Lessons from AR Memorialization: Artists' and Activists' Approaches to Responsible AR Development

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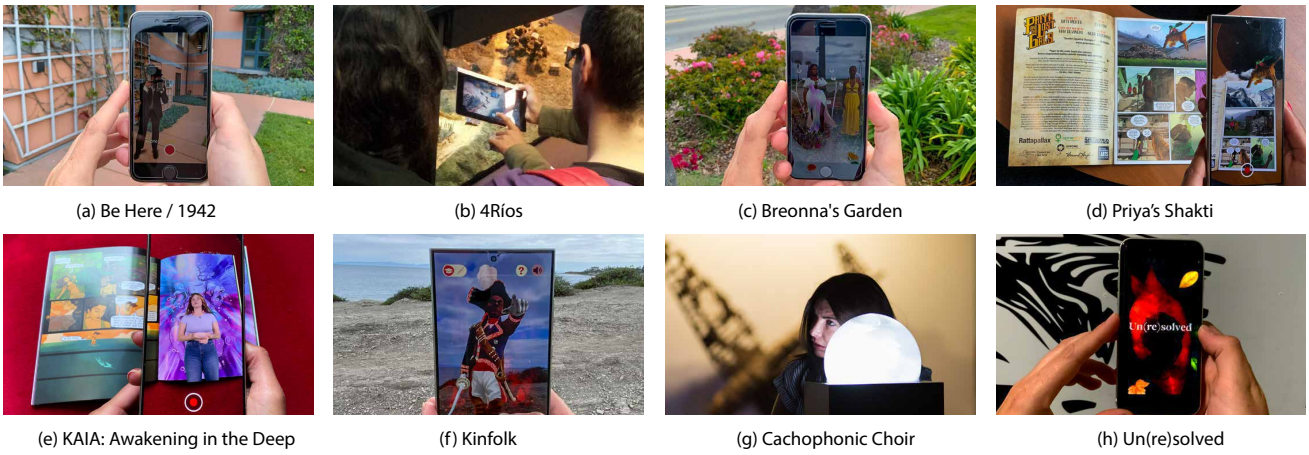

(a) Be Here / 1942 (b) 4Ríos (c) Breonna's Garden (d) Priya's Shakti

(e) KAIA: Awakening in the Deep (f) Kinfolk (g) Cachophonic Choir (h) Un(re)solved

Figure 1: AR memorialization projects offer a context to investigate responsible AR development methods. We document eight prominent examples: a) Be Here / 1942 presents events of the Japanese American internment, b) 4Ríos tells the story the Naya river massacre in Colombia, c) Breonna's Garden is a digital veneration of Breonna Taylor, d) Priya's Shakti augments comics about violence against women in India e) KAIA: Awakening in the Deep augments a comic about activist Natalia Ponce de León, f) Kinfolk augments the public space with monuments of BIPOC and LGBTQIA+ communities, g) Cacophonic Choir represents accounts of sexual assault survivors, h) Un(re)solved narrates an investigation into civil rights era cold-cases

Abstract

Augmented reality (AR) is a rapidly proliferating technology that offers opportunities to blend digital and physical contexts but also poses significant risks. This work seeks to inform responsible AR development with the insights of AR practitioners who engage with complex socio-cultural tensions. We analyze the implementation of AR involving vulnerable communities in human rights memorialization: preserving and conveying memories of human rights violations and resistance. We interviewed creators of eight AR projects addressing racism, state violence, and gender-based violence. Our findings highlight how creators represented sensitive narratives through non-violent portrayals, community participation, and agency. They used AR spatial interactions to engage audiences emotionally and sought media portrayals that were not tied to a specific technology's lifespan. We discuss how these approaches can inform future AR development through the integration of AR production with other media, prioritizing ownership in personal AR representations, and developing authoring techniques that enable immersive participation.

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• **Human-centered computing → Empirical studies in HCI**; **Empirical studies in collaborative and social computing**.

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1 Introduction

As computational technologies expand in application, researchers and designers must grapple with the risks of technological growth and adoption. *Augmented reality* (AR) is one such technology emerging as a pervasive digital layer woven into the physical world [42]. AR enables blending of aspects of the physical environment with digital content [71], offering new paradigms for collaborative [101], public [84], and social interactions [53]. As AR technologies proliferate, however, they also risk creating harm. Researchers have identified several potential harms perpetrated by AR, including new forms of virtual violence [33], privacy violations [2, 86, 95], and widespread perceptual manipulation [13, 63, 78]. Scholars have called for the HCI community to develop a research agenda addressing these risks and broader implications of AR and other emerging mixed reality (MR) technologies [43].

Much of the current focus on AR risks addresses the impacts pervasive AR could have on society at large. Further research is needed to identify and address AR design practices that systematically exclude or harm subsets of people who are *already marginalized or vulnerable.* DIS researchers have investigated the complex relationship between design and marginalization [25, 121], contributing social-justice-oriented design and research practices [14, 25] and applying them to settings where designers engage communities often excluded from mainstream technology design [32, 47, 111]. In the context of AR, DIS scholars have explored participatory approaches [97], considered human-value perspectives [67], and examined the potential harms arising from pervasive AR adoption [28]. However, a gap remains in understanding how current AR creators uphold ethical principles when depicting sensitive and potentially politically disputed subject matter. In particular, we lack knowledge on how to support vulnerable communities and individuals when using AR to depict their stories. We use the term *responsible AR development* to describe efforts to tend to the social implications and values embedded in the technical production of AR experiences [64, 67]. Responsible AR developers are accountable not only to their audience but also to communities whose stories and likenesses are portrayed in AR applications.

Given the broad potential impact of AR and the risks associated with design approaches that marginalize underrepresented voices, we argue for investigating and informing future responsible AR development by incorporating the insights of AR practitioners outside of mainstream HCI who deliberately engage with complex socio-cultural tensions in their work. We identify the practice of using AR for *human rights memorialization*–preserving and conveying memories related to human rights violations and resistance–as a meaningful context to investigate responsible AR development. Memorialization is a relevant space to think about responsible AR design because it provides a context to investigate AR's unique communicative and social potential while confronting the risks and limits of immersive representations of human experiences. It exposes the social implications and values of technology production by focusing on sensitive stories of marginalized communities, which can be difficult to document, share, and witness. Museums, artists, and activists have increasingly adopted AR as an immersive tool for audiences to infer meaning and rationale in historical or violent events and responses to them [30, 51, 56, 90, 116]. In creating AR memorials, practitioners must engage with multiple dimensions relevant to responsible technological production, including but not limited to community engagement [31] and ownership [66], design values [18, 127] and reception [79].

Our attention to responsible technologically enabled portrayals of lived human experience is particularly relevant due to contemporary disputes on *what* aspects of collective history should and should not be documented and *how* emerging technologies may shape the historical record. Within the United States, where we are based, there are ongoing social and political clashes over what should be remembered and conveyed in the media [39, 40], on social platforms [27, 76, 122], and in schools [72, 75]. This includes active government efforts to obscure certain histories, particularly with regard to rights for racial [26], sexual [58], and gender [19] minorities. By studying the approaches of artists and activists to AR memorialization, we can systematically investigate AR production workflows that integrate community norms and values alongside technical implementation when presenting sensitive subject matter.

We document eight AR memorialization projects produced by artists, documentarians, and activists who engage with human rights violations stemming from racism, state violence, and sexual and gender-based violence. We focus on projects created by artists and activists because they are at the forefront of early technological adoption while immersed in social issues and debates [12], and acknowledge their subjectivity in technical implementation decisions. We interviewed the lead creators for detailed descriptions of each project's conception, design, and production.

Our work contributes to an existing body of work examining the implications and ethics of AR in sensitive contexts. Prior research has examined use of AR to advance activist and social causes [99, 104, 106], as a means of augmenting heritage sites [24, 46], and as a tool for collaborative production of non-fiction narratives with communities [52]. We extend this work by exploring how artists and activists have designed AR memorialization projects to deliver intimate stories rooted in social injustices to broader audiences while carefully addressing the personal narratives of individuals. We build from prior studies of a single application of AR for memorialization [18, 126] to examine a range of approaches across different communities.

