to identify strategies to disseminate, publish, and preserve 3D materials" (Snyder 2019: 5), and this goes for XR work as well.

New Immersive Museum "Publications"

An additional layer is added to the concerns of digital art history work when considering the use of immersive technologies. The fields of archeology and architectural history have been leading the way for much of 3D humanities research; however, scholars in Art History, Cultural Studies, Visual Studies, and History, among other disciplines, are building research that utilizes the immersive methods of 3D, VR, and AR to contribute new and different information for the archive.[100] Journalism and documentary production have paved the way for immersive digital scholarship. For example, Nonny de la Peña used audio files and witness accounts to build 3D recreations of events. In doing so, the rigorous work of reporting is acknowledged and challenged, highlighting the difficulty of making sense of multiple narratives and facts.

In a somewhat similar initiative, Maureen Towey was senior producer for The Daily 360 (2018), a campaign at the *New York Times* where a new piece of 360 content was published every day for fourteen months (Towey 2018). Content from Yayoi Kusama's Infinity Mirror Rooms and the Seven Wonders of the World, captured the public's attention, with nearly two million subscribers to the Youtube360 channel, and demonstrated a range of possibilities for the media. In yet another instance, Filmmaker Lucy Walker directed a documentary entitled *A History of Cuban Dance* that was released in 2016 and explores how sound, movement, and

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[100] See: "Publishing and Pushing: Mixing Models for Communicating Research Data in Archaeology" http://www.ijdc.net/article/view/9.1.57.

environment captured with 360° video can provide audiences with greater cultural understanding through a more embodied experience.

While many still conflate immersive technologies under the term VR or virtual reality, specificity is needed when addressing immersive publishing. While it stretches current convention to call outputs from immersive technologies "publications," there are particular outcomes from arts and culture fields that may reach the standards that are characteristic of the term, as publicly accessible and contains a scholarly interpretive layer. Often the abbreviation XR, standing in for the term "extended reality," is used to address the spectrum of experiences on the reality–virtuality continuum, as introduced by Paul Milgram (Milgram 1994: 282-283). While frequently overlooked, the fields engaged with immersive technologies must navigate and wield precise terminology to effectively consider the nuances of various types of digital simulacra from Jaron Lanier's commercial coined "virtual reality" to Fisher and Laurel's more precise terminology of "Virtual Environment" or "Telepresence" (Girvan 2018).

Panoramic / 360

Panoramic or 360° tours have become a popular way for museums and galleries to share their spaces virtually. When it comes to some of the greatest museums in the world, the buildings that house the art can be just as much of a draw for visitors as the art within them. Iconic permanent galleries such as the Louvre[101] and the Metropolitan Museum of Art are being documented and placed on the Web using spherical photography and video.[102] The Met 360°

[101] See: https://www.louvre.fr/en/visites-en-ligne.

[102] Additional examples can be found at: http://www.samrohn.com/360-panoramic-photography/.

Project[103] contains six short videos, for example. Working with an outside production company called Total Cinema 360 | Koncept VR, the Met's Digital Department has captured some of the museum's most famous installations (Diamond 2016).

As but one example, the video "The Temple of Dendur: From the Nile to NYC in 360°"[104] offers compelling experience of the Egyptian monuments from 15 B.C. that were donated to the United States in 1968. The video begins with the camera moving out of a hall and into a large open space of The Sackler Wing. Using a computer's cursor to redirect one's view 180 degrees, a site visitor can feel as if they are floating over the water below, drifting to the large ruins in the center of a spacious room, designed to approximate the original site of the temple in the vast region known as Nubia, including natural lighting and reflective waters reminiscent of the Nile. A second shot has one hovering high in the air and moving along the windows of the museum at an elevation one would not normally have the opportunity to experience the stone architecture from above. Cutting to a time-lapse video on the ground level, the footage shows visitors moving through structures that are still intact from the time of Roman Emperor Augustus's rule in Egypt. Continuing to place the camera in different parts of the room and over the span of a day, one senses changes in ambiance as the daylight turns to night and the hall becomes delicately lit from within and visitors fade away. Placing the cameras within the structure, the viewer can experience the hieroglyphs within the space, as if they had the monument all to themselves. With gentle music by Simon Fisher Turner playing throughout the video, the nearly two-minute clip feels like an immersive meditation as we witness the space transformed over a day.

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[103] See: https://www.metmuseum.org/art/online-features/met-360-project.

[104] Watch the video at: https://www.facebook.com/metmuseum/videos/10153607383692635/.

Google Arts and Culture[105] has documented and published materials concerning over 800 museums around the world, such as the New Orleans Museum of Art,[106] using their Google Street View technology that stitches panoramic images together and provides users with an interface to view the space in 360 degrees and to seemingly move along by clicking, adding a sense of depth through interactivity. In fact, due to this perceived travelling across the space, the panoramas become a virtual reality environment. Using this technology, Google has been able to produce and share a tour of select portions of the National Museum of Brazil that was destroyed by fire -- a powerful memento for the mourning citizens of the world who lost so many culturally significant objects.[107] One can expect similar initiatives to be undertaken regarding the fire-scarred Cathedral of Notre Dame de Paris.

Similar technology is being used to document and share specific temporary exhibitions such as the Cineteca Nacional's show on the work of Stanley Kubrick in Mexico City.[108] Spanning four floors, the team at ECKEN Virtual Spaces used the Matterport 3D camera and platform to document and present each room of the exhibition so that users can click to travel through the space and experience the works in their carefully arranged context. However, as a static documentation of the space, the movies projected on the walls do not play, nor is their sound piped through, as it likely would be in the gallery space. While the technology will be discussed further in Chapter Seven, what is important to note is that without annotations, these

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[105] See: https://artsandculture.google.com/.

[106] See: https://noma.org/visit/noma-tour/.

[107] See: https://artsandculture.google.com/streetview/museu-nacional/uwEZsf0cq9-FFg?sv_lng=-43.22634275697851&sv_lat=-22.90557198094944&sv_h=237.47042458120512&sv_p=18.113824231278315&sv_pid=vumNxsa340uyMkN7JzjsXg&sv_z=0.6960615443935048.

[108] See: https://matterport.com/3d-space/stanley-kubrick-exhibition/.

tours are supplementary to scholarship and education. They do not incorporate a level of interpretive content that enables them to communicate about their subject matter to the user. They simply present materials rather like a photograph. 360° photos and video still communicate a perspective, since the camera operator makes a choice of where to place the camera to capture the content, but without the annotative layer, panoramic tours are merely a more encompassing set of documentary imaging.

While extremely valuable to preservation and outreach, the experience of a panoramic tour may result in only a touristic or even voyeuristic interaction if it is not embedded with additional information to contextualize the presentation. Museums, in their positions of cultural authority, have struggled for many years with similar challenges concerning display of cultural materials. When the work moves to the virtual sphere, the challenges do not disappear. Digitally immersive publications walk a fine line between publicity and extending the museum beyond its physical walls into virtual space. One report states that visitation increases when a museum has a greater online presence (Berwick 2011). However, without annotations, 360 panoramic tours may strike some as more thoughtful presentations than scholarly publications. Acts of interpretation are hidden within the agency that the viewer is provided through the panoramic navigation. In the desire for complete representation is the illusion of authority within the virtual space.

Augmented Reality

If panoramic/360 technology allows us to capture the past in the present for our future's past, augmented reality (AR) and 3D virtual reconstructions allow us to bring the past into our present. Like virtual museum tours, AR has wrestled with moving beyond an entertaining gimmick to adding intellectual value through the layering of virtual space over a physical place.[109] However, due to the increase in smart-device usage over the past decade, AR offers an easier entry point than 360° or virtual reality. In addition, there are so many different ways AR can be applied to an experience that scholars and developers alike have flexed their creative muscles in inventing uses for the arts, history, and cultural heritage.

Ed Johnston worked to build interactive AR content using the Layar app for the Toys Through Time exhibition with his students from Michael Graves College and the Goldberg at Liberty Hall Museum. By scanning promotional toy posters within the exhibition, visitors could experience videos of the toys in action.[110] Johnston also brought historical materials out of the archive and into the city landscapes by using a combination of 3D historical reconstructions and AR in the Augmented Asbury Park project (Johnston et.al 2015). Geospatial mapping allowed the mobile application to track where the user is standing and as the user points their phone at the environment, detailed 3D models appear, like a window into the past.

Google has been prolific in augmented reality development. One feature from Google allows users to translate text in over 20 languages by holding the text within view of the smart device's camera, making exhibition wall labels and textual artifacts more accessible to more people.[111] In concert with museums, cultural institutes, and private collections from around the world, Google Arts and Culture designed a virtual 3D museum to house all 36 known works by

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[109] AAM's Immersion in Museums Primer recommends the following resource for a historical look at augmented reality: https://hbr.org/2016/10/the-mainstreaming-of-augmented-reality-a-brief-history.

[110] See videos of the Layar app in use at: https://michaelgravescollege.kean.edu/toys-through-time/.

[111] To see the application in action, Google developers created this video translating the lyrics to the hit song "La Bamba": https://www.youtube.com/watch?time_continue=36&v=06olHmcJjS0

Johannes Vermeer (Siegal 2018). Users can bring that virtual museum into their physical space using the Meet Vermeer app for iOS and Android devices.[112] Once users select where they want to "set" their virtual museum space, they can zoom in and reorient their view so that their perspective changes from a bird's-eye view to one standing within the walls. Thoughtfully arranged as if it were a physical exhibition, Vermeer's early works are grouped together, followed by thematic arrangements in subsequent rooms of the virtual space. The technology offers curators a powerful tool for designing, pitching, and sharing exhibitions. Because of the limited screen space, long-form textual scholarship would not be a practical choice. However, a curator's scholarship is often shared through an online scholarly catalog to allow visual work to serve as the primary conduit for learning.

In 2018, Arielle Pardes declared augmented reality the next frontier for museums, citing examples of cultural institutions around the world ranging from several Smithsonian museums to the Kyoto National Museum (Pardes 2018). Such progressive places are diving into immersive technologies with the goal to better connect and communicate with their publics. In discussing his experience of the mobile tour app Lumin created by the Detroit Institute of Arts, Ed Rodley (2019) describes how it fills two purposes for visitors: it helps them find their ways through the galleries and it provides them with additional contextually-rich content related to the objects within the physical space around them. While acknowledging that technical issues like a drop-in signal occasionally occurred, he emphasized that engagement is more important than perfection in most cases. While I tend to agree, I worry Rodley undersells the situation which operates as a double-edged sword, making for a superficial rather than significant experience. Due to the novelty of XR, GLAM institutions risk losing their audiences' attention rather quickly if an

[112] See: https://artsandculture.google.com/project/vermeer.

experience does not operate well. During this time of development, GLAM organizations should seek feedback to set measures for defining success. As with 360° applications, augmented reality meets the publishing standard of making work public, but it has yet to reach the level of detail as outlined by Water's nine digital publication features (Waters 2016). Most likely, due to small screen real estate, long-form scholarly publishing will be challenging. Ed Johnston's Asbury Park project steers AR away from the commercial to public service, hinting that AR has the potential to mobilize historic archival content within the physical world (Johnston et.al 2015).

Virtual Reality

3D modeling of historic objects has been an increasingly common occurrence since the 1980s, supporting research and presenting scholarship across disciplines (Münster et. al. 2018: 39-40). In the Humanities, archeology and architectural history were leaders in such early work. As technology has become easier to adopt for scholars, digital humanists from other visual and cultural studies disciplines are joining the methodological practice of virtual reconstruction. In using such methods, scholars are bringing archives to life in ways that are experiential, interactive, and informative. Projects like Angel David Nieves' *Soweto '76 3D*[113] have forged paths for combining digital humanities with cultural studies by creating a 3D digital archive of a politically pivotal township in South Africa to share knowledge of its people and history.[114]

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113 For more information, see the PI's website: http://www.angeldavidnieves.com/research/soweto763d/.

114 Many such projects are shared at the conferences included within the following spreadsheet I assembled: https://docs.google.com/spreadsheets/d/1lsqry_kT5yevg5oI7efiu4ZFl3IFxmGj8PEian8ZJ94/edit?usp=sharing.

Quite often, however, individual websites have been built to showcase and share the scholarship of virtual reconstruction projects. While project teams may have taken the effort to have the project assigned a DOI and worked with a library to form a preservation plan, challenges in terms of publication and long-term preservation remain.

When it comes to museum publications specifically, a few examples of virtual reality constructions showcase collections in a similar way to Angel David Nieves' *Soweto '76 3D* project. The Rubin Museum of Art, with its noted collection of Himalayan arts and culture, has been experimenting with a number of immersive presentations for creating greater digital access to their content and collections. From September 2016 to January 2017, the museum mounted an exhibition entitled *Monumental Lhasa: Fortress, Palace, Temple* which addressed iconic Tibetan monuments prior to the 1950s (The Rubin 2017). Recognizing how virtual reconstruction can offer insight into places that are no longer extant, The Rubin partnered with the University of Virginia to present a project by Religious Studies scholars David Germano and Kurtis Schaeffer called *Virtual Lhasa* on their blog in conjunction with the exhibition (The Rubin 2016). The post links out from the museum's website to the university's WordPress site for the project that directs users to select one of four virtual annotated tours ("Lhasa Historic Tours"). By clicking on a virtual tour link, one is taken to a Drupal site that has a Unity game engine virtual environment display on the left of the screen and an area for interpretive materials on the right. Users can use the arrows above the game engine window to move through the tour, like a slideshow. The environment on the left will automatically readjust and new related information will be presented on the right, including images of special collection materials from the Pitt Rivers Museum (ibid).

Despite the fact that the *Virtual Lhasa* project fits with the Rubin's exhibition topic and makes use of the Pitt Rivers Museum digitized collection materials, it is difficult to see the project as a connected publication. Had there been a computer installation within the gallery that visitors to the exhibition could use, perhaps it would have been more connected in terms of display. Additionally, it is unclear how effective this type of publication would be for someone interested in the museum's exhibition. The digital publication takes several clicks to get to and takes users through multiple Web platform interfaces. For an average Internet user, this could be disorienting. In addition, a user has to select an avatar and type a "name" to start the virtual environment experience, without any knowledge of why it is required or what will be done with the name they submit. The avatars offered are male or female, which is exclusionary to those who do not identify with a gender binary system. All except for one avatar choices across the tours appear to be Caucasian rather than Tibetan. If users are expected to pick an avatar they "identify" with, the limited options are extremely problematic due to their lack of inclusivity in terms of nationality and race as well as gender. These issues may be the result of design or human resource limitations in producing the project, but there is no documentation available on any of the website pages to make that evident to a museum user.

Museums should explore collaborations across their physical and digital sites to enhance the experiences of visitors and engaged audiences. However, virtual audiences need just as much attention and scaffolding for encounters as visitors to a museum's actual location. While it seems easy to link users to more related resources, it is the museum's responsibility to make sure such encounters are clear and well-situated within the context of the museum's mission.

Another example in which a museum worked with a collaborator to produce an immersive "publication" was *Cave Temples of Dunhuang: Buddhist Art on China's Silk Road*.[115] Appearing at the Getty Center in Los Angeles from May 7–September 4, 2016, the exhibition highlighted over a quarter of a century's worth of conservation work between the Getty Conservation Institute and the Dunhuang Academy to preserve the UNESCO World Heritage site (Getty Research Institute 2016). As part of the exhibition, the Getty commissioned Garson Yu and his company Yu + Co. to produce an immersive 3D experience of what is known as Cave 45 as a site that dates back to the 8th century CE (Presburg 2016). The technical feat is described on Yu + Co.'s website in the follow way:

> *"Visitors were handed 3D glasses before entering the immersive screening room, which was dark upon entry with faint light illuminating the statues. The film was projected onto a 180 degree spherical screen spanning 30 feet, so the viewer could experience the convincing illusion of being surrounded by the space. This experience, which marks the first installation of its kind, was developed using Panoramic Stereoscopic technology, enhancing realism by adding depth to the environment.*
>
> *With resolution approximately 3600 x 1000 pixels, highly detailed stereoscopic renderings could be viewed up close and from different angles. The objective was to recreate the experience of a guided tour by using a flashlight to highlight the cave's interior, as a sonorous voice narrated the meaning behind the sculptures and paintings. This was accompanied by a 5.1 Surround Sound design with each sound*

[115] For the exhibition's archives website, see: http://www.getty.edu/research/exhibitions_events/exhibitions/cave_temples_dunhuang/index.html.

> *element having symbolic meaning to the narrative, completing the immersive experience"* (YU + Co).

Built on the Getty campus, the immersive experience also included three replicas of caves for the exhibition. Both styles effectively immersed the viewer to give a better sense of space and scale, and with audio guides offered a deep learning experience. However, what was promising about Yu's experience was that it was designed to be compatible with Oculus virtual reality systems, so it could be released into the VR app store and experienced by headset users. A VR store release of the experience would have been a "publication" that resulted from the exhibition. A headset VR experience could allow those who did not or could not make it to the Getty Center to experience a portion of the exhibition in a repackaged way, which is much like what exhibition catalogs or video compilations do, but with greater scholarly rigor. The Getty has not yet released the experience to a VR app store, but it is opportunities like these that may be future productions.

Others are using virtual reality to create environments to publish their digitized collection materials. The Kremer Collection is comprised of nearly 100 Dutch and Flemish Old Master paintings from the 1600s. While the collection is very "real" (it is an actual physical collection of objects), the Kremer Museum is virtual. Designed by architect Johan van Lierop, the virtual museum presents 74 masterpieces from the Kremer collection. The paintings have been photographed up to 3500 times each to produce high resolution digital facsimiles using photogrammetry. In the experience, visitors to the virtual museum can also see the backs of the paintings, a rare treat for those who do not work in painting conservation. The Kremer Museum experience is currently available on VIVEPORT, Oculus, Steam, and Daydream. While VR is a transportive experiential technology, in this case, it is being used to arrange and present a digital collection, not unlike Omeka, Scalar, Manifold, Fulcrum or VSim. The key difference is the level to which embodied experiences take priority. Similar to how VSim utilizes notions of space to organize information, the Kremer Museum provides users with a sense of size and scale that would not be possible in a digital exhibition or digital monograph. The Kremer Collection website also highlights the choice it is making in terms of investment for the collection, believing money is better spent on digital preservation than building or buying an expensive building to house the collection for permanent public display. This choice enables them to bring the museum to people, rather people necessarily visiting a museum.

Nonetheless, VR is still perceived to be, and to a large degree still is, an elitist and expensive medium. Even if curators, scholars, educators, and publishers are well-intentioned, those working to present arts and cultures research in XR may need to check for blind spots due to inherent privilege. Additionally, we need to be cautious about the ways that VR publications can blur the lines between scholarship and edutainment. For example, Curiosity Stream published the *Nefertari: Journey to Eternity* which is a 3D rendering of Ancient Egyptian Queen Nefertari's tomb.[116] The experience was built using photogrammetry and laser scanning techniques by Experius VR and realityvirtual.co (Koolon 2018). While the project appears flawless, making it treasure in terms of digital preservation and educational outreach, it is not documented in the same way a scholarly publication would have to be to pass peer review for practical concerns of professional careers. The rigor and structure Digital Humanities provide for projects of all kinds can help us to evaluate projects like *Nefertari: Journey to Eternity* to vet it for reuse cases, whether they are pedagogical or academic.

[116] See: https://www.oculus.com/experiences/rift/1491802884282318/?locale=en_US.

Conclusion

At the Advanced Challenges in Theory and Practice in 3D Modeling of Cultural Heritage Sites conference at UCLA, Miriam G. Clinton presented material on *The House of the Rhyta at Pseira: A New Reconstruction for Online Crowdsourcing*.[117] The videogaming project was based on Clinton's study of Minoan culture of ancient Greece. Her unfinished draft 3D model requires a Unity player plugin.[118] The project generates data concerning how students operate in the gaming environment and studies what they learn about cultural subject matter. In her 2016 presentation, Clinton advocated for a workflow through which research is undertaken first, so that modeling decisions can be based on such work and not be arbitrary. Her students chose to use SketchUp to create a 3D model of her archeological site. Clinton uses the motto "Excavate. Educate. Advocate," to define her 3D work.

Museums have also begun to see gaming as a way of engaging their visitors in new ways. The Riddle Mia This AR App at the Minneapolis Institute of Art provides museum-goers with a narrative AR treasure hunt challenge that is based on the museum's collections. Users hunt for clues across the museum to solve the mystery story presented in the app (Mandar 2018). The art historical and cultural heritage information is similarly rich across many GLAM institutions. XR technologies are offering new ways to increase access and discovery for audiences.

Yet, digital publishing in its many forms is still navigating issues of commercial vendors versus open-source options. The battle over information access reached a highly visible breaking point in March 2019 when the University of California ended its long relationship with the publishing giant Reed Elsevier over issues with their ever-rising subscription fees for academic

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[117] See: http://rhytahouse.com/.

[118] See: https://umacesdweb2.campus.ads.umass.edu/Unity/.

journals and open-access options for which the University's scholars and students were lobbying (Hiltzik 2018). Research institutions and agencies in this country and around the world have long demanded a new model to provide free and immediate access to new research and academic papers. Although it had been anticipated that UC and Elsevier might compromise on a hybrid system of some open access combined with a lower subscription rate for the UC system's contract for the Elsevier academic journals, the negotiations failed (Watanabe 2019). The University of California now joins several European universities who also have cut ties with an old model of academic publishing based on a paywall for the public and fellow scholars, and instead have taken a stand for a future of free and open access to their cutting-edge research and scholarly work. Ultimately, the struggle is about standing for educational and information access. Experiments like Volupedia[119] that add 3D models from Sketchfab to Wikipedia pages provide a window into what that future might be.

Thankfully, scholars and activists like Erin Rose Glass are challenging the status quo of software development and applications. In her dissertation "Software of the Oppressed: Reprogramming the Invisible Discipline," Glass examines the history of software development and its implementation within university settings, demonstrating a conditioning of the academic community into a rather lackadaisical acceptance which offers little control or opportunities for intervention when it comes to software applications and features (Glass 2018). Through her own digital projects, Social Paper and #SocialDiss, Glass manifests alternatives to current academic digital technology practices, leading the field by example. Jasmine Clark, a resident librarian at Temple University Libraries, is also paving new ground for digital publication in terms of

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[119] For examples, see http://volupedia.org and click on "Random Example" in the banner that appears at the top of the Wikipedia page.

accessibility and inclusion. She has created a VR Accessibility Resource Sheet and a Web Accessibility Primer to better educate and assist Web designers, students, librarians, and scholars on how to make their immersive technology endeavors meet current standards and to help differentiate between Web accessibility, usability, and inclusivity. I had the opportunity to attend Clark's five-part webinar workshop series entitled "Designing Accessible, Usable, and Inclusive Digital Projects," in which she stressed the importance of developing clear and transparent policies, along with following and implementing Web Content Accessibility Guidelines (WCAG) standards in digital projects. Partnering across fields and disciplines will be necessary to move digital publishing forward in an equitable way.

As demonstrated in this chapter, there are strong reasons 3D data visualization, and by extension immersive technology broadly, can and should communicate humanities research and scholarship. Associate Research Professor at Duke in the Department of Art, Art History, and Visual Studies Victoria Szabo argues similar points regarding conducting and presenting humanistic 3D data (Szabo 2018). While her concern over the potential risk of scholars falling prey to positivist tendencies and striving for Borges-level exactitudes is warranted, Szabo highlights how immersive visualization tools can support greater dimensional thinking through which the privileging of interpretive frameworks can not only be made available, but more apparent, within the marriage of technical decisions and intellectual aims. Alluring as it is to think of these experiences as world and/or time travel, the ways virtual technology announces itself through its design and implementation will play critical roles in its acceptance as a "publication" form and forum rather than solely an entertainment platform. Research and development of methodologies associated with emerging critical-constructive practices and an extended repertoire of the Humanities opens avenues for more embodied epistemological engagement through immersive digital publishing.

Great progress has been made in transitioning traditional arts-publications formats to new digital standards. I have aggregated information on digital scholarly catalogs, collections, exhibitions and monographs in order to provide an overview that speaks to the current state of the field for arts and culture-based digital publishing. In examining four leading publication platform options (Scalar, Manifold, Fulcrum, and hybrids that make use of viewers like VSim), I featured current approaches and challenges for publication when incorporating visual and 3D content. These observations laid the ground work for my examination of 360° panoramic technology, augmented reality, and virtual reality "publications" that are expanding the public's interaction with arts and cultural heritage related content. In the process, these media presentations offer the field new perspectives and questions on the notion of publication. By presenting some exemplary use cases within this chapter, I begin to approximate the needs of particular communities, practitioners, and their applications when it comes to digital publishing for arts and cultural content. The immersive media examples included in this chapter demonstrate that XR "publications" fill a need for greater contextualization within art historical and cultural heritage scholarship, preservation, and access.

Chapter 6: For Display: Challenges and Opportunities in Contemporary Exhibition Practice for XR Work

Artists and curators face new challenges in sharing contemporary immersive artistic productions. Museums are leading the way for the general public to discover many virtual experiences, showcasing work that does not fall into the realm of VR arcades. These experiences more closely aligned with a theatrical performance presented for a curious audience looking to experience resonance and wonder. As such, needs for new standards of display through XR are addressed in this chapter.

In *Reality is Broken: Why Games Make Us Better and How They Can Change the World,* Jane McGonigal asserts that video games satisfy a yearning for social engagement (McGonigal 2012). The rise of XR technology echoes her theory, as another set of tools that focuses on heightening a user's experience by stimulating the human sensorium. The promise of a fully immersive system implies that our minds and bodies will not be able to distinguish the difference between the technology and the real, which can be both exciting and disconcerting. Freed from the confines of reality, artists can explore and create new (hybrid) virtual worlds. If physical and psychological side effects can be avoided, like the motion sickness or "the uncanny valley," the illusory effect of virtual immersion has the potential to radically alter how we consume and receive information.[120]

Art communicates and preserves a society's epistemological production in ways that combine political, moral, and material essence. The late Arnold Rubin referred to art as

[120] Established in the 1970s, the term "uncanny valley" refers to the emotional response generated by an object that resembles a human being. The feeling is typically one of uneasiness (Mitchell et. al 2011). The "uncanny valley" feeling is triggered when likeness of something like a doll, robot, or virtual 3D creation does not mimic a human being precisely enough and so we are left with an unsettling feeling. The epistemology is connected to notions of "the uncanny" as developed by Ernst Jentsch and Sigmund Freud (Jentsch 2008; Freud et. al. 2003).

technology because of the way that it works within society (Rubin and Pearlstone 1989). In reifying art, he suggested that art labors within society by giving life texture, color, context, and meaning, thus providing insight into a culture's social, political, and economic values and understandings. Likewise, folklorist Simon J. Bronner claimed that the creative people of the current day will use "the very material and technology of the official culture," in this case, the expanding network of XR technology, to "express an unofficial social commentary," demonstrating that XR is a phenomenon worthy of artistic and cultural study and presentation (Bronner 1986: 218). Rubin correctly asserted that "objects are records of cultural process, and they provide direct, unmediated access to the values and experiences of their producers – if we know how to read them." He was ahead of his time when writing that objects provide direct testimonies that "are not filtered through somebody else's consciousness (bias, preconceptions) as are data on social systems" (Rubin and Pearlstone 1989: 12). Rubin was writing before the rise of the dot-com world in the 1990s and the social media boom that filled its wake. He could not have foreseen the advances in computing technology that came so rapidly and would change the field of visual studies so drastically (Albrezzi 2015: 10-12) Since then, scholars such as Tara McPherson and Safiya Noble have made strong cases that show inherent bias of digital technology developed mostly by white men. Tom A. Furness III, founder of the Virtual World Society, has describe how his early work was rooted in the military industrial complex (Bambury 2019).[121] When considering XR technologies today and their current application for artistic production, we cannot overlook their origins when considering their use. XR artworks created through these technological platforms and experienced via immersive hardware are still important to producers as they grant access to new cultural experiences created as art.

[121] See: https://www.virtualworldsociety.org/.

With the proliferation of new technologies, artists have kept in step, seeking expression through their creative use. In *The Language of New Media* (2002), Lev Manovich abandoned a chronological approach to visual material, arguing that the distinction between old and new media is moot. In the years since, scholars and practitioners such as Christiane Paul, Scott Ligon, Ron Miller, Steve Anderson, Güvenç Özel, Marcos Novak, Pau Waelder, Montecarlo, Wade Wallerstein, Erkki Huhtamo, and Britt Salvesen have merged the digital and the visual to document and create discourses for rapidly expanding fields of digital art and its many forms across many media. [122]

In that spirit, this chapter focuses on the mounting issues of display, as digital immersive art is shared with audiences in museum and gallery spaces. New technologies are affecting media markets and formats for presenting and consuming art, storytelling, and entertainment. For example, Montecarlo (2016) has written about how the onset of digital imaging shifted the entire audiovisual process, touching on 3D film, video-mapping, 360-degree video, massively multiplayer online role-playing games (MMORPGs), interactive, and immersive. While he focuses on material and system changes, people are the catalyst and enactors of the changes. Similarly, Mark B. N. Hansen (2012) observes how the physical and the virtual are becoming enmeshed in ways that are redefining corporate and entertainment circles.

As the digital and related expressive landscapes change, new roles are forming within museum and gallery settings to accommodate changes in practice and display. When considering positions of audiences, XR technology shifts relationship dynamics between subject and object. XR technologies also pose spatial challenges and opportunities. Those who are making and

[122] See (Paul 215), (Ligon and Dean 2010), (Miller 2008), (Anderson 2017), (Özel 2016), (Moser and MacLeod 1996), (Waelder 2016), (Montecarlo 2016), (Huhtamo, 2011), (Salvesen et. al. 2018).

sharing mixed reality digital art works are building wide-ranging funding and partnership models to create entirely new events. With the power of experience as the driving force behind XR as an artistic media, stakes are high to achieve immersive qualities that make the work provocative, and it takes meticulous coordination across many different areas in order to achieve success.

When effectively produced, digitally immersive work can tap deeply into the heart of what makes us human. With the ability to trigger the human senses on an instinctual[123] level, XR taps into the potential of the human body. Deeply connective, XR experiences can elicit a strong empathetic response in audiences or transport them into worlds known and unknown. While they are mediated experiences and ephemeral in nature due to their ties to experience which happens in the present moment, digital immersive systems are navigating terrains of virtual and physical experience to evoke strong responses. The cognitive difference of the media subjectifies the object blurring the boundaries between the two.[124] XR layers the sensorial and has the potential to transform a broad range of cultural activities.

In this chapter, I will examine aspects of the XR art encounter that contribute to what the experience is through elements of display. The British scholar Alfred Gell (1998) formulated a

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[123] XR technologists references the term “lizard brain,” to refer to our instinctual reaction to stimuli, particularly active during times of danger or fear, to generate experiences that connect on a phenomenological level with users. Popularized by tech executive and author Seth Godin, the concept is also sometimes known as “reptilian brain.” In his use of the term, he is discussing instinctual human reactions to things like fear or danger that are reactionary in nature. While I find the term to be an oversimplification to correlate all phenomenological experience with the activity of our lizard brain, it is important to note this description of the technology that is coming from practitioners. (The term has another connotation not intended here in connection with Illuminati and alien hybrid races, which is government conspiratorial in nature.)

[124] While I do not wish claim domain expertise within cognitive biological approaches to VR, I do want to acknowledge that there are those who are studying these effects in depth. Dr. Nanthia Suthana is the Director of the Laboratory of Neuromodulation and Neuroimaging at UCLA and her research investigates VR’s ability to improve learning and memory. To know more about the lab and her work, see: http://lonn.semel.ucla.edu/.

theory to describe the components of an art encounter and the exchange that takes place between the art and a person. A relationship forms when a person encounters an object that displays a type of human intervention that leads to what Gell called an art object. Due to the fact that a person believes the pattern or form has been made for a reason, s/he is drawn into an exchange to understand its purpose, meaning, and/or design. Gell defined this process and connection as the art nexus. In Gell's theory, "the art nexus consists of the index, the original object; the recipient, the person who encounters the object; the artist, a known or unknown person who created the object; and potentially a prototype, something out in the world that the object represents" (Gell 1998: 10). Gell sought to understand art works through their embeddedness within social worlds. Building from Gell's work, the present discussion may be situated within humanistic discourse to address what has and has not changed within the art nexus as digital technologies have been introduced.

While not exhaustive, the examples included in this chapter are a representative sampling to provide a snapshot of current immersive production and display. In looking at practitioners in the field, interested publics that need to be respectfully managed, spaces of display, and funding opportunities through partnerships, attention will be given to human elements in digital art nexus. Additionally, I will address issues relating to the body when an XR art encounter occurs and those arranging the experience aim for equitable and transparent policies and practices. Los Angeles has become one of the epicenters for XR media creation and display. Benefitting from proximity to and influence of the tech start-up tech world of Silicon Valley and Hollywood's culture of movie magic, animation, and video games, Los Angeles provides fertile soil for new XR experiences (Hicks 2017). Local prominent players in the field and exhibition venues will be considered, as will several international examples as immersive technologies operate on a global scale.

Practitioners

A new set of practitioners is entering the arts and museum fields that can fill technical as well as artistic needs of digital immersive art production and display. Artists, curators, and technical docents are adapting to the new terrain, building solutions to the challenges of presenting virtual material. In surveying the landscape of digital frontiers in museums, the contact zones in question are unfamiliar for many visitors (Clifford 1997: 188-219).[125] The history of museums shows that access and display of art have changed over time, from cabinets of curiosity to salon-style exhibitions in which paintings of all sizes packed the walls from floor to ceiling, echoing devotional practices such as the iconostases of Eastern Orthodox churches or the "imagoria" of certain Sufi practice.[126] In times of transition, practitioners and the public work together to find a new understanding of the space and the work that is presented.

As artists explore extended-reality-based media, they are shaping a new grammar for their art practices. Creators such as Estella Tse, Anna Zhilyaeva, and Jonathan Yeo are mark-making[127] in the virtual world and finding ways to bring their creations into the physical world

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[125] See also, https://www.museumsandtheweb.com/biblio/museums_contact_zones_and_the_internet_0.html.

