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TeleAbsence: A Vision of Past and Afterlife Telepresence

Abstract

This paper presents our vision of TeleAbsence, extending the concept of telepresence to the past and the afterlife to address the vast emotional and temporal distance caused by the memory of loved ones who drifted apart and faded away. Instead of explicit and literal representations of loved ones, TeleAbsence describes poetic encounters with digital and physical traces left by the absence of others. TeleAbsence fosters *illusory communications* to conjure the feeling of being there with those no longer with us without using synthetic or generative representations and utterances. Our vision is deeply inspired by the Portuguese concept "Saudade"—the "desire for the beloved thing, people, place, and moment, made painful by its absence." We present our vision through five design principles: *presence of absence, illusory communication, the materiality of memory, traces of reflection,* and *remote time*, grounded in historical and cultural contexts. We present exploratory narratives to illustrate these principles and the concept of ambient co-presence using poetry, phone, piano, and pen as mediums. We discuss challenges and opportunities for future work, including representational strategies to depict lost loved ones, ethical issues, and the possible extension of TeleAbsence to historical public figures.

"In loving memory of Elise O'Hara (1986–2023) and Kazuko Ishii (1926–1998), whose presence is deeply felt every day."

1 Introduction

"Absence is the highest form of presence."

—James Joyce (1882–1941)[1]

Presence and absence are fundamental states of being for mortal humans: being present, proximate, or close; or being absent, far away, or lost. Our vision, TeleAbsence, expands the current scope of telepresence technologies by focusing on these profound states of being. Unlike traditional telepresence models that concentrate on real-time connections between the living and present, our vision extends to the memories of those who have faded away and the lingering echoes of past relationships. This paper introduces a design philosophy aimed at preserving these memories against the passing of time and the fear of being forgotten, responding to the universal longing encapsulated in phrases like

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[1] "Absence is the highest form of presence" is a quote commonly attributed to James Joyce, though its exact source is unverified.

"I want to always remember you. I want to always be remembered by you," two perspectives on remembering and being remembered.

Our inspiration stems from the Portuguese concept of "Saudade" (Saudade, 2021), which poet Teixeira de Pascoaes describes as "desire for the beloved thing, made painful by its absence." Aubrey F. G. Bell expands on this, interpreting Saudade as "a vague and constant desire for something that does not and probably cannot exist." This sentiment is universally relatable, whether from the loss of family members, the end of a romantic relationship, or the nostalgia for a childhood home. The deep longing that follows the loss of significant loved ones often drives individuals to retain memories and feel the ongoing presence of those they have lost, reflecting the profound influence these relationships continue to exert on their lives (Carlsson & Nilsson, 2007; Daggett, 2005; Haraldsson & Houtkooper, 1991).

While the significance of remembering and sensing the presence of the deceased is acknowledged across various studies, there remains room for further exploration on how to better support these individually tailored experiences (Boelen et al., 2007). Research has shown that while feeling the presence of a loved one can be comforting, it can also lead to distress if individuals fear their experiences will be perceived as abnormal (Anderson & Dimond, 1995; Daggett, 2005). Thus, when individuals have more choices in how they experience these connections, for instance, within their personal and cultural contexts, the effects tend to be beneficial and positively impactful (Steffen & Coyle, 2011). This emphasizes the importance of a thoughtful and respectful approach that respects the bereaved's choices in remembering and maintaining their relationships with the deceased.

While current telepresence technology is mostly focused on designing to connect people in the present in real time, the concept of TeleAbsence expands this scope towards the past experiences and the afterlife, aiming to enriching the ways we connect with and remember those who are no longer with us, whether they have passed away or faded from our lives. We seek to extend the traditional models of telepresence by providing a lens that enables design opportunities to expand beyond the present moment and across our lifetimes, inviting individuals to rethink how we preserve and cherish the memory of ourselves and loved ones in the digital era.

We believe that TeleAbsence expands on existing telepresence concepts to reflect both distance and time. By extending tele- in this way, we aim to underscore a novel experience of "remote time" as mentioned in our paper, where absence is defined not only by physical separation but also by the passage of time. We chose this term as it aligns with our goal of evoking a sense of connection that bridges both spatial and temporal separation. Although tele- is traditionally associated with spatial distance, we seek to broaden its scope here to encompass a temporal dimension as well, allowing users to connect across time to moments or individuals who are no longer present.

To support this, we propose human-computer interaction approaches that enrich the inner life of individuals by embodying personal memories within media, objects, and interactions. This method facilitates highly personalized, memory-laden interactions that are dialogic in nature, emphasizing one-to-one communication with oneself, thereby enriching the ways individuals remember and connect with those they have lost.