Our analysis provides two levels of insight. First, we identify the ways AR can specifically support the practice of *memorialization*. By studying a range of AR projects created in different media, we examine how creators navigate partnerships with archival and research institutions, engage with impacted communities, and make decisions on portrayal and interactions. We describe how AR presented unique opportunities to create spatial interactive narratives, but also presented challenges for interacting with and forming archives. We highlight how creators of AR memorialization projects engaged in multiple ways with impacted individuals and communities, from using archives and testimonials to adopting collaborative models where communities participated in their portrayal and retained ownership of the technologies produced. We distill these practices into specific design choices creators made to uphold ethical principles. These include seeking representation while portraying in absence, safeguarding audiences and communities from (re)traumatization, building enduring media, and ensuring technical agency and ownership. Second, we draw from the design approaches of AR memorialization practitioners to propose responsible design methods for *general* AR research and development. We describe pathways to increase the access and expressiveness of AR-enabled non-fiction storytelling by integrating AR and more traditional media development. We argue that AR platforms can increase community agency by drawing from memorialization practices for personal representation and community ownership of digital assets. Finally, we envision strategies for greater community engagement at the AR implementation level through embodied and collaborative AR authoring systems.

Our contributions are as follows:

(1) Documentation of eight projects that address sensitive narratives through memorialization in AR through interviews with their primary creators.
(2) An analysis of the opportunities and limits of applying AR to memorialization, focusing on the role of narrative devices, archival challenges, technical literacy, and community engagement.
(3) A discussion of implications for the design of socially engaged AR technologies derived from existing practices of artists and activists in the space of memorialization.

2 Related Work

Our work builds on existing design frameworks for engaging with communities in technological production and ethically integrating AR into social contexts. We also extend previous research studying the impact of AR on cultural heritage and memory institutions. Finally, we draw on work exploring the evolving role of emerging technologies in memorialization efforts. We aim to contribute to the conversation around ethical and responsible AR development by focusing on the practices of AR creators documenting and communicating human rights violations and resistance.

2.1 Technology Development with Communities

HCI researchers are broadening their efforts beyond the usability of technology and toward its uses for emotional and social engagement. This turn requires tending to social structures, relational factors, and socio-technical production [3, 4, 49]. Researchers have developed design frameworks to thoughtfully and ethically engage with communities historically harmed by technology production processes. Friedman et al. proposed a Value Sensitive Design [37] framework aimed at integrating human values into the technology design process. The Design Justice Principles provide an intersectional approach to design, calling for developers to create tools and spaces centering, in partnership with, and governed by impacted communities [14, 17]. Social science research has also emphasized researchers' ethical obligations owed to participants and communities [61] and the need for research on violent contexts to adapt to changing social and political conditions [118]. Our work considers the approaches creators have taken in human rights-focused AR production with impacted communities, exploring how these methods align with and complement existing technology design frameworks. We adopt this approach because we believe that, in line with Ceasar McDowell and other scholars [74], studying technology development with and for marginalized communities can inform the development of technologies that serve diverse populations more broadly.

DIS researchers have made significant contributions to understanding how to engage marginalized communities through social justice-oriented design, highlighting the importance of self-determination in technology adoption; critiquing deficit-based narratives; and advocating for commitments to reflexivity, transformation, and accountability in design processes [14, 25]. Researchers have also investigated a broad range of technologies that involve systemically marginalized communities using these frameworks [32, 47, 111, 121]. More recently, researchers in this community have investigated citizen participation in AR [97]; incorporated human values in the design of Mixed Reality [67]; and identified possible harms of the ubiquitous presence of AR, alongside strategies to mitigate these risks [28]. We join these efforts by addressing a topic that often centers the experiences of marginalized communities: memorialization. With our focus on memorialization, we build on previous research that has examined the potential benefits and challenges of using AR for communities in contexts such as education, activism, and cultural heritage [29, 31]. We extend this research on the risks and opportunities of incorporating AR in civic engagement and activism by examining how artists and activists convey intimate stories rooted in social injustices to society at large while making careful design choices around individuals' narratives.

2.2 Activism and Memorialization within AR Development

As the mainstream use of AR grows, current research in HCI and AR venues provides guidelines for the future development of AR. Researchers have demonstrated the lack of designer-oriented authoring platforms [82] and identified ethical, accessibility, and security issues in current development patterns [43, 92]. Efforts to integrate AR into cultural heritage sites have led researchers to propose design principles that guide the ethical integration of AR into public spaces [29] and developed design frameworks for social impact in collaboration with cultural-heritage institutions [23]. Unlike prior work, our research centers on AR practitioners and communities

outside of mainstream HCI. With this approach, we seek to understand how AR can be used to responsibly document, preserve, and communicate the stories of marginalized groups and point to future directions in the ethical and responsible development of AR technologies.

Researchers have specifically sought to guide the critical development of AR in the context of socially engaged technologies, theorizing on the ethical challenges and societal implications of "everyday AR" [28, 85] and proposing new lines of research at the intersections of AR and activism [103, 106]. Previous research has also emphasized trauma-informed practices in media and immersive experiences, focusing on the importance of fostering emotional engagement and reflection without replicating violent or traumatizing events [18, 83, 107]. Outside of academic research, the ManifestAR collective has produced work concerning censorship [119] and human rights violations [1, 34]. The collective's manifesto details the political and artistic potential for AR to expose and re-imagine the institutions, identities, and objects of the elite [110]. Researchers have also collaborated to discuss the implications of using AR for social justice [103]. We extend these studies and initiatives by documenting and analyzing socially engaged works for human rights memorialization.

HCI researchers have studied the implications of using AR in memorialization contexts such as the Museum of Memory in Colombia [18] and the AMA y No Olvida memory museum in Nicaragua [126]. Cárdenas and co-authors study the perspectives of museum specialists in Colombia by co-creating an AR app for the museum that documents events of the Colombian armed conflict. Yang documents her work in the creation of the AMA museum for the memorialization of Nicaraguan victims of human rights violations in collaboration with the families of victims of state violence. We similarly focus on projects that leverage AR for memorialization, but we consider multiple projects in our analysis rather than focusing on a single application context. While our work focuses on memorialization, some of the creators we interview self-identify as activists. Silva et al. also studied AR development practices in activism [104]. Interviews with activists who utilized AR revealed that it enabled them to transform physical spaces, bringing attention to and reimagining social issues. We build on their approach by examining how AR creators collaborate with communities to convey their stories. We explore the use of AR in activism and memorialization to inform more responsible and inclusive AR development practices.

2.3 Emerging Technology in Memorialization Works

The proliferation of digital technology has led museums and other memory institutions to convert their analog artifacts into formats suitable for digital engagement. To support these efforts, HCI researchers have focused on developing archival tools and workflows for organization and intellectual property assignment [8]; streamlined digitization of analog materials [105]; and computational classification, summarization, and retrieval for large archives [45]. While many museums opt to replicate their materials in digital formats, others have included various forms of digital and physical media to reach diverse audiences[21, 96, 100]. These historical narratives are distributed across online databases, films, oral recordings, and more [54, 55, 108]. Memory institutions are also integrating AR technology into their archives and exhibitions [117]. Researchers in this space highlight AR's ability to combine archival materials and historical accounts with an embodied, emotional experience [57, 124]. For example, existing work has argued that overlaying stories atop "built heritages,"–i.e., environments that hold historical memories–allows participants to form a connection with both the narrative and one's physical location [94]. Unlike our work, this research primarily focuses on AR within established cultural institutions like museums. In contrast, we focus on independent creators and community-based organizations who partner with impacted communities to use AR for memorialization. Additionally, although AR is a particularly compelling medium for archival materials, the lessons and implications from AR memorialization projects to general AR development have yet to be studied in HCI. Our research fills this gap. Memory studies research has also provided lenses through which HCI researchers extend the dialogue of design and migration [15]. We seek to contribute to these efforts of connecting insights from memorialization practitioners into HCI.

Many multimodal and immersive archives do more than recreate analog materials; they reimagine archives entirely by developing more accessible and just alternatives. Traditional archives have been criticized as prejudiced, inaccessible institutions [48, 50, 98, 114]. In response, researchers at the intersection of technology and cultural heritage, also known as "digital heritage," [117] work to create sustainable and publicly accessible preservation materials. Engaging with AR, 3D modeling, and other reconstruction tools, developers have cultivated a "collaborative memory" where both the curator and visitor are responsible for carrying the memory of these events forward [124]. Incorporating emerging technologies into archives also raises new challenges for maintainability and longevity [127] due to the rapid rate of change and technical obsolescence for both hardware and software platforms. We identify concrete approaches that AR memorialization creators use for telling underrepresented, sensitive stories; ensuring collaborative design processes; and reducing the risk of technological obsolescence.