[126] See Florensky, P., D. Sheehan, and O. Andrejev, *Iconostasis* (1996, Oakwood Pubs); and A. F. Roberts and M. N. Roberts, *A Saint in the City: Sufi Arts of Urban Senegal* (2003, Los Angeles: UCLA Fowler Museum of Cultural History), 68-83.

[127] Mick Maslen and Jack Southern define "mark-making" as "the broad term used to include all marks that are made visible as a manifestation of applied or gestural energy" in their book *Drawing Projects: An Exploration of the Language of Drawing* (Maslen and Sothern 2015: 28).

through AR, performance, or 3D printing and sculpture casting. In her TED talk "Volumism: Future of Art," Anna Zhilyaeva proposes the term "volumism" to describe the virtual creations she paints while in a headset because she can generate anything within the virtual three-dimensional space (Zhilyaeva TEDx 2018). As many scholars such as Christine Daigle and Cecilia Åsberg posit a post-humanist age with the rise of deep machine learning and digital technologies, Zhilyaeva suggests that VR art can make us more human, claiming the medium for e-dreamers of the world. In another TED talk, artist Jenny Carden, known as Zenka, argues that VR and AR will bring the world into the knowledge age, as they offer users experiential learning opportunities. Embodied learning or learning through doing is known to connect strongly with memory and how our memory processes work (Zenka TEDx 2016). Tapping into what installation and performance artists have been doing for years, VR and AR artists are generating works meant to be perceived as well as experienced.

While world-building is not a new concept for artistic production, digitally immersive tools are allowing artists to create and display ways that bridge virtual and physical realities. For example, artist Jonathan Yeo, working closely with a team at Google Arts and Culture, was able to apply his practice to mark-making in three-dimension space (Yeo 2018). A portrait-painter, Yeo took on the task of creating a self-portrait in VR. Since he could not use a mirror due to his use of the headset, he brought a digital photograph of himself into the virtual space instead. Such reference tools are not new to artistic practice. One of the most notable is the centuries-old technique of the camera lucida, by which an object's likeness could be cast and superimposed onto paper allowing the artist a guide (see Barthes 2010). Yeo's substitution allowed an old method to be put to practical use in a new virtual realm.

In a 2019 Career Professional Development in VR Arts Education panel (#CPDinVR), Sidra Iqbal, a secondary school art teacher at Jumeirah English Speak school in Dubai, discussed how her students are benefitting from the flexibility and control an artist can have in virtual space (Bambury 2019). In instructing students on VR and digital learning for arts and design, she has noticed that when her students are working in VR, they are not as afraid to make mistakes, which increases their confidence in their artistic skills. She also argued that creating in VR gave her students the ability to create greater detail and more precise art. In describing their process, she stressed how bringing in reference images was helpful by providing added context during the creation process. Iqbal noted that students were able to make their sketches as big as they wanted or needed in VR and then use them to create in 3D. What is striking about the workflow Iqbal described is how seamlessly artists appear to be able to navigate their virtual materials in applications like Tilt Brush or Quill. Once created, however, immersive art poses challenges to curators and exhibition designers who wish to share and display such works in their physical spaces, often with other art.

Additionally, exhibition designers, installers, and curators must bridge the divide between artistic expression and tech understandings and requirements. Some, like Agnes Stauber (Creative Director of Digital Media, LACMA) and James Quo-Ping Lin (Chief of Exhibition Service Division, National Palace Museum), have been integrating digital media, including AR and VR, into exhibitions and museum outreach efforts to bring artworks and museum collections to audiences in ways that are dynamic, informative, and technically dazzling. Others, such as Christiane Paul (Associate Professor and Associate Dean at the School of Media Studies at The New School and Adjunct Curator of New Media Arts at the Whitney Museum of American Art), Marcos Novak (UCSB Professor, transarchitect, artist, and theorist), Jesse Damiani (Curator and

Editor-at-Large), and Britt Salvesen (Curator and Head, Wallis Annenberg Photograph Department and Prints & Drawings Department, LACMA), are exploring ways to display immersive art from historical stereoscopic images to mixed reality narrative interactives like *Moonbloom* (Rylah 2018).

In each case, historical challenges of representation and design demands of display still apply and, in some ways, the technical arena is merely another hurdle. Display grants access to the work, and when presenting XR art, experiences must be designed to allow for such engagement. For works like miniature paintings, this would mean providing the audience with a magnifying glass and making sure there was no glare from the vitrine so that patrons could examine details. For immersive artwork, visitors might be required to strap on a wearable hand device or don headgear that they have never worn before. XR technologies still remain science-fiction in the minds of many who may have seen movies like *Lawnmower Man* (1992) or *Ready Player One* (2018), or for more elderly patrons, popular media of their own times. Curators have the difficult job of not only introducing visitors to new types of art work, but also providing them with the means to interpret, understand, and associate themselves with it on some level.

Curation has been described as an act of translation by Mary Nooter (Polly) Roberts. She writes that as one interprets the epistemological frameworks of culture into an exhibition format, the result is "a construction of a cultural imaginary and never a direct reflection of the lived experience" (Roberts 2008: 170-172). However, XR complicates this concept, as the lived experience is embedded within the very nature of such technologies. XR experiences need interaction to be what they are. This is due to their "lenticular" nature. Analog artworks still offer absorptive engagement, but digitally immersive works develop and unfold as we engage them. XR works can be different every time. The experiences "becomes" as we interact with it over time. By using "point of view" or "POV" perspective, the subject is also directly implicated within the work. Such immersive engagement also keeps the experiences disconnected in certain ways from one another when arranged in a space for an exhibition. As active representations of knowledge, exhibitions are the beginning of a conversation, setting the topic and offering a story. In fact, curator Richard Rabinowitz talks about the development of an exhibition in literary terms, describing it as storytelling where the curator is "auteur," drawing our attention to the narrativizing and selective process inherent within curatorial work (Lubar 2014).[128] A curator creates an exhibition through the process of setting narrative and thematic parameters and selecting objects. An exhibition is a selection and a set of ideas. The "Exhibitionary Complex" is a network that can turn time into space by placing historical objects in relation to one another (Bennett 1996; also see Roberts 2012). Curation's roots connect it to the act of caring for objects, which includes their display.

With museum items as object-texts, curators perform a transformation through navigating the epistemologies of one or more cultures to create a bridge of cross-intellectual understanding (Roberts 2008: 172; Benjamin 2007).[129] If the exhibition is the utterance, then an artifact is the voice that communicates through place and time. A physical trace of a historical moment, an artifact can inspire feeling and connection (Roberts 1994). When the object is a virtual recreation, that connection is mediated. While the environment may be reconstructed from

[128] Curators are rarely credited within the wall texts at museums or exhibition brochures. Some are credited within news articles, but the recognition is often uneven and obfuscates the village it usually takes to mount an exhibition. For a deeper discussion on such matter, please see Michelle Millar Fisher's article "Acknowledging the Intellectual Labor of Curators in a Museum" (Fisher 2018).

[129] Roberts derives the notion of "Object-texts" from W.J.T. Mitchell's concept of "image-texts" (Mitchell 2010) referring to the way that images communicate to us through visual language (Roberts 2008: 170-171).

historical materials, it can only be an informed and interpreted based upon subjective senses of history. In the case of contemporary XR art works, "imagine-texts" are transformed into sophisticated, dimensional imaginaries; built worlds or objects that are bound by the laws of the virtual, not the physical. These digital immersive systems operate using the language of experience, presence, and embodiment.

The term "resonance" is used to describe the connection that visitors feel when encountering a work of art, as something that communicates and stirs personal understandings that they can bring to what they are experiencing (Greenblatt 1991). Wonder quite often precedes resonance and is the impact that an object has on viewers which they distinctly feel (ibid). These reactions are an emotional response to the disorientation of the encounter; reminiscent of being awestruck. Objects help form the foundations of interpretation. When an object is virtual or a perceived environment, the curator's mission must leave even more room for the agency of the experiencer, once a headset is donned. A curator and exhibition team will need to develop techniques to translate the optical apparatus, controller requirements, and new digital aesthetics to an often-unfamiliar audience.

One curator who is addressing such display challenges is Britt Salvesen at LACMA, who heads the Wallis Annenberg Photography Department and the Prints and Drawings Department. Her exhibition *3D: Double Vision* is the first in the United States to present a historical survey of 3D artworks, spanning nearly 200 years. Having researched the Victorian stereoscope for her dissertation, Salvesen did not initially believe that artworks involving the binocular vision device could be the subject of exhibition due to display challenges (Kim 2018). Because the viewing apparatus would be needed to produce dimensional effects of stereoscopic three-dimensional images, the curation for LACMA involved supplying three different sets of glasses or viewers for use within the exhibition. Doing so made it possible for audiences to experience various types of 3D work.[130] Directions were provided through icons and italicized font within wall labels so that visitors understood which glasses to use when approaching artworks to view them properly. However, since many are sensitive to the optical strain of 3D, I was surprised by the absence of an explicit warning to visitors regarding possible side effects from wearing the glasses (LaMotte 2017). In recent years, the public has pushed for trigger warnings for sensitive materials, as in the case of the Netflix series *13 Reasons Why*. Warnings are a method of inclusion—an acknowledgement of difference and an opportunity for audiences to make informed choices before engaging in something that may prove harmful to them, whether psychologically, physically, or both. Similarly, some individuals should not participate in immersive headset experiences due extreme disorientation and motion sensitivity. Vision instruments, like viewers and headsets, present a display challenge both in terms of equipment procurement and management, as well as the physical ramifications and impact for patrons.

Salvesen was able to realize an historical exhibition on 3D because she gained access to the materials needed for experiencing the artwork during her research and then was able to provide them to visitors. If curation is the process of selecting material worthy of presentation and arranging it in a way that provides context to wider audiences, curators will need similar access to the wide range of XR devices that are flooding the market to make decisions about what to select and display.[131] Today, if an artwork is digitally available online, the hivemind[132] of

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[130] Similar but earlier initiatives have been undertaken at the Museum of Jurassic Technology, where visitors are invited to don 3D glasses or to look through lenses that offer 3D effects.
[131] When selecting work for an exhibition, curators negotiate and balance values such as historical importance and significance within a certain cultural context when it comes to art, understanding that an exhibition is an interpretation and presentation.

[132] The concept of the "hivemind" or "group mind" describes an entity made up of individuals that forms a collective intelligence.

the Internet can make something an overnight sensation. In this way, digital art has the capability of offering publics a shared cultural authority in the making of art history.

For James Quo-Ping Lin, head of the division of Education, Exhibition, and Information Services at National Palace Museum in Taipei, museums must adapt to new digital equations by incorporating newer technical displays of collections or risk becoming relics themselves. In this case, the artwork itself is not digitally immersive. Instead, Lin sees new digital media as a way of connecting museum collections to younger audiences, who often grew up with the knowledge and exposure to the Internet, touch screens, and 3D, and expect to find these opportunities reflected in modern displays, from shopping malls to museums. In his presentation at the Getty's Pacific Neighborhood Counsel (PNC) conference in 2016 entitled "A Progressive Model of New Media Art in the Museum Context: A Case Study of the National Palace Museum," Lin discussed the ways he has led his team to incorporate technologies that enhance the experience of visitors of their collections[133] (Lin 2016).

The National Palace Museum (NPM) started increasing their digital initiatives in 1996 to match rising global standards, adopting what Lin calls "a hybrid exhibition display approach" that he claims "is a more versatile display format and can more fittingly serve museum audiences of the present age." He cites three successful new-media art exhibitions from the museum as examples: "Rebuilding the Tong-an Ships" (2013), "Qianlong C.H.A.O." (2014), and "Giuseppe Castiglione: Lang Shining New Media Art Exhibition" (2015) (ibid). In discussing the NPM's use of 3D laser scanning, projection mapping, and interactive digital displays, Lin emphasized

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[133] For more information, see: http://www.pnclink.org/pnc2016/program2016.html#; http://www.pnclink.org/pnc2016/Docs/2016/A%20Progressive%20Model%20of%20New%20Media%20Art.pdf ; and http://pnclink.org/pnc2016/Docs/2016/August%202016%20Digitization%20Projects%20at%20the%20NPM.pdf.

the need for today's exhibitions to engage visitors with collection materials on a digital level, stressing that doing so has the added benefit of promoting cross-institutional cooperation and cultural diplomacy (ibid).

Digitally immersive exhibitions are inevitably collaborative endeavors from curator to artists to technicians of varying types. In working with an exhibition design team and those who will install and mount the artwork, curators will need to assist in forming an exhibition's technical inventory and carefully choreograph how visitors will encounter the art when a smartphone, tablet, headset or other device is necessary for the experience. Additionally, as exhibition styles continue to change and integrate digital technologies, new roles have been forming to fulfill installation needs.

One such role is that of "tech guide." Museum and galleries utilize staff to facilitate the immersive experience, demonstrating and assisting the use of technology for museum and gallery guests. While GLAM institutions are still defining such roles, different language is used at different locations, which include "visitor experience team member" or "visitor experience representative." These alternative position titles from ARTECHOUSE[134] de-emphasize the technical aspect of the position, highlighting personal interaction instead. Exposure to immersive technology can vary greatly amongst museum and gallery visitors, but exhibition designers must err on the side of an unfamiliar public. As such, tech docents have been used to assist with the learning curve, demonstrating how to use the equipment, providing hygienic masks and cleaning equipment in between uses, and helping visitors into their headsets. They also assist users during the experience, preventing them from moving in a way that may cause

[134] Website: https://www.artechouse.com/.

harm to themselves, others, or the environment. Additionally, tech facilitators protect the expensive equipment from being broken or stolen.

An ideal location to witness the evolution and current practice of such a technical facilitator at work within an exhibition in is within a university where elements of the professional, scholarly, and educational are present and fluid. To this end, I attended the exhibition "Deep Dive or The Limits of Immersion: An Exhibition of Augmented Reality and Virtual Reality Artworks" at UC Berkeley. Students and artists were on hand to assist visitors with the XR equipment. [135] I spent time speaking with artist Jill Miller, who had a mixed-reality piece entitled *Liar* (2018), in the exhibition. Initially when I put the Microsoft Hololens on, nothing came up on the headset display. Realizing this was a problem in connecting to the WiFi, Miller talked me through her artwork while a student technical facilitator helped to reset the equipment. After about ten minutes, I was able to try again, and this time, hands flickered into view, as I turned and moved about the room. Miller asked me if I could hear anything. The audio was very faint, but I could occasionally hear a whispering voice saying "Liar," coming from the speakers on the headset. In the wake of the #MeToo movement, Miller's work attempts to provide insight into the feelings and anxiety that sexual assault survivors carry, demonstrating why so many are afraid to come forward out of fear of not being believed (Miller 2018). With a line forming behind me due to the technical difficulties experienced, I only stayed within the experience for a minute or two, feeling concern that others were waiting for their chance. The range of the headset was limited, and the way the color settings were calibrated made it difficult to always see the hands, but the artwork was compelling. The bizarre disembodied hands that

[135] For more information about the exhibition, see: http://art.berkeley.edu/events/event/deep-dive/.

appeared at every turn for the viewer were haunting and alarming. However, the technical difficulties drained some of the power from Miller's work, affecting its impact.

With digital-media-heavy exhibitions, technical hiccups happen, but when they do, clear policies should be in place to help guide staff and the public when there are problems or delays. These could include alerts on the museum's social media (website and Twitter) and signage at the museum's box office much like Broadway theaters which announce cast changes due to illness or Disneyland signs when Space Mountain is under repair, offering time-frame for fixes and/or refunds for the disappointed. Fortunately, Miller was present to help test the work after it had ceased functioning. She was able to tell me what to listen and look for, but artists usually are not present to guide visitors in this manner.

Another engrossing VR artwork I encountered in the same Berkeley exhibition was "Vessel."[136] In this work, curved planes of color are layered and gently move like sliding cylindrical windows around the center where the viewer is positioned. Reminiscent of Piet Mondrian's abstracts or Mark Rothko's color fields,[137] "Vessel" harkens to meditations on color and form that have come before, translating those interventions into a virtual environmental context. Moved and intrigued, when I removed the headset I asked the young women who had helped me into the headset if she was the artist, based on my previous interaction with Miller. She informed me that she was not and when I inquired who was, we both had to walk to a small label on the wall behind us, carefully navigating electrical cords, VR sensors and laptop set-up, to read the artist's name: Greg Niemeyer.

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[136] For more information on the artwork, see: https://www.gregniemeyer.com/vessel.

[137] See Foster, Hal, Rosalind Krauss, and Yve-Alain Bois. 2004. *Art Since 1900: Modernism, Antimodernism, Postmodernism*. London: Thames & Hudson.

When I then asked the young woman if she knew much about the work, she said she knew the artist was focusing on feelings and turning what is inside outward but seemed unsure in her explanation. In my eagerness to know more about Niemeyer's work, I had conflated the role of technical facilitator with gallery docent. The role of technical facilitator has yet to be standardized for visitors, which can lead to confusing interpersonal interactions.[138] Rather than audiences intuiting how to navigate an exhibition, clear signage, along with consciousness training and scripting for technical support staff can go a long way to helping the public better understand the etiquette and expectation of XR displays. Greater difficulty lies in cultivating the public's understanding and perception of immersive materials. In some ways, the "how" of operating can be easy, if one needs only to "look around" the virtual world once immersed in the headset. Controllers may present many challenges for those who have never used them or been exposed to video games.

Additionally, there are accessibility concerns. In recent years, museum staffs have become more aware of addressing issues of inclusion. Such factors can be particularly complicated when it comes to XR content. For instance, game designer Ben Formaker-Olivas addresses how VR is not a one-size-fits-all experience (Formaker-Olivas 2019). Currently, virtually immersive setups do not automatically account for height discrepancy. Many require users to recalibrate the sensors so that the virtual environment is presented at an eye height that feels natural to any given user. For example, if someone who is five feet tall puts a headset on after a person who is six feet tall without recalibrating it, that five-foot-tall individual would see

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[138] During the summer I worked at LACMA and in subsequent visits, I have seen guards who routinely serve as docents when asked for information. Admittedly, it is unclear in these situations if their helpful reactions are in connection with a museum policy or simply kind acts by engaged persons.

the environment as if s/he were of a child's height. Formaker-Olivas points out the additional issue for people with dwarfism, where a person's limb ratio is more compact (ibid). Often requiring full-body interactions, XR technologies present many challenges to user experience and user interface designers. If the museum's mission is to serve the public by making art available to as many people as possible, we will have to continue to look for strong solutions and accommodations when displaying XR work. The Curb-Cut Effect, as referenced by Formaker-Olivas, describes the beneficial effect that results for populations overall when designers prioritize accessibility (ibid).[139] The outcome is more accessible to everyone. Essentially, we all win when accessibility wins.

The need for calibration and more accessible equipment is just one example of the challenges facing display of XR art. If museums hold positions of power and authority in society and are leading the way for access to immersive XR, then they hold a responsibility to the work and the public to address barriers to entry across levels of access. As GLAM and other cultural organizations seek to present a wider range of immersive work, contemporary digital artists, curators, and exhibition designers and facilitators will need to rely on effective means for communicating with the public and choreograph the experiences in a way that buttresses the intentions of the art work without hampering the encounter with technical aspects. But as noted by the writers and researchers in *Hanging Out, Messing Around and Geeking Out*, "Media theorists have argued for decades that media 'consumption' is not a passive act and that viewers and readers actively shape cultural meanings" (Ito et al. 2010: 246). Their case studies support that in our current moment of global participation, youth practices will define new terms in

[139] The term "Curb-Cut" comes from the ramps placed in sidewalks as part of the Americans with Disabilities Act (ADA) of 1990.

digital media production and networked media ecology (ibid: 14). Many museum and gallery visitors want art and displays that are reflective of their current culture, including the digital.

The Public

Today's major art museums like the Louvre in Paris or the Metropolitan Museum of Art in New York hold collections that still focus on material objects, not digital ones. While the context, culture, or aesthetics of any given work may be unfamiliar to a visitor, the typical process of engagement, through which one gazes upon a work and perhaps reads label copy, allows the attendee to appreciate the item's formal properties along with the significance it holds or messages it communicates within its particular cultural contexts. On the new frontier of the digital, audiences lack reference points to understand works on several different levels. Scholars like Barbara Kirshenblatt-Gimblett have written about the representation of objects within museum spaces, drawing attention to differences in reception and emphasis when objects are displayed in context versus in situ (Kirshenblatt-Gimblett 1998; also see Vogel 1995). For XR artworks, the spectrum of virtuality may complicate Kirshenblatt-Gimblett's distinction, as experiences are often portable in their design and nature. While they will always be connected to certain origins, their exchange on the Web often makes the Internet or virtual space more of their natural context than any particular physical location. That being said, XR works can rely on or be calibrated for site specificity. In XR, physical place becomes space, a conceptual construct.[140] Vitalities are built on our ways of experiencing the world through our senses (Merleau-Ponty

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[140] Future work in this area may consider how VR spaces is additionally complicated by the Aristotelian distinction that space is neutral while place has been assigned or reveals meanings and purposes.

1968). The human sensorium interprets the simulacrum of "environment" on a spectrum of believability (Milgram et. al. 1994). Individual experience serves as the central reference point for a user within an XR experience.

Despite the fact that people may not understand basic concepts of "the virtual," from how virtual objects and environments are constructed to how to operate within them, XR tools have the power to illicit strong responses through their immersive characteristics which tap into phenomenological and kinesthetic realms. It would be a disservice to XR art to instruct audiences to consider works solely on a formalist level. Art history has a long tradition of understanding a work of art through its inherent properties like color, line, shape, contrast, size, weight, and texture, to name only a few. At the turn of the twentieth century, modernism disrupted artistic conventions of realism in the spirit of experimentation motivated by political, social, and philosophical concerns. For example, Heinrich Wölfflin was a Swiss art historian who formulated a set of principles around notions of perception and representation (Wölfflin 2015). He attempted to keep art historical study and critique connected to works themselves. In focusing on elements that are specific to the art, he aimed to distance Art History from defining itself through a history of artists and styles. To Wölfflin, such factors fell into the discipline of History. Instead he sought to build a field that could trace artistic developments through seeing (ibid, 2). His ideas are rooted in Immanuel Kant's theory that knowledge results from the interaction of subject and object (ibid). Attempting to assess XR work on visual style alone, as Wölfflin prescribed, would alienate viewer from encounters. To understand XR, we must move away from strict attention to forms of seeing to embrace forms of experiencing more broadly.

Yet, the connection that we can have with a work is dependent on optical technologies which need to be operated in particular ways to achieve experiences the artist desires his viewers to have. Here we should distinguish unfamiliar content from unfamiliar viewing conditions. When video works were introduced into museum settings, it may have felt odd to walk into dimly lit rooms within an exhibition space to view the installation.[141] However, the conditions were necessary in order to provide audiences with an optical viewing of the video piece. Viewing conditions function as part of the environment for an encounter. In this new set of encounters, the public will similarly grapple with the viewing conditions of XR. Crowd management within the context of display seems an administrative task, but the conditions by which an audience is introduced to XR can contribute to its reception.[142]

In facing a public that is unfamiliar with XR, exhibition staff should attempt to prepare audiences in certain ways prior to arrival if possible. It has become customary for museums or galleries to have explicative materials online regarding a show's content. For XR experiences, these online texts have added a prescriptive element in some cases to prepare audiences for the more unconventional or unfamiliar matters of an exhibition. Additionally, these sites may address practical concerns. For example, the MORI Building DIGITAL ART MUSEUM: teamLab Borderless in Japan has a "Notice for Visitors" section on their Visit Us information page on their website (TeamLab Borderless). In the list provided, they have noted information regarding conditions like wheelchair access. Additionally, they address specifics of the immersive experiences, such as warning that "There are some works with a mirror floor. Those

141 This is still often the case, and much more depends upon gallery architecture as designed for particular exhibitions than may meet the eye.

142 For example, LACMA's one-at-a-time immersion exhibitions have proven problematic, in terms of the very basic parameters of crown control, and many hopeful visitors were unable to experience the work due to tickets selling out. Such factors are important when museums do not have the funding to construct new facilities to accommodate such needs for temporary exhibitions.

who wish can borrow a wrap skirt close by" (ibid). The list demonstrates that the institution has thought about what visitors may be unaware of and wish to prepare for before attending. It also allows for museum staff to alert audiences to what types of accommodations they are able to offer. While museums and galleries cannot assume that every visitor will have checked (or even have access to) the website prior to attending the exhibition, it does follow a precedent as good practice. Signage with this information could also be posted at the venue's entrance. For those interested in bringing people into an XR encounter, deliberate framing will help to re-engineer audience expectations. Such careful arrangement should start before visitors arrive on the premises.

The public's encounter with immersive experiences requires careful crowd management considerations. On-boarding and off-boarding techniques, as Ed Rodley, Associate Director, Peabody Essex Museum has described them in his article "Unpacking Our Understanding of Immersion," serve to scaffold visitors' immersive experiences (Rodley 2019). The techniques often need a level of personalization to match each person's unique experience. They can be built into the experience, like a tutorial at the beginning of an AR app or opt-in add-ons, such as drinks and discussion after completing the immersive theater experience *Sleep No More* when one ends the masquerade in the Manderley Bar.[143] Managing visitors' expectations with new environments and experiences requires careful thought and planning. Rodley identifies pitfall areas for museums looking to display immersive work, starting with balancing attraction and distraction (ibid). While affording a greater level of agency, the architecture of digitally

[143] To find out more about this immersive theatrical experience, visit: https://mckittrickhotel.com/sleep-no-more/.

immersive work needs to allow for the experience to be inviting and not intimidating or frustrating.

Due to the often-individualized nature of XR experiences, several methods for queuing have proven popular and effective. "Single Reservation," "Watch and Learn," and Performance are pre-production choices for crowd management that result in particular outcomes for visitors. Improper application or management of these techniques can make or break an immersive experience for attendees. Each of the identified strategies aims to maximize the art encounter for the public while maintaining realistic expectations for staff and facilities. When finding the right balance, considering the cost of implementing such accommodations will have to be weighed against an organization's competing needs for limited funding and staffing.

For very popular immersive experiences, many institutions have opted for what I call the "Single Reservation" method, in which one is assigned or can pick from available times windows. This method tends to be implemented when a "blockbuster" immersive exhibition is mounted or when a museum itself proves an unusually attractive destination, as the Smithsonian's National Museum of African American History and Culture is proving. Although opening in 2016, timed entrance passes are still required.[144] With a narrative digitally immersive experience, the "Single Reservation" method prevents a long line within the exhibition space by staggering visitors based on the length of the experience or time allotted within the space as determined by the exhibition practitioners. One example of the "Single Reservation" method is the digital ticketing system using an iPad kiosk station implemented by The Broad Art Museum for Yayoi Kusama's Infinity Rooms.[145] By entering one's name and phone number, a place is

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[144] See the museum's website for more details: (https://nmaahc.si.edu/).

[145] Read more about the Infinity Rooms at the Broad at: https://www.thebroad.org/visit/mirror-rooms.

assigned in a virtual queue. Based on a first-come, first-served method, the application lets visitors know their approximate wait time, so they are able to roam the rest of the museum in the meantime. A text is sent to the visitors when their wait time is down to ten minutes, so they may make their way to the installation. Even such seemingly straightforward interventions will not serve all visitors, however, as some do not text or use apps.

In the case of Alejandro González Iñárritu's award winning 2017 virtual reality experience *Carne y Arena* (Flesh and Sand), people could register their email online. In this second example of the "Single Reservation" method, an email blast would let those who registered know when there were times available and people would sign up online for a slot to attend the experience. In each instance, the institution organizing the exhibition assumed that visitors would have access to technology to allow them to make a reservation. I have yet to see an institution that has an apparent policy in place for any visitor who may not have the access to text enabled mobile cellular devices or online Web services and hardware or would prefer to not provide their personal information to organizations that could sell it to marketing firms. While these experiences are few and new, if museums are seeking to be inclusionary and accessible, it will be important that policies are developed and in place for addressing an audience that may not participate in or have access to the technology required to make a reservation. An alternative may be to use the buzzer-units that crowded restaurants and hospital post-operation waiting rooms sometimes hand out for reservations, which light up and vibrate when a person's turn comes up in the queue. This choice comes with caveats regarding practicalities, including how long visitors might need to wait their turns. The units would be an added budgetary expense in which a museum or gallery would need to invest. Some units would inevitably be lost or broken, and the range may need to be extended for spacious museum halls. Nevertheless, they would not require visitors to own a personal digital device or provide any personal information to the institution.

A second popular technique that digitally immersive exhibitions at VR Scout in Culver City, Sp[a]ce in Pasadena, and the Worth Ryder Art Gallery at UC Berkeley have used is to create makeshift stalls or small rooms to provide separate areas for different headset experiences. Attending a show with several immersive tech installations can feel like attending a carnival fair, in which one must wait in line to experience the attraction. Visitors may get a glimpse of what is to come, which builds anticipation and excitement. In this way, VR art shows usually have a different ambiance than what is typically fostered in a museum or art space. This method of display does not stimulate resonance and wonder in the reverent way that cultural scholar Stephen Greenblatt describes when discussing the phenomenological experience of a traditional fine arts museum experience (Greenblatt 1991). Nonetheless, digital immersive audiences are connecting with audiences in powerful ways. Meow Wolf co-founders, Vince Kadlubek and Golda Blaise described in their keynote presentation for the American Alliance of Museums' two-day convening titled, "Immersion in Museums: AR, VR or Just Plain R?" how they would see families return over and over to attend their experience, almost like a playground (Kadlubek and Blaise 2019). The exploration and inevitable difference of each time spent within a VR artwork because of experiential aspects of the medium are creating relationships with audiences more like that of a children's museum, where repeat interaction is planned for and encouraged.[146] Many video games share the characteristic of repetitive interaction in order to understand the meaning or story of the game. Museum-goers facing elements atypical of a fine arts experience

[146] Museums of all kinds hope visitors will visit an exhibition more than once, and often suggest that different things can be learned or otherwise experienced each time. Docent exercises in noticing lend themselves to such possibilities.

may find interactive aspects tedious, gimmicky, and uninteresting. Currently, most XR experiences are not designed for deep looking and extended contemplation, and long lines discourage multiple visits. The aesthetic strengths of the range of digitally immersive media are imaginary, curiosity-building, uncertainty, and otherworldliness.

For smaller installations or for those with many different works, simply forming short lines to gain admission can create a positive social atmosphere, if a monitor is installed to allow those in line to see what those in the headset are experiencing. Having a monitor available also helps the technical facilitator orient the user within the experience, talking them through what they should be doing or seeing. Such a “Watch and Learn” method of queuing is more akin to a gaming model, through which one watches others play. In video gaming culture, spectatorship is a way of participating without direct engagement. It also allows for others to learn by watching. As people wait, they can discuss what they are previewing. By watching a series of people ahead of them get in and out of the headset and take their turns navigating the environment, they learn what to do and not to do, which helps with assimilating users to a new experience. Additionally, tech facilitators can use the monitor to see what the visitor is seeing, so they can direct them more accurately while they are in the headset. While the “Watch and Learn” method may seem to improve the odds for technical onboarding, drawbacks include losing an element of surprise and a “personal” feeling of the individual in the headset since they are now a spectacle. The “Watch and Learn” method not only displays the work, but the viewer of the work, turning their experience into a performance of the work as it is witnessed by others in line.

The third method embraces elements of performance and uses them to shape display of the work. One example is when VR artists perform their craft in public. From large theaters to public spaces like exhibition halls or galleries, Anna Zhilyaeva uses virtual reality applications like Tilt Brush or Quill to construct virtual volumetric paintings while people watch (Emory 2018). While in the headset, artists use controllers to select colors, textures, and sizes for their virtual brushes. Simultaneously, their virtual environment is displayed via a synced monitor or screen to allow the audience to see what the artist is seeing in the headset. In many cases, the performance is accompanied by live or DJ'ed music. In attending VR Scout's second Art Show at CTRL Collective in 2017, for instance, I saw three artists perform separate VR painting sessions on stage accompanied by a DJ (Probst 2017). One of the performers, Estella Tse, gained attention through several social media videos that showed her producing VR adaptations of work by well-known painters such as Frida Kahlo and Gustav Klimt.[147] Popularizing the medium through works of visual ekphrasis, VR artists such as Tse are paying homage to the originals while reinventing those artistic concepts in new media, thus creating a new work with its own aesthetic and identity. Like Marcel Duchamp's 1912 painting *Nude Descending a Staircase, No. 2* reimagined in photography by Gjon Mili in 1949, VR adaptations are a new chapter or a continuance of conversation during the liminal moments in Art History when transition is in action as a new form of art is introduced and tested.

Immersive artists have looked to the past to support their creative performances through the adoption and use of fulldomes. "Fulldome" refers to immersive environments created through dome-based projection technology begun in the 1980s and that emerged more prominently in the 90s. Projection techniques continue to advance, allowing for images to be cast across walls to fill large spaces. One example, Wisdome LA, an immersive art park, is notable for its incorporation of performance. The venue is host to Samskara, an immersive experience,

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[147] Examples of this work can be found at: https://www.facebook.com/watch/?v=10155338939636117.

borrowing its name from the Sanskrit word for the summation of one's experiences in life (Samskara Exhibition). A visual journey through religious and New Age iconography that weaves together notions of regions, spiritualism, and human experience, the exhibition venue has also hosted concerts. "Beyond the Wall" was one hosted by Wisdome LA that joined Samskara experience with live music performed by members of Pink Floyd, Jane's Addiction, Hendrix Experience, and Fishbone.[148] Performances such as these are one of very few ways VR artists and venues have been able to be paid for their craft and for the space. In these cases, pressure is taken off the audience to engage directly with the technology. Production teams work with artists to design performances that can be viewed passively by audiences.

A last performance technique that has been in development is collective XR experience. Platforms like Engage and AltspaceVR use virtual avatars to bring people together in virtual space for educational, performance, and professional events.[149] Recently, the startup Parallux out of NYU, along with members of the Future Reality Lab, has been building a collective VR technology that brings elements of live performance into virtual space through real-time sensor tracking for all audience and performance members in combination with a shared VR environment.[150] As such, each person experiences the environment through her or his own point of view, while inhabiting the virtual space with others, like in Second Life.[151]

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[148] More about the immersive Pink Floyd concerts is available at: https://wisdome.la/think-floyd-exp.

[149] Their company websites are https://engagevr.io/ and https://altvr.com/.