The concept of TeleAbsence is visually illustrated in Figure 1, depicting the journey from birth to biological death, and to the "second death"—the point at which an individual is forgotten and all traces of their lives have vanished from the memory of living people. This visual representation emphasizes the innate human desire to remember and to be remembered, a fundamental aspect of human identity (Waggoner et al., 2023).

TeleAbsence is designed around the dual perspectives of potential users: recalling personal past experiences and remembering departed loved ones. To facilitate these design opportunities, we introduce five principles foundational to designing for TeleAbsence: *presence of absence, illusory communication, materiality of memory, traces of reflection*, and *remote time*. These principles, which are elaborated on in Section 4 with detailed examples of their application in Section 5, offer tailored design opportunities for four primary user cases, each principle creating a distinct space to explore interaction models that meet specific needs. These designs support the journey of remembering and being remembered,

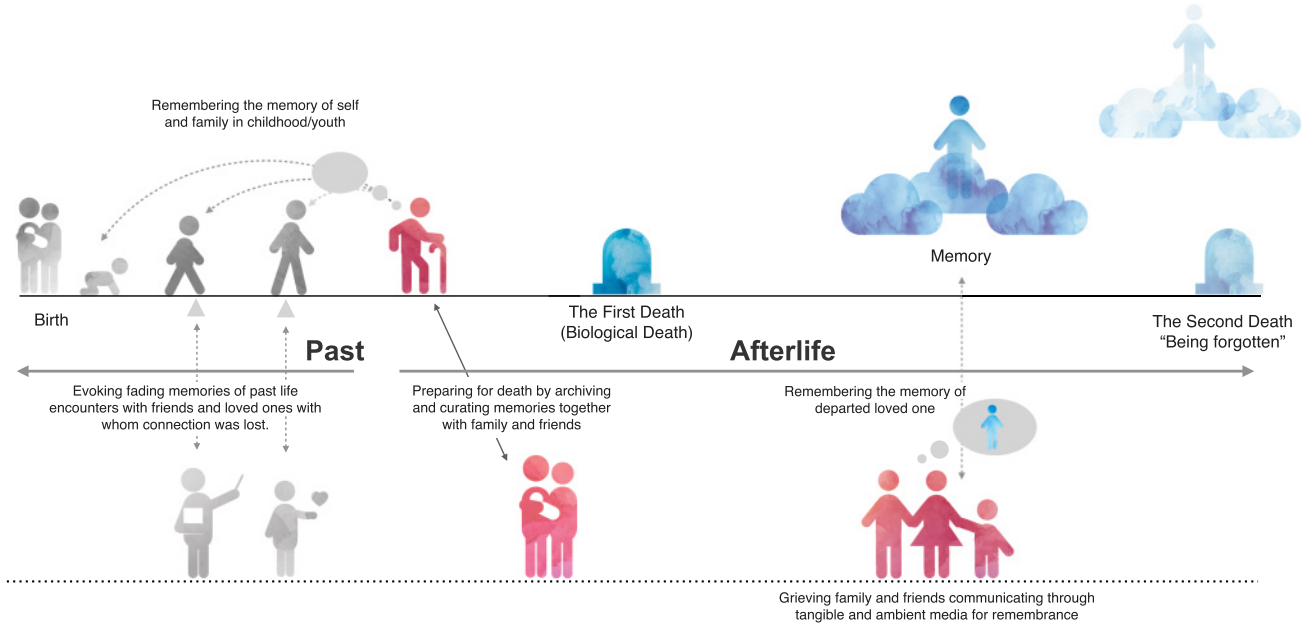

Figure 1. *Illustrates the lifespan and afterlife of a human being. Left-to-middle illustrates how TeleAbsence applies to lifespan, from birth to biological death, through acts of remembering and interactions with one's past. Middle-to-right depicts an application of TeleAbsence to the afterlife, from biological death to second death, leading to methods for interacting in the future with family and friends. Dotted lines with arrows signify Illusory communication with people who drifted apart. Pink shows active user groups, gray shows connections from one's own past, and blue represents people who passed away.*

providing meaningful ways to engage with the past and maintain connections with those who have departed, thereby enriching the user's ongoing narrative with their memories.

"People die twice.
First, when they die.
Then when they are forgotten."

—Rokusuke Ei (1933–2016)

1.1 Designing for Revisiting Personal Past

The first perspective focuses on individuals revisiting their own past memories to engage with significant yet fading moments. Evoking one's past self is crucial for reflection and self-development (Alves et al., 2018; Siriaraya & Ang, 2014; Yamaguchi et al., 2012), yet as individuals age, their earlier identities and experiences often fade into mere memories. Despite a natural inclination for memories to fade over time, there remains a strong human desire to hold onto them (Waggoner et al., 2023). Through the use of TeleAbsence, individuals can interactively design and preserve these moments, enabling deeper connections with their former selves and significant events in their lives.