3 Methodology

Our objective was to understand the practices of memorialization practitioners who incorporate AR as a method to document and communicate the experiences of individuals or groups of people who have experienced human rights violations. To do so, we conducted a qualitative analysis of eight AR memorialization projects using data from interviews with the project creators.

3.1 Author Backgrounds

Our research is motivated and informed by the multidisciplinary experience of the authors spanning AR engineering, human rights research, and memorialization practice. Ana and Payton are graduate students who have conducted prior research co-designing human rights AR applications and developing frameworks for designing and evaluating liberatory technologies, respectively. Töbias , Kai , Emilia and Jennifer are research faculty at US-based research universities. Töbias is a computer science professor focusing on

fundamental AR research. Kai is an international studies scholar researching conflict, violence, authoritarianism, and methods for studying violent environments. Emilia is a scholar, artist, and community organizer with expertise in the creation of community-based transmedia and transformative justice projects. Jennifer is faculty in an interdisciplinary engineering program with expertise in developing computational technologies in partnership with domain professionals. We were motivated to undertake this research out of combined belief in AR technologies' potential to support new forms of community engagement, storytelling, and cultural and political discourse. Simultaneously, we recognize the history of engineering communities developing technological platforms without accounting for the risks such platforms pose for vulnerable communities and so we seek to interrogate engineering practices (including our own) and develop new engineering methodologies that account for potential harms and misuse.

3.2 Interview Methodology and Participants

Our team conducted a series of semi-structured interviews over Zoom with eight AR memorialization creators over a period of one year. We primarily solicited participants through our networks developed from prior work and projects we identified through research. We sought to interview creators who focused on a variety of human rights topics from both within and outside the US. We focused on projects that were completed, had been exhibited to the public, and—in most cases—received media attention or awards, indicating an initial level of success and public awareness. We deliberately selected projects that used AR with different technological capabilities and augmentation approaches. This allowed us to represent, at least partially, the range of approaches memorialization creators take when applying AR in their work.

We conducted all interviews remotely, lasting an average of 1 to 1.5 hours. Our objectives were to understand the project motivation and target audience, how creators engaged with the communities depicted in their project, how they conceived of and implemented the AR interactions, and what specific production stages they undertook. Before each interview, we reviewed each project and, when possible, gained access to and tested the materials and applications themselves. We developed a custom interview framework for each creator.

3.3 Data Collection and Analysis

We audio-recorded and transcribed each interview, and then used ATLAS.ti to conduct a reflexive thematic analysis focusing on an inductive approach [10]. The research team met to discuss initial reflections and observations following each interview. Ana and Payton each open coded two interviews. Ana , Payton , and Jennifer met to review the preliminary codes and resolve coding conflicts. We repeated this cross-coding process with one additional interview to verify the degree of intercoder calibration. Ana and Payton then divided the remaining interview transcripts between them and coded them independently. Once coding was complete, the entire research team met to discuss preliminary themes, which were subsequently refined through weekly discussions between Ana , Payton , and Jennifer . Further discussions with Töbias , Emilia , Kai led to the refinement of our themes, analysis of AR components, and design choices guided by ethical principles presented in section 5. We received IRB approval for all research methods and obtained participant approval to attribute quotes, images, and names in this publication.

3.4 Limitations

Our analysis of each AR memorialization project is based on our direct experience with the application and the creators' description of the project. We interviewed one creator per project who held a primary creative or leadership role, which may not fully capture all production perspectives. Conducting interviews with community or audience members would enhance our ability to gauge the impacts of each project; however we were unable to undertake this work at this phase. Our aim was to explore how creators engage with design practices, which is why we chose to interview creators rather than end-users. Due to the prior experience of Ana , Kai , and Emilia in working directly with impacted communities, we recognized that speaking directly to victims of human rights abuses would require additional training and safeguards on part of the authoring team, and sampling audience members would necessitate different data collection techniques. We see opportunities for this work to inform future co-development research in AR memorialization that will provide appropriate guidance and context for studying the experiences of communities and audiences. Future work could also further validate the design implications of this work through direct engagement with communities in applications of memorialization.

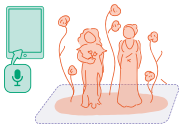
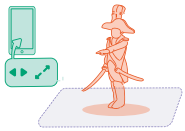
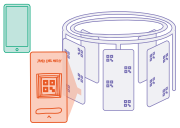
We considered a broad range of AR applications, including sound augmentations, which are often overlooked in AR research [93]. However, the general AR representation in our final sample is limited and does not include either projection-mapped AR or head-worn AR displays as these are currently less accessible formats for AR and, therefore, less applied outside of research and industry settings. Finally, none of the applications we study include concurrent multi-user or remote-user features. Most applications focus on the experience of a single user, with the exception of Breonna's Garden which includes a feature to upload user messages in the AR environment. However, we document how designers thoughtfully considered the multi-user co-located scenarios that arise from large-scale physical installations.

4 Memorialization Projects using Augmented Reality

We examine eight AR memorialization projects created by artists, documentarians, and activists that address human rights violations. Although some projects showcased multiple interactive artifacts, in our interviews, we focused on a single AR application, delving into its design, development, and deployment. In this section, we briefly summarize the projects' memorialization topics. We also introduce the AR components that creators used in their interactive narratives in Table 1. We use these components to structure our analysis of the creator's approaches to AR memorialization in section 5.

The projects we analyze span diverse themes and approaches in memorializing human rights violations. **Be Here / 1942** presents a 3D scene of the forced internment of Japanese Americans and the photographers who captured these events, using AR to place

Table 1: How creators leverage physical anchors, augmentations, and audience interactions for memorialization storytelling.

		AR Components of Memorialization Projects			
Project Name	**Interviewee**		**Augmentation**	**Interaction**	**Physical Anchor**
Be Here / 1942 United States	Masaki Fujihata *Project creator*		3D scene of Japanese Americans boarding buses and nearby photographers in 1942	Pointing tablet's camera *(co-located multi-user)*	JANM outdoor courtyard
4Ríos Colombia	Elder Tobar *Project director*		3D renderings of paramilitaries and the Indigenous and Afro-Colombian population	Pointing tablet's camera and changing scenes *(single-user)*	Diorama
Breonna's Garden United States	Lady Pheønix *Project creator and director*		Breonna's 3D model and Ju'Niyah 3D capture in a flower garden	Pointing tablet's camera and uploading voice messages *(async multi-user)*	Floor/ Surface
Priya's Shakti India	Ram Devineni *Project director*		Videos from NGOs, and animated illustrations of a fictional character (Priya)	Pointing phone's camera *(single-user)*	Comic book panels
KAIA Colombia	Melanconnie *Project creative director*		Video interviews of Natalia with the comic's creators and 3D animation	Pointing phone's camera *(single-user)*	Comic book panels
Kinfolk United States	Glenn Cantave *Project co-founder*		A 3D monument and audio and text description of a BIPOC / LGBTQIA+ historical figure	Pointing phone's camera, selecting and scaling *(single-user)*	Floor/ Surface
Un(re)solved United States	Tamara Shogaolu *Project co-creator and director*		Audio, images and text descriptions of individual cases	Pointing phone's camera and saying a person's name to open their case *(co-located multi-user)*	QR codes in large sculptural installation
Cacophonic Choir United States	Şölen Kıratlı *Project co-creator*		Synthesized and dynamic audio of survivor's testimonies	As visitors get closer to a sculpture the survivor's voice changes *(co-located multi-user)*	Physical sculptures

the scenes in today's Little Tokyo in Los Angeles. **4Ríos** is a series of multi-media installations that incorporate an AR pop-up book and an augmented diorama to represent data and stories from the Colombian armed conflict. **Breonna's Garden** is a digital veneration project developed in collaboration with the family of Breonna Taylor, a Black American woman killed in her home by police. **Priya's Shakti** uses an interactive AR comic book to address gender-based violence. The comic narrates the story of the power of survivors through a fictional character, Priya. **KAIA: Awakening in the Deep** shares the story of Natalia Ponce de León, an acid attack survivor and activist, by augmenting a comic book and a mural that portray Natalia's story. **Kinfolk** is an app that brings forward underrepresented histories through monuments of BIPOC and LGBTQIA+ historical figures. **Un(re)solved** narrates civil rights-era cold cases through an AR installation based on investigative reporting by PBS Frontline. Lastly, **Cacophonic Choir** uses interactive sound sculptures to represent the voices of sexual assault survivors shared in the "When You're Ready Project." We provide expanded descriptions of each project, interviewees, and collaborators in Appendix A.