[150] Further documentation at: https://noproscenium.com/a-collective-experience-in-vr-with-cave-q-a-44f5c616c63f.

[151] Since 2003, Second Life has been an ongoing virtual world. While the design is similar to massively multiplayer online role-playing games (MMORPGs), there are no set objectives for users. Users are meant to use the virtual world(s) in whatever way they want to and interact with other players if or when they choose. For more information, see: https://secondlife.com/.

Experiences like *Holojam in Wonderland* and *CAVE*, featured in Tribeca's 2019 immersive line-up, cut down on the long lines and wait times that happen when virtual immersive works are exhibited because they are group-based story-telling experiences.[152] Additionally, the technology of collective XR opens up new avenues for storytelling, performance, and art by virtual mixes with live action. For instance, Onedome is an exhibition venue in San Francisco with several different XR experiences that are designed to be collectively experienced.[153] Their production *The Unreal Garden* combines AR with art installation forming a surrealist environment through sound, objects, architecture, and digital art.[154] Augmented reality headsets layer holographic objects onto the environment, while allowing users to remain aware of their surroundings. Collective XR works can heighten performance aspects of immersive presentations by allowing audience members to be aware of one another and the mixed reality they share.

Outstanding issues remain in terms of access, for tickets sell out quickly and time with the art is usually limited. First, for many bigger experiences like *Flesh and Sand*, *Red Flags*, and *Alien Zoo,* reservations were sold out in minutes when they first opened and some continue to be unavailable. Second, some events can be prohibitively expensive. For example, admission to *Red Flag*, which is an hour-long immersive narrative, costs $75. For displaying immersive art, both

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[152] Descriptions of *Holojam in Wonderland* and *CAVE* can be found at the following websites: https://frl.nyu.edu/wonderland/ and https://www.tribecafilm.com/stories/tribeca-immersive-full-lineup-2019.

[153] Onedome's website: https://onedome.global/.

[154] For a description of the Unreal Garden experience, see: https://onedome.global/experiences/the-unreal-garden/.

limited access and expense risk lending an air of elitism.[155] Third is the question of how much time a visitor is allowed with the artwork. While the Broad only permits one to have sixty seconds within Yayoi Kusama's immersive installations, exhibitions like *The 14th Factory* used large rooms for video and physical installation art pieces, enabling easy foot traffic for visitors who were able to stay within a gallery space for an extended period of time of their choosing.[156]

Long immersive experiences such as *Red Flags* (2019), *Defrost* (2016), or *Mind at War* (2018) pose a challenge to exhibiting works publicly, and visitors may not be able to experience the work in its entirety due to the practicalities of crowd and equipment management.[157] Finally, in some cases, it has proven difficult to achieve repeat visits due to the popularity or expense of an experience, both for the visitor and for the venue. While practitioners work through details of the technologies and business models, it will be vital to the continuation of the industry and growing field of art that visitor and consumer concerns are kept in the foreground (Hart 2016). Whether it is acknowledging the fact that a large portion of the general public suffer side effects due to motion sensitivity when entering a VR headset or accommodating low- or no-tech visitors, venues must remember to consider access and inclusion in their display of XR work (Kemeny et. al 2017; LaMotte 2017; Statt 2016).

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[155] Many of the examples presented here fall into this restrictive category for creating and enjoying XR art, where the experiences are stimulating for a few, but inaccessible to the vast majority of the world's people. XR practitioners such as Jason Jerald are aware of these criticisms and are working to change this dynamic (Jerold 2016).

[156] The website archiving the 14th Factory exhibition is https://the14thfactory.com/.

[157] Credits for each immersive narrative can be found at the following links: https://www.imdb.com/title/tt9000160/, https://www.imdb.com/title/tt4896390, https://www.imdb.com/title/tt9062934/, https://www.ryot.org/films/mind-at-war/.

The Space

The nature of exhibition spaces presents opportunities and challenges for the experience of digitally immersive media. The concept of world-building as developed by Alex McDowell more than a decade ago has been a design technique adapted by many museums, galleries, and pop-up exhibition spaces over the years as these venues house various types of immersive experiences (Karlin 2014). World-building can breathe life into exhibition formats by offering additional context to spatial narrative with interpretive materials through details aimed at transporting a visitor through the construction of an environment. At the 2018 symposium "Visionworlds: Immersion and Experience in Extended Reality" held at IDEAS, a creative incubator and lab space of UCLA's Department of Architecture and Urban Design, a panel of interdisciplinary thinkers and practitioners, including McDowell, gathered to present ways that extended-reality technology can renegotiate concepts of architecture and spatial design.[158] As Technology Director of UCLA's IDEAS space, Güvenç Özel's opening remarks considered the potential environmental applications of immersive technologies to place digital and physical worlds in the same experiential plane. The event drew attention to the importance of concepts and experience of space when addressing XR technologies. Even virtual spaces have physical spatial requirements, in other words.

Included in the conference were various XR works including Özel's multimedia installation work *Cypher*. Özel and his team played with scale and blurred delineations between sculpture and architecture in the piece by integrating machine learning with virtual reality, robotics, and sensor interaction. With the intention to merge digital and physical experiences, the

[158] Event information can be found at: http://www.aud.ucla.edu/news/visionworlds_immersion_and_experience_in_extended_reality_856.html.

work inspired viewers to question what constitutes a tech object, an art object, and realizations of architecture.

A video created by Ozel Office and projected behind the sculptural installation at the event demonstrated interactive components of the work (Cypher 2019). In it, audience members saw the sculpture changed by outside interaction with environment as a person within the video held a hand close to the black form and the audience witnessed it move in response to the stimuli. In an additional layer of human and computer interaction, the person in the video placed the virtual reality headset that extends from the black mass onto her head so that interaction with the VR environment made changes to the shape of sculpture. As if reading headset user's thoughts, when the actor pushed upward, the sculpture seemed to bulge, as if someone on the side was pushing outward. The VR space was simultaneously affected by any outside interactions with the sculpture. As a human/robot collaboration, gestures generated spaces, both physical and virtual. Speculating on what might evolve as an interface through which VR can be used to form space, *Cypher* speaks to a future in which the interconnectedness and complex dynamics between the digital, virtual, and physical are fluid and unencumbered.

In her introduction to *Transmission in Motion: The Technologizing of Dance,* Maaike Bleeker notes that "researchers and artists have come to recognize that motor activity—not representationalist verisimilitude—holds the key to fluid and functional crossings between virtual and physical realms" (Bleeker 2017: xix-xx). Display techniques and methods grant access to work, and such experiences must be designed to permit direct engagement. In this future, Özel's cyberphysical architecture is not meant to represent physical space, but offers audiences the ability to travel through different vantage places. In each case, a subject is being created that one cannot see from the vantage point they currently occupy, calling into question how distinctions between subject and object can be complicated to instigate new experiences.

Cypher models the challenges and opportunities facing digitally immersive work in terms of space, from projection mapping to virtual reality projects. Organizers of Academy of Motion Picture Arts and Sciences and film festivals around the world have recognized the efforts and artistry of immersive creators with accolades and awards. Despite such acknowledgement, museums, galleries, and expo-style events have proven leading and ideal locations for showcasing this type of work to a greater public, more than cinematic theatrical release venues, and this is for several reasons. First, exhibition venues are flexible facilities, receptive to change so that they may meet the needs of rotating exhibitions. Temporary exhibitions can last as little as a few weeks to many months, and each is specific in its spatial design and mounting requirements for the art works involved. Secondly, as such, such institutions have the tools and budgets to make design-based changes. Engrained within exhibitionary practice, buildings and spaces are redesigned to work with artists virtual creations. In the case of *Flesh and Sand* (2018), for example, environmental details were important to the experience of the work. Audiences were expected to be barefoot in the space, which had sand on the floor and the temperature lowered to mimic the cold night air as the headset experience is set in the desert at night (Chagollan 2018). Finally, exhibition centers are usually prepared with various power options, have inventories of electronic equipment for variable technical setups and specifications, and have budgeted for high energy costs.

True readiness and willingness to support and show artists making digital work has only been realized in the last several years. Artists have been experimenting in the media for much longer, and many are eager to do more, but barriers remain to the production and display of extended reality-based arts and exhibitions due to facility needs. New spaces are being developed in response to the growing demand from artists and audiences alike. The artist collective Meow Wolf spent roughly a decade attempting to solve the monetary equation that would permit exhibition spaces to display their immersive narrative experiences. Finally, with the help of the donor George R.R. Martin (creator and author of *Game of Thrones*), a bowling alley in Santa Fe was purchased and converted into Meow Wolf's first immersive narrative exhibition entitled *House of Eternal Return*.[159] Producing physical-virtual hybrid installation artwork that weaves storytelling, music, and creative practices of all kinds from set design to app design, Meow Wolf found success when they obtained the space and financial support to realize their creative dreams.

In 2018, the American Alliance of Museums organized a two-day convening entitled, "Immersion in Museums: AR, VR or Just Plain R?" Held at the Detroit Institute of Arts, the event brought together more than 75 museum leaders, technologists, scholars, and artists to address the rise of immersive displays and the demands they pose. Meow Wolf's co-founders Kadlubek and Blaise provided a keynote presentation from an artist's perspective. Making a powerful argument against those who wish to dismiss immersive arts as a passing trend, Kadlubek and Blaise shared their experience with Meow Wolf and its success as proof. They expressed that they see immersive art as an inclusive expression (Kadlubek and Blaise 2018). Moved by those they have encountered who have felt alienated by the art world, their mission is

[159] A description of the multimedia immersive experience and a documentary film about the artist collective can be found on the Meow Wolf website at: https://meowwolf.com/explore/watch/origin-story.

to create more “accessible” art for the general population[160] (ibid).[161] The idea that fine art has to be a particular output is dismantled through immersive work as it turns focus away from an object toward an experience. Kadlubek and Blaise emphasize their wish for audiences to relate to the work, offering involvement through their proposed storylines that unfold with physical investigation and playful moments of unexpected discovery (ibid). Their sentiment echoes McGonigal’s message for better engagement. Other artists and organizations have followed suit, reframing exhibition spaces and the interactions within them in order to attract visitors, appealing to their wish for a better art encounter.

While VR gaming has embraced the framework of the video arcade, VR arts entertainment have experimented with design approaches to fit the media. Looking to circus arts as a model, for instance, Two Bit Circus was formed by a group of creative engineers in 2012 as they founded the first “Micro-Amusement Park™” to showcase the latest in immersive entertainment from games to narrative interactives (Bishop 2018).[162] Each attraction requires a ticket that one can purchase online, reserving specific times. While some are more game-based, the Story Rooms offer more narrative experiences.

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[160] A poignant example of how utopian such hopes can be is Tyree Guyton’s installations (or amassings) of detritus on the east side of Detroit as featured in the NY Times Magazine of 12 May 2019, pp 42-45.

[161] Despite Meow Wolf’s humble origins, the collective the scale of production for *House of Eternal Return* was anything but. The expensive scale of production that was required to make immersive narrative installation make it not only unique but elite in the sense that it is not achievable by most artists. The neon on black psychedelic techno aesthetic and playful doorways and hidden spaces that is associated with much of the work may not be relatable to an older generation, who might have concerns when they are expected to turn into dim hallways or duck to squeeze through passages.

[162] The Two Bit Circus website is: https://twobitcircus.com/.

The illusory nature of XR experiences resonate with carnival themes and offer a correlation with Mikhail Bakhtin's notions of the grotesque.[163] In *Rabelais and His World* (1984), Bakhtin identifies the carnival as a liminal event, through which people from all walks of life come together and experience a freedom from hegemonic structures. Carnival grotesqueries have equalizing effects for those in attendance. The concept of the carnivalesque speaks to blurred boundaries and role reversals. Bakhtin's four categories dovetail with characteristics present within XR experiences and events.[164] In a role reversal, virtual environments make users into subjects. AR and MR layer the virtual and the real, bringing what is typically separate together. The carnivalesque also stresses humanity's more base instincts over rational, reasoning minds. As a tool for designed experiences, XR strives to be intuitive and (re)action driven. Finally, unbound by the limits of reality, environments can permit behaviors that are atypical for the quotidian. Here reference is not simply to first-person shooter play, through which violent fantasies are played out graphically as users run around high-tech arcades. Rather, one can turn to experiences such as those offered by the National Geographic VR app that can be run through

[163] Circus and carnival cultures are distinct from one another, but they share characteristics that can be described by Mikhail Bakhtin's work.

[164] The contact zones that allow people to become exposed to XR technologies may seem constrained to elite environments, which detracts from my assertion of the carnivalesque (Clifford 1997). However, I have seen $10 headsets being sold at gas stations, which demonstrates a saturation that is looking to penetrate markets at all levels. It remains to be seen if the media will become adopted by popular culture across ethnicities and other social differences. Several other waves of VR have tried, but never quite accomplished a permanent residence within quotidian culture. But perhaps this does support the notion of the carnivalesque after all, as carnivals are not meant to last forever. The designation of spaces particularly designed for XR do gesture toward a separation from current culture, not unlike the first step within a rite of passage, as understood through cultural studies scholar and ethnographer Victor Turner, who was following in the theoretical footsteps of fellow ethnographer and folklorist Arnold van Gennep (Turner 2017). Turner understood that the concept of the liminal as a state of "betwixt and between," could apply to far more moments in life than just seminal rites of passage (ibid). The point is that XR technologies inherently seek to break us away from our current experiences of the world in order to have us question how we perceive life itself.

a mobile phone, and experiences with Google Cardboard that places users face to face with lion cubs and great white sharks or float high above it all and see Earth from an astronaut's point of view. Most of these are experiences that the average person would never have, but they can now enjoy through digitally immersive XR.

Freedom from boundaries is echoed in the way Bakhtin perceived the grotesque body. He believed that, "we find at the basis of grotesque imagery a special concept of the body as a whole and of the limits of this whole," or really, the lack of limits (Bakhtin 1984: 315). Bakhtin described the grotesque body as, "cosmic and universal" (ibid: 318). The body and mind relationship re-orients when a person dons a headset, as the world one perceives on an everyday basis is separated from the world one occupies through the headset or viewing instrument. The aesthetics of XR deconstruct notions of the body and physical boundaries. In VR and 360 capture, physical actions can be heightened, as when a push gesture can move a boulder, or one can remain in an underwater scene without needing to hold one's breath or use an oxygen tank. By recalibrating the sensors, users can augment their perceptions of scale, so that a person can feel as big as a giant or as tiny as a mouse. Another definition Bakhtin offered for the grotesque is "a body in the act of becoming" (ibid: 317). VR and 360 modes operate through something more like lenticular vision, emphasizing process or development. The environment is continually "becoming," existing for the user when in view.

The agency and identity of the body displayed in new media arts also complicates Alfred Gell's notion of the art nexus (Gell 1998). For Gell, certain aesthetic traits symbolized a physical object's inner life, such as indicators of an outside and an inside to an object as reminiscent of a body, triggering empathetic responses for those encountering the object. While today's computing devices and digital cameras and displays can simulate an even more realistic intersubjectivity, artists are utilizing technology to immerse a viewer in an experience that generates reflective responses on one's own relationships to technology. Arts practitioners have long questioned and incorporated latest technologies. XR artists are attempting to reach out to viewers by creating experiences with contemporary digital media that disrupt perceptions of reality, consider the efficacy of real and virtual objects, and draw on human empathy.

While a thematic approach to space has been effective for Two Bit Circus, venues like ARTECHOUSE are attempting to offer XR "a room of one's own," and allow the space to be defined by the needs of the installation.[165] Opening in 2017 and expanded from its original Washington DC, location to New York and Florida, sites like ARTECHOUSE are better suited for large scale digitally immersive installation work.[166] As converted warehouse-like spaces, these facilities do not fit neatly into categories of museum or gallery. Often with no physical objects on view, the spaces are arranged to allow atmospheric digital projection through which architecture is transformed into canvas. From the animated paintings of Van Gogh and Gustav Klimt at The Atelier des Lumières[167] in Paris to the ethereal and/or alien landscapes presented at the MORI Building Digital Art Mseum: teamLab Borderless[168] in Tokyo, technically equipped

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[165] The quote is a reference to Virginia Woolf's feminist essay "A Room of One's Own" which argued for "a space" for women within the literary world, both figuratively and literally (Woolf 1935 [1929]). XR practitioners today are making their case for being included within the "fine arts" scene.

[166] These spaces are not always permanent. For example, The Factory 14 rented the space for the exhibition. Also, see: The ARTECHOUSE website is: https://www.artechouse.com/.

[167] The Atelier des Lumières website is: https://www.atelier-lumieres.com/en/home.

[168] MORI Building DIGITAL ART MUSEUM: teamLab Borderless's website is: https://borderless.teamlab.art/.

experimental environments are needed to show and support this art making.[169] More commercial narrative works have found support in a franchise chain model, like The Void,[170] which is currently located in eleven different cities where their spatial designs bridge the virtual world with the physical one to enhance sensory believability.

Artists such as René Magritte have used trompe l'oeil techniques to tease visual perception of reality, creating the illusion of three dimensions through understandings of light, shadow, and the science of perspective (Foster et. al. 2004). VR has the potential to make one question the "materiality" that makes up our understanding of reality ever more deeply. The reaction of our so-called "lizard brains"[171] within digitally immersive experiences calls into question what human brains perceive to be true. The philosophical and sociological concept of habitus, foregrounded in much of Pierre Bourdieu's work, is another way of reflecting on what we do out of habit (Bourdieu 1977). Bourdieu theorized that even our unconscious actions are culturally informed and situated. In that vein, we may extend Bourdieu's line of thinking to virtual space. Whether it is digital 360 video, interactive VR game displays, or multimedia immersive installations, works in the field of XR prompt deeper thinking about relationships between people and new technologies. XR will continue to help audiences think about how we

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[169] With the physical space being essential to the work, these projected worlds are a challenge for the archive. 360 capture, which will be discussed in more detail in the next chapter, offers the art world a way of documenting the greater context of the work, beyond the digital file projections and installation designs.

[170] The Void's website is: https://www.thevoid.com/.

[171] Popularized by Seth Godin, the term "lizard brain," also sometimes known as "reptilian brain," refers to our instinctual reaction to stimuli, particularly active during times of danger or fear.

conceptualize performance, investigate the ways technology affects our understanding of human agency when theorizing the body, and define our humanity within a growing digital world.

While experimental art spaces are still establishing themselves, commercial companies have been working to make the experiences portable, bringing immersive environments to the public. Portable immersive experiences are ideal for festival venues, corporate parks, or pop up environmental VR presentations that meet the needs of events like South By Southwest, VRLA, and the Sundance Institute's New Frontier Exhibition.[172] Dream Space VRhas mobile digitally immersive setups, from VR simulator seats to inflatable geodesic domes that can be rented for an event.[173] Sensiksis a company that has focused on building a multi-sensory immersive experience pod that includes haptics and smell.[174] The Sensiks pod, designed as a small room with a bench and a glass front door, aims to be a home or office fixture with a range of applications from relaxation to therapy. BroomX Technologies has created a system known as the MK Player360[175] which transforms a room into an immersive experience theater, through an all-in-one tripod that integrates an immersive projection system (roughly 270 degrees coverage), a CPU, Internet connectivity, and an audio and domotics control system.[176]

In each case, combinations of technology and artistry attempt to create complete worlds for audiences to experience, as Ed Rodley notes from Vince Kadlubek's keynote closing at the

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[172] More information on some of these events at: https://www.sxsw.com/ and https://www.sundance.org/festivals/sundance-film-festival/program/new-frontier-exhibitions.

[173] http://www.dreamspace-vr.com/english/.

[174] See: https://www.sensiks.com/.

[175] See: http://www.broomx.com/mk-player360.php.

[176] Used by mostly hotels currently, UCLA's Young Research Library is the first educational institution to invest in the use of the MK Player360 for teaching and research purposes.

AAM 2018 event (Rodley 2019). Exhibitions traditionally arrange objects in conjunction with designed display techniques and supporting interpretive materials to coordinate a narrative through a space. Visitors see the educational mission at work as disparate elements are brought together in proximal and careful arrangement to make a whole, like a mosaic artwork. Familiar components such as lighting, wall labels, and audio guides have assisted museum goers in navigating the elements of exhibitions. In terms of display, what XR changes most from earlier artistic productions is the seamless way it operates and forms a cohesive sense of space. "Meow Wolf, immersive theatre, and VR experiences create the entire world the user experiences," Rodley states, "and as such, may have a much easier time of creating that illusion of place," which redefines the intention behind their display, prizing an experiential learning over an interpretive one (ibid).

<u>Funding and Partnerships</u>

Quandaries regarding funding plague the new territories formed by immersive media. Patronage in the arts bears benefits and consequences. Parties interested in XR are navigating necessity through strategic partnerships. The power dynamics of material and monetary control may not be new for cultural producers and stewards; however, the introduction of digital technology into the infrastructure has generated a few particulars to consider. In the following section, I will address a sampling of potential assumptions in the current workflow and production of virtual immersive exhibitions to identify possible problem areas for future work.

Assumption 1: Digital art is easier to install and less expensive to show.

If unfamiliar with digital art, one might assume that with a few wall monitors and digital files on a thumb drive, one can produce a digital art show. Despite the fact that some works are as easy as plug-and-play, most require a sophisticated level of understanding of various technical equipment and methods in order to install a piece according to artist specs. In some cases, installation and maintenance may require knowledge of code. What digital art exhibitions save on shipping and artwork insurance costs is frequently offset by the expense of equipment and equipment insurance, whether purchased, borrowed, or rented. This financial expense poses a barrier for entry, since only certain institutions and organizations have the budget to get involved in XR technology in the first place. Such circumstances pose substantial risks for institutions with limited funds to invest in equipment and software without a long-term plan and commitment to XR programing and use. Realistic worry that immersive technologies are a fad or that the technology is still in a phase of rapid development which could render any equipment purchase out-of-date within a few years, prevents more museums from getting involved.

Assumption 2: With proliferation of XR, identification of digital immersive work for exhibitions is a straightforward process.

For curators working in the field of XR today, identifying works for an exhibition can be a daunting process. Typically, curators working in the contemporary art field often become familiar with new artists and artworks through a network of galleries and well-known showcases like the Venice Biennial. In some cases, works by artists have been acquired by museums and archives. Such works have records with identifying information, allowing them to be preserved and referenced in the future. XR work is slowly being integrated into this workflow, but a great deal can only be found online in growing repositories such as Google Poly[177] and Sketchfab.[178] Although these sites are commercial in nature, anyone with a free account can upload work. However, curators searching through such repositories have few tools to sift through the work to identify quality work that matches the intentions and mission of their proposed exhibitions. Additionally, such work requires diligence on the part of the curator to make a good faith effort to ensure the digital work is not plagiarized and that proper attribution is noted in cases of creative commons license use.

Assumption 3: Artists working in XR hold ownership and rights to their work and its distribution.

For artists who create XR works using platforms like Google's Tilt Brush or Blocks, significant issues of rights and ownership remain unclear, particularly when work is hosted and shared on a proprietary public platform like Google Poly. One wall label for Wesley Akksbrook's work *COSMORAMARAMA* at the "Spatial Reality" exhibition in Pasadena during the fall of 2018[179] claimed that "according to Facebook and Google's licensing agreements, all assets generated using their direct VR creation tools cannot be owned by their creators" (sp[a]ce). This is a confusing claim, given that Google's Tilt Brush is an open-source platform. Google released the code as free to the public, with no restrictions regarding modifications or redistribution. Still, such confusion reveals uncertainties concerning authorship matched by artists real needs to earn livings often ignored in discussion of open-sourcing.

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177 See: https://poly.google.com/.

178 See: https://sketchfab.com/.

179 More archival event information can be found at: http://space.ayzenberg.com/spatial-reality/.

In the world of 3D modeling, experts like Kyle K. Courtney, Copyright Advisor and Program Manager at Harvard University, are paying close attention to what 3D work can hold copyright. In his presentations at Community Standards for 3D Preservation (CS3DP) forums, he explained that 3D scans of objects can be licensed, but do not fall under the protection of copyright as they are rendered factual measurements.[180] In order to claim copyright, there must be a sufficient level of creative production which can be proven by a legal team. Artists, curators, and archivists must also be concerned by the possibility of artworks disappearing. If a company decides to no longer support a proprietary platform, artworks reliant on the application may receive little notice and have few means for preserving the work once the platform is no longer extant.

Assumption 4: Artists have creative control when producing virtual immersive work.

Commercial partnerships have been a current trend in the production and display of immersive digital works, but artists may have concerns regarding the levels of control benefactors will then exert over art they will support. Whether they are individuals, institutions, or corporations, sponsors may have agendas that can intentionally or unintentionally undermine or limit the creative agency of an artist. Several tech companies such as Google have hosted artists through a Tilt Brush residency program.[181] If an artist is being introduced and taught how to use a tool by the company that produced it, unspoken assumptions may exist that could impact expectations for the work that is produced. For example, would an artist in residence be encouraged to find ways of "breaking" the tool or producing work that operates in way different

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180 Find more information regarding CS3DP at: http://gis.wustl.edu/dgs/cs3dp/.
181 The Tilt Brush Artist in Residence Program website is: https://www.tiltbrush.com/air/.

than the intended design? Likely not. Alternatively, some museums partner with companies to fund experimental projects that combine art and tech, such as LACMA's Art + Technology Lab and The Tech Museum of Innovation's Tech+Arts Incubator.[182] Ultimately, the field may find the need for an intermediary that can shepherd new artists working in XR without the ties to corporate interests.[183] These interests are why we should remain skeptical of corporate partnerships. Any artistic content that has a social, political, or controversial subject matter could become a liability to the sponsor. While XR hack-a-thons usually have groups operating under the banner of "VR for Good," it can be difficult to find benefactors willing to take a chance on showcasing socially conscious XR artwork. Pioneers like Nonny de la Peña have skirted the line of journalism and artistry for the sake of social impact (Goldman 2018). With the great potential of XR, this remains a contested area which practitioners in the field are learning to navigate.

Assumption 5: Artists can make money from their XR artwork in the same way that traditional Fine Arts artists do.

The financial market for stand-alone XR works is mostly commercial based. Artists who work in 3D can sell models of their work through platforms like Sketchfab or TurboSquid. However, collectors are often interested in owning the original or only copy of a work. Blockchain, a method of secure digital transference, most well-known for its use regarding cryptocurrencies such as Bitcoin, may be a way to allow digital art to be sold as a guaranteed "original" and "one-of-a-kind." The contemporary art market is notoriously obscure when it

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[182] For more information on the programs, see: https://www.lacma.org/lab and https://www.thetech.org/TechArts.

[183] Universities face similar problems, with faculty and researchers in some units producing works on university time in university places that they then monetize. In theory there are controls, but it can be equivocal in practice.

comes to pricing artwork, as the Netflix documentary *Blurred Lines: Inside The Art World* (2017) investigates. For better or worse, blockchain technology may allow XR artists to enter the auction arena in a way that dovetails with current “high-art” practices. Others are using social media platforms like YouTube to monetize their work, creating videos demonstrating their work in progress and generating revenue based on how many views they receive. Anna Zhilyaeva holds raffles for derivatives of her work. By retweeting Zhilyaeva’s posts, people can automatically enter the drawing for elements connected to her XR work. Creating a cult of personality or personal brand has become another way for artists working in XR to make a living. Still, as these examples suggest, most assumptions at play regarding XR work and those who create it are anything but established.

Conclusion

XR technologies challenge the very idea of display through their illusory nature. In doing so, they further stress the changes to accommodate forms of art that incorporate new technologies. In his article “The Art Market in the Age of Access,” Pau Waelder details the difficult start the art market has had with incorporating digital technology. While he demonstrates that “digital art festivals and exhibitions at museums and art centres continue to be the most favourable environment for showing digital artworks,” he suggests the possible need for a third art market, dismantling old structures to make opportunities for new ones (Waelder 2016: 43).

By focusing on practitioners, audiences, spaces, and partnerships, attention can be drawn to institutional issues in addressing human elements of virtual immersive display methods. In “The Impact of the Internet on Cultural Creation,” for example, Mariana Moura Santos offers a human-centered design approach to new media cultural production (Santos 2016: 29). Her mission to foster empathy with the use of online media is a lesson that should be brought to bear on XR installations. A field once dominated by (White male) engineers interested mostly in military applications, XR now holds potential for all kinds of creators. Exhibitions like *Virtual Futures: XR Showcase*, organized by curators Britt Salvesen and Jesse Damiani for DIVERSEartLA at the LA Art Show, highlight the diversity represented in the field today, not just in technique but in identity as well.[184] Works shown by Wesley Allsbrook, Nancy Baker Cahill, Jorge R. Gutiérrez, and Drue Kataoka demonstrate that women, people of color, and those from the LGBTQ community are shaping futures of and for XR media.

Partnerships with big tech companies make commercial aspects of XR alluring, but much more is at stake than making money. XR exhibitions may redefine how virtually immersive experiences are accessed and understood by wider audiences. Display techniques and methods grant access to the work, and such experiences must be designed to permit engagement in ways that are respectful and fair to as many visitors as possible. As GLAM organizations learn to move beyond public outreach to community partnership and engagement, they must continue to shift the balance of cultural power through more equitable models. Museums in particular, as institutions with cultural authority concerning objects in their collections, will have essential roles to play in setting standards for practices within XR display that are inclusive, respectful, and accommodating of audiences that may have no digital background or exposure.

[184] For archived event details, see: https://www.laartshow.com/virtual-futures/.

Chapter 7: For Posterity and Pedagogy: Using 3D Models and 360 Capture to Preserve Exhibition Spaces for Teaching and Learning

A fundamental shift in scholarly perspectives on memory and history occurred when slide projectors were introduced into classrooms and culture more broadly, as the noteworthy episode of Mad Men, “The Wheel,” demonstrated. In the episode, Don Draper rebrands the slide projector as the “carousel.” Pulling on our childhood heartstrings, he sells the new technology as a time machine that allows us to revisit our happiest memories again and again, like riding on the mechanical horses on a carousel at a fair. Although fictional, the moment vividly crystalizes the transformative power of what was once a new technology. Slide projectors are descendants of earlier optical technologies like magic lanterns, which were astoundingly popular in the mid-to-late 19th and early 20th centuries (Crary 1990: 33,117,132). After slide projectors became readily available in the 1960’s, libraries and universities carefully built their slide collections, expanding the lessons that could be taught in Art History classrooms (Spivey and McGarry. 2019; 1, 5-6). Instructors could arrange historical narratives for classroom and personal needs and preferences, and styles of teaching changed accordingly. In the early 1990’s, classroom teaching shifted again for visual studies disciplines when computers began to handle image data and digitization efforts rapidly expanded.[185] With expanded access to digital collections, making comparisons across art objects became greater than anything the art historian Aby Warburg (a great comparer of art works) could have imagined.[186]

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[185] It should be noted that technologies rarely replace each other completely, and instead they overlap, merge, and exist complementarily.

[186] For an expanded discussion on Warburg’s influence on today’s digital art history practice, see pages 73 and 37 of Brandhorst, J. P. J. 2013. "Aby Warburg's wildest dreams come true?" *Visual Resources / Sponsored by the Visual Resources Association.* 72-88. For a greater detailing of how technological developments effected art historical pedagogy, see Kathleen Cohen, “The Nina, the Pinta, and the Internet,” The Art Bulletin 79, no. 2 (June, 1997): 187–91.

In this chapter, I focus on new tools for teaching visual materials. These notable technologies instigate interaction in classrooms and have the potential to offer groundbreaking shifts as did previous optical technologies. Immersive technologies stress environmental[187] context as an area often neglected in museum and curatorial studies. Not unlike cultural repositories and archives, virtual spaces may become extensions of the self and of particular identity communities. Similar to museums, virtual realities are negotiated, representative, and carefully curated. While many museums have permanent exhibition displays, most reserve a designated space for temporary exhibitions. Many years of scholarly research and curatorial debate often contribute to creation of exhibitions that may only remain open for several months at any given venue. While exhibition catalogs and, more especially, scholarly books associated with exhibitions delve into and preserve the content and intellectual mission of exhibitions, design decisions are usually not preserved in a way that is accessible to a greater audience.

Virtual spaces can rectify this by offering practitioners chances to detail, share, and preserve the design, research content, and installation decisions of particular exhibitions for teaching and future learning. 3D modeling and 360 photo and video capture can illustrate the design and decisions made during the development of an installation, giving viewers a sense of a gallery layout, architecture, and walk-through. Building annotated virtual tours using immersive technologies allows users to experience digital facsimiles of artworks in exhibition contexts of presentation and juxtaposition, and suggests frameworks to preserve thematic research content to complement cataloging and design information, as well as intellectual impacts of essays and other features of accompanying books. In doing so, virtual tours encourage spatial

[187] By "environmental" I mean in relation to a person's physical surroundings, not the impact of human activity on nature.

understandings by offering situational context while providing access to supplemental resources, making richer educational content for students regarding museums and their exhibitions.

Current arts educational practices, such as museum visits, employ a number of different methods for shepherding students through a rigorous training to help them to succeed in exhibition-building and archival activities.[188] In the classroom, students read articles that describe and critique exhibitions. These contain an occasional documentary and illustrative photo or two. However, without access to the process, students of exhibition, archival, and/or performance studies are missing out on fundamental components of design and curation when working with art. The current trend is for future practitioners to garner these skills and understandings through apprenticeship, usually in the form of an internship or volunteer work. While this type of exposure can be effective, it is by no means standardized, for better or for worse, and experiences can vary greatly depending on the institution, collection, and mentor.

Additionally, educational work experience opportunities have several limiting factors. First, because museum and cultural heritage institutions often operate with complex funding sources on restrictive budgets, internships and volunteer positions such as gallery docents have become essential to their day-to-day operations. Such realities may perpetuate an unfair labor economy by which people offer their labor gratis or for low wages in order to gain the skills and knowledge needed to eventually earn a living. With investment in Open Educational Resources (OERs) such as Art History Teaching Resources (AHTR),[189] and other dissemination methods, a gradual shift from the hoarding of cultural knowledge by the educational elite is underway. Moreover, unpaid internships offer limited results, and often, a person must intern in various

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[188] See Art History Teaching Resource's "Visiting the Museum Learning Resource" for specific examples: http://arthistoryteachingresources.org/lessons/visiting-the-museum-lesson-template/.