1.2 Designing for Reconnecting with Shared Memories with Departed Loved Ones

The second perspective focuses on revisiting shared memories with those who are no longer physically present due to death or separation. Reflecting positively on memories of deceased loved ones not only supports coping mechanisms but also enhances psychological well-being and contributes to identity formation (Pocinunaite & Wolf, 2023). By enabling interactions through digital embodiments of these memories or narratives, individuals can experience a renewed sense of presence and connection with those who have drifted from their lives, thereby addressing feelings of longing, Saudade,

and maintaining continuing bonds (Pociunaite & Wolf, 2023).

1.3 Designing for Enabling Remembrance for Loved Ones

The third perspective centers on how individuals wish to be remembered after their passing. Preparing for one's afterlife has been shown to reduce death-related anxiety and stress, increase appreciation for life, and promote a more positive awareness of death—fears that many individuals face (Liu & Van Schalkwyk, 2019). TeleAbsence offers individuals the freedom to design their own remembrance, granting them autonomy and choice in how they are remembered. By designing legacies, mementos, and specific moments to leave behind, individuals ensure their memories are meaningfully preserved, maintaining connections with loved ones even after their departure.

In later sections, we present our vision guided by five design principles, mentioned above. We illustrate our wishes through exploratory design narratives to envision applications of these principles. Finally, we discuss challenges and opportunities, including representational strategies for depicting lost loved ones, as well as ethical issues.

We hope that the vision of TeleAbsence demonstrates how HCI can address challenging aspects of the human condition, moving beyond utilitarian applications to convey deeper resonances between HCI and the human experience. We envision how technology, through critical and reflective design, can uplift not just our intellectual capacity, but also the very core essence of our human nature, at the end of our life and beyond.

2 Related Works

In the following section, we situate TeleAbsence in the broader fields of HCI and CSCW (Computer-Supported Cooperative Work), specifically focusing on the research area of telepresence. We also provide an overview of a broad spectrum of research concerned with loss and bereavement beyond the HCI community.

2.1 Telepresence

Telepresence is a real-time, remote communication and collaboration system, mainly using video and focused on the illusion of "being there" (Knoll, 2007). Research on telepresence has a long history in the HCI and CSCW community. Many telepresence systems were proposed and studied in the 1990s and 2000s (Agah & Tanie, 1999; Buss, 2004; Deml, 2007; Pongrac et al., 2007). Our review of the relevant literature considered the impact of many significant and seminal papers, including Xerox PARC's "Media Space" in the 1980s (Harrison, 2009), Bellcore's VideoWindow (Fish et al., 1990), the CAVECAT project by the University of Toronto (Mantei et al., 1991), as well as the seamless collaborative media "ClearBoard" by NTT Human Interface Laboratories (Ishii & Kobayashi, 1992; Ishii et al., 1994). These telepresence systems were largely limited to a model of real-time video-mediated emulation of "being there."

Broadly speaking, telepresence relies on a digitally mediated form of presence. In a study by Skarbez, Brooks, and Witton (2017) titled "A Survey of Presence and Related Concepts," the authors discuss various definitions, measures, and models of presence found in a range of academic literature. Skarbez et al. (2017) expand on the common understanding of "presence" as a feeling of "being there" (the illusion of place) to include the notion of "being together" (the illusion of co-presence or social presence). This experience of co-presence over distance with other people is largely informed by our pre-existing concepts of physical space.

According to Lindemann and Schünemann (2020), telepresence's notion of space is derived from our implicit concepts of space drawn from face-to-face interactions. In each of these theories of space, the concept of telepresence is constrained to relationships occurring in human-to-human interactions happening during one's lifetime.

Telepresence focuses on the concept of "being there and together" using real-time telecommunication technologies (Knoll, 2007). Building on this, TeleAbsence extends the idea by incorporating past memories, enabling meaningful interactions with people and

moments that no longer exist in the present, thereby enriching the experience beyond the constraints of real-time presence.

2.2 Evoking the Memory of the Past

The past plays a critical role in defining human identity, both individually and collectively, through our historical and episodic memories—recollections of personal life events and experiences (Mahr & Csibra, 2020). People frequently share these episodic memories, using them to reinforce and continually redefine their sense of belonging, their relationships with family and friends, and their personal identities (Mahr & Csibra, 2020). Research indicates that humans discuss their past two to three times more often than their future (Demiray et al., 2018), and approximately 40% of our conversational time is devoted to recounting past events (Eggins & Slade, 2004; Hirst & Echterhoff, 2012). However, these conversations are not just acts of recalling but are often about actively remembering our lived experiences (Pociunaite & Wolf, 2023).

Remembering the past becomes particularly significant when a person associated is no longer present. Grief is often associated with deep sorrow, especially that which is caused by the death of a loved one. The process of remembering is an integral part of the bereavement process (Stroebe & Schut, 2010), encompassing the loss of someone or something significant, extending beyond death (Davis et al., 2003).