The creators of these projects used AR to embed multiple forms of digital content that interact with specific and meaningful physical contexts while supporting interactive experiences for audiences. To represent these approaches, we use a framework of three components of interactive AR applications: the **Augmentation** or digital context aligned with the physical world; the **Interactions** that audiences could have with the AR content; and the **Physical Anchor** that creators used to trigger or ground the AR content. Table 1 describes how the projects we analyzed built narrative AR experiences through these components. When describing the interaction component, we also clarify which applications were optimized for a shared experience in co-located large-installation settings *(co-located multi-user)*, which ones enable asynchronous interaction of users *(async multi-user)*, and which ones were designed for individual use *(single-user)*. We use these concepts to highlight the specific design choices made by creators to shape how audiences interact with and experience the memorialization narratives in the following section.

5 Artists' and Activists' Approaches to AR Memorialization

We used our analysis of AR human rights memorialization projects and creators' descriptions of their creation process to conceptualize three themes of AR memorialization of communities impacted by human rights violations. In this section, we describe (1) the portrayal of impacted individuals in AR applications; (2) the use of AR-driven spatial interactions as a narrative tool; and (3) the relationship between traditional archives and AR-based documentation of archival material. Finally, we build on these themes to identify the specific design choices creators undertook to uphold ethical principles in creating AR applications.

5.1 How Creators Portrayed Impacted Communities through AR

The creators of the AR memorialization projects sought to digitally portray real people and their experiences in ways that aligned with impacted communities' values. This was often accomplished through long-term partnerships with the individual victims of violence or their communities. As Table 1 shows, seven out of eight projects consisted of **augmentations** portraying impacted individuals and communities, historical figures, and events surrounding them. Additionally, all the creators we interviewed sought to avoid sensationalizing historical events or re-traumatizing communities by developing engaging and informative AR portrayals without overtly displaying graphic violence.

The creators of Breonna's Garden , Priya's Shakti , and KAIA used artistic animation styles to focus on the beauty and strength of the victims of violence, not the violence itself. Similarly for Un(re)solved , Tamara explains that she sought to "tell the story without centering the aspect of white violence that led to their murders." Creators who opted for photorealistic representations of events and people also strategically avoided reproducing graphic moments while maintaining a focus on accurately portraying people and events. For example, Lady Pheønix used 3D modeling to represent Breonna and volumetric capture to represent her family, but deliberately refrained from including violence in Breonna's Garden . She stated that she wanted to honor and memorialize the beautiful elements of Breonna Taylor's life, not her violent death [88]. Three projects also relied on interdisciplinary collaborations to ensure their portrayals met impacted communities' standards. Tamara , for instance, used original material from a journalistic investigation and consulted extensively with the Un(re)solved research team; she highlighted how this process even involved carefully reflecting on the distinct skin tones of the people featured in the project. Realistic portrayals also provided opportunities for creative directors to engage directly with represented communities. Through volumetric capturing, Masaki and Breonna's Garden creator Lady Pheønix found opportunities to connect with internment camp survivors and Breonna's family, respectively, while also involving them in the authoring process. This collaboration enabled them to create high-quality 3D assets and ensured the co-creation of AR content. Lady Pheønix explained the value of this process, saying,

> [Volumetric capture] allowed for Breonna's sister, her partner, and her mother to share memories and to sort of plant their own flowers in the form of memories in the garden …It allowed for more of an immersive experience for the viewer.

While creators prioritized depictions that were, above all, sensitive to and protective of victims, all eight projects exercised caution in what they displayed when considering their target audience and what might be engaging but not traumatizing when portraying human rights violations. They recognized that the gravity of violent and traumatic events might be more effectively conveyed through allegory, metaphor, and symbolism. The Un(re)solved AR installation featured multiple hanging panels that display augmented animations and information about each case when a phone scans a QR code. In describing these design decisions, creator Tamara emphasized, "Animation allows me to blend and create a more surreal aesthetic to it that could create that emotion without necessarily needing to be graphic." Kinfolk , Priya's Shakti , and KAIA used illustration aesthetics to design for young audiences and educational objectives. "I'd say the [aesthetic] decisions were more on the education side …It's for kids. The approach is to make it friendly and accessible," Glenn explained in reference to Kinfolk 's audience. Ram sought to have KAIA and Priya's Shakti function as tools for educators through a combination of bright colors, accessible language, and interactive AR: "I thought that could be a really cool way for educators to kind of talk about these complex topics." Familiarizing audiences with the technology also was a form of considering the impact of the narrative. For example, when engaging teenagers—his target audience—in Priya's Shakti , Ram stated that he focused on introducing the group to AR through workshops that informed the shape of Priya's comics.

Creating digital portrayals of real people and events in AR involves the production of digital data and assets. The creators we interviewed recognized that this content was sensitive and worked to safeguard it in ways that prioritized the rights of the people portrayed. Three creators established formal relationships for collaboration and assigning intellectual property ownership to affected communities for materials related to their identity and likeness. When creating KAIA and Priya's Shakti , Ram established a reciprocal exchange of assets developed in partnership with NGOs. Lady

Pheønix went further by providing Breonna's family with legal rights to all data and digital assets for the project. She felt this was critical given that the project involved partnerships with multiple large companies, stating, "We partnered with Microsoft…but the family owns all of the data and the assets…We're merely stewards of the content and the project." Lady Pheønix 's approach reflected her general principles on how data ownership–particularly when reflecting someone's likeness–should be handled in memorialization work: that ownership should be guaranteed for families or trusts and withheld from corporations.

Additionally, abstract AR representations were especially necessary for two projects where survivors' safety could be compromised if their identity was revealed. In working on Priya's Shakti , which primarily focuses on sexual violence survivors, Ram had to document survivors' experiences without revealing identifiable information. He explained that, in India, while it's not illegal for survivors to speak out publicly, it is illegal for him or people who are not survivors—like the press—to reveal their identities due to safety concerns. In other cases, creators used abstraction to convey to the audience prior efforts to distort or attack members of a victimized community. Şölen relied on an anonymous dataset of sexual violence survivors in developing Cacophonic Choir . To illustrate the way social media distorts the narratives of victims of sexual assault, she and her collaborators chose to computationally distort the synthesized audio of anonymous victims' accounts.

Projects like KAIA and Kinfolk featured less realistic and more figurative representations, yet their creators still partnered with communities to capture aspects of their identity in the AR representations. For example, Melanconnie took particular care in researching the life and context of KAIA 's protagonist, Natalia Ponce de León. They discussed meeting multiple times with Natalia to establish visual and narrative elements of the comic that were guided by Natalia's personality and activist principles; this discussion determined the way Melanconnie illustrated Natalia's appearance and the decision to include her attacker in the narrative. When faced with the challenge of representing individuals they could not directly engage with, creators relied on community partners who had established connections with the subjects of the applications. Glenn highlighted an example of this when creating the AR representation of a revolutionary who led one of colonial Mexico's first successful slave uprisings in Kinfolk : "We made sure that for Gaspar Yanga, the artists that creative directed it [were] Mexican-American artists."

These accounts show how creators chose artistic abstractions and visual or auditory metaphors in AR portrayals as protective mechanisms for both impacted communities and audiences, and as a way to more effectively convey the experiences and qualities of the people represented. In addition, they show how creators were able to create intimate portrayals by engaging impacted communities and audiences in equitable technical collaborations that shaped the way communities were portrayed.

5.2 How Creators Used Spatial Interactions as Emotionally Engaging Narrative Devices

Creators used AR to re-situate the virtual narratives of harmed and disenfranchised people in a real-world context to more deeply engage audiences with the subject matter and its importance. Table 1 shows how creators leveraged the **interactive** affordances of AR applications, such as camera movement and voice input, as storytelling devices. Four of the eight projects used spatial interactions to invite embodied critical reflection from audiences by encouraging them to move and interact with physical installations. In Be Here , participants encounter 1942 California from the perspective of two notable photographers sent on a government commission. Masaki intentionally considered how participants should hold the iPad to view the project, lifting it like they would a camera and making it so that they are "standing at the same position [as] the photographer." Masaki additionally asserted that "the existence of [the] photographer is more important …than the object inside the images" because this role invokes a responsibility to look carefully, closely, and considerately.