[189] For website, see: http://arthistoryteachingresources.org/.

departments at different institutions to gain an idea of the working whole while seeking positions available within museums or cultural heritage institution. Finally, career paths in collections management, exhibition design, and archival work are in a state of flux. “Curator” has usually demanded a graduate degree to practice.

With the rise of the artist curator, we see an acknowledgement of and respect for expertise held by those outside academia. The prizing of related community perspectives for exhibition forms shows a growing attention to representation, paving the way for new collaborations regarding exhibition spaces, types, and techniques. It is also worth noting that definitions of exhibitions or museums have shifted in the digital era. Examples are The Museum of Illusion and The Museum of Ice Cream as environments generated so that visitors can have specialized experiences and take that perfect selfie as a prized commodity in many social spheres (Adams 2017).[190] These types of museums are often popularized through social media and shift the concept of the museum away from a space designed for object care and display and toward a notion of curated experience.

This chapter offers an outline of immersive technologies being used to document culturally significant display spaces and propose how they may be used in teaching and for non-formal learning. Practitioners of immersive technologies are only beginning to form methods to collect data to measure success in their educational efforts. For this reason, I have conducted two qualitative interviews with practitioners in the field to provide context concerning how XR experiences may be produced and incorporated into classroom learning. I will also draw from my

[190] For information on these alternative museum examples, see https://laillusions.com/ and https://www.museumoficecream.com/. For celebrities and social media entrepreneurs, the unusual settings offered by such experiences make desirable backdrops for photos that are used to bolster brands and businesses.

own experiments in the field to consider challenges that others may face when attempting to produce immersive work in museum and cultural heritage spaces. Finally, frameworks for learning involved in documenting exhibitions using immersive technologies in the classroom are presented to offer ideas for scholarship regarding teaching and learning (SoTL) in visual studies.[191]

Two forms of immersive documentation of exhibition spaces will be addressed: 3D and 360 capture. Creating a virtual 3D environment for an exhibition permits practitioners to illustrate the design and decisions made during development of an installation. Such an initiative preserves a sense of an exhibition space and its layout rather than simply providing a reductive map and photos. Furthermore, 3D exposes students to new technologies, building valuable and marketable skills.

360° panoramic tours are made with 360° captured images, comprised of two or more photos stitched together to produce a single spherical image. A tour of a space can be created by stringing together 360° images through clickable hotspots, jumping from one area of the environment to another. In each case, annotations may be added to enhance the environment, permitting users to experience digital facsimiles of the artworks, related content, videos, and the like. Finally, for each of these methods, many versions are web accessible. Larger viewing publics can be anticipated that extend the online life of an exhibition.

Dimensional Documentation and Presentation of Exhibition Spaces

Methods for documenting and preserving exhibitions need to be adjusted to

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[191] Virginia Spivey and Renee McGarry offer a suite of digital art history tools and techniques (2019: 1-18).

accommodate the digital age. Currently, museum professionals preserve their exhibition design decisions through administrative and archival work – if at all. Contained within binders or sets of digital documents, information related to the design of the exhibition is typically filed away and not often revisited. 3D virtual reconstructions have been extremely laborious, for it takes time and attention to details to document a space. However, while reconstructions from archival documentation may still require intensive labor, technology is becoming available to permit creation of a 3D model of a room within minutes (Bradley 2018). By simply walking around the room with a device on one's head or in hand, one can produce a 3D mesh or photogrammetric model of the space allowing for it then to be shared and experienced virtually from practically anywhere.[192]

Nicknamed the "Godmother of Virtual Reality," Nonny de la Peña has recently developed Reach as a platform for creating and distributing WebVR content (Knoepp 2017: 1). While volumetric capture is still being perfected, Reach is lowering the barrier of entry for 3D modeling and the creation process, building a database for use by a greater public. Similar technology is already used to document and preserve cultural heritage sites around the world by non-profits like CyArk and though initiatives like the Smithsonian's growing X3D collection. The same can – and should – be done for temporary exhibitions, for objects may be brought together only once in a great while, and possibly never again. For example, an exhibition at LACMA entitled *The Jeweled Isle: Art from Sri Lanka* is the first comprehensive American survey of art from the country.[193] Historically, only two other exhibitions have ever brought this

[192] A 3D mesh describes the shape of a 3D object using vertices (points), edges (straight line segment connecting 2 vertices), and faces. A photogrammetric model is made from digitally captured images that are stitched together to produce a 3D model often with photorealistic texture mapping.

[193] The exhibition's page on the LACMA website is: http://www.lacma.org/jeweledisle.

many objects together in a comparable way (Lee 2019: 1). It may be decades before another exhibition of this caliber is attempted, and given the plethora of conflicts marking the 21st century, no one can be certain that objects seen in an exhibition will exist "forever." With such historic and cultural significance, important exhibitions should be documented in as much detail as possible to share them with those who may not have the ability or resources to visit exhibition venues, or for audiences wishing to learn from works destroyed in war or by environmental disasters.

A recent example of similar technology being used within a museum setting is the Matterport experience of the "Striking Iron: The Art of African Blacksmiths" exhibition at UCLA's Fowler Museum.[194] The exhibition begins with a tunnel-shaped scrim with images of iron in the universe, in human blood, and iron being forged, all projected from behind the cloth. Designed by Peter Kirby, the entryway provides an immersive experience when documented with 3D technology. Using a Matterport 3D camera and platform, Joshua White was able to create an experience where users can click to travel through the exhibition space.[195] Using a computer mouse to drag and click or the arrow keys to navigate, users can deploy the "Explore 3D space" mode to travel through the space. An animation effect provides the illusion of movement with the ability to pan and tilt the user's view 360 degrees, and the experience provides a simulation that is rather like walking through the exhibition space. Though one's "jumps" are limited to where the camera operator placed the camera when creating the stereoscopic images, users can choose a "Dollhouse" or "Layout" view as options which provide

[194] The Fowler's website page for the *Striking Iron* exhibition is: https://www.fowler.ucla.edu/exhibitions/striking-iron/.

[195] See the *Striking Iron* Matterport immersive experience at: https://my.matterport.com/show/?m=qDUrPP5k3oX&utm_source=4.

an aerial interaction with the space. While extremely valuable for documentation and outreach, the experience only offers a touristic-level of understanding without added layers of interpretive content.

In contrast, the Hallwyl Museum in Stockholm, Sweden, has produced a number of 3D virtual tours of their space using photogrammetry, a method that involves taking many pictures and using a computer program to stitch them together to create a 3D model. Completed in 1898, the former palatial home to Count and Countess Walther and Wilhelmina von Hallwyl now serves as the museum for the couple's eclectic collection (Hallwyl Museum Website). Sometimes containing an audio guide, these virtual tours are textually annotated and published online using the SketchFab platform.[196] Within the experience that places users within the upper vestibule, every subsequent click is a tributary that leads to supportive information, through layers of audio and textual annotation complemented by photorealistic texture-mapping that retains and communicates some of the distinctiveness of original places and installations.

As introduced in Chapter Five, VSim is also a tool and resource for presenting 3D material in the classroom. As a 3D repository, Vsim[197] provides an archival presentation platform for teaching and learning, as developed by Lisa Snyder at UCLA with funding from the National Endowment for the Humanities (NEH). Similar in format to PowerPoint but for 3D models and environments, users can upload a model and annotate it with the text editor or the embedded resource feature. The archive and repository allow for related materials such as photos and articles to be preserved with rich metadata, facilitating sharing and reuse among scholars, teachers, and students. The repository and archive content are still in development, but presently

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[196] For an example of the Hallwyl Museum 3D room tours, see: https://skfb.ly/6uvr8.

[197] To access the VSim Repository and Archive, see: https://vsim.library.ucla.edu/xmlui/.

a model of Karnak in Ancient Egypt that is available on the VSim library website, and ten more models will be added to the collection soon. Dr. Snyder's NEH white paper outlines several of the current benefits and challenges of working with 3D material for scholarship, teaching, and learning. The challenges faced by those who produce 3D model scholarship can offer a road map to scholars and creatives who pursue 360° production, which will be discussed in the following sections (Snyder 2018: 4-16).

360° Panoramic Tours of Exhibition Galleries

In terms of 360° capture, the technology has steadily become lighter weight, easier to use, higher quality, and more reliable. Although these types of technology lack the depth of field that can be achieved from doing a full photogrammetric mesh, we have cameras that can shoot 8k and fit in your pocket, literally. To avoid being in the shot, users can control the camera remotely from a mobile phone app, and several cameras on the market can live stream video to Facebook or YouTube if they have access to an Internet connection. Additionally, these 360° camera file types and their formats hold some familiarity to archivists, since they are essentially high-resolution photos or videos, so in terms of long-term preservation, very little will have to change for special collection information systems to accommodate items.

I started experimenting with 360° cameras in 2015 to capture exhibitions and dance performances in museum spaces. In this section, I discuss three 360° platforms and project examples for documenting exhibition work. The first is an open source platform called Pano2VR that I experimented with to make a basic walkthrough of a special collections exhibitions I collaborated on through a class project at UCLA. I utilized the second platform, Google Tour Creator, in a second library exhibition documentation project at UCLA with Dr. Patricia

Greenfield. Finally, ThingLink is an application that University of California, Santa Cruz, used to virtually present one of their library's exhibitions. I interviewed the project lead to discuss the details of the project and the technical production. While 360° cameras are being used in larger museums, the three examples cited in the following are all exhibitions hosted in library spaces that were presenting collections materials, allowing for a consistency in terms of setting for the following research. Moreover, the three examples used the same type of camera to document the exhibition, the Samsung Gear360.

The first examples resulted from Miriam Posner's "Museums in the Digital Age" class at UCLA in the winter quarter of 2016, which offered students the opportunity to create an exhibition within the Young Research Library's Special Collections based on the George P. Johnson Negro Film Archive. I served on the interpretive design team with two other students. While we worked closely with the curatorial team and assisted in the selection of objects for the exhibition, we were primarily responsible for honing the approach to the exhibition proposed by curation. A culmination of two quarters of work, the resulting exhibition was entitled "The Industry of Uplift: Silent Race Film, The Lincoln Motion Picture Company and George P. Johnson."

We worked to create representations that touch on the influential yet often uncredited history of the Lincoln Motion Picture Company, the first successful all-black owned race film company 1916-1923. The work of Noble Johnson, his brother George Johnson, and a group of black artists and producers changed the way black performers and audiences alike were perceived by mainstream Hollywood. The success of these films proved that not only were black audiences hungry for great content that included dignified representations of black life, but that they were willing to turn out in force when these movies made their way into their communities.

Producer, distributor, and book keeper George Johnson meticulously archived 71 boxes of material related to the silent race film genre and the role of African-American artists in all forms of creative media, until giving his files over to UCLA in the 1970s. As the first formal exhibition of the collection, it sought to emphasize the group of artists who were pioneers not only of Black Cinema, but of Hollywood itself.

The three main themes of the physical exhibition were: the Johnson Brothers, The Lincoln Motion Picture Company, and Contributors to Silent Race Film. For the companion digital exhibition, we decided on the more overarching theme of legacy. The digital exhibition includes photos and documents of the Johnson Family and also expands on the accomplishments of African Americans in film (specifically on the actors, actresses and other silent race films in that era). With over 50 years' worth of material, George P. Johnson collected a vast amount of content; however, we envisioned the digital companion site to serve as an extension of the themes that were already laid out in the physical exhibition and not as a digital repository for the rest for the collection.

As part of the digital exhibition, I created the 360° panoramic tour.[198] The online tour remains a digital experience of the physical exhibit, where users can navigate the space through linked 360 photographs that are annotated with hot spots. We had hoped to add to the tour as the items within the exhibition were digitized in order to fill it out in more detail. In the current design, the tour navigates users from case to case, providing annotations of the case descriptions so that people can get a sense of what was displayed and see how it was arranged. The hope was to give this exhibition a wider audience than just those who could show up in person to see it

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[198] To view the tour, see: https://dh150racefilmexhib.wixsite.com/theindustryofuplift/physical-exhibit-tour.

displayed in Special Collections.

Using Pano2VR, an open source tool, I was able to connect my 360° image stills through clickable hotspots and to create a custom skin layer to annotate the spherical images with text, image, and video annotations. While the ability to control the look and feel of the experience was great and feedback was positive about being able to visit the exhibition space virtually, users suggested they needed more onboarding through the interface to help them learn how to navigate the experience. In the following screenshot, you can see the tour embedded on the site. At the bottom of the embedded interactive window is a set of tools to navigate the 360° image. While the caption above prompts the user to "explore," it does not provide further instructions to the user on "how."

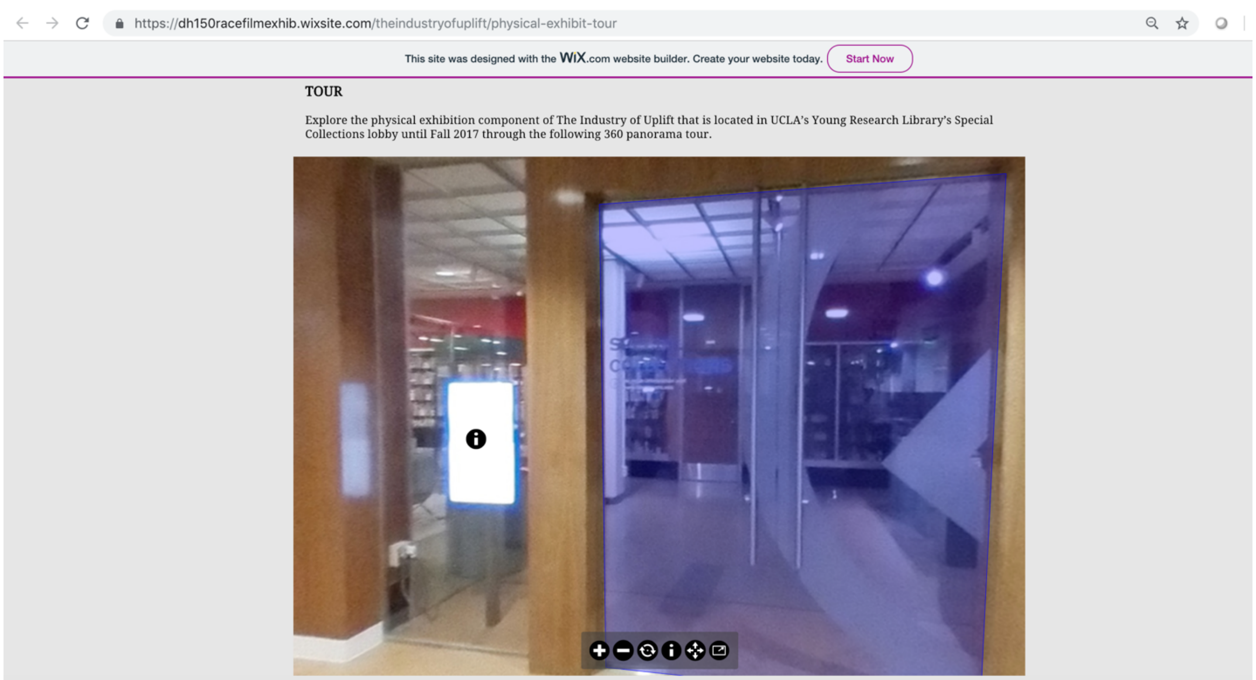

Figure 1: Screenshot of the Industry of Uplift Exhibition Website taken by the author on February 22, 2019.

If the user were to click on the "i" ("information") button on the glowing rectangle to the left of the doors, they would open a window that welcomes them to the tour, but again provides no directions on how to navigate it. If the user happened to hoover their cursor over the blue doors, they would see a tool top that states "Begin Tour," and clicking would display the next 360° image from within the exhibition space.

As the designer of the experience, my familiarity with the tool became a user experience issue, as I did not do enough to onboard the functionality of the navigation for visitors of the panoramic tour. To do so would require extra time to make changes to the out-of-the-box features of Pano2VR in order to connect more clearly with the user audience. The other challenge I faced when building this panoramic tour was that sharing drafts was difficult. Pano2VR is a desktop application. While I could export into a file format that could be hosted on the Web, I could not easily collaborate with others without having them download the software and then send files back and forth, which caused version-control issues.

However, after visiting Google's headquarters in Venice, California, to test and give input on some of their latest immersive education endeavors, I learned about Google Tour Creator,[199] a platform for creating annotated 360° tours. Like the rest of the Google Suite of tools, Tour Creator is accessed online with the use of a Google account. It connects with their Google Poly repository, for 3D and now 360° immersive content.[200] Tour Creator is less customizable than Pano2VR, but requires a much shallower learning curve when learning how to use it.

My second project example began in December of 2016 when I worked with Dr. Patricia Greenfield to document her traveling exhibition *Weaving Generations Together: Evolving*

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[199] To access the Google Tour Creator platform, see: https://vr.google.com/tourcreator/.

[200] Google Poly and Google Blocks are effective tools for a classroom setting students. Students can start to explore and created their own 3D immersive content through a Web browser interface, which can then be paired with Google Cardboard and displayed immersively on a mobile device.

Creativity of the Maya of Chiapas,[201] that was displayed in Powell Library at UCLA. The exhibition examined the teaching, learning, and practice of weaving over nearly half a century through Dr. Greenfield's work with several families in the region. By documenting an exhibition that focuses on a culture in transition, I hoped to have the opportunity to address how technology can help in the display of non-Western art, while critically assessing the stratum that same technology might create in terms of class and communities. The examples I wanted to gain from working with Dr. Greenfield, a psychologist in culture and human development, would allow for me to not only address the concerns of creating digital resources that can be used for teaching children, but also the considerations that are essential when working with and representing indigenous or non-western communities. Unfortunately, the project did not proceed beyond the initial 360° capture as the tools I used to document and share the content had some limitations that are important to note.

Dr. Greenfield is the mother of documentary photographer and filmmaker Lauren Greenfield. As such, she had high expectations for what the technology should be able to offer in terms of quality. Unfortunately, the quality of capture did not meet her standards. Unlike in the previous exhibition example that was documented in the lower level of Young Research Library where there is very little natural light, Dr. Greenfield's exhibition was on the second floor of Powell Library where there are many windows at the top of very high ceilings. While we attempted to document as quickly as possible, we unfortunately had no time to prepare for the photo capture, since the exhibition was slated for deinstallation the next day. From this experience I learned two very important things: while documentation with technology designed

[201] For the UCLA Powell Library's page for the exhibition, see: https://www.library.ucla.edu/events/weaving-generations-together-evolving-creativity-maya-chiapas.

for mobility and ease-of-use can be very quick, it does, like most other documentation, take ample planning and an understanding of the space that will be captured in advance. The photos that resulted from our efforts varied in quality as the sunlight changed the way the room appeared throughout the day. When assembling the virtual tour, the room looked very different as you clicked from one area of the room to the next because the shift in lighting was so drastic. The change in light disrupted the illusion of a single moment capture in time as a person navigated the virtual tour. Dr. Greenfield was understandably looking for consistency in terms of outcome. In the end, she was able to use individual photos for her exhibition website[202] to give a panoramic context to her collection's display at Powell Library.

Additionally, the Google Tour Creator platform made it easier for me to share my work in-progress, however it was not the right fit for the presentation Dr. Greenfield was hoping for. First, not all Google educational licenses cover Tour Creator, so I had to use a personal Google account. Both account types are free, but G Suite for Education allows unlimited storage for Google Drive, Gmail, and Google Photos, while a G Suite Basic account only allows for 30 GB. When handling the significantly large 360° image files, storage limits are an obstacle. Additionally, Google Vault, Google's method for regulating file retention is free under the Google Educational license, while G Suite Basic is fee-based for its users. The outcome of the virtual tours needs to be stable, so the guarantee that the materials used to complete it will not expire from the platform where they are stored. Finally, G Suite for Education is compliant with the Family Educational Rights and Privacy Act (FERPA),[203] which protects students' private

[202] For the Weaving Generations Together website, see: https://weaving-generations.psych.ucla.edu/.

[203] For more on Google's FERPA compliance, see: https://cloud.google.com/security/compliance/ferpa/.

data; private Google accounts are not held to such a standard. When I reached out to Google representatives regarding my inability to access the Tour Creator from my educational account, I was told that it was likely due my school's educational licensing agreement, which did not cover the application.

There is also a word limit for annotations, so long-form scholarship is not currently supported. In its current form, only a shallow level of supplemental content can be shared through the platform. For GLAM organizations looking to showcase their extensive digital collections, Google Tour Creator may be too limited in terms of functionality for a significant engagement from online users. Although tour builders can overlay photos or audio narration to their tours as points of interest, Tour Creator does not have the ability to include video or other media files at the moment. When I uploaded 360° images, unfortunately the quality was diminished and the settings affect the display so that at times the content seems warped, a result that was unsatisfactory for Dr. Greenfield's project.

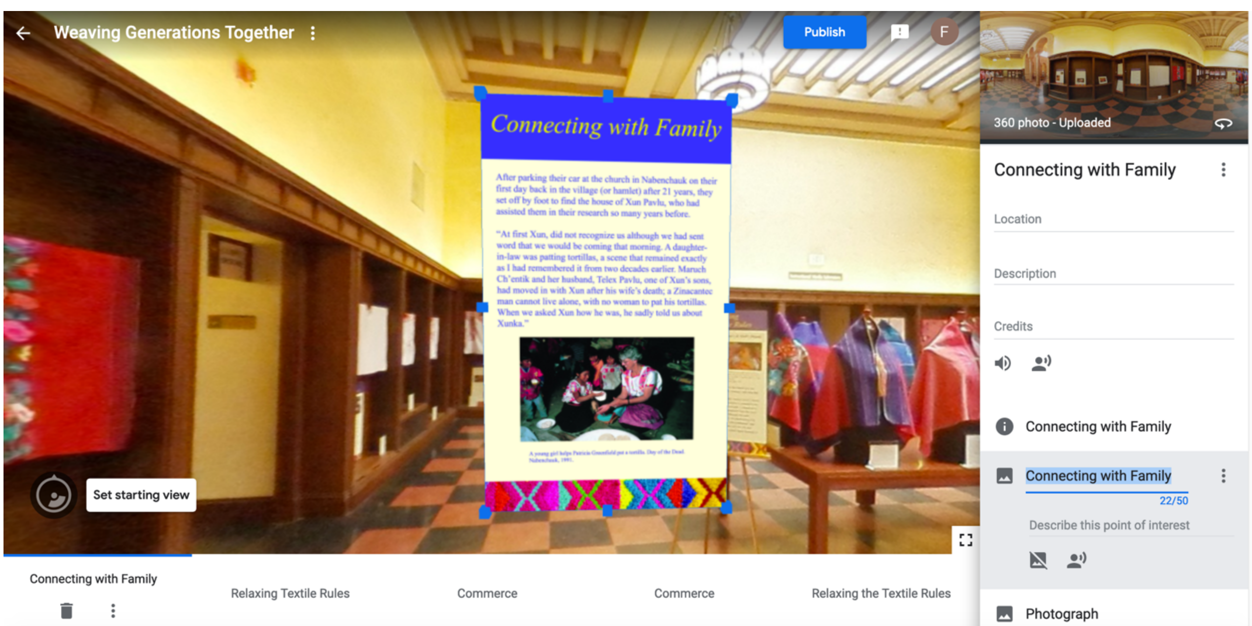

Figure 2 Screen Shot of Weaving Generations Together 360 Exhibition Prototype Using Google Tour Creator.

For example, when I uploaded a PDF of text that I had converted to an image format so that it could be layered into the space for greater context (a work-around I tried for the lack of text I was not able to include in the text annotation feature), the text became blurred and difficult to read. These issues should be carefully considered and may prove to be a barrier when incorporating Google Tour Creator within educational environments unless it becomes part of G Suites core applications. While I hope Tour Creator will continue to improve with community feedback, it currently works best for prototyping rather than publishing.

The third example is a project that exemplifies a high standard for documenting exhibitions using 360° technology entitled *Love On Haight 360 Virtual Tour*. Kristina Golubiewski-Davis, Director of the Digital Scholarship Commons at the UC Santa Cruz University Library worked with a small team to produce the *Love On Haight 360 Virtual Tour* of a special collections exhibition that opened in their library in 2017.[204] The goal of the physical exhibition was to situate the Grateful Dead in the cultural phenomenon of their time. Using a Samsung Gear 360, six 360° photos were taken of the physical exhibition gallery. Additional images of case material were taken with the library's DSLR camera. Then, using the ThingLink[205] platform, the team created a tour of the exhibition that contains custom-designed American 1960s-style psychedelic tie-dyed hotspots to connect various types of content to the panoramic images of the space. From wall label quotes, to close-ups of the objects in the exhibition cases, to materials from UCSC's Grateful Dead digital archive including audio tracks, photos, and video, the team was able to preserve and enrich the exhibitions content.

[204] For the *Love On Haight 360 Virtual Tour*, see: https://guides.library.ucsc.edu/loveonhaight360.

[205] For more about the ThingLink platform, see the website: https://www.thinglink.com/.

The six 360° images of the exhibition space are linked together via a "hotspot" annotation on the image, which is represented by an arrow and demonstrates which direction within the space users will move to in the next panoramic image. As an overview, the wireframe layout below the 360° window on the UCSC library landing page allows for users to locate themselves within the tour, if they choose to use the experience within the browser Webpage. Next to the 360° Tour window is a set of instructions labeled "How to Experience the Virtual Tour," which briefly explains how to navigate by clicking and dragging on the image, selecting annotation icons for more information, and using the arrows to move to the next section of the tour. Dr. Golubiewski-Davis said that the use of the arrow was in an effort to mimic some functionality of Google Maps, a platform that users might be more familiar with and could therefore aid in their orientation to this 360° experience. Additionally, a tool-tip pop-up appears when you hover the cursor over the arrow and states "Move to Space 2," further emphasizing the user's location within the experience. Users can also expand the 360° experience into a full screen mode, which then displays the other images as rectangles at the bottom for users to navigate through. Dr. Golubiewski-Davis expressed that careful thought was given to the icons and their design, to reflect the look and feel of the Grateful Dead in the late 1960s in San Francisco, but also to clearly indicate to the user what they would see when they clicked on them. The annotations also have clearly labeled tool-tip pop-ups that appear when the cursor is placed over them to give users a sense of the subject matter in addition to the form of content they will see when they click. The space captured within the 360° tour is a long rectangular room that leads to a "chapel" room at the back. The first 360° image allows users to focus on the three displays encased by glass at one end of the room, but does not provide a useful view of materials on the other end. Because of this limitation of the photographic image, five different 360° images were taken, moving the camera in a progression from one end of the room to the other in order to provide users with optimal perspective to view the various elements of the exhibition (Golubiewski-Davis 2019: 24:00).

Rearranging the point of view to look downward at the floor, each 360° image has the logo for the "Grateful Dead Archive Online," which UCSC maintains, operating as a menu of information about the 360 experience. Around the logo, icons are placed to allow users to access information about the content represented within the experience. The “Rights” icon shares with readers that most of the materials are from UCSC’s Grateful Dead Archive Online, used for educational purposes under Fair Use, and instructs anyone who may be concerned about a rights violation to contact the UCSC library for removal. The “GDAO” icon links users to the Grateful Dead Archive Online (GDAO), where they can browse the collection that the 360° tour makes use of within most of the annotations.[206] Clicking the “Home” icon relaunches the browser window to the original landing page settings. Selecting the “Digital Exhibit” icon links users to a digital companion exhibition presented on the Omeka platform. The Omeka digital exhibition also makes use of the socially constructed GDAO and builds a more textual representation of the physical exhibition’s content, expanding on topics through the use of the additional archival material. Lastly, “More about the Grateful Dead Archive” brings users to the UCSC library special collections landing page for the archive, where the collection readers can get an overview of what materials they will find within the collection. In addition to centering the user throughout the tour, the logo has the added benefit of hiding the 360° camera’s tripod that was used to take the photos (ibid: 31:30). The logo addresses the need to maintain clear contextualization for the

[206] The online archive does not contain the full collection, just a sample of the full collection. It also allows users to upload their own ephemera and add stories.

user through an accessible menu guide, but also deals with a very practical issue of working in 360°.

Dr. Golubiewski-Davis and her additional team members, Alix Norton (Archivist), Ann Hubble (Digital Initiatives Librarian), and Reed Scriven (DSC Student Assistant), created the experience after the exhibition had already been curated by three special collection archivists at the UCSC library and sought to build upon their work to further its mission through digital means (ibid: 26:00). For the annotations within the *Love on Haight 360 Virtual Tour* experience, the project team selected things they felt would be meaningful and interesting for people to view both from the exhibit, such as quotes and high-resolution images, and from outside of the physical exhibitions display, like sound tracks and videos. Dr. Golubiewski-Davis stated that one benefit of a 360° tour was the ability of the ThingLink platform to embed videos from YouTube. The skeletons used in the "Touch of Grey" music video were on display in the physical exhibition, and the embedded video annotation allows users to view them in their significant context. While Dr. Golubiewski-Davis admitted that iPads could be used throughout the gallery to provide a similar effect, that would be an added element to manage within the space for library staff (ibid: 24:45). The embedded video within the ThingLink experience has required little maintenance and adds additional information that was not supported within the physical exhibition. The team also made use of Calisphere,[207] a digital asset management system that aggregates digital collections material from California libraries, archives, and museums. By doing so, the 360° virtual tour could build out context in ways that were not possible with the Grateful Dead Archive alone. Pleased with the outcome of the 360° experience, Dr. Golubiewski-Davis plans in the future to coordinate with curators before a show is mounted to

[207] To access the Calisphere collections, see: https://calisphere.org/.

collaborate on the what elements of the exhibition are translated into or added as annotations for the 360° experiences.

To enable better viewing of the cases, the team brought in a program called "Deep Zoom." First, high-resolution photos were taken of the objects in the cases. The challenge here is the glare off the glass that the photographs capture. While the effect is relatively minimal, this is one drawback to using this technique. However, the physical experience is often not much different, as visitors also experience the glare within the space. In fact, because of Deep Zoom's functionality, viewers can get "closer" to the texts than they could if they were reading them in their cases while physically in the exhibition space. These photos also maintain a sense of the exhibition layout and the relationship between the objects. Curators think carefully about how arrangement can enhance a person's learning experience. These contextualizing photos allow for that work to still come through in a way that a link out to a digital archive cannot.

The "i" buttons recreate in the virtual environment some of the wall or section labels that were placed throughout the exhibition space. While the Website landing page for the *Love on Haight 360 Virtual Tour* provides significant contextualization, the first room does not contain an "i" annotation. Therefore, the tour creators did not explicitly state that the first area within the tour is dedicated to other artists contributing to mainstream music at the time. The situation presents another challenge within 360° panoramic tour, which is leveraging screen space effectively. Textual banner labels would limit what people could see of the space, but would increase their awareness of the themes presented in the area. More "i" annotations would likewise begin to inhibit how much of the space was visible. Tangential to this discussion is the functionality that is allowed within pop-up windows. Unlike Google Tour Creator that has a word limit, ThingLink allows for the ability to scroll within a text window, which enables for longer form text to be included. If 360° tours are going to be useful for teaching and preservation, they will need to be able to accommodate supplemental information that may be longer than a few sentences.

Dr. Golubiewski-Davis also shared with me some changes that were made to the experience, based on data analytics and metrics for the site.[208] Originally, a wireframed map of the space appeared without the 360° window on the library's landing page. In this scenario, people were not clicking through the 360° images to see the full tour. The team decided to let go of their intimate knowledge of the space, which required you to enter the space and turn left. In doing so, they rotated the map 360° to put the first space on the left. In real life, the first space is actually on the right.[209] The team also removed the details from the map layout that indicated where specific cases were within the space. The aim was to decrease the information in the layout that could overwhelm and confuse the viewer, and highlight the element of progression in the design to encourage users to click through the tour. The team saw an initial uptick in the ThingLink use statistics after the change was made. In following up with Dr. Golubiewski-Davis via email around two months later in April 2019, she confirmed that traffic had increased within the 360° environment. To her, that qualified as success.

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208 Dr. Golubiewski-Davis, Alix Norton (Archivist, Center for Archive Research and Training), and Ann Hubble (Digital Initiatives Librarian) highlighted these changes during their presentation entitled "Bridging the Digital and Physical: Increasing Engagement with Unique Collections Through Digital Tools" at the 2019 Midwinter conference for the American Library Association (ALA). See: https://www.eventscribe.com/2019/ALA-Midwinter/fsPopup.asp?Mode=presInfo&PresentationID=477438.

209 This particular switch was based directly on user feedback. On screens, people still tend to read from left to right. The physical map locked the team into having users "start" on the right and "move" left. These physical details of the space were not important to the experience in the virtual environment. Adapting the layout to reflect people's tendencies to read left to right helped increase users' likelihood to engage more with the tour (ibid: 34:00).

Thinglink was chosen as the platform for several reasons. Dr. Golubiewski-Davis had considered using Google's Tour Creator platform, but in discussions with Google, a contract was presented to UCSC's Associate University Librarian that the library on their own could not have signed. The legal document had language in it that would have required the Chancellor's permission. When UCSC requested that the language be changed to allow for the library to sign, Google did not accommodate the request, so they were unable to proceed with the project in that platform (ibid: 36:00). Dr. Golubiewski-Davis has not tried Pano2VR. She expressed that what she likes most about ThingLink is the ease with which she could add annotations (ibid: 37:00). In making the decision to use it for the *Love on Haight 360 Virtual Tour* experience, it also helped that it was low cost ($35 for a teacher with 35 students per year at this time). Most of the other 360° experiences that she found as comparative examples at the time were custom built. Custom built digital experiences usually mean more expense, time, and effort. Additionally, they are often more difficult to reproduce. The team knew they would not be able to support this level of customization. ThingLink was the best tool at the time that fit their functionality requirements, including cost and ease of use, and so it was chosen for the experience.