Three creators designed interactions that combined digital and physical environments to facilitate embodied experiences and movement. Şölen described how Cacophonic Choir used the distance between the audiences and physical installations to modulate the distortion of sexual assault survivors' testimonials. The audience's experience is dynamic, with the sounds of someone stuttering or mumbling becoming more or less coherent with their distance to the installation. Elder highlighted a similar technique, finding that he could direct audiences' attention toward more minute visual details by using participants' proximity to speakers embedded in the walls of the physical installation. By softly playing audio, Elder encouraged audiences to lean in closer, revealing other hidden elements. Creators reflected on the use of AR to enable shared experiences between multiple audience members in the same physical space. Tamara designed Un(re)solved to require audience members to say victims' name three times to enter the AR experience: "The first time they're saying it is kind of pushing a play button …the second time they say it, there's a little bit of frustration, and then the third time they say it, they realize this is the name of a person." She described how this interaction created a powerful co-located immersion:

> There's multiple people saying different names, it almost starts to feel very meditative. This cacophony of sounds that are all the different names and different voices that I think adds a level to the experience that isn't really something that you could recreate in VR.

Tamara described the ability of AR to support collective experience in physical space as the primary motivation for using AR in her work. When comparing virtual reality (VR) to AR, she likened it to "watching a movie by yourself at home [versus] in a movie theater where there is this power and a collective experience."

As Table 1 shows, six out of eight projects relied on **physical anchors**–other than surface tracking–to tie the digital content into physical media counterparts. These included dioramas, postcards, 3D-printed sculptures, comic books, and explicitly selected physical spaces. Creators used AR to add context and additional meaning to these companion materials. Ram felt it was important that the physical comic books for Priya's Shakti and KAIA could function independently of AR. "The great thing about the comic book is you can read [it] from cover to cover and never know about the AR and still be impacted," he said. In describing future projects, Glenn spoke

about the importance of maintaining a physical component, like a painted mural, as an element of an AR project that may dominate a space and be experienced by those without the technology.

Two creators discussed the impact of linking AR to a particular geographic location. Masaki selected the name Be Here as a call to action for the audience to be fully present when entering the physical space and engaging with history. He described how he leveraged AR in a meaningful location by having the audience members interact with the Japanese-American internment process and how it was documented through photography:"Actual happenings were there, and there are people who have been waiting for the bus and [the] cameraman . . . Now, again, the audience as a cameraman [goes] into this data and they retrieve the situation." Kinfolk 's initial intention was to subvert existing physical monuments using AR. Glenn explained that "the original idea was to have geolocated augmented reality monuments. So you're standing at Columbus Circle, and you're replacing [Christopher Columbus] with Toussaint Louverture in augmented reality." The intention was to simultaneously engage viewers with historical figures and allow them to envision a future with decolonized public monuments.

These reflections demonstrate how AR memorialization creators prioritized AR interactions that engaged audience members physically. They used AR-driven spatial interactions to underscore critical narrative or conceptual aspects of the stories they memorialized. Creators frequently grounded their AR interactions with custom-developed physical installations, artifacts, or media. These physical attributes often increased the work's accessibility for a given audience or increased the visibility of the overall memorialization experience.

5.3 How Creators Engaged with and Challenged Traditional Archives Through AR

Creators built AR memorials using existing archives, government records, journalistic investigations, and academic research. These resources encompass large amounts of specialized content that is often inaccessible to general audiences. In the projects we document, AR served as a tool to transform information from archives into publicly available experiences with which people could connect.

Three of the eight projects relied on access to large databases that creators used to select media and other data utilized in the AR applications. They sifted through extensive, largely unsorted repositories, carefully curating historical materials to craft compelling and accurate narratives. For example, Masaki created Be Here by working with archives within both the Library of Congress and The National Archive Museum. In describing these repositories, Masaki explained that the materials were not "selected by the [original] photographer. It [had] no curation." He undertook a manual process of familiarizing himself with the material, tracing back the stories of some survivors, and selecting images that revealed the role of the US-commissioned photographers. While AR applications were the ultimate mechanism for engaging audience members with archival material, creators preceded their development with extensive research to identify which components of a large historical archive or dataset could be meaningful to audiences *and* communicated through AR. Un(re)solved 's AR aspects were developed at the end of a 15+ year-long investigation re-examining over 100 killings from the US civil rights era. Tamara stated that this process took "years and years of work to turn [the data] into a meaningful experience that people could connect to."

Three creators also considered their AR projects to constitute archives—historical records of human information—in and of themselves. Glenn described Kinfolk as "a digital archive that shows augmented reality monuments of Black and Brown and BIPOC and LGBTQIA+" figures. While creating Be Here , Masaki was interested in AR as an "externalized memory device" inquiring into processes by which we store and retrieve memories mediated by technology. Both creators were also careful to recognize how the use of AR disrupted many of the key functions of archives in preserving material for the longer term. They highlighted how the infrastructure that supports AR is constantly changing, requiring continuous labor to remedy platform incompatibilities and guarantee sustained access. Glenn pointed to "server space, AWS [Amazon Web Services] accounts [and] charges for Apple or keeping up Unity" as specific issues in maintaining his work, stating that "you got to pay the light bill no matter what if you want the app to continue functioning." Masaki also described challenges with software updates, saying, "We only used product[s] made by Apple and . . . three weeks before the opening, [they] released a new [operating system] version . . . and suddenly our application didn't run."

We discuss these problems of AR technology change and application maintenance as *brittleness*. Five projects partially addressed the brittleness of AR infrastructure by creating robust records of their work in other media formats. Referring to Priya's Shakti , Ram planned for AR platform obsolescence through thorough documentation:

> I made sure that I properly documented everything . . . even though those AR [projects] from 2013-14 and BlipAR [don't] exist anymore, I still have the videos of the process and what the experience was.

Another strategy to counter the brittleness of AR infrastructure involved positioning AR as one component within a larger ecosystem of media formats and information that did not depend on the AR application to function. For example, Cacophonic Choir , Un(re)solved , and 4Ríos featured web versions of their physical installations to enable broader access. Şölen noted that Cacophonic Choir 's website served as a way to archive the physical installation but acknowledged that the website "is nowhere near as compelling as the original project." Creators felt that different platforms had their own unique affordances and were not interchangeable. Therefore, rather than substituting one medium with another, creators like Tamara focused on the benefits of using AR to diversify the narrative experience: "I was really interested in multi-platform. I thought it was something where it could add onto the film experience. I never wanted to replace film or replace games."

Creators inevitably made subjective decisions in curating the historical record and portraying events and people, but had different perspectives on how this subjectivity impacted their project's status as an archival work. Tamara distinguished her work in Un(re)solved from an archive , explaining, "All of this information was public record, so it already exists in archives . . . all I did was take what was already archived and tell a story ...similarly to how somebody would make a film based off of research that they've

Project Name	Portraying in Absence	Safeguarding (re)traumatization	Building Enduring Media	Technical Agency and Ownership
BeHere/1942	Engaging family members and survivors in volumetric capture to create assets for the application.		Developing curricula and engaging educators and cultural institutions.	
Breonna's Garden		Building narratives around intimate memories towards healing.	Using printed media, web applications, installations, and murals to develop multi-media ecosystems, expanding access and preservation of materials.	Assigning intellectual property ownership to affected communities.
Un(re)solved	Leveraging assets from community or organizational archives alongside art contributed by community members.	Using narrative and visual symbolism to represent moments of violence.		
4Ríos		Using material fabrication and immersive audio to engage with traditionally neglected senses and emotionally engage audiences.		
Cacophonic Choir	Utilizing illustrated animations and immersive audio to anonymously portray survivors whose identity must be protected.			
Priya's Shakti				Remedying gaps in technological literacy by hosting workshops and public events, exposing community members to AR, and allowing them to contribute to the project.
KAIA				
Kinfolk				

Table 2: Creators' design choices informed by four ethical considerations in developing memorialization AR applications. Cell groupings represent multiple projects (rows) implementing a particular design choice. Some groupings are not consecutive, i.e. Un(re)solved, 4Ríos, and Kinfolk all sought to portray in absence by leveraging assets from community members or organizations.

done." Tamara contrasted her efforts with the presumed neutrality often attributed to archives, contrasting: "I wasn't trying to be neutral about racism. So that's why I don't know if I see myself as creating an archive by doing this but rather participating in a conversation around preexisting material that was already there." In contrast, Lady Pheønix saw Breonna's Garden as akin to an archival effort despite the work embodying her partial perspective and design choices. She described her work as "a record of truth about a loved one, about a person's life from the standpoint of their community and themselves."

Overall, creators felt AR provided novel opportunities to preserve and document historical information. However, they recognized that AR applications alone currently have limited ability to serve as archival sources because of the difficulty of AR application maintenance. They partially compensated for this brittleness by developing multi-media ecosystems and extensively documenting their design process. Furthermore, some creators challenged the connection between archives and their projects, questioning whether their positionality and embedded perspective prevent them from creating "neutral" documentation.

5.4 Design Choices Informed by Ethical Principles

We distill the previous themes into specific design choices made by creators, aiming to highlight their guiding ethical principles towards responsible AR memorialization. These decisions were informed by their community partnerships, technical and creative expertise, and personal convictions, and we summarize them in Table 2. This table does not encompass all of the design choices made by all creators; rather, we highlight key implementation decisions that illustrate clear efforts toward responsible AR development.

In seven out of the eight projects, creators could not rely on their primary subject to directly guide or approve their narrative due to safety concerns or death. In these cases, creators focused on **portraying in absence**, seeking to respect the voices of those who could not participate in the telling of their own stories. In these cases, creators were faced with telling the stories of people whose rights had been violated and required careful portrayals, while doing so without their direct participation. Engaging families and communities in the design process offered one way to approach this sensitive portrayal. These partnerships were directly reflected in the applications, as they produced assets through collaboration with families and incorporated archives enriched by community and family contributions. Creators' respect for absent individuals was also reflected in the assets that creators chose *not* to use. This encompassed the use of abstractions to safeguard identity.

Trauma-informed practices in media and immersive experiences aim to encourage emotional engagement and reflection while steering clear of replicating harmful or distressing events (section 2.2). In **safeguarding (re)traumatization** creators sought to truthfully depict violent situations without (re)inflicting harm on the audience. To achieve this, creators focused on narratives that sought community healing, used symbolic storytelling and visual metaphors, and built abstract but impactful narratives by engaging multiple senses through immersive audio and digital fabrication. Fostering healing entailed allowing communities to share their voices and memories instead of focusing on representing the violence they had experienced. Creators also extended the symbolic language of AR beyond visual representations, leveraging interactive metaphors in reactive installations and material forms to convey the gravity of the events.

Creators faced the challenge of preserving and disseminating obfuscated stories despite the brittleness of AR technologies. Striving towards **building enduring media**, they developed multi-media

platforms, conveying narratives in accessible and resilient formats. They also seeded paths for further knowledge-building and discussion by developing curricula and engaging educators and cultural institutions. Many creators relied on "multi-media ecosystems" consisting of websites that supplemented or replicated the materials found in the installation and leveraged the unique integration of AR with physical materials such as printed comics, installations, and murals to maintain their content even when the AR was no longer functioning. Creators also built and produced materials in collaboration with educators and public-facing institutions.

Finally, creators sought to develop technically complex projects with communities historically excluded from technology production. They established design strategies for facilitating **technical agency and ownership**, aware of the responsibility to empower communities to amplify their stories. This included granting communities legal rights to digital assets that ensure their stories and likeness remain under their control, rather than that of external entities. Additionally, creators conducted workshops to familiarize participants with AR technology, foster trust, build technical literacy, and enable participants to contribute to the design process and increase their sense of ownership.

6 Discussion

Our analysis of prominent AR memorialization works demonstrates how creators prioritize impacted communities' agency and audience experiences when designing and implementing specific AR interactions, visuals, and narrative devices. We draw from these approaches in AR memorialization development to suggest new directions and priorities for responsible AR development. We describe how memorialization creators' efforts to mitigate AR brittleness can reshape how we conceptualize AR development paradigms. We identify specific practices for preserving community agency through data ownership, privacy, and personal representation policies. Finally, we envision new methods for collaborative AR production that support community engagement in the implementation stages. We summarize these future directions for responsible AR development in Table 3, mapping them to the AR memorialization approaches and related ethical principles.

6.1 From Archiving and Storytelling Tensions to Multi-Modal AR Authoring Paradigms

AR memorialization projects recover and preserve stories that are often ignored or suppressed and offer a means to augment traditional archival and communication forms. Yet their use of AR reveals two pressing tensions between AR memorialization and traditional archival processes: 1) the challenge of long-lasting material preservation in contrast with the brittleness of AR technologies, and 2) the issue of balancing evocative storytelling and respectful representation. AR memorialization creators addressed these tensions by leveraging the interplay between AR and other physical and digital media to both enhance narrative richness and ensure the preservation and dissemination of obfuscated stories. This framing can inspire a shift in AR authoring to support AR's use as an adaptable component within existing storytelling ecosystems instead of an isolated digital overlay.

When describing their objectives for long-term documentation, the creators in our study discussed their struggles with AR technologies quickly becoming inaccessible or non-functional. In response, creators worked toward **building enduring media** by making AR only one component of the experience or one means for engaging with the public. By using AR as a method for extending murals, sculptures, comic books, websites, and films, creators were able to expand their audience, draw from their existing professional skills, and prolong the portrayed stories' lifespan beyond that of an individual AR application.

The issue of AR technology rapidly becoming inaccessible or difficult to maintain is not unique to memorialization. Researchers have highlighted the brittleness of AR, particularly in the contexts of activism [104] and art [112]. Independent creators have also sought to address these limitations through the development of alternative platforms that support cultural institutions [7] and empower artists [12, 41]. Most relevant to memorialization efforts is the perpetual risk of AR application obsolescence, which has different consequences when the content at stake is untold or suppressed stories of individuals and communities who have suffered human rights abuses.

To build *resilient* rather than brittle AR systems, we argue that AR developers can learn from memorialization creators' conceptualization of AR as a supplementary component of existing media platforms. By framing AR as a technological platform that can *complement* existing forms of digital and non-digital media, rather than a fundamental shift away from other forms of media authoring, systems developers can support creators in producing AR *in parallel* and *interwoven* with different media. This approach is in dialogue with existing memorialization approaches, integrating technology with established infrastructure and practices. For example, the Hīnātore Learning Laboratory at Te Papa extended student learning by complementing school-based digital access with museum-based AR, VR, and 3D media [5]. Similarly, the project "Remendar lo Nuevo" integrated digital components into collective textilemaking practices, supporting reflection and healing without displacing embodied, relational spaces of reparation [91]. Finally, building AR into existing creative workflows resonates with calls to develop AR authoring technologies that leverage familiar tools [80] and current skillets [104] .

The second tension AR memorialization creators faced when reconciling their work with more traditional archival methods involved creating engaging storytelling content while accurately and respectfully portraying sensitive–and often traumatic–content. Our study highlights how AR memorialization creators sought to combine different material and interactive forms of storytelling for **safeguarding (re)traumatization**. By integrating AR's spatial interactions with physical media, creators engaged audiences with sensitive subject matter in ways that would convey histories and foster pro-human rights sentiments without overwhelming them emotionally. For instance, Elder , Şölen , and Tamara integrated AR content with physical installations to engage audiences in metaphorical interactions that represented complex stories through multi-sensorial and embodied storytelling.

The creators' approaches to sensitive portrayals are in dialogue with existing research that highlights the risks of immersive, realistic media [69, 73], points to the risks of unexpected horror [107],

Table 3: Responsible AR directions informed by AR memorialization creator's approaches, and guiding ethical principles.

AR Memorialization Approach	Future Responsible AR Direction	Ethical Principles
Reconciling Archiving and AR Tensions. Creators navigated AR brittleness and sensitive storytelling challenges by blending AR technologies with enduring digital and tangible installations, resulting in sensitive, multisensory narrative experiences.	**Multi-Modal AR Authoring Paradigms.** AR should function as a complement to existing digital and non-digital media rather than as a replacement for established storytelling formats.	• Building enduring media • Safeguarding (re)traumatization
Facilitating Community Agency in Memorialization. Creators ensured that communities controlled their representation in AR by engaging in sustained dialogue concerning what to include or omit and sharing or transferring ownership of the materials.	**Ownership of Personal Representations in AR.** AR platforms must uphold user agency in data management and enable individuals to make informed and ongoing decisions about their identity and personal environment representations.	• Technical agency and ownership • Portraying in absence
Developing Community-Driven Memorialization. Creators directly involved communities in the AR design and authoring by incorporating embodied methods like 3D scanning, workshops, and collaborative feedback.	**Embodied and Collaborative AR Authoring.** AR should support collaborative production processes through collaborative, situated creation that enables the authoring of assets, spatial interactions, and narrative structure.	• Technical agency and ownership • Portraying in absence

and formulates trauma-informed practices for engaging immersive experiences [18, 83]. The creators' ethical choice to avoid displaying overt violence closely aligns with discussions by Black feminist archival scholars, who emphasize the disconnect that often arises between witnessing digital violence and recognizing the human suffering behind it [115]. This choice also resonates with memory scholars' attention to the role of art and allegory in existing approaches adopted by memory museums to narrate difficult stories as a way to engage viewers in reflection without reproducing trauma [6, 68] and the role of "physical touchstones" to encourage physical and emotional engagement with historical narratives in memory sites [109, 128]. The tensions in how to represent narratives that still connect with audiences point to AR's spatial affordances in combination with physical installations and tangible media as an avenue for rich and tactful storytelling.