In terms of preservation however, Dr. Golubiewski-Davis still plans to make a video of someone clicking through the 360° tour that can then be preserved at the library. Her decision to do so, is based on the fact that web-based exhibits utilizing proprietary software and are dependent on client-side technology, such as browsers, are problematic for long term preservation (ibid: 38:15). Dr. Golubiewski-Davis knows that an mp4 file type is one that the library knows how to save and does not require proprietary software in order to open and play the file. Currently, a Shared Google Team Drive holds the individual 360° images, text, and custom icons that were used to build the virtual tour. The team does not yet have a planned workflow for archiving these items within the archive, and the decision to do so has not been made. If ThingLink stops supporting their software or makes changes to the software that the library is unable to implement, the video will ensure that the experience was captured and documented in a way that can be reviewed and used later. The 360° images themselves may be easier for a library to archive, but the virtual tour presents as much of a challenge as a 3D model or VR environment because of the large number of files and different file types that are associated with the experience. In our discussion on preservation, Dr. Golubiewski-Davis stressed the question that faces libraries today when dealing with XR preservation: are you archiving the files or the experience? In her opinion, "Libraries are very much at the point where archiving the experience is beyond current capabilities and depending on the library you are, they may be more or less interested in trying to find a way around that" (ibid: 41:00). Claiming something has been "archived" holds deep meaning for those who are interested in preserving material culture. Libraries, which remain one of our main centers for institutional information, have been adapting in critical ways to the shift in technology, both in terms of research and learning (Canuel et. al. 2017). Practitioners are stretching standards to adjust to the digital age but libraries, special collections, and museums were not founded with preserving hardware and software in mind. Organizations like the Software Preservation Network,[210] founded in 2015, help guide institutions regarding issues of long-term storage for virtual applications through strategic partnerships and collective action. Addressing the challenges of preservation for virtual

[210] For the Software Preservation Network website, see: https://www.softwarepreservationnetwork.org/.

objects, environments, and interactions will be an ongoing and growing field.[211]

My interview with Dr. Golubiewski-Davis helped to break down what is required to make a digital representation of a physical thing as well as archive item in a library. In discussing *Love On Haight 360 Virtual Tour*, Dr. Golubiewski-Davis explained that “our goal with this what not just to recreate the space, but add to it,” and she did so by extending the immersive beyond the scope of the original materials with online resources from GDAO and Calisphere (Golubiewski-Davis 2019: 30:25). Sharing the experience virtually, the UCSC’s exhibition became accessible to “Dead Heads”[212] that are not local to the campus library. In archiving a physical site within a digital space, Dr. Golubiewski-Davis and her team demonstrated what functionality can expand learning opportunities through digital platforms.

In discussing the use of Pano2VR, Google Tour Creator, and ThingLink to capture exhibitions, I have highlighted limitations and advantages for creating 360 annotated tours. Online tours of exhibition spaces expand the museum’s mission of outreach to include the virtual realm. Documentative XR tours provide opportunities to collaborate across digital archives to enhance resources with collections material that might not have been able to be brought together or displayed otherwise. Additionally, the functionality of the platforms allows for multimodal engagement, bringing video, image, and audio files types together under the umbrella of a single virtual environment. XR tours expand the types of pedagogy that GLAM organizations can utilize to share collections materials.

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[211] Because I am working with the Community Standards for 3D Preservation group, I have chosen not to address issues of preservation in greater depth with the dissertation. See the forthcoming publication from the CS3DP group for those discussions.

[212] Fans of the rock band the Grateful Dead often call themselves “Dead Heads.”

The Possibility of Engaging Additional Educational Frameworks Through Document Exhibitions with Immersive Technology

Teacher-based lecture presentation remains a standard practice and likely will continue to be used as a core method for instruction (Snyder 2003: 55-77).[213] However, when engaging digital immersive media for a museum and/or curatorial studies lesson plan, additional learning frameworks are invoked. In the following section, I consider how XR technology can engage with four significant pedagogical methods: object-centered learning, distance or online learning, immersive learning, and digital humanities. In addition to providing key examples of these methods, I also conducted a second qualitative interview with Steven Sato, Director of Technology at Rolling Hills Country Day (RHCD) school, which serves students from kindergarten through eighth grade in Palos Verdes, California. Mr. Sato has been in education for nineteen years, with an additional six years of experience in 3D animation rendering for the field of architecture. Over the past four years, he has been bridging immersive technologies with education at RHCD and more broadly through the Los Angeles-based Immersive EdTech Meet Up group that he leads. Weaving salient aspects of that interview in to my analysis of the four pedagogical methods, I illuminate the benefits that can be garnered by employing XR technology in educational settings.

Object-Centered Learning

First, XR experiences can allow for object-centered learning, a pedagogical methodology that uses art or culturally significant objects as the catalyst for the creation of lesson plans or

[213] The dissertation work of Dr. Lisa M. Snyder entitled "The Design and Use of Experiential Instructional Technology for the Teaching of Architectural History in American Undergraduate Architecture Programs" inspired my critical thinking around how XR methods could expand learning opportunities.

learning opportunities. The articles within the edited volume *Perspectives on Object-Centered Learning in Museums* demonstrate the shared value and tradition across disciplines of contextual learning from the use of objects (Paris 2010). If schools and/or students cannot afford a trip to a local museum, or instructors want to reference objects that are relevant to their lesson plan but are not available at any local cultural heritage centers, 3D models and environments can bridge the gap, allowing for virtual object-centered learning lessons. More and more institutions are using photogrammetry to place 3D models of their objects online for study. For example, the Uffizi Digitization Project,[214] a collaboration between the Virtual World Heritage Laboratory (VWHL) at the Indiana University School of Informatics and Computing, the Politecnico di Milano, and the University of Florence, is scanning the Gallerie degli Uffizi's collection of Greek and Roman sculpture to produce a database of virtual 3D facsimiles.[215] Teaching with 3D digital replicas, an educator is no longer reliant on what photographs they can find online or in databases of the objects they wish to show their students. Photos or video may or may not have the angle or detail an instructor wishes to use in the classroom. Using 3D virtual models can provide an instructor with both control (to show precisely what they want to) and freedom (to go "off book" and examine other areas of the virtual object).

A 2016 conference paper by Juno Rae and Lizzie Edwards on the British Museum's earliest effort to incorporate VR technology into their digital learning program, The Samsung Digital Discovery Centre (SDDC), provides valuable insight into the complex planning that goes into such an introduction of new tools at a major institution for object-centered learning (Rae and Edwards 2016). Improvements in hardware, accessories, and software in recent years had

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214 For the collection of models, see: http://www.digitalsculpture.org/florence/.

215 For more about the project and those involved, see: http://www.digitalsculpture.org/florence/main/about.

resulted in successful "virtual tours" at several London galleries. The British Museum looked to contribute to the new venture of VR for its own visitors. The initial event was a SDDC family weekend in August 2015 held at the museum.

The museum staff decided to focus on the Bronze Age as the historical period for the VR experiment for several reasons. The teaching of prehistory is part of England's mandatory school curriculum, so the Bronze Age offered potential opportunities for school programs to dovetail their lesson plans with the VR experience at the museum. In addition to adding curricular value, the museum also felt it would be easier to test the benefit of VR in a period from the distant past where familiarity with the archeological evidence was scant. Without prior exposure to the subject matter, the team felt it was easier to track how effective the experiences would be at building knowledge.

Three objects from the museum's extensive collection were selected to be placed in a Bronze Age roundhouse context. Visitors who donned Samsung Gear VR headsets could individually encounter the pieces, selecting each by touchpad and rotating the view of the object as desired while an audio description (narrated by the museum's Bronze Age curator, Neil Wilkin) played through the headset. The new experience elicited such a positive response from the families attending that the museum soon followed up with several additional trials with VR content and headsets in fall and winter of 2015. A SDDC review of visitor and staff reactions in January 2016 concurred that the VR experiences provided a type of visitor engagement that increased the educational benefit for the audience and evoked greater interest in the museum's collection.

If instructors could further contextualize objects within an exhibition, they could gain the added educational benefit of being able to compare objects and study the narrative built into their arrangement. Now in 2019, portions of British Museum exhibition halls can be explored through a Google Arts and Culture online 360° experience, enhancing the public's knowledge of the collection through the relationship of objects in the museum's displays.[216] In my interview with Mr. Sato, he recounted his classroom use of the Shepard Fairey AR Exhibition entitled *Damaged* based on the Los Angeles exhibition by the same name (Sato 2019: 7:00). The experience allowed his students to engage with a large showing of Fairey's political artwork that addresses contemporary social and cultural issues in the United States. Audio narration by the artist offers insight into the creative inspiration and motivation for the work. The experience was an opportunity to discuss current event issues through artistic production as students moved through the virtual space learning about the different item on display and how they related. Remote access to display information promotes understanding of art objects as arranged and situated within an exhibitionary complex (Bennett 1996). XR technologies can strengthen object-centered learning by granting access to objects and exhibition environments through online virtual platforms.

Distance/Online Learning

Secondly, digital immersive methods allow for distance/online learning. Flipped classrooms[217] or online courses offer students flexibility and convenience. Rather than clicking

[216] For the Google Arts and Culture 360 tour of the interior of the British Museum, see: https://artsandculture.google.com/streetview/british-museum/AwEp68JO4NECkQ?sv_lng=-0.12660245092570221&sv_lat=51.51905368906714&sv_h=325.58614823053483&sv_p=-1.525405863600696&sv_pid=JeKwUFYAMWXNWPh3IOg3jw&sv_z=1.3008183935042945.

[217] A flipped classroom approach reverses the flow of instruction. In this model, students usually learn at home from instructional online resources, such as videos, and meet to work on what might be thought of traditionally as "homework." The change in format switches the dynamic from an instructor-centered model to a learner-centered model.

through a PowerPoint of images, we can now offer students a chance to digitally transport themselves to another learning environment. Doing so can bring cultural heritage space to them, like in the experience created by Intel and the Smithsonian American Art Museum (SAAM) where virtual docents talk to classes about the exhibition *No Spectators: The Art of Burning Man*.[218] A virtual experiential learning activity can enrich the online learning environment for students who often feel left out of the typical educational experience received on a physical campus. On-campus learning provides students with easy, location-based access to fundamental educational resources, such as libraries, learning labs, archives, and a supportive community.

Remote learners, through the use of XR technologies, can access a greater level of support than was previously available because they can participate in live discussions with subject matter experts and peers within a virtual environment that mimics physical educational spaces. Of course, many of these educational resources are not free. For example, a virtual field trip to the National WWII Museum is $100 for a class, with discounts available for higher volume classes (National WWII Museum Website). However, some free options are available and more are being provided at a growing rate. Steve Sato has been using Google Expeditions[219] with his students for several years now. When he started, there were approximately six hundred VR and AR experiences and now there are over a thousand for instructors to choose from (Sato

[218] For a video and article related to the technology used to showcase the exhibition, see: https://newsroom.intel.com/news/intel-smithsonian-american-art-museum-power-education-immersive-virtual-reality/#gs.LpImixZt.

[219] For more information, see: https://edu.google.com/products/vr-ar/expeditions/?modal_active=none.

2019: 3:38).[220] Mr. Sato believes we can level the playing field by granting access through technology. To illustrate his point in our conversation, Mr. Sato used the example of a student who might live in an area where there is no easy access to a zoo, the ocean, or a landmark like the Grand Canyon. For him, sharing those experiences, even in a mediated way, has value for his students and their education. In the same way that teachers have been using photographs, film, or television to supplement their lesson plans, XR is being used more and more as another window to the world. Former history teacher Kai Frazier has started a company CuratedxKai[221] to produce immersive field trips for students, with special attention on bridging the gap for underprivileged communities. Currently, CuratedxKai has over thirty 360° immersive experiences[222] available on their website, accessible with a free account.

Immersive Learning

Immersive technology also obviously promotes immersive learning, meaning learning through non-linear, dynamic engagement where activity can be exploratory and iterative to enable realization, those "ah-ha" moments that are personal and memorable. Imagine the possibilities for learning in a virtual environment where you are able to explore a gallery at your own pace and in your own way, taking a path that resonates with you or through a space that is significant to you. Google Arts and Culture was able to reconstruct parts of the National Museum

[220] To browse Google Expeditions spread sheet for VR and AR experiences, see: https://docs.google.com/spreadsheets/d/1uwWvAzAiQDueKXkxvqF6rS84oae2AU7eD8bhxzJ9SdY/edit#gid=0.

[221] For Kai Frazier's website, see: https://curatedxkai.com/.

[222] To view the immersive experiences currently available, see: https://curatedxkai.com/3-vr-field-trips/.

of Brazil after it experienced a terrible fire.[223] To have some semblance of the space back provides hope for those involved in greater cultural heritage preservation and study that continued learning can still happen from those prized materials, despite the fact that they are no longer extant.

Experiences that bring lost culture back in digital form can provide learning opportunities that foster lessons about cultural significance and the value of heritage. In addition to offering rigorous academics, RHCD focuses on supporting agile, well-rounded student development. Mr. Sato shared that the RHCD program seeks to also build soft skills like "empathy, collaboration, and communication" through their lesson plans. In our discussion, Mr. Sato noted that Jam Studio VR[224] has an educational and health care edition that emphasizes Social Emotional Learning (SEL) through VR musical interactive play. The curriculums were developed to "benefit children of all ages, anyone requiring physical & cognitive therapy exercises, and individuals with a variety of disabilities and special needs (such as Down syndrome, Autism, Muscular Dystrophy, Cerebral Palsy, Spinal Cord Injuries, Intellectual Impairment, Physical Impairment, and much more), including their friends & family members," according to the Jam Studio VR website (Jam Studio VR). In the instance of Jam Studio VR, the immersive elements help promote an interactive engagement that strengthens a variety of physical, creative, and critical learning skills while also offering therapeutic benefits. Another example of interactive-learning that Mr. Sato shared with me is when the fourth-grade studies the Gold Rush. Mr. Sato organizes a classroom VR experience where the students explore mining camps from a historical

[223] To access the immersive experience, see: https://artsandculture.google.com/project/museu-nacional-brasil.

[224] For more on Jam Studio VR, see their website: http://www.jamstudiovr.com/.

first-person perspective. “There is something about the kinesthetic aspect of it,” he said; “Yes, you have the visual and you have the audio […] but there’s something about the interaction that just solidifies and creates these really strong memories based on these experiences” (Sato 2019: 14:40). Mr. Sato has the students do the immersive mining experience before they go on an extended fieldtrip to pan for gold, so that they are prepared with historical knowledge and realize the harsh conditions the miners faced.

Mr. Sato has also spent two years partnering with the University of Southern California and the Shoah Foundation to bring RHCD students the “Dimensions in Testimony”[225] project. Led by Bill Swartout, David Traum, Paul Debevec, the project uses an archive of Holocaust survivor testimony to produce an experience that simulates an interview. Students can ask questions and the “survivor” response with the most appropriate answer that was recorded from the archive. As an opportunity for primary source engagement within the classroom, Mr. Sato expressed excitement that the experience will soon be available in VR.

Digital immersive learning also comes with great responsibility on behalf of the instructor in terms of onboarding not just technical skills, but a sophisticated sense of appropriate interaction that is sensitive to the subject matter at hand. During the fifth panel entitled “Ethics, Avatars, and Difficult Histories” at the Advanced Challenges in Theory and Practice in 3D Modeling of Cultural Heritage Sites conference at University of California Los Angeles in June of 2016, Dr. David Neville, project lead for the Grinnell College Immersive Experience Lab (GCIEL), gave a presentation, “The Uncle Sam Plantation: A 3D/VR Learning Environment for Teaching Lost and Difficult Histories,” regarding a historical reconstruction of a southern

[225] To read more about the ongoing project, see: http://ict.usc.edu/prototypes/new-dimensions-in-testimony/.

plantation house in the United States.[226] In the discussion following the presentation, Dr. Marisa Parham, Professor of English and director the Immersive Reality Lab for the Humanities (IRLH) at Amherst College, brought up profound points about how the experiences would likely translate very differently for people of color, particularly of African American descent. In her reaction to the project she broached the question of where the experience "starts." If a person enters the experience and is placed directly in the slave quarters, that is a very different point of view than if the person starts the experience in the grand foyer of the main house. With a technology that simulates an embodied point of view, Dr. Parham also expressed concern that a virtual experience of this nature might imply that the user is embodying a person of a different race. Additionally, because of 3D and VRs history and connection with the gaming industry, virtually simulated experiences risk being "gamified," where a user treats them not with the respect one would an educational cultural environment, but as a fun videogame where the rules of reality are gleefully challenged. With such sensitive cultural material, the value of the reconstruction needs to be weighed alongside what is at stake within the presentation of the material in a digitally immersive manner. Instructors likewise need to be prepared to address student behavior within the digital experiences. Physical, psychological, and emotional warnings should be spelled out to users prior to entering the experience. For Mr. Sato, part of this acknowledgement of the risks involved comes by way of a permission slip. Before students engage with any digitally immersive experience at RHCD, Mr. Sato has a document sent home for students' parents to review and sign.

Resources like Steve Bambury's YouTube playlists for immersive experiences in various

[226] For more information on the Uncle Sam Plantation project, see: https://unclesam.sites.grinnell.edu/author/nevilled/.

disciplines (including "Art and Design"[227] and "Performance"[228]) and the community he is building through platforms like VirtualiTeach[229] will help establish a standard for implementing XR into classroom settings. However, a sense of criticality and caution is warranted. While instructors like Elizabeth Cappello at Mount Saint Mary College in Newburgh, New York fostered her students' art historical appreciation through the use of VR and AR in the classroom (Cappello 2017), the concept of "transporting" can produce a touristic approach that risks detracting from the significance of the subject matter. Even still, the notion of digital immersion remains compelling for educators and projects like Dr. Bernard Frischer's Rome Reborn,[230] has demonstrated a way forward for translating virtual historical scholarly reconstructions into immersive VR for education. The Rome Reborn experience has been made available for classroom use through partnerships with Khan Academy and SmartHistory with great success.[231]

More research is needed to support our understanding of digital immersive learning. In discussing his observations from employing digital immersive learning in classrooms, Mr. Sato expressed that "when you link those critical core senses together […] hearing, sight, movement engaged on a single task, it really reinforces whatever they are doing at that moment. And so, if one of our goals as teachers is to transfer knowledge, and there needs to be studies, but my hunch

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[227] To access the experience in Steve Bambury's "Art and Design" playlist, see: https://www.youtube.com/playlist?list=PLtZ7rcj9igDlwivjPodh48hRNGVbnhNVU.

[228] To access the experience in Steve Bambury's "Performance" playlist, see: https://www.youtube.com/playlist?list=PLtZ7rcj9igDkQJh0J9CagdvS2XfeARliq.

[229] For the VirtualiTeach website, see: https://www.virtualiteach.com/.

[230] For the Rome Reborn website, see: https://www.romereborn.org/.

[231] According to Dr. Frischer's personal website, the Rome Reborn videos on Khan Academy have over two million views, making it one of the most popular projects within the arts and humanities category (http://frischer.org/).

is that it is enhancing the learning and increasing retention" (Sato 2019: 15:30). As the fields of art, art history, and cultural heritage engage XR technologies for sharing work with audiences immersively, critical thought will need to develop around the framework for the experiences. XR offers a powerful method for the future of learning that could change the landscape of training in certain fields of study by way of a more embodied approach.

DH Learning

Lastly, the framework of Digital Humanities (DH), which uses computing methods to do humanities research and study, offers a lesson in reflexivity for students in order to cultivate a criticality regarding digital tools and their uses. As we increasingly access, share, and create information digitally, we must re-evaluate our critical approaches. Working with these new technologies within the classroom allows for students and scholars alike to investigate the productive tension that results from combining computational methods with humanistic inquiry, which continues to break new ground.

A digital humanities approach recognizes the benefit to increasing students' digital literacy. Building skills that can translate into professional fields is important to Mr. Sato. While having students learn to use trade programs like Unity or Maya is a goal for Mr. Sato, he has seen students master the basic skills of modeling using applications such as CoSpaces,[232] TinkerCAD,[233] and 123D. When AutoDesk, a leader in architectural modeling software, bought TinkerCAD and 123D, Mr. Sato thought it was a good thing for future immersive education. Under the roof of one leading company in the field, he expressed "there is a possibility for a

[232] For CoSpaces website, see: https://cospaces.io/edu/.

[233] For TinkerCAD website, see: https://www.tinkercad.com/.

progression of skills in these programs over time." (ibid: 24:00) In Mr. Sato's opinion, skills for coding, programing, and artificial intelligence (AI) will play a large role in the world in the years to come. As such, he wants his students to at least have a vocabulary around computing so they feel prepared to assess new technologies and make informed decisions, whether it is professionally or in the voting booth. "Exposure to the process early on" he said, "makes them more adept when they head into the field" (ibid: 25:00).

With new technology, there will always be a learning curve, and that is why exposure is critical to learning. Mr. Sato's comments resonated with me on a personal level. I grew up making films, and won my first award at eleven years old. However, when I took up a 360° camera, many of the rules I had been taught changed. There was not a way for me to "frame" the shot because when the images from the two cameras are stitched together, they capture the entire environment. I gained experience through experimenting with the technology, learning what the "tech" did well and what it did poorly. In January of 2017, Bernard Brown choreographed and performed for the Fowler Out Loud Series at the Fowler Museum and he graciously allowed me to document the performance with 360° cameras. Brown presented several solos and small ensemble dances connecting past and present. The case performed in the exhibition *Nkame* (which means "greeting" and "praise" in the language of Abakua). The show was a retrospective of Cuban print maker Belkis Ayon "who mined the founding myth of the Afro-Cuban fraternal society Abakuá to create an independent and powerful visual iconography" (Exhibitions 2016). Brown and the dancers "explore how movement, space, and intention can translate to freedom for the black body, mind, and spirit" (Fowler Out Loud: Bernard Brown 2017). For the performance, two cameras were used; however, one camera overheated during Brown's first solo, melting the data storage chip into the camera. I was not able to recover the footage of this part of the performance. The equipment failure taught me that there may be technical limitations to filming a performance over a long period of time with the first-generation Samsung Gear 360 cameras. In future work, I was prepared for the possibility of the camera overheating and tested it rigorously when I purchased the second-generation of the Samsung Gear 360 camera. The improvements the company made to the camera made a difference, but the camera still does not perform well when the ambient temperature is warm.

Bernard Brown's performance at the Fowler Museum was also my first opportunity to observe people's reaction to the technology within a space. The experience revealed ways that setting can dictate behavior with unfamiliar devices. The technology within the space had a Duchampian[234] effect, causing visitors to gaze pensively at the object as if to question if it was part of the exhibition. Interested in the phenomena brought on by the camera, I decided to change tactics when attending a show at the LA Contemporary Art Gallery. While the footage was again able to gather information on people's reaction to the camera in the space, I opted not to use a tripod and carried the camera myself instead. In this way, the documenter is included in the documentation. In the digital humanities, we often talk about exposing the choices made within the process of the project or while creating the data. I see this exposure as an extension of that practice. At the art show, when I tested a gallery's new digital touch screens for displaying subscription-based digital artwork, the 360° camera captured my interactions and reactions simultaneously, directly implicating myself within the research documentation.

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[234] Marcel Duchamp was an artist of the modern period whose work was influential at the beginning of the 1900s. He is well known for "readymades," an artistic concept by which he would take an object from daily life, title, date, sign, and place it within a gallery to "make" the object into art. One of his most famous works is "Fountain," which was a urinal turned on its side. Duchamp's readymades challenged numerous aspects of the art world, from production to display.

To better prepare students, we should take advantage of the growing immersive experiences and tools available for teaching and learning. Within the Institute for Digital Research and Education, Dr. Lisa M. Snyder is the Office of Instructional Technology's (OIT) Director of Campus Research Initiatives at UCLA. She is also the Acting Director of the Research Technology Group (RTG), and Manger of GIS, Visualization, and Modeling Group within the RTG. Her dissertation and continuing scholarship are examples of experiential instructional technology research for the study of architecture (Snyder 2003). VSim, the platform she developed to navigate and present 3D models and environments for teaching and learning (as I have previously discussed), demonstrates a suite of functionality that is responsive to stakeholder's needs. While Dr. Snyder's dissertation focused on the use of the technology in architectural history survey courses, she notes that "there is a broad range of disciplines that could benefit from the use of experiential learning environments. Future research should focus on developing and testing a prototypical learning environment, integrating the environments into the survey classroom, testing impacts on student learning, and identifying other likely users and classroom opportunities" (ibid, 302). My research has also indicated a desire for the humanistic development and implementation of digital tools for arts and cultural heritage learning, particularly in the area of XR technology. In future educational study of XR applications, researchers can build on Dr. Snyder's foundations through a greater survey of the work being done by instructors like Mr. Sato, who are on the front lines for implementation of digitally immersive learning.

Conclusion

Investing in immersive documentation of exhibition spaces provides a prototype for sharing spatial- and design-oriented epistemologies that promotes discussions about the significance of the placement of artworks in a physical installation. Additionally, annotated 360° panoramic tours or 3D reconstructed environments suggest a framework that preserves thematic research content alongside cataloging and design information. Immersive learning experiences of museum and cultural heritage sites critically promote a paradigm shift in museum studies' teaching and learning for exhibition preservation and practice. Curators and creators of panoramic exhibitions tours and virtual environments can foster a greater focus on connections for visitors and students by encouraging rhizomatic thinking through the inclusion of contextual documentation. Highlighting where and how people are seeing the relationship of objects within space calls attention to the individualized and personal experience. Everyone moves through an environment in a way that is particular to them. There are benefits to directed lecturing, but we can also enhance learning by allowing for students and publics to assert their own agency through spatial exploration. Allowing people to navigate, make choices, and create their own learning experience is powerful. In her upcoming article for the Journal of Digital Art History, Johanna Drucker utilizes fictional prose to probe at the future of museums, archives, and collections when sensory technologies make visiting the past as real as the present and interconnected with encyclopedic store of knowledge that can be called up at a whim. While she leaves her reader with an uneasiness as to what that future may cost humanity, her fictional virtual Muse@um portal experience conveys the resonance and wonder that only the privileged few feel when they enter within a museum's hallowed halls (Drucker, forthcoming). However, Drucker's imagined scenario will not be possible if we do not capture and preserve those spaces today.

In this chapter, I reviewed three platforms for 360° panoramic virtual tour documentation and presentation of exhibition space. My field research, which consisted of my own experimentation and interviews with two other practitioners using XR technology for teaching and learning, aggregated lessons learned within the field. These perspectives offer a foundation from which others in the field can build. The chapter also brought together examples of others in the field who are exploring the power of creativity and play within the classroom to inspire and engage curiosity through the use of XR platforms. The four pedagogical frameworks I cover (object-centered learning, distance/online learning, immersive learning, and Digital Humanities) offer insight into how GLAM organizations can think about adopting new technologies to educate audiences with their collections and exhibition spaces. In doing so, GLAM institutions can also begin to document their exhibition work for the archive, preserving spatial context alongside rigorous scholarly interpretation.

Part III:

Conclusions

Chapter 8: XR Implementation Checklist: Recommendations for Implementing XR into Arts and Culture Settings

Throughout this dissertation, I have investigated challenges and opportunities that digital tools present to fields of art, art history, and cultural heritage today. When practitioners at GLAM organizations break from "traditional" models and use digital modes for publication, display, and information capture, they generate potential to reach new audiences and engage publics in novel ways that can pique interest, foster curiosity, and produce excitement. The digital modalities produce a distinct paradigm for epistemologies of art and culture. Human interaction helps to create what Virtual XR objects and environments are: experiences. By joining the areas of Digital Humanities and Digital Art History, Museum and Curatorial Studies, and ways of seeing and technologies of vision as understood through Media Studies, and Culture and Performance Studies, I have addressed a spectrum of immersive modalities and extended reality (XR) technologies within museum and cultural heritage contexts. In doing so, the dissertation makes a case for establishing implementation standards for XR within museums, where the very notion of XR problematizes the object-centered methods of display and representation.

During my research period from 2015 to 2019, I observed substantial changes in XR landscapes, which can fit a model known as a "Hype Cycle." Developed by the Gartner firm, which performs research and provides advice for fields within information technology, the line-graph visualization describes the transformation within expectations that takes place over time, from the release of a new technology to its general adoption/ steady development (Fenn and

Blosch 2018).[235] Starting in 2015, I witnessed a proliferation of XR media that rose to a "Peak of Inflated Expectation" in 2017 with *The New York Times* producing "The Daily 360" and Alejandro González Iñárritu's VR experience winning the Special Achievement Academy Award. It had been twenty years since the academy last chose to bestow this award. I have also noted a "Trough of Disillusionment" that followed after the surge. In 2018, many companies in the XR sector experienced a funding drop off (Lee 2019). The popular refrain within the news media became that VR was fading away again; it still was not ready for "prime time."

With the establishment of entities like the Software Preservation Network, the International Image Interoperability Framework, and the Community Standards for 3D Preservation, in addition to initiatives such as "Lib3DVR" and "Scholarship in 3D: A Proposal for a Digital Edition Publishing Cooperative," funded by Andrew W. Mellon Foundation and the National Historical Publications and Records Commission, academic institutions are now pushing up the "Slope of Enlightenment." Creating standards and best practices will lead to the technology's ability to reach the "Plateau of Productivity," where the bridging of theory to practice can become more regular and increasingly regulated.

In this concluding chapter, I offer a loosely organized set of recommendations in the spirit of moving the field toward forming a set of best practices. First, I provide summaries of key points within XR practice that have emerged from the dissertation research. These topics provide scaffolding for the XR Implementation Checklist that follows, which guides practitioners when creating or displaying XR works in connection with arts and cultures venues. Finally,

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[235] For the visualization of the Hype Cycle developed by Jackie Fenn and Marcus Blosch for Gartner, see https://www.gartner.com/en/research/methodologies/gartner-hype-cycle.

future areas of research and development for XR are suggested to support cultural heritage and arts education applications.

Introduction to the XR Implementation Checklist and Conditions for Use

The XR Implementation Checklist is meant as a starting point or a litmus test to assess a XR museum project proposal prior to implementation.[236] As a document designed to help GLAM organizations in their preparation, it offers a set of directives to help practitioners gauge the type of implementations that will be possible. The checklist can also assist in managing stakeholder expectations by demonstrating clear criteria to track implementation efforts. The goal of the XR implementation checklist is to guide "practitioners," including artists, content creators, curators, archivists, educators, and technologists, within GLAM institutional settings.

The list is not meant to be all-inclusive, but it is a thorough review of critical aspects to XR implementation. The checklist looks to address key challenges and areas of concern involving access, inclusion, usability, user experience, communication, staff training, documentation, preservation, stakeholder support, associated cost, outreach, education, and assessment. Considerations in each of these areas are addressed in sections prior to the checklist, so that readers have the related issues in mind before reviewing the suggested implementation items. These sections range from providing specific relevant examples to general best practices and project management recommendations. Practitioners using the XR implementation checklist should adjust and apply the list as it is appropriate. While tasks are grouped within the list, the

[236] The XR Implementation Checklist is not designed for a classroom setting. Future scholarship may involve a broader look at XR use in the classroom to produce an implementation checklist for art historical, cultural heritage, and museum studies classes.

list is not in a particular order. Practitioners should reorder the tasks within the list based on their own implementation plan and schedule.

Access, Inclusion, and Usability/User Experience

Often conflated, “accessibility,” “usability,” and “inclusion” have distinct meanings. Jasmine Clark, Resident Librarian at Temple University Library, hosted a five-part webinar series on “Designing Accessible, Usable, and Inclusive Digital Projects" in January and February of 2019 to define each area clearly and address best practice approaches when implementing new technologies. Her presentations and discussions drew attention to principles, policies, and standards to help build conscious awareness of accessibility, usability, and inclusivity issues when implementing digital tools (particularly VR technology) into public learning spaces. Clark explained that for a digital application to be accessible, access must be possible for disabled or differently abled users. Attention to accessibility prevents discriminatory practices by attempting to build or offer equivalent user experiences for people with disabilities (which also includes people with age-related impairments). For online content and digital tools, accessibility means that people with disabilities can “perceive, understand, navigate, and interact” with websites and tools, and that they “can contribute equally without barriers” (Henry 2016). For an application or set of equipment to be usable, people must be able to access the technology efficiently. In this way, usability and user experience design are linked. For a product to be usable, it has to be designed in a manner that makes it “effective, efficient, and satisfying” for users in achieving their goals (ibid). For an environment or platform to be inclusive, access needs to be equitable, addressing a person’s requirements until their experience aligns with the standard that is set for all. While the one-size-fits-all model fails in its promise, adopting universal design principals and building multimodal systems can help increase a project's usability and inclusiveness. Designing to reach the greatest audience possible avoids the need for adaptations, which can cause users to feel excluded or "singled-out" (from What is Universal Design: http://universaldesign.ie/What-is-Universal-Design/). The issues of inclusion can be wide-ranging, assessing both access to and the quality of software, hardware, and Internet connectivity. Inclusive practices also address concerns regarding difference in digital literacy and skillsets, economic situations, education, geographic location, language, age, and disability (Henry 2016).

While not mutually exclusive, understanding delineated and specific meanings of "accessibility," "usability," and "inclusion" foster a more critically-aware practice. Achieving progress on these fronts permits a more successful implementation of XR and helps GLAM institutions fulfill their mission of community service more broadly. *Appendix A* is "Project Gap Analysis Rubric" developed by Jasmine Clark to assess the extent to which a digital project is accessible, usable, and inclusive. Through seven layers of criteria, practitioners rate a total of twenty-one elements as "Weak (1)," "Average (2)," or "Strong (3)" and tally their results. Access to detailed project information makes the "Project Gap Analysis Rubric" most useful. However, the elements combine well with the XR implementation checklist as a way to think about accessibility, usability, and inclusion within the early stages of a project. Clark stressed within her presentations that even if practitioners do not have the time or resources to accomplish everything within the rubric, considering such matters is a substantial step.

Communication and Staff Training

Having well-defined and clear communication with the public through written policy and trained staff can improve visitor experiences, especially in the case of unfamiliar technology. Additionally, within her presentations, Clark emphasized the importance that clear and transparent communication and policy play to reaching and serving a diverse public when digital tools are involved. By adding "creating and updating policy" as a line item within a project plan, practitioners further parameterize and define the project's mission. Policy can address how content is being created, included or accepted by creators or a wider public. It can explain a vetting process to manage who is reviewing, editing, or producing content. Setting policy can document how financial transactions such as reimbursement occur or what content can be shared in what way due to issues of copyright, cultural sensitivity, or legality. Policy can guide staff when dealing with problematic content that may need to be redacted, augmented, or corrected. Taking time to be specific within policy will help others understand the priorities of your work.