Our studies of AR memorialization demonstrate how authoring expressiveness– i.e., the ability to author custom spatial, embodied, and context-sensitive interactions that can combine physical and digital media–is critical not just for aesthetic variety but also for conveying the subjective experiences of the impacted community members, communicating the positionality of the creator, and enriching the audience's experience while avoiding explicit depictions. Sharing subjective viewpoints through diverse mechanisms is particularly vital for memorialization efforts, as traditional centralized approaches to memorialization can de-historicize and de-contextualize local knowledge and reinforce societal divisions rather than offering multiple pathways for understanding, reconciliation, and healing [20]. To further enable AR to serve as a tool for highly individualized storytelling, we advocate for the continued diversification of AR development to foster richer interactions with physical materials and digital platforms.

6.2 From Community Agency in Memorialization to Ownership of Personal Representations in AR

In the projects we examined, creators ensured that communities had agency and ownership over how they were portrayed in AR. Although the requirement for active engagement of impacted communities is heightened in memorialization projects, it is also vital in general AR production. We argue such engagement is particularly critical in social forms of AR, where people share representations of themselves and give access to their private environment. We use our analysis of AR memorialization strategies for community agency to identify approaches for collective and individual control over data ownership and personal representations in AR.

The intimacy involved in the memorialization projects led some creators to involve community members in their portrayal and provide them with ownership of these depictions. Our results identify the design choices that enabled depicted communities to procure **technical agency and ownership**. Notably, creators' efforts to assign ownership to the people depicted did not restrict their ability to engage in industry or organizational partnerships. Breonna's Garden 's creator acknowledged the importance of taking legal action to protect community ownership, even when collaborating with corporate partners. The Priya's Shakti and KAIA projects provided the community-based organizations with which they worked open access to the assets and applications that developed from their efforts (section 5.1). Community-centered memorialization helps ensure projects align with communities' desires and understandings rather than imposing a specific outside framework [20], and researchers have explored the community-centered development of AR applications [23, 29, 97, 99], but our findings highlight community ownership of projects' source material and products as a key concern. Scholars in Participatory Memory Work (PMW) have also pointed at the need to move beyond participation and towards understanding the socio-material arrangements that enable memory practices which include digital infrastructures, licensing, ethics,

and legal frameworks [62]. Furthermore, as policymakers work to regulate the development of widespread extended reality (XR) technologies, they are particularly concerned about privacy and inclusive platform development [28, 87]. Memorialization efforts, particularly focused on stories of those historically excluded from technology production, emphasize the need to scaffold ownership and agency for impacted communities.

User agency over data ownership is not yet common practice in the development of most AR platforms. Social media companies currently control some major development frameworks like Meta Spark (no longer supported as of 2025) [77] and Lens Studio [113], limiting the publication of content created with their software to their own platforms, where it remains subject to platform-specific review processes. These platform-specific policies are also subject to potential changes to the terms of service around privacy and data ownership or may disrupt the creative and labor practice of AR content creation by stopping their publishing services altogether [16]. Additionally, end-user security and privacy are often not significant considerations in the design of AR applications [92], despite many forms of AR requiring camera access to what could be a user's personal environment. Our research highlights that prioritizing user agency in data management and privacy as a core principle of AR application development fosters trust and encourages individuals to share meaningful stories through this emerging medium. As AR expands into social domains and increasingly integrates with personal spaces, and as new platforms allow the blending of remote physical environments for digital connection, these systems must uphold the same principles of respect for user ownership and agency over data and identities [67] demonstrated by memorialization applications.

One of the primary motivations for creators securing ownership and community agency in their memorialization efforts was their desire to preserve the memories and experiences of vulnerable individuals and communities. In our results, we highlight the strategies creators took when challenged with **portraying in absence**. Memorialization creators ensured communities' agency in decisions about how to represent their physical appearance by investing extensive effort in learning about communities' values, history, and preferences and by engaging individuals' families and broader communities in developing digital assets that comprised their AR representation when direct representation (and consent) of the individual themselves was not feasible. Furthermore, creators decided *not* to show certain personal elements of the people they portrayed in AR. Partnerships also played an important role in achieving portrayals that adhered to communities' values (section 5.1).

Representation of the self and others is one of the powerful yet delicate capacities of technologies that can shape our perception of reality. When discussing the potential risks and opportunities of AR, researchers have emphasized AR's capacity to realistically alter images of oneself or others [11, 36, 85, 107] and to express social identity [9]. Prior research around avatars of people with disabilities has also highlighted the importance of giving agency to represent or hide certain aspects of people's appearance or to change and update them [70]. Designers for inclusive avatars have approached community portrayal through informed technical collaborations, detailed interviews, and long-lasting relationships, highlighting design principles for digital bodies involving reversible, informed, and specific consent [66].

We argue that co-design, the option to obfuscate elements of one's lived experience, and support for longitudinal modification are all critical to the responsible development of AR-based forms of personal representation. AR is compelling partly because it offers the potential to alter the surrounding world digitally and how individuals are portrayed within a hybrid digital/physical context. Body and face filters and avatars provide the means to modify one's appearance digitally, but the agency users have in this respect is directly determined by the actions of the developer. Beyond engaging communities on project scoping and designs, memorialization projects show that it is critical to maintain opportunities for individuals or affected communities to influence not only appearances but also how their histories, present, and potential futures are portrayed. We can responsibly approach this kind of expression by allowing all AR users to selectively redact and reveal aspects of their identity through time, making technically informed decisions regarding their digital appearance and what parts of their experiences are visible or accessible.

6.3 From Community-Driven Memorialization to Embodied and Collaborative AR Authoring

Memorialization creators develop AR applications that directly involve communities in the design and authoring process, revealing clear and actionable practices within co-creation and participatory design. Memorialization AR creators expanded the boundaries of authoring and participation by integrating embodied methods such as 3D scanning and incorporating community-driven workflows like workshops and collaborative feedback mechanisms. Building on these practices, in this section we describe how AR authoring can expand to prioritize collaborative production processes that foster stronger ties between technology developers, artists, and communities to produce meaningful and inclusive narratives.

Memorialization creators engaged communities in AR production processes by using embodied methods such as 3D scanning and collaborative production workflows, encompassing workshops and social events, to establish feedback mechanisms from target audiences . We identify specific strategies for **portraying in absence**, which include collaborating with community members to create volumetric captures. Creators engaged communities in designing their own portrayals (section 5.1). These efforts included partnering with local artists to design representations of historical figures and sourcing NGO materials as augmented content. These collaborative design processes point to new directions in the production of AR assets. Researchers in general AR development have created systems that prioritize collaborative authoring of AR content [44, 81] and have identified collaboration with non-technical designers, such as students and creatives, as a trend in XR authoring tools [80]. However, this research has yet to be extended to collaborative authoring with *communities*. Scholars in memory studies have highlighted how digital technologies enable non-state actors to reclaim memorialization spaces. These technologies facilitate the emergence of counter-memories, support grassroots agency, and open space for collective expression that resists state-sanctioned silencing and

denial [35, 130]. The role of digital technologies as a catalyst for decentralized memory and the co-authoring experiences of the memorialization applications point to authoring avenues that center the role and importance of multiple communal partners and give them agency in not only approving but actually implementing the AR content.

The practices we document here could be expanded to include the communal authoring of AR interactions. For example, an *embodied community authoring process* could involve communities directly intervening in the creation of 3D characters, environments, and objects by using increasingly accessible 3D scanning technologies. A *communal production workflow* might encompass shared authoring environments that allow multiple people to discuss and prototype interactions in a workshop setting. Building AR tools that directly facilitate shared authoring for AR experts and newcomers could further involve impacted communities in the implementation of AR memorialization works. We envision future XR authoring tools that extend the approaches we studied into embodied practices of participation, which entail the active, physical engagement of communities in the creation process through direct interaction with digital tools and spatial authoring environments [65].

These forms of authoring could also leverage current advances in 3D capturing and image generation [125, 129] to allow communities to easily create 3D audio-visual assets. However, such features should not overshadow the fundamental labor and role of artists, who were initiators and critical parts of the production of many of the applications we reviewed. Instead, we propose critical development of participatory workflows for asset production that evaluate the many opportunities for direct participation and inclusion of skilled artists and designers in content creation.

Bringing these insights together, we recommend an approach that emphasizes the integration of digital AR authoring tools with embodied, place-based practices that engage multi-disciplinary teams and communities as co-creators of AR content. This vision aligns with previous research that discusses the concept of spatial justice in AR, where allowing communities to curate AR content recognizes the political dimensions of the spatially-located virtual content [31]. We are also inspired by the collective, co-located, and collaborative potential of asset creation that could be achieved through community events—like how Priya's Shakti and KAIA 's comic-creation workshops and murals informed the creation of the AR projects themselves in an effort to provide **technical agency** —pointing to opportunities for participatory workshops using sketching and prototyping outcomes as generators of AR content.

7 Conclusion

This paper examines eight AR memorialization projects, providing insights that inform broader ethical and responsible AR production. We draw on perspectives outside of mainstream AR development because artists, documentarians, and activists are often immersed in social movements and marginalized communities, are early technology adopters within socially engaged applications, and work to thoughtfully integrate their subjectivity with their technical implementation. Our thematic analysis, resulting from our interviews with lead creators of AR memorialization projects, reveals insights on partnering with and portraying impacted communities, designing immersive interaction modalities, and creating long-lasting documentation in AR projects. We discuss how these design decisions in memorialization have general implications for resilient, expressive, and emotionally engaging AR; data ownership and personal representation in AR systems; and collaborative AR authoring.

Going forward, we argue that AR researchers should continue to investigate forms of production that occur outside of our primary community. We demonstrate the value of examining expert approaches to working with AR in collaboration with marginalized and silenced communities by showing the level of care and sensitivity that is possible to enact in a technical design process. We see future opportunities to learn more about sensitive and collaborative approaches to AR design, development, and deployment within communities by directly partnering with AR memorialization practitioners to create new approaches to AR authoring and production.

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A Memorialization Projects using Augmented Reality

Our interviews focus on the design, development, and deployment of eight projects leveraging AR in the context of human rights memorialization. This section describes these projects' memorialization topics and impacted communities. We also introduce the interviewees, their roles in the projects, and their collaborators.

A.1 Be Here / 1942

Be Here / 1942 [38] is a multimedia exhibition on the 1942 internment of Japanese Americans in Little Tokyo, Los Angeles. First displayed in 2022, the exhibition showcased an iPad AR app (Fig. 1-a) where audiences explore a 3D recreation of the events of Saturday, May 9, 1942, in which Japanese Americans were forced to board buses to concentration camps. We interviewed Masaki Fujihata, creator of the exhibit, which was co-presented by the Japanese American National Museum (JANM) and the Yanai Initiative for Globalizing Japanese Humanities at University of California, Los Angeles (UCLA) and Waseda University (Tokyo). Be Here / 1942 was created with the involvement of members from the local Japanese American community, including three individuals who experienced life in the camps as children. The exhibition at JANM opened 80 years after the depicted internment and ran for nine months.

A.2 4Ríos

4Ríos [120] is a multi-media project presenting stories of the Colombian armed conflict [18] via interactive webcomics, an animated short film, an AR pop-up book, and an AR installation (Fig. 1-b). We interviewed Elder Manuel Tobar, the project director, who collaborated with an interdisciplinary team for the project's production and development. Elder also obtained authorization from the Kite Kiwe community, who contributed to his initial research, and is currently working on a new version of 4Ríos for a new museum for this community. 4Rios was first presented at the 2014 International Image Festival and has since participated in several media festivals and cultural events at universities, schools and public spaces in Colombia.

A.3 Breonna's Garden

Breonna's Garden [89] is a digital veneration project in honor of Breonna Taylor, a Black American woman who was killed in her bed by local police. Through a mobile AR application and VR exhibition, the experience depicts Taylor and her sister, Ju'Niyah Palmer, as users listen to and record messages in the surrounding digital garden (Fig. 1-c). We interviewed Lady Pheønix, the creator and director of the project, who partnered with Breonna's family, YESUNIVERSE Productions, EyeJack, Microsoft, and others. Breonna's Garden first premiered in 2020 and was created with Taylor's family and the larger Black community in mind. The project was featured at South by Southwest, the Tribeca Film Festival, the Grace Hopper Celebration of Women in Computing, and more. The work also won the 2022 Auggie Award for Best Societal Impact, was a 2024 PGA Innovation Award finalist, and was nominated as an AUREA Top 50 project in immersive entertainment.

A.4 Priya's Shakti

Priya's Shakti [22] is an AR comic book narrating the journey of a sexual assault survivor as she navigates the resulting isolation and social stigma that accompanies such violence. The AR component was released on the Blippar platform in 2014, allowing readers to experience additional digital components by scanning the comic book pages with their phones (Fig. 1-d). We interviewed creative director Ram Devineni, who partnered with survivors of gender-based violence, writer Vikas K. Menon, artist Dan Goldman, and others throughout the design process. The work is available in five languages and has a global reach while catering to younger audiences. Priya's Shakti received Best Animated Film and the Climate of Change Award at the UK Asian Film Festival. The project has also been featured in over 1000 news articles worldwide.

A.5 KAIA: Awakening in the Deep

KAIA: Despertar en lo profundo (KAIA: Awakening in the Deep) [123] tells the story of acid attack survivor Natalia Ponce de León through an interactive AR comic book and mural (Fig. 1-e). The 2022 project uses the ArtVive platform in mobile phones to activate AR content when users point their cameras toward particular images. We conducted separate interviews with director Ram Devineni and art director Melanconnie, who developed this work alongside writer Laura Velandia and illustrator Faebian Ceruleo. Throughout the process, Ram and his team closely partnered with Natalia's foundation, including Natalia and other survivors. The comics aimed to tell Natalia's story to a general audience while paying special attention to children and younger audiences that could be interested in comics instead of documentaries. The project was first shown at Muestra Internacional Documental de Bogotá Columbia and as an AR exhibition at ARTBO. Additionally, the team has conducted several workshops alongside the Natalia Ponce de León Foundation.

A.6 Kinfolk

Kinfolk [59] is a digital archive revealing the underrepresented histories of BIPOC (Black, Indigenous, and other people of color) and LGBTQIA+ (lesbian, gay, bisexual, transgender, queer, intersex, and asexual) communities. Through an AR app launched in 2017, users explore a collection of lesser-known historical figures, select a digital monument, and watch it come to life with educational stories (Fig. 1-f). We interviewed co-founder and previous chief advocacy officer Glenn Cantave, who collaborated with Pariah Interactive and artists Derrick Adams, Tourmaline, Hank Willis Thomas, and Pamela Council to develop the project. The archive was also sponsored by the Mellon Foundation, Open Society Foundation, Ford Foundation, and more. Created as an educational platform for children, teachers, parents, and others interested in learning about these less-told stories, Kinfolk was nominated for the Tribeca Festival's 2021 Best Creative Non-Fiction award and Games for Change's 2021 Best XR For Change Experience prize.

A.7 Un(re)solved

Un(re)solved [102] is a multi-platform project that narrates the story of 150 civil rights era killings investigated by the US Federal Bureau of Investigation (FBI). This project emerged in 2021 from investigative reporting and research in collaboration with the family members. Un(re)solved includes an interactive website, podcast, documentary, and an AR exhibition. The AR component consisted of a scannable physical sculpture featuring panels with the victims' names and stories (Fig. 1-g). We interviewed filmmaker Tamara Shogaolu, whose studio Ado Ato Pictures partnered with FRONTLINE (PBS), StoryCorps, and other organizations and family members. Un(re)solved debuted at the Tribeca Festival in 2021, and the AR installation toured multiple cities in the US. The project has

also been awarded the 2021 International Documentary Film Festival, Amsterdam's Award for Digital Storytelling , among others.

A.8 Cachophonic Choir

Cacophonic Choir [60] is an interactive sound installation created by artists Şölen Kıratlı and Hannah E. Wolfe as a reaction to the #METOO movement and the social media response around it. It is an interactive installation based on the stories shared in the "When You're Ready Project," a website of anonymous first-hand accounts of sexual assault survivors. The installation consists of nine 3D-printed sculptures using a vocal synthesizer to represent survivors' voices (Fig. 1-h). A software component modulates the voices according to the audience's proximity to the sculpture. This project is an example of auditory augmentation. Cacophonic Choir was presented at SIGGRAPH's Art Gallery, where it was awarded the 2020 New Technological Art Award.