In the case of displaying XR technology, it will be crucial to set policy that explicitly states a stance in cases where people do not have access to technology and what to do when it is required for an experience. Clark highlighted that the mode and/or platform of delivery requires consideration. The means by which you communicate with your audience or visitors can increase or hinder your effectiveness. This includes stating policy in a place that is visible to those to whom it applies. Placing important communications on an online website is not helpful to those who do not have access or choose not to use certain kinds of technology. Consideration for more language options may be essential depending on the crowd who will be participating in the experience. While it may be impossible to have a policy for everything, it is good practice to have a policy in place for dealing with the unknowns when they arise. This could be as simple as having a suggestion box onsite, which is checked every week. The larger public will likely play a crucial role in helping to shape future etiquette and policy around XR display.

In addition to setting written policy, staff who interact with visitors will be an essential mode of communication. As I discussed in Chapter Six, “technical facilitator” is a new role developed to assist in the use of generally unfamiliar XR technology in exhibition settings. The field is beginning to form standards and practices, like those describe in the article by Juno Rae and Lizzie Edwards when discussing the Bronze Age VR experimental experience at the British Museum. Rae and Edwards found that an instructional video was not practical for the activity of administering the VR headsets, so they opted for a one-to-one support model where “Samsung family facilitators” were available to describe the experience and how to navigate it to guests (Rae and Edwards 2016: 6). Additionally, these facilitators were responsible for learning the visitor’s name, helping them into the headset, and timing their experience. (Due to the non-linear nature of the experience, visitors were given approximately five minutes within the headset to interact with the virtual objects and environment.) Finding out a visitor’s name was an adjustment made to their facilitation methods because in early trials they found that many visitors were difficult to communicate with when in the headset because they were so immersed in the experience (ibid). Using a visitor’s name assisted facilitators with this complication within communication. In addition, extra-facilitators were on hand for “hot-swaps” to recharge the mobile phone batteries that last roughly three hours. The workflow assisted in maintaining a steady pace in visitor engagement with the activity. Finally, the VR experiences were supported by analog writing and drawing activities, as well as object replicas and 3D printed models of objects within the virtual experience. These activities operated on several practical levels, offering alternative engagements and understandings, as well as helping manage people's attention while they were in line for the VR experience.

One aspect that Rae and Edwards did not discuss in their article was if the facilitators were given any instruction for the physical interaction that is required when assisting visitors in putting on a headset or if signs were posted with warnings regarding the possible health risks involved with using a headset. As technology that is place on the head, the headsets need to adjust to fit, and it takes time to fine-tune the focal length to make sure the picture is not blurry. If a visitor has glasses, extra care is needed to make sure the headset does not break the glasses. If the straps have Velcro, they can get caught in a visitor's hair. When in the headset, users may begin to move in directions where they can bump into things, and staff may need to touch them to prevent them from colliding into things or from cords getting tangled. Staff will need to be trained on how to handle situations like these and make sure they have verbal permission from users to assist them physically throughout the experience. Signed waivers may help communicate to visitors what exactly the immersive experience entails (unexpected or loud soundscapes, sensitive topics, intense visual stimuli, mirrored-floors, etc.) to allow for visitors to make an informed decision prior to participating or request accommodations or alternatives if they are available. When a public is unfamiliar, GLAM organizations should demonstrate responsible practice by offering a large amount of information in as many formats as possible.

Garnering Support

As discussed in Chapter Six, business and technical partnerships play a significant role in the current XR display landscape. An increase in adoption will require support on an institutional leadership level with GLAM organizations. Looking to those who have crossed similar terrain, the Getty's Online Scholarly Catalog Report offers key insights for preparing a digital project in ways that engender institutional support. From the "Nine Lessons Learned" section of the report, lessons two, three, six, eight, and nine are particularly helpful in targeting project areas which can strengthen the case for granting the needed project funding and resources. Lesson two, "Choose Technology Wisely," recommends using functional design documents, which clearly define the functionality and intentions of the experience, to build understanding between creators, investors, and technologists. In lesson three, "Rightsize the Project," the OSCI report makes suggestions on how to appropriately scale the project. The T-shirt approach (small, medium, or large) is a useful method for determining what "size" the project is.[237] To utilize the T-shirt approach, find examples of what your team would consider small, medium, and large XR projects to use as comparators. Based on the examples, define what category you believe your project most closely resembles and begin to plan accordingly. Lesson three also discusses the benefits of delimiting your project's requirements and goals. Setting limits assists in clearly tracking project gains, troubleshooting project blockers, and avoiding the temptation of scope-creep. Lesson six, "Find Ways to Serve Multiple Audiences," adds to the previous discussion of accessibility, usability, and inclusion by considering they ways audiences may wish to engage with an experience. The OSCI report references the National Gallery of Art's "skim, swim, dive" approach, which help practitioners identify the type(s) of engagement they wish to provide their audiences, from introductory to deeply proficient. Lesson eight, "Get the Right People and Structure in Place," is likely the most essential component for implementation overall. The OSCI report rightly advocates for a team approach, hiring and

[237] I learned this method from John Lynch, Academic and Technology Manager of the Humanities Technology group at UCLA.

prizing “project managers,” identifying new roles (which may take time and some trial and error), and organizational and workflow restructuring to accomplish project goals. Entitled “Think Sustainably,” lesson nine of the OSCI report reminds practitioners to consider long-term aspects of the project work that can enhance its value and investment over time. In pursing XR work, developing project pipelines will improve the process through iteration. Demonstrating change over time can help to advocate for more resources through merit-worthy work. It can also assist in projecting future outcomes, and promote thinking in terms of phases of development rather than single finished projects. Each of these project-based strategies garner support for implementation through proficient planning and communication.

Additionally, identifying key deterrents early will help prevent waylaying. In 2003 Lisa M. Snyder published her dissertation research on the use of experiential technology for teaching of architectural history, which covered individual and instructional deterrents to the use of new instructional technology. Many of her findings can be generalized to settings outside of the classroom where technology and learning still intersect. People often default to the technology they believe to be most expedient (Snyder 2003: 65). Fixed beliefs about the operation of their field and loyalty to familiar technology can hinder acceptance of new methods (ibid: 54-62). Unfamiliarity with emerging or alternative technology may cause possible stakeholders to decline involved because they are uncomfortable with technological change (ibid).

Finally, due to ever-present budgetary constraints, the proposal to adopt new technology can produce anxiety and resistance, in comparison to tried and proven methods (ibid: 130). In my interview with Steve Sato, Director of Technology at Rolling Hill Country Day School, he also added that the biggest barrier he faces to implementation is concerns regarding how much time it will cost instructors. While his experience draws from work within a classroom setting, accuracy in terms of time will be critical for implantation. In addition, Mr. Sato noted that prior to any implementation, he needed approval from the school's administration, classroom teachers, and computer lab teacher. Coordinating and convincing stakeholders is a significant task in achieving institutional "buy-in." To gain administrative support for XR classroom programs, Mr. Sato found that "the fewer words, the better." Avoiding overly technical descriptions of the process and addressing key concerns such as time, scope, resources, and milestones will generate momentum and institutional support for XR implementation or most any digital project.

Documentation and Preservation[238]

The issue of access and discoverability is not simply a matter of permissions and availability. To identify, locate, retrieve, and reuse 3D materials requires consideration of a multiplicity of content types, and a community and financial investment to resolve challenges related to usability, interoperability, sustainability, and equity. With this in mind, I have been working with a team within the Community Standards for 3D Preservation (CS3DP) group to identify the current forms of 3D production, and consider their requirements for long-term access.

We have identified four primary categories of 3D materials. The first is reality-based forms of 3D production that are generated from physical data that has been measured by technical instruments. This category includes photogrammetric models, scanned volumetric models, scanned surface models, and digital terrain models. The next category is procedural/algorithmic models that are created computationally based on rules or shape grammars. Our third category of 3D forms contains born-digital, sources-based model types,

[238] Parts of this section were co-authored with members of the CS3DP "access" group.

which encompass manual models (i.e., built with 3D modeling software), virtual worlds, and immersive virtual environments. Our fourth and final category of 3D materials are games, which can take the form of many of the previous model types, but also require very specific interactions related to game-play (e.g. goal objectives, activities, stages). Cross-cutting these four categories is the distinction between 3D objects and 3D scenes, each with their own unique access and long-term preservation requirements and challenges.

After identifying all the current forms of the 3D production, we have been considering the appropriate files for preservation for the different forms of 3D data. In the upcoming publication, we will likely share the matrix we created that identifies for each 3D type the source material, methods of construction/creation/capture, hardware and software used in their creation, outputs (file types, metadata, paradata, etc.), derivatives, and methods of interaction. In doing so, we also assessed each 3D type to determine what would be the minimum files needed for access (i.e., files required for reuse) and the maximum files that could be desirable for preservation (i.e., files that document the project and design reasonings, or would be required to reproduce the 3D object). Additionally, the team developed a list of the features necessary for academic use and reuse of 3D materials. The preliminary list was used to inform consideration of the software and hardware required for long-term access and included navigation and interaction; spatial annotations for text, audio, image, and video; citations that can reference the scholarly generated content within the 3D model; tours, pathways, or some form of guided experience; metadata and paradata; interpretive apparatus such as comparison or layered commentary; branding/watermarking; protection of intellectual property; and the creation of derivatives.

As mentioned in Chapter One, the viewer landscape continues to shape issues of discovery, access, and reuse. Developing and following standards that increase interoperability will help to ensure long-term access and preservation of XR material. Attention and adherence to metadata and technical standards will enable reuse of the XR material across any number of open-source or commercial players. Practitioners in the field should continue to look to organizations like the IIIF 3D community and the CS3DP group as leaders within the area for guidance.

In identifying challenges related to access and discovery of XR data, the question of open-source is significant. In making a commitment to the promotion of open data and open access, consideration must be given to circumstances where site locations and virtual objects are culturally sensitive. In the spirit of mitigation, compromise, and ethical practice, XR practitioners should identify what access looks like for underserved and at-risk communities with consideration of the digital divide and equity issues. Additionally, I recommend generating some exemplative use cases. In doing so, practitioners can approximate the needs of particular communities, practitioners, and their applications. For example, there may be a benefit in weighing the pros and cons for instances when XR materials should be hosted offline instead of online for classrooms and communities that do not have internet access. Other situations may reflect the need for a more responsive design to accommodate various hardware types. Finally, when attending to issues of access, inclusion, usability and user experience, thorough user testing by diverse set of people will be critical. User testing also opens lines of communication, which in turn can help those implementing XR to better understand what is of importance for their users and stakeholders.

Preservation of immersive technology and content will be a central concern for future field research and development. Essential to this mission is a way to standardize the preservation of complex digital works. These standards will need to take into account the differing requirements for scholarly use and reuse and a more general public's needs for engagement. Additionally, GLAM organizations will need to find technological and financial solutions to fulfill their responsibility to preserve and complete forward migration workflows on 3D resources. 3D data is complex and usually requires a large amount of storage. Dr. Kristina Golubiewski-Davis concurred in her interview that 360 photos or videos, as image-based technology, are familiar file formats and, in that sense, easier for a library to archive, which may make them an appealing alternative for adding spatially contextualizing material to archival records for scholars interested in capturing and preserving spatial data (Golubiewski-Davis 2019: 40:50). Despite their familiarity, high-resolution images still require significant digital storage space. In the case of 360 projects, like UCSC's *Love On Haight 360 Virtual Tour*, the volume and complexity of file formats can easily rival that of a 3D environment or object. When considering platforms and collections offered by resources like University of Michigan Online Repository of Fossils (UMORF)[239] or Duke University's Morphosource,[240] it is still unclear how the field will reconcile these resources with databases like WorldCat,[241] where it will need to be determined what "object" receives a catalog entry; just the overall project or every separate tooth? The field would also benefit from the formal development and adoption of a citation system for 3D materials and their layered annotations or resources. The citation format should include a reference to the coordinates both on the x, y, z access, but also including details on h, p, r, when available.

[239] For UMORF's online repository, see: https://umorf.ummp.lsa.umich.edu/wp/.

[240] For Morphosource's online database, see: https://www.morphosource.org/.

[241] For the WorldCat website, which is the largest online network of library content and services, see: https://www.worldcat.org/.

Associated Costs

The cost of XR technology can vary dramatically, from Google Cardboard headsets for under $10 available through Amazon to studio-level volumetric video rigs that cost thousands of dollars. Different types of costs will be associated with different stages of development and implementation. The associated costs of creating an XR experience will usually be more than simply displaying one. In my interview with Dr. Golubiewski-Davis, she discussed the UCSC Library's decision to purchase Samsung Gear 360 cameras and a Galaxy Note 8 mobile phone to begin a library equipment lending program (Golubiewski-Davis 2019: 15:20). While she noted that two graduate students had expressed the wish for cameras that could provide higher-resolution and greater depth of field range, she expressed the library's need to weigh the range of impact the program could have for its diverse set of patrons against the needs of a few (ibid: 17:50). Ultimately, XR implementation operates as linked network where desired impact, cost, and time are linked and must shift to accommodate the parameters of the project. For example, a higher impact project will likely require a large investment in time and budget. An even greater budget may mean the project can be accomplished faster through the purchase of better equipment or more staff time.

XR technology is still in fairly rapid development with substantially better equipment release within a year or two of the present writing in 2019, so I advise XR practitioners to conduct an equipment assessment based on their project's needs in order to draft the best budget proposal possible. Not likely to be one-time investments, like buying a painting, related hardware and software will require regular upgrades. Thorough consideration should be given to the financial expense and proprietary platform issues. *Appendix B* is an example spreadsheet compiled by Andrew Jessup and Shan Vartanian of UCLA's Humanities Technology group for building a portable VR cart for classes in the Humanities that may wish to incorporate VR into their lesson plans.[242] UCLA's Humanities Technology group is responsible for technical support, training, development, and infrastructure for Humanities instruction and research at UCLA. Like Dr. Golubiewski-Davis at the UCSC Library, their mission is to serve a broad and diverse set of departments, faculty, and students. In determining their needs, they realized that a mobile cart would be important, so that technology could be portable for classroom use across campus. Additionally, the two distinctive budgets within the spreadsheet show that they assessed if building a customized computer processing unit (CPU) was more cost effective than purchasing a VR gaming consult, in this case, the PlayStation 4. Currently, the popular mid-range headset models are the Oculus Rift and the HTC VIVE, which cost three-hundred and fifty and five hundred dollars, respectively. Compatible computers that are required to operate the headsets are nearly a thousand dollars for a desktop or around seven hundred for a laptop. If the XR installation that requires headset-use is only temporary, practitioners may consider equipment rentals rather than making a large investment through a personal or business purchase. Additional costs to consider are VR store purchases to download games or experiences, stands for sensors, disposable sanitary masks and access to terabytes of storage if pursuing game development.

[242] I also want to acknowledge Thomas Garbelotti at UCLA's Humanities Technology, who involved me in the development of the VR implementation process within the Rolfe Learning Lab. The discussions we had drew my attention to considerations for VR serving the broader discipline of the humanities, which includes language learning.

Outreach and Education

Outreach and education are central to the mission of GLAM organizations. As an underlining value of cultural heritage institutions, their community service contributes to a greater historical understanding and cultural identity. The contact zone for these learning opportunities can extend beyond museum or gallery walls (Clifford 1997). The use of XR technologies, collections materials, scholarship, and educational techniques can be combined for rich learning resources online and in instructor led experiences.

Two scholars, Corrado Petrucco and Daniele Agostini from the University of Padova, wrote an article entitled "Teaching Our Cultural Heritage Using Mobile Augmented Reality" in 2016 regarding their project proposal for teaching primary and middle school children the cultural and historical importance of several of Italy's famed walled cities using AR applications on mobile devices. Working with Italia Nostra and other cultural and educational associates, Petrucco and Agostini formulated a broad intent for their proposed project: "From a pedagogical and educational point of view the emphasis is on a constructivist social-cultural approach which helps students become active citizens more aware of their historical identity," by layering 3D models, maps and other data onto actual physical landscapes through the use of augmented reality (Petruccio and Agostini 2016: 115). The pilot project was "Verona Roman Mobile Learning" in March 2015 which involved seven primary school classes ("5th Year" students) (ibid: 121). As with the British Museum project discussed in Chapter Seven, which dovetailed with the national curriculum for historical study requirements in England, this project was geared to the Italian students' curriculum in the fifth class which includes the study of Roman civilization: a Verona tour led by an historian and their teachers of the Roman remains in Verona "to understand their function and meaning." The classes were divided in half so that half the class would use a mixed reality tool in conjunction with the historian's explanations during the tour and the other half would use a paper aid with material equivalent to the MR tool instead. The tour was proceeded by classroom preparations including a two-hour lesson plan which also acquainted students with the technology to be used during the tour. The interpretive process was to include observation of the environment during the tour of the city and the experience was videotaped to provide quantitative and qualitative data for research purposes after completion.

Usability was an immediate issue noted by the authors as the students frequently did not know how to use smart phones and tablets and ignored many of the basic functions. They also noted that students expected quick reactions from the application and interpreted any delays as malfunctioning (ibid: 124-125). Early follow-up interviews were conducted after this "quasi-experimental" approach with the two classes who had gone all the way through the process. As with the results from the British Museum VR experience, these results from students and teacher were "general" impressions and quite positive. Teachers reported that even with "rowdy" students who typically lacked concentration, when using the AR tools these students had greater focus on the material being discussed (ibid: 125). Student professed high interest in the subject matter and appreciated the way the material was presented with the AR tool and wanted to have it used more. Both the teachers and students seemed to recognize the effectiveness of the technologies for learning. Resulting from their study, Petrucco and Agostini advocate that AR technology and project-based learning can bridge formal and informal learning (ibid: 126). Combining AR with cultural heritage content, Petrucco and Agostini attest that informal learning spaces have the potential to be as relevant and important as classroom learning environments.

While recognizing the benefits of XR implementation like Petrucco and Agostini, GLAM institutions should consider the ramifications of leveraging personal devices for educational-related XR experience. In my interview with Mr. Sato, on the topic of using personal mobile devices for school-related activities, he stated, "Schools aren't providing one-to-one devices for students. If they are, they're likely chrome books, which aren't designed for high-end AR" (Sato 2019: 14:00). Additionally, Mr. Sato pointed out that leveraging student's devices puts instructors in the position where some will work and some will not. These occurrences risk drawing attention to difference negatively, if a student's (or in a broader case a visitor's) device is not compatible or they do not have one to use. To avoid such situations, a device lending program, similar to audio tour equipment rentals, could be implemented.

Assessment and Measuring Success

The field needs XR studies developed with clear data production methods, assessment techniques, and measurements for success. In each of my interviews, I asked "What do you use for assessment, both for the technology and for student learning with it? How do you define and measure success?" Both Dr. Golubiewski-Davis and Mr. Sato expressed measuring success had been somewhat of an oversight. In the case of the University of Santa Cruz's *Love On Haight 360 Virtual Tour*, Dr. Golubiewski-Davis has relied mostly on metrics and analytics for the library's website and those provided through the ThingLink software. Informal feedback has helped them to make adjustments to the experience, as I covered in Chapter Seven, but detailed user assessments have yet to be conducted. Likewise, Mr. Sato felt like this was something he was not doing but should be consciously tracking. While he could offer meaningful anecdotal student encounters with XR technology, he did not have them preserved in a way that he could then share to motivate stakeholders. His remarks echoed issues of assessment that are being under addressed, considering Rae and Edwards and Petruccio and Agostini's articles, which also sited minimal user experience data. Each article offered sentences of praise for the implantation of the XR activities within their respective settings from participants. While useful feedback, a more rigorous approach could better enhance the implementation team's ability to improve the experience.[243] I would flag this as an area for improvement and an opportunity for the Scholarship of Teaching and Learning (SoTL) community.

One example might be a large sample of user testing of a variety of arts and culture based XR experiences. Those administering the testing would guide users through the experience, asking questions throughout to understand where users are navigating, when, and why, through each step. The guide would also ask the user questions about their expectations for the experiences functionality and content to assess if the user's expectation were being met and if the encounter matched what they thought it would be. Detailed user testing of XR experiences in this manner would help assessment move past the surface-level praise or concern that is most regularly noted in current project write-ups.

XR "evangelists" are motivated to make necessary changes to see wider adoption and improved results.[244] Jason Jerald aptly describes the current wave of XR practitioners in terms of focus, passion, and drive within his book's dedication (Jerald 2016: 10-11). You could also interpret those qualities as insular, navel-gazing, and fanatical. XR will need to continue to seek

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[243] As an aside, gaining user feed-back has been a museum exercise for quite some time now. When I worked at LACMA, part of my duties involved asking visitors if they would be willing to fill out surveys regarding the exhibitions they saw. Often this feedback is collected to satisfy funding sources, especially those of the US government when support for the Humanities is perennially challenged. Yet needs to "justify" expenditures are only one use for such feedback. Community input can help keep an organization responsive to a wide range of stakeholder interests and concerns. However, for developing specific programs and XR experiences for the long-term, a more robust "user-testing" style approach will be needed.

[244] The term "technology evangelist" has been modified to apply to those within the specific immersive tech fields (Lucas-Conwell 2006).

broader forms of assessment if it wishes to be accepted and incorporated into the mainstream. If museums need to provide a hand-held personal experience with assistants for an exhibition of XR works, the circumstances significantly shift the scale of support when compared to an exhibition of painting or sculpture. The question becomes: should success also be measured in terms of costs and benefits? With many shallow, commercial and entertainment applications, a respectable but experimental set of educational resources, and a growing handful of serious art works, what threshold of success must XR meet to warrant continued investment and investigation? If experiences can cultivate art (or other discipline specific) appreciation in certain communities, like early technology adopters, is that enough? While one could wish that art should never be dictated by such practical matters, the reality for most institutions is one of careful balance and consideration.

Admittedly, much of the discussion in this dissertation is descriptive and anecdotal, and the claims about success are often from within interested parties' points of view. Notably though, "thick description" applies to work in virtual and museum landscapes as much as it did in the fieldwork of the early anthropologists (Geertz 1988: 531-552). In such a fast-moving world of innovation, surveying the landscape is valuable to document the details that may be lost otherwise over time. Therefore, a qualitative emphasis serves to texture the future historical record. Careful to avoid traps of synecdoche, the descriptions offered within the dissertation help bring definition and nuance to a field in development.

XR Implementation Checklist[245]

- ☐ Understand the standards related to your content and its production, presentation, and preservation.
- ☐ Identify a metadata schema that fits your content and user community's needs.

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[245] See *Appendix C* for a printable version of the XR checklist.

- Build persona profiles to carefully consider how the technology can be used by differently-abled bodies and people of different ages.
- Seek out differently-abled people to test the equipment and experience to provide feedback for improving the experience.
- Build thorough use cases to examine possible scenarios to prepare for through policy setting, clear communication, and staff training.
- Identify audiences who may be sensitive to the subject matter or physical experiences and make a plan for addressing their concerns through trigger warnings or cautionary health notices.
- When building an experience, start small and build in time for planning, storyboarding, and prototyping. For example, if the goal is to document an exhibition in 360 and create a virtual tour with annotations, start with one room (Golubiewski-Davis 2019: 27:00). Share your results early to improve user experience and garner institutional understanding and support.
- Do due diligence with community-related stakeholders, as appropriate.
    - Consult with experts in the field of disabilities and computing for guidance on creating workflows within the exhibition space that address concerns regarding things like wheelchair accessibility, hearing impairment, and visual impairment.
    - Consult with local community leaders to make sure the experiences are responding to the surrounding cultural environment and values.
    - Consult with experts in diversity and inclusion to avoid exclusionary or deterring practices.
    - Consult with communities related to the collection objects that are being represented virtually to ensure that the digital treatment of the objects is respectful of and in line with their cultural beliefs, values, and practices. Form formal partnerships when possible to acknowledge cultural authority.
    - Consult with educational specialists to produce and present materials in ways that are optimal for teaching and learning.
    - Consult with relevant technologists to confirm the most appropriate tools are being utilized to meet your goals.
- Develop policies and workflows for audiences without access to technology. Offer analog alternatives where possible and train staff on how to relay those options to visitors.
- Make policies available in non-digital formats and place them in areas that are visible to visitors. Train staff to help guide visitors to this information when needed.
- Track the time you invest in production, documentation, and implementation.
- Develop a workflow to address new concerns or issues. Do you need twenty-four hours or two weeks to answer a complaint, write a new policy, identify resources, or complete a specific action?
- Confirm that the location for the “installation” is outfitted for the XR experience(s) needs. These could include:
    - Space for movement and/or equipment, which may include marked areas and/or barriers for safety. Consider the heights of your users and the actions that will be required to make use of the installation within this preparation.
    - Electrical outlets with certain power capacities.
    - Access and control of room temperature and humidity

- The need to hang or mount projects using the ceiling or walls, bolting equipment or items to the floor.
  - Stands or wall mounts for placing computers, controllers, and headsets.
  - Consider using an electricity usage tracker to estimate the experiences power consumption for budgetary purposes.
- Prepare a data management and storage plan and budget.
  - When budgeting, evaluate if this will be a one-time investment
  -   Consider benefits and drawbacks before investing in particular proprietary hardware and/or software
  - Leave room for upgrades
  - Evaluate funding and equipment partnerships carefully to assess if they are in line with institution and project values
  - Develop data management and storage standards early and make use of current best practices as recommended by organizations like CS3DP, IIIF, and the Software Preservation Group
- Define how staff will be involved with managing and facilitating XR experiences and how you will communicate their role and responsibilities to visitors.
  - Post trigger warnings or cautionary health notices.
  - Consider diversity among the facilitator staff.
  - Consider adopting time limits for users with XR displays.
  - Consider how best to manage an installation queue and if an analog or alternative media option will be provided.
  - Consider having facilitators introduce themselves and briefly explain their role to visitors.
  - Have facilitators explain that they may need to touch the visitor to assist them with equipment (headset or controllers) or prevent them from running into obstructions and ask for permission to do so. This may also be handled through a waiver that participants could be asked to acknowledge or sign before the experience.
  - Have facilitators ask for the visitor's name before they help them put on the headset.
  - Create a plan for situations in which the system needs to be recalibrated for users of different heights.
- Be strategic about equipment.
  - Assess the experience requirements and consider your operations model before purchase equipment.
  - Identify if you need the equipment to serve particular needs or support a range of options for content creation and engagement.
  - Plan routine maintenance for cleaning, charging, and checking the functionality of equipment. Consider swapping out equipment regularly, providing sanitizing products, or hygienic protective masks.
  - Create a workflow for handling when technology breaks and have backup equipment available, if possible.
  - Choose a tool that allows you to effectively manage your screen real estate to avoid overwhelming the user.

        - For performance work, practice with the equipment in near-performance-like conditions as a “stress-test” for issues like internet speed and bandwidth (if you are livestreaming an event in 360), overheating the camera, or data storage for long recordings.
    - If developing an experience, consider use and reuse.
        - Review relevant resources on best practices such as CS3DP’s forthcoming publication, (Jerald 2016), (Tricart 2018), (Yang 2019), and (Snyder 2018).

Next Steps and Outstanding Questions and Research

The intention of this dissertation has been to provide a broad perspective on challenges and opportunities for the use of XR in arts and cultural heritage repositories and learning settings. Each of the chapters in Part II could be developed into entire research projects in themselves. The field would benefit from a survey of current practices and challenges. Future scholarship could involve conducting more qualitative interviews with current practitioners who implement XR for arts, cultural heritage, and related classroom learning. The conversations I had over the course of the fieldwork were incredibly rich and offered deep insight from a practitioner’s perspective.

Synthesizing the lessons learned within various implementations can help provide the eagle’s eye perspective the growing XR field needs in order to produce standards that will allow for greater interoperability across platforms and devices. Field research often takes time to receive approval and funding. Additionally, it takes more time to conduct the research, and make adjustments along the way. By the time the work gets published, others who could have benefited from the information have had to make decisions and move their projects forward. For this reason, conferences have been a great source for exchange regarding the quickly moving field of XR. The more that we can produce reports that build a shared state of the field perspective, the more quickly we can address key challenges, as seen in the work of scholars like

Sherry Turkle. Conducting hundreds of interviews amidst key periods of adoption and use, Turkle's research provides a rich tapestry of perspectives on personal computing and mobile device use (Turkle 2005, 2016, and 2017).

State-of-the-field reports can also help build cross-disciplinary solutions for implementation. From STEM to Arts and Cultural Heritage, many fields are considering the benefits of XR implementation. Cross discipline coalitions and shared resources could help strengthen institutional "buy-in." In February of 2019, UCLA's Executive Vice Chancellor and Provost released a report that was commissioned by the office to investigate "the idea of a multi-disciplinary Virtual Reality Institute at UCLA" (Virtual Reality Task Force 2019: 1). The report contains the results of a faculty survey conducted in the fall of 2018 to assess the breadth of research on campus that involves XR technologies. Additionally, the task force compiled a list of XR related "programs, centers, institutes, labs and projects" at major universities to review the XR work occurring at peer institutions (ibid: 2). The task force also held a symposium with cross-disciplinary examples of XR scholarship. As a result of their research, the task force recommended that UCLA should take steps to found a XR Institute due to the breadth of development and available expertise within the field on campus. The report demonstrates an interdisciplinary trajectory for the future of XR practice, research, and scholarship.

"Practitioners" including artists, content creators, curators, archivists, educators, technologists, all have challenges that represent future work. Areas of the dissertation research were fueled by my own experiments within the field. In moving forward, I plan to continue that engagement and produce more XR work myself. I hold learning from experience as an important value within research. In my future endeavors within XR, I hope to foster greater creativity and self-expression, increasing my mastery as a producer, in addition to consumer. Digital

Humanities has shown me that creating online resources and tools can have an immense impact. In the Spring 2019 issue of *Georgetown Magazine*, Kate Colwell discusses the work of Psychology professor Rachel Barr in her article entitled “Raising Children in the Digital Age: A Profile in Georgetown University Psychological Research”. In the interview, Professor Barr says that research shows “when you track kids over time, it’s the kids in low-resourced homes that are benefitting most from high-quality media” (Colwell 2019: 23). I feel a responsibility to continue to build more and better digital media projects that can enrich student learning and produce greater equity within education.

While there are many arenas of XR that this dissertation did not address, I would have liked to focus on concepts of visual storytelling and connections to the genre and method of the documentary. I believe XR has great potential within these areas, but the research I gathered did not fit the scope of this project. Additionally, I did not seek to address issues of preservation as a dedicated chapter within this dissertation, though it was an ever-present topic woven throughout my work. The issues around archiving and preserving XR material are vast and I was only able to cover a fraction of the work that the Community Standards for 3D Preservation Group has been accomplishing for the field. CS3DP intends to produce a guide for the critical appraisal of 3D forms to facilitate the identification of reliable models/scenes for easy forward migration, long term preservation, and reuse.

In a future iteration of the project, I wish to pursue a digital format for the presentation of this project. My primary source videos and projects are part and parcel of the research and should be part of its outcome, in order to better illustrate what the immersive has to offer the fields of cultural heritage and museum studies. For the greatest impact and understanding, the digital works from the case studies should be experienced visually in tandem with my written contextualization, analysis, reflection, and theorizing. Digital platforms Scalar, Manifold, or Fulcrum, which supports the use of multimedia and online sources for scholarly digital publishing (as discussed in Chapter Five), would be better suited to present my argument than a static document. UCLA's Graduate Division requires that dissertations be submitted as PDFs so that they can filed and stored within the ProQuest database. Had I been able to present my various digital and media methods in direct communication with one another, pairing traditional text and images with interactive additions such as hyperlinks and videos, I could have challenged the academic dissertation model of the static document and called attention to the imaginary notion that any object is fixed or permanent. While flat text and images are still the standard for much of academic publishing, the dynamics of interactive publications require us to think differently about the work. For instance, when I reference any of the numerable digital art history projects that are available on the Web, a hyperlink would allow readers to immediate experience that object for themselves.[246] When that person continues reading the dissertation, their reaction becomes more of a conversation with my scholarship, since they now have their own experience to compare with my description. The interactive element provides the reader with greater agency over their learning experience. In continuing to aggregate information on XR experiences, I will seek to find a digital way of presenting and preserving research.

[246] For this reason, I have included the websites for many sources within the footnotes. I see these as primary texts that were mined as part of my research.

Appendix A: Gap Analysis Rubric by Jasmine L. Clark [247]

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Project Gap Analysis Rubric

This rubric is meant to act as a guide to help assess whether a project is accessible, inclusive, and usable.

Definition of Criteria

1. **Deliverables:** the parts of the project that will be presented to users (the data/information you want to share).

2. **Audience:** Those meant to use and interact with deliverables.

3. **Mode and Platform of Delivery:** The means by which deliverables are delivered to the audience (hardware/software) and the publisher or host of selected format (providers of that hardware/software)

4. **Sustainability/Preservation:** Is the project one that is meant to be sustainable or preserved? Is the content important to preserving information regarding underrepresented groups? Is there a preservation plan in place?

5. **Accessibility:** Are the deliverables/mode of delivery accessible to disabled populations?

6. **Inclusion:** Should those who are low income, ESL, low literacy, or marginalized in some way have access to, or be centered in your deliverables? If so, do they have it? Are your set audience and collaborations excluding important stakeholders?

7. **Usability:** Can users successfully and efficiently navigate your mode and platform of delivery to access deliverables?

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[247] Included here with permission from Jasmine L. Clark. Current draft finalized in 2018.

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Criteria	Weak (1)	Average (2)	Strong (3)
1. Deliverables	Project's deliverables have not been assessed for any of the criteria.	IRB, copyright, and other defined legal/institutional/organizational criteria are met. I.e. "Can I share this?"	Along with the previous criteria, more nuanced philosophical and ethical concerns have been addressed including: cultural sensitivity, risks associated with poor contextualization, etc. I.e. "Should I share this"
2. Audience	No audience is specified.	Audience is identified without underlying data. Ex: This book is written for high school students.	Audience is specified and researched. Ex: According to federal and state census data, the Philadelphia school district is ~50% Black/African American with a significant number of students qualifying for government assisted meal plans.
3. Mode and Platform of Delivery	-Format does not support effective data use/access. -Format is obsolete, not supported, unreliable, etc. -Platform is questionable, not widely available, or hard to get to.	Format is effective and supported. Format has accessibility features. Platform is reputable. Mode of delivery is not	Along with previous criteria: Format is assessed for sustainability (long term preservation potential) and long term access to data. Platform prioritizes accessibility.

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	Mode of delivery is proprietary, expensive, hardware limited, or otherwise difficult for intended audience to access.	proprietary, expensive, hardware limited, or otherwise difficult for intended audience to access.	-Platform is ethical in publishing practices with appropriate terms of use.
4. Sustainability/ Preservation	No preservation plan in place	Preservation discussed with repository/archivist/etc. after project	Preservation discussed and planned at beginning of design process.
5. Accessibility	Not legally compliant/ not assessed for legal compliance. Not assessed for perceivability, operability, robustness, understandability Accessibility information not present.	Remediated to compliance or assessed for compliance with plans to remediate. Accessibility information present.	Designed to compliance or programmatically determined. Accessibility information easy to find, upfront and transparent.
6. Inclusion	Format and Platform of Delivery rated weak. Deliverables rated weak. Accessibility rated weak. Stakeholders not addressed or invited to participate/provide feedback.	Format and Platform of Delivery rated average. Deliverables rated average. Accessibility rated at least average. Stakeholders acknowledged through appropriate research, lack of direct consultation addressed.	Format and Platform of Delivery rated strong. Deliverables rated strong. Accessibility rated strong. Stakeholders are consulted and supported with appropriate research.

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7. Usability	User testing has not been performed. Users are unable to locate or use deliverables due to navigation conventions being inconsistent. Directions pertaining to navigation conventions are not available. Mode of delivery not functioning or rated weak.	Basic user user feedback is solicited after launch. Navigation conventions are consistent. Directions pertaining to navigation conventions are available. Mode of delivery functions.	Along with previous criteria, user testing has been incorporated before launch.
			Total: _____ /21

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Appendix B: Example Equipment Evaluation Spreadsheet for Portable VR Cart for Rolfe Lab at UCLA.[248]

Part	Model	Cost	Notes	Link
CPU	Intel Core i7-8700K	$376		https://www.amazon.com/Intel-i7-8700K-Desktop-Processor-Unlocked/dp/B07598VZR8/?tag=li-org-main-20
GPU	RTX 2070	$500		https://www.newegg.com/Product/Product.aspx?Item=N82E16814487413&nm_mc=AFC-C8Junction&cm_mmc=AFC-C8Junction-LogicalIncrements.com%20Inc-_-na-_-na-_-na&cm_sp=&AID=10440897&PID=5961731&SID=0
HDD	Seagate ST4000DM006 4TB	$161		https://www.amazon.com/dp/B01MSW4MNS/?tag=pcpapi-20
SSD	Crucial MX500 500GB	$70		https://www.amazon.com/Crucial-MX500-500GB-NAND-Internal/dp/B0784SLQM6/?tag=li-org-main-20
Case	Fractal Design	$139		https://www.newegg.com/Product/Product.aspx?item=N82E16811352029
Motherboard	GIGABYTE Z390 GAMING	$152		https://www.newegg.com/Product/Product.aspx?Item=N82E16813145093&nm_mc=AFC-C8Junction&cm_mmc=AFC-C8Junction-LogicalIncrements.com%20Inc-_-na-_-na-_-na&cm_sp=&AID=10440897&PID=5961731&SID=0
CPU Fan	be quiet! 250W TDP Dark Rock Pro 4	$81		https://www.newegg.com/Product/Product.aspx?Item=9SIA68V6YA3005&Description=dark%20rock%20pro%204&cm_re=dark_rock_pro_4-_-9SIA68V6YA3005-_-Product
Power Supply	EVGA Supernova 750 G3	$118		https://www.amazon.com/EVGA-SuperNOVA-Modular-Warranty-220-G3-0750-X1/dp/B005BE058W/?tag=li-org-main-20
RAM	G.SKILL Ripjaws V Series 16GB (2 x 8GB) 288-Pin DDR4	$100		https://www.newegg.com/Product/Product.aspx?Item=N82E16820232181&ignorebbr=1&nm_mc=AFC-C8Junction&cm_mmc=AFC-C8Junction-PCPartPicker,%20LLC-_-na-_-na-_-na&cm_sp=&AID=10446076&PID=3938566&SID=
PC Case Screws		$8		https://www.amazon.com/LINDY-Security-Screws-PC-Cases/dp/B000I2JWE0
		Sub-Total		
		$1,705		
Cart	Peerless	$450	B&H	
Monitor	Samsung UN49NU8000FXZA Flat 49" 4K UHD 8 Series Smart LED TV (2018)	$544.00	Amazon	https://www.amazon.com/Samsung-49NU8000-Flat-Smart-2018/dp/B079NRXDKQ/ref=sxin_10_osp21-02f5c2ea_cov?ascsubtag=02f5c2ea-ebf2-4dc9-a416-a2a5eeb8526e&creativeASIN=B079NRXDKQ&crid=15PAMUWEH7T6L&cv_ct_id=amzn1.osp.02f5c2ea-ebf2-4dc9-a416-a2a5eeb8526e&cv_ct_pg=search&cv_ct_wn=osp-search&keywords=55%2Binch%2B4k%2Btv&linkCode=oas&pd_rd_i=B079NRXDKQ&pd_rd_r=1a341169-8023-498d-8528-b9773eaa4291&pd_rd_w=yMuJT&pd_rd_wg=NThdL&pf_rd_p=37dcfc87-cdc2-4138-941e-56f6d8e6b463&pf_rd_r=ECZNH035FXM2NZM8MS2Q&qid=1551989096&s=gateway&sprefix=55%2Binch%2B%2Caps%2C276&tag=onsitertings-20&th=1
ps4	ps4	$399.00	Amazon	https://www.amazon.com/PlayStation-4-Pro-1TB-Console/dp/B01LOP8EZC/ref=sr_1_3?keywords=PS4&qid=1551991814&s=gateway&sr=8-3&th=1
ps4	vr bundle	$319.00	Amazon	https://www.amazon.com/PlayStation-VR-Skyrim-Bundle-Discontinued-4/dp/B076PW5K56/ref=sr_1_8?keywords=PS4+vr+bundle&qid=1551990952&s=gateway&sr=8-8
ps4	game	$50.00	Amazon	TBD
ps4	game	$50.00	Amazon	TBD
Cables	Misc. Cables	$75.00	Amazon	TBD
		$1,895		

[248] Created by Andrew Jessup and Shan Vartanian in 2019 and used with permission here.

Appendix C

XR Implementation Checklist
Developed by Francesca Albrezzi
Version 1, June 2019.

The XR Implementation Checklist is meant as a starting point or a litmus test to assess a XR museum project proposal prior to implementation.[249] As a document designed to help gallery, library, archive, and museum (GLAM) organizations in their preparation, it offers a set of directives to help practitioners gauge the type of implementations that will be possible. The checklist can also assist in managing stakeholder expectations by demonstrating clear criteria to track implementation efforts. The goal of the XR implementation checklist is to guide "practitioners," including artists, content creators, curators, archivists, educators, and technologists, within GLAM institutional settings.

The list is not meant to be all-inclusive, but it is a thorough review of critical aspects to XR implementation. The checklist looks to address key challenges and areas of concern involving access, inclusion, usability, user experience, communication, staff training, documentation, preservation, stakeholder support, associated cost, outreach, education, and assessment. Considerations in each of these areas are addressed in sections prior to the checklist, so that readers have the related issues in mind before reviewing the suggested implementation items. These sections range from providing specific relevant examples to general best practices and project management recommendations. Practitioners using the XR implementation checklist should adjust and apply the list as it is appropriate. While tasks are grouped within the list, the list is not in a particular order. Practitioners should reorder the tasks within the list based on their own implementation plan and schedule.

XR Implementation Checklist

- ☐ Understand the standards related to your content and its production, presentation, and preservation.
- ☐ Identify a metadata schema that fits your content and user community's needs.
- ☐ Build persona profiles to carefully consider how the technology can be used by differently-abled bodies and people of different ages.
- ☐ Seek out differently-abled people to test the equipment and experience to provide feedback for improving the experience.
- ☐ Build thorough use cases to examine possible scenarios to prepare for through policy setting, clear communication, and staff training.
- ☐ Identify audiences who may be sensitive to the subject matter or physical experiences and make a plan for addressing their concerns through trigger warnings or cautionary health notices.
- ☐ When building an experience, start small and build in time for planning, storyboarding, and prototyping. For example, if the goal is to document an exhibition in 360 and create a

[249] This iteration of the XR Implementation Checklist is not designed for classroom settings.

virtual tour with annotations, start with one room (Golubiewski-Davis 2019: 27:00). Share your results early to improve user experience and garner institutional understanding and support.

- Do due diligence with community-related stakeholders, as appropriate.
    - Consult with experts in the field of disabilities and computing for guidance on creating workflows within the exhibition space that address concerns regarding things like wheelchair accessibility, hearing impairment, and visual impairment.
    - Consult with local community leaders to make sure the experiences are responding to the surrounding cultural environment and values.
    - Consult with experts in diversity and inclusion to avoid exclusionary or deterring practices.
    - Consult with communities related to the collection objects that are being represented virtually to ensure that the digital treatment of the objects is respectful of and in line with their cultural beliefs, values, and practices. Form formal partnerships when possible to acknowledge cultural authority.
    - Consult with educational specialists to produce and present materials in ways that are optimal for teaching and learning.
    - Consult with relevant technologists to confirm the most appropriate tools are being utilized to meet your goals.
- Develop policies and workflows for audiences without access to technology. Offer analog alternatives where possible and train staff on how to relay those options to visitors.
- Make policies available in non-digital formats and place them in areas that are visible to visitors. Train staff to help guide visitors to this information when needed.
- Track the time you invest in production, documentation, and implementation.
- Develop a workflow to address new concerns or issues. Do you need twenty-four hours or two weeks to answer a complaint, write a new policy, identify resources, or complete a specific action?
- Confirm that the location for the “installation” is outfitted for the XR experience(s) needs. These could include:
    - Space for movement and/or equipment, which may include marked areas and/or barriers for safety. Consider the heights of your users and the actions that will be required to make use of the installation within this preparation.
    - Electrical outlets with certain power capacities
    - Access and control of room temperature and humidity
    - The need to hang or mount projects using the ceiling or walls, bolting equipment or items to the floor
    - Stands or wall mounts for placing computers, controllers, and headsets.
    - Consider using an electricity usage tracker to estimate the experiences power consumption for budgetary purposes.
- Prepare a data management and storage plan and budget.
    - When budgeting, evaluate if this will be a one-time investment
    - Consider benefits and drawbacks before investing in particular proprietary hardware and/or software
    - Leave room for upgrades

    - Evaluate funding and equipment partnerships carefully to assess if they are in line with institution and project values
    - Develop data management and storage standards early and make use of current best practices as recommended by organizations like CS3DP, IIIF, and the Software Preservation Group
- Define how staff will be involved with managing and facilitating XR experiences and how you will communicate their role and responsibilities to visitors.
    - Post trigger warnings or cautionary health notices.
    - Consider diversity among the facilitator staff.
    - Consider adopting time limits for users with XR displays.
    - Consider how best to manage an installation queue and if an analog or alternative media option will be provided.
    - Consider having facilitators introduce themselves and briefly explain their role to visitors.
    - Have facilitators explain that they may need to touch the visitor to assist them with equipment (headset or controllers) or prevent them from running into obstructions and ask for permission to do so. This may also be handled through a waiver that participants could be asked to acknowledge or sign before the experience.
    - Have facilitators ask for the visitor's name before they help them put on the headset.
    - Create a plan for situations in which the system needs to be recalibrated for users of different heights.
- Be strategic about equipment.
    - Assess the experience requirements and consider your operations model before purchase equipment.
    - Identify if you need the equipment to serve particular needs or support a range of options for content creation and engagement.
    - Plan routine maintenance for cleaning, charging, and checking the functionality of equipment. Consider swapping out equipment regularly, providing sanitizing products, or hygienic protective masks.
    - Create a workflow for handling when technology breaks and have backup equipment available, if possible.
    - Choose a tool that allows you to effectively manage your screen real estate to avoid overwhelming the user.
    - For performance work, practice with the equipment in near-performance-like conditions as a "stress-test" for issues like internet speed and bandwidth (if you are livestreaming an event in 360), overheating the camera, or data storage for long recordings.
- If developing an experience, consider use and reuse.
    - Review relevant resources on best practices such as CS3DP's forthcoming publication, (Jerald 2016), (Tricart 2018), (Yang 2019), and (Snyder 2018).

References

Albrezzi, Francesca. 2019. *Virtual Actualities: Extended Reality Technologies and Museums*. PhD diss., University of California, Los Angeles.

Golubiewski-Davis, Kristina. Interview by Francesca Albrezzi. Zoom Recording. Los Angeles, February 8, 2019.

Jerald, Jason. 2016. *The VR Book: Human-Centered Design for Virtual Reality*. [San Rafael]: Morgan & Claypool.

Snyder, Lisa Marie. 2018. "VSim: Interface Software and Online Repository and Archive to Facilitate Distribution and Educational Use of Three-Dimensional Computer Models of Historic Urban Environments." NEH Digital Humanities Implementation Grant #HD-50164-14 White Paper. National Endowment for the Humanities, December 27. https://securegrants.neh.gov/publicquery/Download.aspx?data=EbwGdSyLkD7zoB3W75cvd%2bXST%2bWypC%2bllBU2ufu2RULwbUhBjXJaukHmx8Tleg3x%2fx5XKXhjPTv50YZ9EBc3MgqPkIsjTuX6AJ32XoiVNwc3AzY%2feF24LT1RlMIOwPjJIMjucS%2fe2h7y091TH2FCXfQWF9ducIoU.

Tricart, Celine. 2018. *Virtual Reality Filmmaking: Techniques & Best Practices for VR Filmmakers*. New York: Routledge, Taylor & Francis Group, 2018. http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=1662196.

Yang, Kenneth C. C. 2019. *Cases on Immersive Virtual Reality Techniques*. Hershey, PA: IGI Global.

Bibliography

A Companion to Digital Humanities, ed. Susan Schreibman, Ray Siemens, John Unsworth. Oxford: Blackwell, 2004. http://www.digitalhumanities.org/companion/.

Adams, Susan. "The 25-Year-Old Behind The Museum Of Ice Cream." *Forbes*. May 19, 2017. https://www.forbes.com/sites/forbestreptalks/2017/05/19/the-25-year-old-behind-the-museum-of-ice-cream/#132f88ca2e4e.

Albrezzi, Francesca et. al. 2016. "Physical Exhibit Tour." The Industry of Uplift: Silent Race Film, The Lincoln Motion Picture Company and George P. Johnson Website. https://dh150racefilmexhib.wixsite.com/theindustryofuplift/physical-exhibit-tour

Albrezzi, Francesca, Johanna Drucker, Steven Nelson, Miriam Posner, and Todd Presner. 2016. *Digital Art History 101: A Basic Guide to Digital Art History*. UC Regents. https://ucla-beyond-slide-library.github.io/DAH101/About.html

Albrezzi, Francesca. "Making, Curating, & Engaging Data - UCLA Digital Seminar Series." YouTube. March 15, 2017. https://www.youtube.com/watch?v=lfEOlwVmTiM&feature=youtu.be.

Albrezzi, Francesca. 2016. "Report on the 104th Annual CAA Conference," *HASTAC* (blog), November 18, 2016. https://www.hastac.org/blogs/francesca-albrezzi/2016/11/18/report-104th-annual-caa-conference

Albrezzi, Francesca. 2015. *Visiting Digital Tombstones: Unearthing Questions of Digital Personhood, Commemoration, and Remembrance Processes*. eScholarship, University of California. http://www.escholarship.org/uc/item/8zq1c5xj.

Alliance for Networking Visual Culture. "All New Editorial Workflow Features Debut with Scalar 2.5." University of Southern California. January 22, 2019. https://scalar.me/anvc/all-new-editorial-workflow-features-debut-with-scalar-2-5/.

Anderson, Benedict. 2016. *Imagined Communities: Reflections on the Origin and Spread of Nationalism*. London: Verso.

Anderson, Chris. 2017 [2013]. "20 Years of Wired: Maker Movement." *WIRED*. October 04, 2017. https://www.wired.co.uk/article/maker-movement.

Anderson, Steve F. 2017. *Technologies of Vision: The War Between Data and Images*. MIT Press.

Arup Foresight + Research + Innovation. 2014. Museums in a Digital Age, London: Arup.

Aufderheide, Patricia, and Peter Jaszi. 2015. *Code of Best Practices in Fair use For the Visual Arts*. http://bibpurl.oclc.org/web/80840.

Baca, Murtha. 2013. "Getty Voices: Rethinking Art History," *Getty Iris* (Blog). March 4, 2013.

Baca, Murtha and Anne Helmreich. 2013. "Introduction," *Visual Resources*, 29:1-2, 1-4, DOI: 10.1080/01973762.2013.761105

Baca, Murtha, Anne Helmreich, and Nuria Rodríguez-Ortega. 2013. *Digital art history*. Oxfordshire, U.K: Routledge/Taylor & Francis Group. http://www.tandfonline.com/toc/gvir20/29/1-2.

Baca, Murtha, et al. 2015. *Pietro Mellini's Inventory in Verse, 1681: A Digital Facsimile with Translation and Commentary*. Los Angeles: Getty Research Institute. http://hdl.handle.net/10020/mellini.

Baca, Murtha, et al. 2015. "History of the Project." *Pietro Mellini's Inventory in Verse, 1681: A Digital Facsimile with Translation and Commentary*. Los Angeles: Getty Research Institute. http://hdl.handle.net/10020/mellini/about

Baca, Murtha, et al. 2015. "List of Works." *Pietro Mellini's Inventory in Verse, 1681: A Digital Facsimile with Translation and Commentary*. Los Angeles: Getty Research Institute. http://hdl.handle.net/10020/mellini/works

Bakhtin, Mikhail. 1984. *Rabelais and His World*. Bloomington: Indiana University Press.

Bal, Mieke. 1996."The Discourse of the Museum," in *Thinking About Exhibitions*, edited by Reesa Greenberf, Bruce W. Ferguson, and Sandy Naime, London: Routledge, pp. 200-218.

Bambury, Steve. "VR in Art Education Panel Discussion inside Engage March 1st 2019." YouTube. March 08, 2019. https://www.youtube.com/watch?v=oR0vvJ-yoek.

Bambury, Steve. "Interview with The Grandfather of VR Tom Furness inside Engage". Filmed [March 2019]. YouTube video, 1:31:09. Posted [March 2019]. https://youtu.be/rGkRdHVChvo.

Barthes, Roland, and Richard Howard. 2010 [reprint edition]. *Camera Lucida: Reflections on Photography*, Hill and Wang.

Battles, Matthew and Michael Maizels. 2016. “Collections and/of Data: Art History and the Art Museum in the DH Mode,” *Debates in the Digital Humanities 2016*.eds. Gold, Matthew K., and Lauren F. Klein. Minneapolis, MN; London: University of Minnesota Press. 325-344.

Benjamin, Walter. 1999. *The Arcades Project*. trans. Howard Eiland and Kevin McLaughlin. Cambridge: Harvard University Press.

Benjamin, Walter, and Michael W. Jennings. "The Work of Art in the Age of Its Technological Reproducibility [First Version]." *Grey Room*, no. 39 (2010): 11-38. http://www.jstor.org/stable/27809424.

Bennett, Tony. 1996. “The Exhibitionary Complex,” in Thinking About Exhibitions, edited by Reesa Greenberf, Bruce W. Ferguson, and Sandy Naime, London: Routledge, pp. 81-112.

Bentkowska-Kafel, Anna. 2015. "Debating Digital Art History." *International Journal for Digital Art History*[Online], 0.1.

Berger, Peter L. 1967. *The Sacred Canopy: Elements of a Sociological Theory of Religion*. Garden City, N.Y.: Doubleday.

Bergson, Henri. 1990. *Matter and Memory*. Trans. N.M. Paul and W.S. Palmer. New York: Zone Books.

Bergson, Henri. 1910 [1889]. *Time And Free Will: An Essay on the Immediate Data of Consciousness*. Trans. F.L. Pogson. London: George Allen and Unwin.

Bernhard, Mathias. 2016. "Gugelmann Galaxy: An Unexpected Journey through a collection of Schweizer Kleinmeister." *International Journal for Digital Art History* [Online], 0.2.

Berwick, Carly. “Up Close and Personal with Google Art Project,” *Art in America*; Apr 2011, Vol. 99 Issue 4, p23.

Bird-David, Nurit. 1999. “‘Animism’ revisited: Personhood, environment, and relational epistemology.” *Culture - a Second Chance?*. 67-91.

Bishop, Bryan. "How Two Bit Circus Is Turning Its 21st Century Carnival into One Giant Game." The Verge. August 22, 2018. https://www.theverge.com/2018/8/22/17764018/two-bit-circus-micro-amusement-park-escape-rooms-virtual-reality-immersive.

Bishop, Claire. 2017. “Against Digital Art History.” *Humanities Futures*, Franklin Humanities

Institute, 9 Mar. 2017, humanitiesfutures.org/papers/digital-art-history/.

Bishop, Claire. 2015. “Against Digital Art History.” *International Journal for Digital Art History* [Online], 0.1.

Bleeker, Maaike. 2017. *Transmission in Motion: The Technologizing of Dance*. London: Routledge.

Boluk, Stephanie, and Patrick LeMieux. 2017. Metagaming: Playing, Competing, Spectating, Cheating, Trading, Making, and Mreaking Videogames. https://manifold.umn.edu/projects/metagaming.

Borges, Jorge Luis, and Andrew Hurley. 1999. *Collected Fictions*. New York: Penguin Books.

Bourdieu, Pierre. 1977. “Structures and the habitus.” *Outline of a Theory of Practice*. Trans. R. Nice. Cambridge: Cambridge University Press. 72-95.

Bradley, Ryan. "How Nonny De La Peña, the 'Godmother of VR,' Is Changing the Mediascape." The Wall Street Journal. November 03, 2018. https://www.wsj.com/articles/how-nonny-de-la-pena-the-godmother-of-vr-is-changing-the-mediascape-1541253890?redirect=amp#click=https://t.co/mAG6UqcxxZ.

Breton, André. 2012. *Manifestoes of Surrealism*. [Ann Arbor, Mich.]: Univ. of Michigan Press.

Bronner, Simon J. 1986. “Folk Objects,” In *Folk Groups and Folklore Genres: An Introduction*, edited by Elliot Orig, 199-223. Logan, Utah: Utah State University Press.

Brooker, Peter. 1994. "Key Words in Brecht's Theory and Practice of Theatre." *Cambridge Companion to Brecht,* ed. Thomson, Peter and Glendyr Sacks. Cambridge: Cambridge University Press.

Brown, Deidre, and George Nicholas. 2012. "Protecting indigenous cultural property in the age of digital democracy: institutional and communal responses to Canadian First Nations and Māori heritage concerns". *Journal of Material Culture.* 17 (3): 307-324.

Brown University. "Retooling the Monograph: The Manifold Scholarship Project" with Matthew Gold and Douglas Armato." YouTube. April 20, 2017. https://www.youtube.com/watch?v=DWcgMICuwtI.

Buber, Martin. 1958. *I and Thou*. New York: Scribner.

Canuel, Robin, and Chad Crichton. 2017. *Mobile Technology and Academic Libraries Innovative Services for Research and Learning*.

Cappello, Elizabeth. "Virtual Reality in the Art History Classroom." Art History Teaching Resources. March 15, 2017. http://arthistoryteachingresources.org/2017/03/virtual-reality-in-the-art-history-classroom/.

Carlile, Jennifer. 2004. "A New Way to View London: From a Toilet." NBCNews.com, March 5, 2004. http://www.nbcnews.com/id/4326340/ns/world_news-weird_news/t/new-way-view-london-toilet/#.WhYZv7qIafA.

Caswell, Michelle. 2014. "Seeing Yourself in History: Community Archives and the Fight Against Symbolic Annihilation." *The Public Historian* 36, no. 4. November 1: 26-37.

"Cave Temples of Dunhuang: Buddhist Art on China's Silk Road." Getty Research Institute. May 7–September 4, 2016. http://www.getty.edu/research/exhibitions_events/exhibitions/cave_temples_dunhuang/gallery.html.

Caygill, Howard. 1995. *A Kant Dictionary*. Oxford and Cambridge: Blackwell.

Chang, Heewon. 2008. *Autoethnography as Method*. Walnut Creek: Left Coast Press.

Clifford, James. 1997. *Routes: Travel and Translation in the Late Twentieth Century*. Cambridge, Mass: Harvard University Press.

Clifford, Marissa and Sarah Waldorf. 2017. "5 Cutting Edge Innovation in Art History Tech," *Getty Iris* (Blog). August 21, 2017.

Celaya, Javier. 2016. *AC/E Digital Culture Annual Report 2016: Smart Culture: Impact of the Internet on Artistic Creation. Focus: Use of New Digital Technologies at Cultural Festivals*. Madrid: Acción Cultural Española (AC/E).

Chagollan, Steve. 2018. "Bleeding Edge - Iñárritu's 'Lumiére Moment'." DGA, Homepage. https://www.dga.org/Craft/DGAQ/All-Articles/1801-Winter-2018/Bleeding-Edge-Inarritu.aspx.

Clark, Jasmine. 2019. "Designing Accessible, Usable, and Inclusive Digital Projects" Webinar: Session 2. Temple University.

Colwell, Kate. 2019. "Raising Children in the Digital Age: A Profile in Georgetown University Psychological Research" *Georgetown Magazine*, Spring Issue. http://issues.washcustom.com/publication/?i=578615&ver=html5&p=20

Craig, Emory. "Virtual Reality Artist Live Performance at the Louvre Museum, Paris." Digital Bodies. August 27, 2018. https://www.digitalbodies.net/virtual-reality/virtual-reality-artist-live-performance-at-the-louvre-museum-paris/.

Crary, Jonathan. 1990. *Techniques of the Observer: On vision and Modernity in the Nineteenth Century*. Cambridge, MA: MIT Press.

Cubitt, Sean. 2014. *The Practice of Light: A Genealogy of Visual Technologies from Prints to Pixels*. Cambridge [Massachusetts]: MIT Press.

Cusick, William. 2016. *Virtual Reality and Theater: Simulacra and Simulation*. TEDxTalks. https://youtu.be/SEgSkfflgvg.

"CYPHER." Vimeo. April 09, 2019. https://vimeo.com/276330843.

Diamond, Nina. "The Temple of Dendur: From the Nile to NYC in 360" Digital Underground. Metropolitan Museum of Art. June 6, 2016. https://www.metmuseum.org/blogs/digital-underground/2016/facebook-360-temple-of-dendur.

Dillenberg, Eugene. 2011. "What, If Anything, is a Museum?" *Exhibition: A Journal of Exhibition Theory & Practice for Museum Professionals*. Spring Issue. https://static1.squarespace.com/static/58fa260a725e25c4f30020f3/t/594b9ffb03596e6ae9f19f8c/1498128431536/5+EXH_spg11_What%2C+if+Anything%2C+Is+a+Museum__Dillenburg.pdf.

Doulkaridou, Elli. 2015. "Reframing Art History." *International Journal for Digital Art History* [Online], 0.1.

Drucker, Johanna. Forthcoming. "The Museum Opens." Journal of Digital Art History.

Drucker, Johanna. 2010. "Graphesis: Visual Knowledge Production and Representation," *Poetess Archive Journal* 2.

Drucker, Johanna. 2011. "Humanities Approaches to Graphical Display," *Digital Humanities Quarterly* 5, no. 1. http://www.digitalhumanities.org/dhq/vol/5/1/000091/000091.html

Drucker, Johanna. 2013. "Is There a 'Digital' Art History," *Visual Resources*, 2: 1-2, 5-13.

Eck, Diana L. 2007. *Darśan: Seeing the Divine Image in India*. Delhi: Motilal Banarsidass Publ.

Edgar, Andrew, and Peter R. Sedgwick. 1999. *Key Concepts in Cultural Theory*. London: Routledge.

"Exhibitions." 2016. Fowler Museum Website. https://www.fowler.ucla.edu/exhibitions/nkame-belkis-ayon/.

Fenn, Jackie and Marcus Blosch. "Understanding Gartner's Hype Cycles." Gartner Research. August 20, 2018. https://www.gartner.com/en/documents/3887767.

Fletcher, Pamela M., and Anne L. Helmreich. 2012. *Local - Global Mapping Nineteenth-Century London's Art Market*. Nineteenth Century Art Worldwide / Association of Historians of Nineteenth Century Art (AHNCA). http://www.19thc-artworldwide.org/autumn12/fletcher-helmreich-mapping-the-london-art-market

Fisher, Michelle. "Acknowledging the Intellectual Labor of Curators in a Museum." Hyperallergic. July 31, 2018. https://hyperallergic.com/453438/acknowledging-the-intellectual-labor-of-curators-in-a-museum/.

"Forerunners: Ideas First" University of Minnesota Press. February 21, 2019. https://www.upress.umn.edu/book-division/series/forerunners-ideas-first.

Formaker-Olivas, Ben. "Why AR/VR Developers Should Prioritize Accessibility in UI/UX Design." Medium. March 19, 2019. https://medium.com/inborn-experience/why-ar-vr-developers-should-prioritize-accessibility-in-ui-ux-design-66b97e73a3ac?sk=67ad5420e96132bae9b20c581d341366&fbclid=IwAR3iqSyYqqtoE5nG2thu2KT1Moj4tAevJ7uRaAWpn9qsJKDjESFY0JSt2n4.

Foster, Hal, Rosalind Krauss, and Yve-Alain Bois. 2004. *Art Since 1900: Modernism, Antimodernism, Postmodernism*. London: Thames & Hudson.

Foucault, Michel. 1977. *Discipline and Punish: The Birth of the Prision*. New York: Vintage Books.

"Fowler Out Loud: Bernard Brown." 2017. Fowler Museum Website. https://www.fowler.ucla.edu/events/fowler-out-loud-bernard-brown/

Freud, Sigmund, David McLintock, and Hugh Haughton. 2003. *The Uncanny*. New York: Penguin Books.

Friedberg, Anne. 2009. *The Virtual Window: From Alberti to Microsoft*. ACLS Humanities E-Book. Cambridge, Mass: MIT Press.

Fulcrum. 2018. "Accessibility." Last updated: October 15, 2018. www.fulcrum.org/accessibility.

Fulcrum. n.d. "Partner With Us." www.fulcrum.org/partner-with-us/.

Gardiner, Hazel, Anna Bentkowska-Kafel, and Trish Cashen. 2009. *Digital Visual Culture: Theory and Practice*. Bristol, UK: Intellect.

Geertz, Clifford. 1988. "Thick description: toward an interpretive theory of culture." *High Points* *in Anthropology*. 531-552.

Gell, Alfred. 1998. *Art and Agency: An Anthropological Theory*. New York: Oxford UP.

Gell, Alfred. 1996. "Vogel's Net: Traps as Artworks and Artworks as Traps." *Journal of Material Culture*.

Getty Foundation. 2017. "Museum Catalogues in the Digital Age." February 13, 2017. https://www.getty.edu/publications/osci-report/.

Getty Foundation. "Online Scholarly Catalogue Initiative." http://www.getty.edu/foundation/initiatives/current/osci/.

Getty Foundation. 2017. "Museum Catalogues in the Digital Age." February 13, 2017. https://www.getty.edu/publications/osci-report/.

Ghosh, Pallab. 2015. "Google's Vint Cerf Warns of 'digital Dark Age'." *BBC News*. February 13, 2015. https://www.bbc.com/news/science-environment-31450389.

Ginsberg, Elisabeth. 2016 "Mining the Museum." *Beautiful Trouble.* Ed. Boyd, Andrew, and Dave Oswald Mitchel. https://beautifultrouble.org/case/mining-the-museum/

Girvan, Carina. 2018. "What Is a Virtual World? Definition and Classification". *Educational Technology Research and Development.* 66 (5): 1087-1100.

Glass, Erin R. 2018. *Software of the Oppressed: Reprogramming the Invisible Discipline*. https://academicworks.cuny.edu/gc_etds/2889.

Gold, Matthew K., and Lauren F. Klein. 2016. *Debates in the Digital Humanities 2016*. Minneapolis, MN; London: University of Minnesota Press.

Goldman, Naomi. "NONNY DE LA PEÑA: Pioneering VR and Immersive Journalism." VFX Voice Magazine. April 03, 2018. http://vfxvoice.com/nonny-de-la-pena-pioneering-vr-and-immersive-journalism/.

Golubiewski-Davis, Kristina. Interview by Francesca Albrezzi. Zoom Recording. Los Angeles, February 8, 2019.

Goriunova, Olga. 2016. "Digital Ontologies as Productive Process." Theorizing the Contemporary, *Cultural Anthropology* website, March 24, 2016. https://culanth.org/fieldsights/digital-ontologies-as-productive-process

Gramsci, Antonio, and David Forgacs. 2014. *The Gramsci reader: selected writings, 1916-1935*. Lawrence & Wishart. http://muse.jhu.edu/books/9781909831735/.

Green, Harriett E. 2016. "Fostering Assessment Strategies for Digital Pedagogy through

Faculty–Librarian Collaborations: An Analysis of Student-Generated Multimodal Digital Scholarship." *Laying the Foundation: Digital Humanities in Academic Libraries*, edited by White John W. and Gilbert Heather, 179-204. West Lafayette, Indiana: Purdue University Press. doi:10.2307/j.ctt163t7kq.13.

Greenblatt, Stephen. 1991. "Resonance and Wonder," In Exhibiting Cultures: The Poetics and Politics of Museum Display, edited by Ivan, Karp, Steven Lavine, and Rockefeller Foundation, 42-56. Washington, DC: Smithsonian Institution Press.

Haartz, Deborah. 2017 "From Princesses to Pop Culture: Bryn Mawr Special Collections' New Exhibition on the Tale of Genji." The Bi-College News. February 3, 2017. http://bicollegenews.com/2017/02/03/from-princesses-to-pop-culture-bryn-mawr-special-collections-new-exhibition-on-the-tale-of-genji/.

Hansen, Mark B. N. 2006. *Bodies in Code: Interfaces with New Media*. New York: Routledge. http://www.myilibrary.com?id=113605.

Haraway, Donna. 1991. "A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century," *Simians, Cyborgs, and Women: The Reinvention of Nature,* 149-181. New York: Routledge.

Haraway, Donna.1988 [2002]. "The Persistence of Vision," *The Visual Cultural Reader*. Ed. Mirzoeff, Nicholas. London: Routledge. http://classes.dma.ucla.edu/Fall14/252A/readings/haraway-persistence-of-vision.pdf

Hart, Hugh. 2016. "Learning Curve." DGA, Homepage. https://www.dga.org/Craft/DGAQ/All-Articles/1602-Spring-2016/Technology-Virtual-Reality.aspx.

Hayles, Katherine. 2012. *How We Think: Digital Media and Contemporary Technogenesis*. Chicago: The University of Chicago Press.

Headland, Thomas N., Kenneth L. Pike, and Marvin Harris. 1990. *Emics and Etics: The Insider/Outsider Debate*. Newbury Park, CA.: Sage.

Hegel, George Willhelm Friedrich. 1998. "Introduction," *Aesthetics*, translated by T.M. Knox. Oxford and New York: Clarendon Press.

Henry, Shawn Lawton, Shadi Abou-Zahra, and Kevin White. "Accessibility, Usability, and Inclusion." Web Accessibility Initiative (WAI). Updated 6 May 2016. First published March 2010. https://www.w3.org/WAI/fundamentals/accessibility-usability-inclusion/.

Hicks, Michael, and Michael Hicks. "Inside LA's Exploding VR and AR Scene." Wareable. September 01, 2017. https://www.wareable.com/vr/wearable-tech-hubs-los-angeles-3345.

Hiltzik, Michael. "In UC's Battle with the World's Largest Scientific Publisher, the Future of Information Is at Stake." Los Angeles Times. December 07, 2018. https://www.latimes.com/business/hiltzik/la-fi-hiltzik-uc-elsevier-20181207-story.html.

Hoffman, Chris. "What Lossless File Formats Are & Why You Shouldn't Convert Lossy to Lossless." How-To Geek. September 06, 2017. https://www.howtogeek.com/142174/what-lossless-file-formats-are-why-you-shouldnt-convert-lossy-to-lossless/.

"Home." Jam Studio VR. http://www.jamstudiovr.com/.

Hong, JeeHee. 2003. "Material/Materiality," *The Chicago School of Media Theory*. https://lucian.uchicago.edu/blogs/mediatheory/keywords/materialmateriality/.

Huhtamo, Erkki. 2011. *Media Archaeology: Approaches, Applications, and Implications*. University of California Press.

IIIF. "IIIF Consortium." https://iiif.io/community/consortium/#members.

Ingold, Tim. 1996. “Language is the essence of culture” in *Key Debates in Anthropology*. London: Routledge. http://site.ebrary.com/id/10165472.

Ingold, Tim. 2011. “Rethinking the Animate, Reanimating Thought” in *Being Alive: Essays on Movement, Knowledge and Description*. London: Routledge.

Ingold, Tim. 2000. “A Circumpolar Night’s Dream” in *The Perception of the Environment: Essays on Livelihood, Dwelling & Skill*. New York: Routledge.

Isaac, Gwyneira. 2008. "Technology Becomes the Object." *Journal of Material Culture.* 13 (3): 287-310.

Ito, Mizuko. 2010. *Hanging Out, Messing Around, and Geeking Out: Kids Living and Learning with New Media*. Cambridge, Mass: MIT Press.

Ivanhoe, Philip J., Owen J. Flanagan, Victoria S. Harrison, Hagop Sarkissian, and Eric Schwitzgebel. 2018. *The Oneness Hypothesis: Beyond the Boundary of Self*. New York Columbia University Press.

Jerald, Jason. 2016. *The VR Book: Human-Centered Design for Virtual Reality*. [San Rafael]: Morgan & Claypool.

Johnston, Ed, Marina Vujnovic, and Michael Richison. "Augmented Asbury Park: Disrupting the Present with Remnants of History in Augmented Reality" ISEA 2015, 21st International Symposium on Electronic Art, At Vancouver, Canada. August 2015.

Johnson, R. Burke, Anthony J. Onwuegbuzie, and Lisa A. Turner. 2016. "Toward a Definition of Mixed Methods Research". *Journal of Mixed Methods Research.* 1 (2): 112-133. http://journals.sagepub.com/doi/abs/10.1177/1558689806298224

Jaschik, Scott. 2014. "Obama vs. Art History." *Inside Higher Ed*, 31 Jan. 2014, www.insidehighered.com/news/2014/01/31/obama-becomes-latest-politician-criticize-liberal-arts-discipline.

Jentsch, Ernst Anton. 2008. *Zur Psychologie des Unheimlichen*. http://nbn-resolving.de/urn:nbn:de:hebis:30-1100953.

Kadlubek, Vince, and Golda Blaise. "How Immersion Makes Art Accessible." American Alliance of Museums. November 12, 2018. https://www.aam-us.org/2018/11/12/how-immersion-makes-art-accessible/.

Karlin, Susan. 2014. "How World Building Will Shape The Future Of Media And Business." *Fast Company*. November 19. https://www.fastcompany.com/3038146/how-world-building-will-shape-the-future-of-media-and-business.

Karp, Ivan. 2008. *Museum Frictions: Public Cultures/ Global Transformations*. Durham: Duke University Press. https://ezproxy.aub.edu.lb/login?url=http://dx.doi.org/10.1215/9780822388296.

Kemeny, Andras, Paul George, Frédéric Mérienne, and Florent Colombet. 2017. "New VR Navigation Techniques to Reduce Cybersickness." *Electronic Imaging, The Engineering Reality of Virtual Reality 2017*. Society for Imaging Science and Technology. 48-53(6). https://doi.org/10.2352/ISSN.2470-1173.2017.3.ERVR-097

Kim, Chi-Young. "Interview with Curator Britt Salvesen on "3D: Double Vision". Unframed. July 5, 2018. https://unframed.lacma.org/2018/07/05/interview-curator-britt-salvesen-3d-double-vision.

Kirshenblatt-Gimblett, Barbara. 1998. "Objects of Ethnography," *Destination Culture: Tourism, Museum, and Heritage*. Berkeley and Los Angeles: University of California Press, 17-78.

Klerk, Taylor De. "Ethics in Archives: Decisions in Digital Archiving." NC State University Libraries. June 1, 2018. https://www.lib.ncsu.edu/news/special-collections/ethics-in-archives:-decisions-in-digital-archiving.

Kirshenblatt-Gimblett, Barbara. 1998. "Objects of Ethnography," *Destination Culture: Tourism, Museum, and Heritage*. Berkeley and Los Angeles: University of California Press, 17-78.

Koolon, Nikholai. "Explore Nefertari's Tomb In VR With Nefertari: Journey to Eternity [Updated]." VRFocus. July 13, 2018. https://www.vrfocus.com/2018/07/explore-nefertaris-tomb-in-vr-with-nefertari-journey-to-eternity/.

Knoepp, Lilly. "Forget Oculus Rift, Meet The Godmother Of VR." Forbes. April 13, 2017. https://www.forbes.com/sites/lillyknoepp/2017/04/13/forget-oculus-rift-meet-the-godmother-of-vr/.

Knox, Hannah and Walford, Antonia. 2016. "Digital Ontology." Theorizing the Contemporary, *Cultural Anthropology* website, March 24, 2016. http://culanth.org/fieldsights/820-digital-ontology

LaMotte, Sandee. 2017. "The Very Real Health Dangers of Virtual Reality." *CNN*. December 13. https://www.cnn.com/2017/12/13/health/virtual-reality-vr-dangers-safety/index.html.

Lawrence, Lee. "'The Jeweled Isle: Art From Sri Lanka' Review: Reclaiming a Country's Creative History." The Wall Street Journal. January 01, 2019. https://www.wsj.com/articles/the-jeweled-isle-art-from-sri-lanka-review-reclaiming-a-countrys-creative-history-11546344000.

Lee, Wendy. "VR Gets Reality Check with Significant Decline in Investment." Los Angeles Times. January 13, 2019. https://www.latimes.com/business/hollywood/la-fi-ct-virtual-reality-investment20190113-story.html.

Levola, Jaakko. 2017. "Virtual Reality Gets Real." *Forbes*. October 05. https://www.forbes.com/sites/forbesinternational/2017/10/05/virtual-reality-gets-real/#1c35434f3518.

Lewis, Geoffrey D. 2019. "History of Museums," Encyclopædia Britannica, Encyclopædia. https://www.britannica.com/topic/museum-cultural-institution#ref341406, Access Date: April, 18 2019.

Liu, Alan. 2013. "The Meaning of the Digital Humanities." *PMLA* 128 (2): 414.

Liu, Alan. 2016. "N + 1:A Plea for Cross-Domain Data in the Digital Humanities," *Debates in the Digital Humanities 2016*. Minneapolis, MN; London: University of Minnesota Press.

Long, Tisha Carper and Catherine King. 2011. "Is a 'Virtual' Museum Still 'Real'? A Conversation About the International Museum of Women," *Exhibitionist*, Spring.

Longair, Sarah. 2015. "Cultures of Curating: The Limits of Authority." *Museum History Journal*, 8:1, 1-7, DOI: 10.1179/1936981614Z.00000000043

"Lhasa Historic Tours." University of Virginia. https://pages.shanti.virginia.edu/LhasaVR/.

Lerman, Liz, John Borstel, and Julian B. Kabenge. 2003. *Liz Lerman's Critical Response Process: A Method for Getting Useful Feedback on Anything you Make, from Dance to Dessert*. Takoma Park: Liz Lerman dance exchange.

Ligon, Scott, and Michael W. Dean. 2010. *Digital Art Revolution: Creating Fine Art with Photoshop*. New York: Watson-Guptill.

Lin, James Quo-Ping. "A Progressive Model of New Media Art in the Museum Context: A Case Study of the National Palace Museum." Paper presented at the Pacific Neighborhood Counsel (PNC) Conference, Getty Research Institute, August 2016.

Lubar, Steven. 2014. "Curator as Auteur," *The Public Historian.* 36 (1): 71-76.

Lucas-Conwell, Frederic. 2006. "Technology Evangelists: A Leadership Survey." Growth Resources, Inc. December 4. https://www.gri.co/pub/res/pdf/TechEvangelist.pdf.

Manovich, Lev. 2002. *The Language of New Media*. Cambridge, Mass: MIT Press.

Maslen, Mick, and Jack Southern. 2015. *Drawing Projects: An Exploration of the Language of Drawing*. London: Black Dog Publishing.

Marx, Karl. [1857] 1973. *Grundrisse: Foundations of the Critique of Political Economy (Rough Draft)*, translated by Martin Nicolaus. London: Penguin.

Marx, Karl. 1976 [1887]. 'The Fetishism of the Commodity and its Secret'; in, Capital: Volume I. UK: Penguin in association with New Left Review. Pp: 163-177.

McGonigal, Jane. 2012. *Reality is Broken: Why Games Make Us Better and How They Can Change the World*. London: Vintage.

McLuhan, Marshall. 1997 [1964]. *Understanding Media: The Extensions of Man*. Cambridge, Mass: MIT Press.

McPherson, Tara. 2012. "U.S. Operating Systems at Midcentury: The Intertwining of Race and UNIX." *Race After the Internet*, Eds. Lisa Nakamura and Peter Chow-White. New York: Routledge.

Meier, Anna Moblard, Nina Blomfield, and Sarah O'Connell. 2017. "Restored Screen." *The Tale of Genji from Princesses to Pop*. https://digitalscholarship.brynmawr.edu/scalar/tale-of-genji/restored-screen.

Meier, Anna Moblard, Nina Blomfield, and Sarah O'Connell. 2017. "Exhibition Checklist." *The*

Tale of Genji from Princesses to Pop. https://digitalscholarship.brynmawr.edu/scalar/tale-of-genji/exhibition-checklist.

"Mellon Foundation, NHPRC Announce Digital Publication Grant Winners." The Andrew W. Mellon Foundation. February 14, 2018. https://mellon.org/resources/news/articles/mellon-foundation-nhprc-announce-digital-publication-grant-winners/.

Merleau-Ponty, Maurice. 1968. *The Visible and the Invisible*. Trans. Alphonso Lingis. Evanston, IL: Northwestern University Press.

Michael Jackson. 2005. *Existential Anthropology: Events, Exigencies and Effects*. New York: Berghahn.

Milgram, Paul; H. Takemura; A. Utsumi; F. Kishino.1994. "Augmented Reality: A class of Displays on the Reality-Virtuality Continuum." SPIE Vol. 2351, *Telemanipulator and Telepresence Technologies*.

Miller, Jill. "Liar Augmented Reality Environment." Website. 2018. https://www.jillmiller.net/#/liar/.

Miller, Ron. 2008. *Digital Art: Painting with Pixels*. Minneapolis, MN: Twenty-First Century Books.

Mitchell, Wade J, Kevin A Szerszen, Amy Shirong Lu, Paul W Schermerhorn, Matthias Scheutz, and Karl F MacDorman. 2011. "A Mismatch in the Human Realism of Face and Voice Produces an Uncanny Valley." *I-Perception*, January. 10–12. doi:10.1068/i0415.

Mitchell, William J. Thomas. 2010. *What Do Pictures Want?: The Lives and Loves of Images*. Chicago: University of Chicago Press.

Mondloch, Kate. 2011. *Screens: Viewing Media Installation Art*. Minneapolis: University of Minnesota Press.

Montecarlo. 2016. "Data, Interfaces, and Storytelling: Audiovisual in the Digital Age," in *AC/E Digital Culture Annual Report 2016: Smart Culture: Impact of the Internet on Artistic Creation. Focus: Use of New Digital Technologies at Cultural Festivals*. Madrid: Acción Cultural Española (AC/E).

Moretti, Franco. 2005. *Graphs, Maps, Trees: Abstract Models for a Literary History*. London: Verso.

Moser, Mary Anne, and Douglas MacLeod. 1996. *Immersed in Technology: Art and Virtual Environments*. Cambridge, Mass: MIT Press.

Mulvey, Laura, Rachel Rose, and Mark Lewis. 2016. *Visual Pleasure and Narrative Cinema*

(1975). London Afterall Books.

Münster, Sander, Kristina Friedrichs, and Wolfgang Hegel. 2018. "3D Reconstruction Techniques as a Cultural Shift in Art History?" *International Journal for Digital Art History*. Issue 3. München: Graphentis-Verl. http://dah-journal.org/issue_03.html.

Nakamura, Lisa, and Peter Chow-White. 2012. *Race After the Internet*. New York: Routledge.

"Nieves and Sullivan Awarded Mellon Foundation, NHPRC Digital Publication Grant." Apartheid Heritages. February 23, 2018. http://apartheidheritages.org/nieves-and-sullivan-awarded-mellon-foundation-nhprc-digital-publication-grant/.

Nora, Pierre. 1989. "Between Memory and History: Les Lieux des Memoire," Representations, No. 26, Special Issue: Memory and Counter-Memory: 7-24.

Omeka. "Project." https://omeka.org/about/project/.

Ong, Walter J. 1988. *Orality and Literacy: The Technologizing of the Word*. London: Routledge.

Opitz, Rachel S., Marcello Mogetta, and Nicola Terrenato. 2018. *A Mid-Republican House from Gabii*. https://quod.lib.umich.edu/g/gabii.

Ortega, Nuria Rodríguez and Murtha Baca. 2009. "Ut Pictura Poesis: Pietro Mellini's 'Relatione delle Pitture Migliori di Casa Melini' (1681)," *Getty Research Journal*, no. 1: 161–68.

Özel, Güvenç. 2016. "Toward a Postarchitecture." *Log.* (36): 99-105.

Pardes, Arielle. "For Museums, Augmented Reality Is the Next Frontier." *Wired*. September 21, 2018. https://www.wired.com/story/museums-augmented-reality-next-frontier/.

Paris, Scott G. 2010. *Perspectives on object-centered learning in museums*. New York, N.Y.: Routledge, Taylor & Francis Group.

Paul, Christiane. 2015. *Digital Art*. London: Thames & Hudson.

Peaker, Alicia. "Scalar Exhibition Template." Bryn Mawr. https://digitalscholarship.brynmawr.edu/scalar/scalar-exhibition-template/index.

Petrucco Corrado, and Daniele Agostini. 2016. "Teaching Our Cultural Heritage Using Mobile Augmented Reality." *Journal of E-Learning and Knowledge Society*. 12 (3): 115-128.

Pollock, Griselda. 2008. *Vision and Difference: Feminism, Femininity and the Histories of Art*. London: Routledge.

Poole, Deborah. 1997. *Vision, Race, and Modernity: A Visual Economy of the Andean Image World*. Princeton, N.J.: Princeton Univ. Press.

Posner, Miriam, et. al. 2017. "Keywords." Museums in the Digital Age. http://miriamposner.com/classes/dh150w17/readings/keywords/.

Posner, Miriam. 2016. "What's Next: The Radical, Unrealized Potential of Digital Humanities," *Debates in the Digital Humanities 2016*.eds. Gold, Matthew K., and Lauren F. Klein. Minneapolis, MN; London: University of Minnesota Press. 32-42.

Posner, Miriam. 2015. "DH101 1B: What is the humanities? What is digital humanities? WHY ARE WE HERE?" slide 11, https://www.dropbox.com/sh/b95zerby07tva4k/AACMZMlU_s-5Jk--IXLwIydBa?dl=0&preview=1B+DH101.pptx

Press, Gil. "A Very Short History of Digitization." Forbes. January 11, 2016. https://www.forbes.com/sites/gilpress/2015/12/27/a-very-short-history-of-digitization/#e5eb9649ac27.

Presner, Todd Samuel, David Shepard, and Yoh Kawano. 2014. *HyperCities: Thick Mapping in the Digital Humanities*. Cambridge: Harvard University Press.

Pressberg, Matt. "LA's Getty Center Blends Oculus-Ready VR With Ancient Chinese Art in Virtual Reality Museum Exhibit." International Business Times. May 05, 2016. https://www.ibtimes.com/las-getty-center-blends-oculus-ready-vr-ancient-chinese-art-virtual-reality-museum-2364802.

Probst, Malia. "Inside VRScout's Second Annual VR Art Show in LA." VRScout. November 07, 2017. https://vrscout.com/news/inside-vrscout-vr-art-show-la/.

Rae, Juno, and Lizzie Edwards. "Virtual Reality at the British Museum: What Is the Value of Virtual Reality Environments for Learning by Children and Young People, Schools, and Families?" MW2016: Museums and the Web 2016 (blog). https://mw2016.museumsandtheweb.com/paper/virtual-reality-at-the-british-museum-what-is-the-value-of-virtual-reality-environments-for-learning-by-children-and-young-people-schools-and-families/.

Reggente, Nicco, Joey K.-Y. Essoe, Zahra M. Aghajan, Amir V. Tavakoli, Joseph F. McGuire, Nanthia A. Suthana, and Jesse Rissman. 2018. "Enhancing the Ecological Validity of fMRI Memory Research Using Virtual Reality". *Frontiers in Neuroscience.* 12.

Rodley, Ed. "Unpacking Our Understanding of Immersion." American Alliance of Museums. January 10, 2019. https://www.aam-us.org/2018/11/07/unpacking-our-understanding-of-immersion/.

Ramsey, Abby Smith. 2016. *When We Are No More: How Digital Memory is Shaping Our Future*. New York, N.Y.: Bloomsbury Press.

Roberts, Allen F. 1993. "Insight, or, Not Seeing is Believing." *Secrecy: African Art That Conceals and Reveals.* New York: Museum for African Art. 65-79.

Roberts, Allen F. 1996. "The Ironies of System D." *Recycled Reseen: Folk Art from the Global Scrap Heap*, eds. C. Cerny and S. Seriff. Santa Fe NM: Museum of International Folk Art.

Roberts, Mary Nooter. 1994. "Does an Object Have a Life?" *Exhibition-ism: Museums and African Art.* 36-55.

Roberts, Mary Nooter. 2008. "Exhibiting Episteme: African Art Exhibitions as Objects of Knowledge," in *Preserving the Cultural Heritage of Africa: Crisis or Renaissance*, edited by Kenji Yoshida and John Mack, Muckleneuk: Unisa Press, 170-186.

Roberts, Mary Nooter. 2012. "Tradition Is Always NOW: African Art and the Curatorial Turn" *African Arts*, 45 (1), 1-7.

Roberts, Allen F. and Mary Nooter Roberts. 2008. "Flickering Images, Floating Signifiers: Optical Innovation and Visual Piety in Senegal," *Material Religion* 4 (1), 4-31.

Roberts, Allen F. and Mary Nooter Roberts. 1996. *Memory: Luba Art and the Making of History*. Munich: Prestel, for the Museum for African Art, New York.

Roberts, Allen F. and Mary Nooter Roberts. 1996. "Memory: Luba art and the making of history". *African Arts.* 29: 22-35.

Roberts, Allen F. and Mary Nooter Roberts. 2007. "Mystical Graffiti and the Refabulation of Dakar." *Africa Today.* 54: 51-77.

Rodley, Ed. "Unpacking Our Understanding of Immersion." American Alliance of Museums. January 10, 2019. https://www.aam-us.org/2018/11/07/unpacking-our-understanding-of-immersion/.

Rumsey, Abby Smith. 2016. *When We Are No More: How Digital Memory is Shaping Our Future*. New York, N.Y.: Bloomsbury Press.

Rubin, Arnold, and Zena Pearlstone. 1989. *Art As Technology: The Arts of Africa, Oceania, Native America, Southern California*. Beverly Hills, Calif: Hillcrest Press.

Rylah, Juliet Bennett. "Check Out Cutting-Edge Virtual Art in Pasadena This October." RSS. October 11, 2018. https://www.welikela.com/spatial-reality-pasadena-virtual-art-october-2018/.

Salvesen, Britt, Nicholas Barlow, and Thomas Banchoff. 2018. *3D - Double Vision*. Los Angeles: Los Angeles County Museum of Art; Munich, London, New York: DelMonico Books. Prestel.

"Samskara Exhibition." Wisdome. https://wisdome.la/samskara.

Santos, Mariana Moura. 2016. "The Impact of the Internet on Cultural Creation" in in *AC/E Digital Culture Annual Report 2016: Smart Culture: Impact of the Internet on Artistic Creation. Focus: Use of New Digital Technologies at Cultural Festivals*. Madrid: Acción Cultural Española (AC/E).

Sato, Steven. Interview by Francesca Albrezzi. Zoom Recording. Los Angeles, February 11, 2019.

Saukko, Paula. 2010. *Doing Research in Cultural studies: An Introduction to Classical and New Methodological Approaches*. London [u.a.]: SAGE.

Scalar. "Editorial Workflow." Scalar 2 User's Guide. Updated August 27, 2018 http://scalar.usc.edu/works/guide2/editorial-workflow.

Shea, Andrea. 2015. "Beacons, QR Codes and 3-D Printing: Enter the Museum of the 21st Century" *The ARTery*, September 14. http://www.wbur.org/artery/2015/09/14/museums-digital-technology.

Siegal, Nina. "Want to See All the Vermeers in the World? Now's Your Chance." The New York Times. December 03, 2018. https://www.nytimes.com/2018/12/03/arts/design/meet-vermeer-google-app-mauritshuis.html?partner=rss&emc=rss.

Silverman, Kaja. 2005. *Male Subjectivity at the Margins*. New York: Routledge.

Silverman, Kaja. 1988. *The Acoustic Mirror: The Female Voice in Psychoanalysis and Cinema*. Bloomington: Indiana University Press. http://public.eblib.com/choice/publicfullrecord.aspx?p=4955944.

Smith, Abby, 2004. "Preservation," *A Companion to Digital Humanities*. Malden, Mass: Blackwell Pub. http://www.digitalhumanities.org/companion/.

Snyder, Lisa Marie. 2003. *The Design and Use of Experiential Instructional Technology For the Teaching of Architectural History in American Undergraduate Architecture Programs*. PhD diss., University of California, Los Angeles.

Snyder, Lisa Marie. 2018. "VSim: Interface Software and Online Repository and Archive to Facilitate Distribution and Educational Use of Three-Dimensional Computer Models of Historic Urban Environments." NEH Digital Humanities Implementation Grant #HD-50164-14 White Paper. National Endowment for the Humanities, December 27.

https://securegrants.neh.gov/publicquery/Download.aspx?data=EbwGdSyLkD7zoB3W75cvd%2bXST%2bWypC%2bllBU2ufu2RULwbUhBjXJaukHmx8Tleg3x%2fx5XKXhjPTv50YZ9EBc3MgqPkIsjTuX6AJ32XoiVNwc3AzY%2feF24LT1RlMIOwPjJIMjucS%2fe2h7y091TH2FCXfQWF9ducIoU.

sp[a]ce. Exhibition label for Wesley Akksbrook, *COSMORAMARAMA*. “Spatial Reality.” Pasadena, CA. Seen on: October 25, 2011.

Spivey, Virginia B., and Renee McGarry. 2019. "Bridging the Research/Teaching Divide with DAH and SoTL-AH". *Visual Resources*. 1-18.

Statt, Nick. 2016. "How Game Designers Find Ways around VR Motion Sickness." *The Verge*. October 13. https://www.theverge.com/2016/10/13/13261342/virtual-reality-oculus-rift-touch-lone-echo-robo-recall.

Stogner, Maggie Burnette. 2011. Communicating Culture in the 21st Century, *Journal of Museum Education*, 36:2, 189-198.

Stone, Mark. 2018. "How VR Is Helping Paraplegics Walk Again." *Forbes. Duke Neurobiology*. January 17. https://www.neuro.duke.edu/research/research-news/how-vr-helping-paraplegics-walk-again.

Lévi-Strauss, Claude. 2010 [1966]. *The Savage Mind*. Chicago: The University of Chicago Press.

Sullivan, Elaine A., and Lisa M. Snyder. 2017. "Digital Karnak: An Experiment in Publication and Peer Review of Interactive, Three-Dimensional Content." *Journal of the Society of Architectural Historians*. 76 (4): 464-482.

Szabo, Victoria. "Knowledge in 3D: How 3D Data Visualization Is Reshaping Our World." Parameters. July 10, 2018. https://parameters.ssrc.org/2018/07/knowledge-in-3d-how-3d-data-visualization-is-reshaping-our-world/.

"The Hallwyl House." Hallwyl Museum. http://hallwylskamuseet.se/en/explore/palace.

“The Daily 360.” *The New York Times*. Last Updated January 18, 2018. https://www.youtube.com/playlist?list=PL4CGYNsoW2iDN-xj9xxfgRLsqmAdY8J_W.

The Kremer Collection. “Collection.” http://www.thekremercollection.com/#section-7.

The Kremer Collection. “Museum.” http://www.thekremercollection.com/the-kremer-museum/

The Rubin Museum of Art. 2016. "Virtual Lhasa: An Interactive 3D Map of Tibet's Historic Capital.” Posted December 21, 2016. http://rubinmuseum.org/blog/virtual-lhasa-interactive-3d-map-of-tibets-historical-capital.

The Rubin Museum of Art. 2017. "Monumental Lhasa - Fortress, Palace, Temple."

http://rubinmuseum.org/events/exhibitions/monumental-lhasa.

Towey, Maureen. "Immersive Storytelling at The New York Times." American Alliance of Museums. November 12, 2018. https://www.aam-us.org/2018/11/12/immersive-storytelling-at-the-new-york-times/.

Tricart, Celine. 2018. *Virtual Reality Filmmaking: Techniques & Best Practices for VR Filmmakers*. New York: Routledge, Taylor & Francis Group, 2018. http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=1662196.

Trouillot, Michel-Rolph. 2015. *Silencing the Past: Power and the Production of History*. Boston, Massachusetts: Beacon Press.

Turkle, Sherry. 2017. *Alone Together: Why We Expect More from Technology and Less from Each Other*. New York: Basic.

Turkle, Sherry. 2016. *Reclaiming Conversation: The Power of Talk in a Digital Age.* New York, New York: Penguin Books.

Turkle, Sherry. 2005. *The Second Self: Computers and the Human Spirit*. Cambridge, Mass: MIT Press.

Turner, Victor, Roger D Abrahams, and Alfred Harris. 2017. *The Ritual Process: Structure and Anti-Structure*. http://www.tandfebooks.com/isbn/9781315134666.

Twiss-Houting, Beth A. et al. 2010. "Learning Theory in the Museum Setting," *An Alliance of Spirit: Museum and School Partnerships*. eds. Kim, Fortney, and Beverly Sheppard. Washington, DC: AAM Press, American Association of Museums.

Umble, Diane. 2003. "Sinful Network or Divine Service: Competing Meanings of the Telephone in Amish Country" *New Media, 1740–1915*. eds. Lisa Gitelman and Geoffrey Pingree. Cambridge, MA: MIT Press.

"University of Minnesota Press's Quadrant Initiative is Revolutionizing Interdisciplinary Publishing and Collaborative Scholarship: Program to Launch Online Research Archive and Book Series" University of Minnesota Press. June 08, 2011. https://www.upress.umn.edu/press/press-releases/university-of-minnesota-presss-quadrant-initiative-is-revolutionizing-interdisciplinary-publishing-and-collaborative-scholarship.

Ushizima D., Manovich L., Margolis T., and Douglass J. 2012. "Cultural Analytics of Large Datasets from Flickr". *AAAI Workshop - Technical Report.* WS-12-03: 30-34.

Vasari, Giorgio, Gaston du C. De Vere, and Philip Joshua Jacks. 2006. *The Lives of the Most Excellent Painters, Sculptors, and Architects*. New York: Modern Library.

Vectors Journal. "About the Vectors Journal." Vectors Journal: Introduction. University of Southern California. http://vectors.usc.edu/journal/index.php?page=Introduction.

"Virtual Field Trips." The National WWII Museum. New Orleans. Website. https://www.nationalww2museum.org/virtual-field-trips.

Virtual Reality Task Force. "Virtual, Augmented, and Extended Reality at UCLA," Executive Vice Chancellor Report. University of California, Los Angeles. February 8, 2019. https://evc.ucla.edu/reports.

"Visit Us," TeamLab Borderless Tokyo Official Site: MORI Building DIGITAL ART MUSEUM. https://borderless.teamlab.art/#information.

Vogel, Susan Mullin. 1991. "Always true to the object, in our fashion". *Exhibiting Cultures: the Poetics and Politics of Museum Display / Edited by Ivan Karp & Steven D. Lavine.* 191-204.

Vogel, Susan. 1995. *Art/artifact: African Art in Anthropology Collections*. N.Y.; Prestel.

Waelder, Pau. 2016. "The Art Market in the Age of Access," in *AC/E Digital Culture Annual Report 2016: Smart Culture: Impact of the Internet on Artistic Creation. Focus: Use of New Digital Technologies at Cultural Festivals*. Madrid: Acción Cultural Española (AC/E).

Watanabe, Teresa. "UC vs. Elsevier, Stanford Drinking and More Higher Education News." Los Angeles Times. March 01, 2019. https://www.latimes.com/local/education/la-me-edu-higher-ed-roundup-20190301-story.html.

Waters, Donald J. "Monograph Publishing in the Digital Age." The Andrew W. Mellon Foundation. July 22, 2016. https://mellon.org/resources/shared-experiences-blog/monograph-publishing-digital-age/.

Weinstein, Deena, and Michael A. Weinstein. 1991. "Georg Simmel: Sociological Flâneur Bricoleur: Theory, Culture" *Society*. 8 (3): 151-168.

Wernick, Adam. 2018. "Scientists Warn We May Be Creating a 'digital Dark Age'." *Public Radio International.* January 1, 2018. https://www.pri.org/stories/2018-01-01/scientists-warn-we-may-be-creating-digital-dark-age.

White, Hayden. 1981. “The Narrativization of Real Events.” *Critical Inquiry* 7, no. 4 (July 1, 1981): 793–98.

Wölfflin, Heinrich, Jonathan Blower, Evonne Anita Levy, and Tristan Weddigen. 2015. *Principles of Art History: The Problem of the Development of Style in Early Modern Art*.

Woolf, Virginia. 1935 [1929]. *A Room of One's Own*. London: Hogarth Press.

Wyman, B., et al., Steve.museum: An Ongoing Experiment in Social Tagging, Folksonomy, and Museums, in J. Trant and D. Bearman (eds.). *Museums and the Web 2006: Proceedings*, Toronto: Archives & Museum Informatics, published March 1, 2006 at http://www.archimuse.com/mw2006/papers/wyman/wyman.html.

Yang, Kenneth C. C. 2019. *Cases on Immersive Virtual Reality Techniques*. Hershey, PA: IGI Global.

Yardley, Ainslie. 2008. Piecing Together—A Methodological Bricolage [25 paragraphs]. Forum Qualitative Sozialforschung / Forum: Qualitative Social Research, 9(2), Art. 31, http://nbn-resolving.de/urn:nbn:de:0114-fqs0802315.

Yates, Francis. 1966. “Renaissance Memory: The Memory Theater of Guilio Camillo,” *The Art of Memory*, 129-159. Chicago: The University of Chicago Press.

Yeo, Jonathan. "Jonathan Yeo Experiments with Google." Google Arts & Culture. March 2018. https://experiments.withgoogle.com/jonathan-yeo.

YU + Co. "The Getty." https://www.yuco.com/works/the-getty-dunhuang.

Zenka. "Will Virtual and Augmented Reality Move Us into the Knowledge Age? | Zenka | TEDxJacksonHole." TEDx Talks. YouTube. November 11, 2016. https://www.youtube.com/watch?v=2FA-IuDTMjE.

Zhilyaeva, Anna. "Volumism: Future of Art | Anna Zhilyaeva | TEDxBologna." TEDx Talks. YouTube. October 31, 2018. https://youtu.be/Y0CQfsb5Wsc.

Zorich, Diane. *Transitioning to a Digital World: Art History, Its Research Centers, and Digital Scholarship* (New York: Samuel H. Kress Foundation, 2012), esp. 6, 14, 20. Available at: http:// www.kressfoundation.org/uploadedFiles/Sponsore d_Research/Research/Zorich_TransitioningDigital World.pdf.

Zweig, Benjamin. 2015. "Forgotten Genealogies: Brief Reflections on the History of Digital Art History." *International Journal for Digital Art History* [Online], 0.1.