Several theorists have identified a distinction between the impacts of reflecting on lost loved ones in a positive, reflective manner and in a negative, ruminative way. Adopting a self-positive approach when remembering lost loved ones has been shown to lead to positive changes in perspective and aid in the grief process, whereas a self-negative approach has been associated with intensified feelings of grief (Pociunaite & Wolf, 2023). The cultural theorist Svetlana Boym distinguished between two types of nostalgia, which she termed *reflective nostalgia* and *restorative nostalgia* (Boym, 2001). The first type, reflective nostalgia, centers on "longing and loss, the imperfect process of remembrance." Reflective nostalgia acknowledges that the past can never truly be reconstructed. The second type, considered by Boym as an unhealthy version of nostalgia, seeks to resuscitate the past as rigorously as possible.

Therefore, remembering—a critical part of dealing with loss—can be an active process that encourages the processing of positive memories to transform grief into a less painful but more self-positive experience (Pociunaite & Wolf, 2023).

2.3 Memory and Virtual Space

Memory is intricately linked to objects and spaces as individuals navigate the passage of time within their physical environments. Memory anchors serve as psychological reference points tied to specific objects or spaces that vividly trigger the recall of past experiences when revisited (Ch'ng, 2022). Although photographs and videos provide memory cues that spark remembrance, they are constrained by their two-dimensional nature and the subjective perspective of the recorder (Barthes, 1981; Ch'ng, 2022).

In contrast, Ch'ng highlights virtual environments as powerful tools that sustain and enrich our connections to the past (Ch'ng, 2022). These digital spaces act as comprehensive memory anchors, capturing the full spectrum of physical spaces, including objects and sensual elements, thus enabling a strong, multisensory recall of memories. Beyond mere visual representation, virtual environments allow for interactive experiences where individuals can navigate and engage with the memory itself, transforming the way memories are preserved and shared (Ch'ng, 2022).

This capability is transformative both on personal and collective levels. For instance, while the elderly may share stories with the young, the narratives are confined to the elderly's personal experiences. Virtual spaces as memory anchors, however, allow these memories to be shared and experienced beyond one's narrative or within the constraints of traditional mediums. This enables the transfer of living stories and memories, enabling collective memory preservation and the extension of cultural heritage through keeping memories alive (Ch'ng, 2022).

Building upon the dynamic nature of virtual environments as memory anchors, the concept of the virtual memory palace introduces an alternative approach to memory enhancement. Originating from the ancient "method of loci," memory palaces traditionally involve navigating a physical or imagined environment to place and recall information systematically (Yates, 2000). In these spaces, information is encoded by associating it with specific locations within the palace, creating a structured pathway for recall. By employing virtual reality, virtual memory palaces modernize this method, creating immersive, interactive spaces that mimic the complexity and sensory richness of real-world environments (Peeters & Segundo-Ortin, 2019).

As Peeters and Segundo-Ortin (2019) discovered, virtual memory palaces are not solely focused on visual stimulation but emphasize embodied interaction with the digital space (Peeters & Segundo-Ortin, 2019). By physically moving through a virtual environment—such as retracing steps in a digitally recreated historical site—users engage in cognitive activities deeply embedded within their interactions with the virtual space. Fassbender's earlier work on "The Virtual Memory Palace" underscores the importance of these interactions, pointing out that tailoring these virtual environments to align with individual learning styles can greatly enhance memory retention (Fassbender, 2006). Additionally, Fassbender emphasizes the role of multisensory cues, which go beyond visual elements to include auditory and tactile stimuli, thereby triggering more robust memory recall (Fassbender, 2006). While TeleAbsence does not primarily aim to enhance cognitive abilities through memory recall, the concept of a virtual memory palace provides valuable insights for guiding the design space that encapsulates an individual's past memories for positive reflection. This approach highlights the potential of spatial dimensions to aid in memory retention, showing a promising direction for designing experiences beyond traditional media, particularly using spatial, sensory, and immersive elements in virtual spaces.

This emphasis on interactive and multisensory engagement in memory recall resonates with Samuel's "theatre of memories," which is a metaphorical and analytical framework for understanding how historical knowledge is constructed, represented, and retold across various "stages" of society and culture (Samuel, 1994). Samuel critiques the traditional, top-down academic approach of historians in creating history and, instead, advocates for a bottom-up approach, introducing the concept of "unofficial knowledge." This term encompasses the everyday, imperfect recollections of personal and family life, which Samuel argues should be regarded as equally important for connecting to one's heritage as the unified, singular views of national history. He posits that history is a living, collaborative form of social knowledge enriched by these diverse and informal narratives (Samuel, 1994).

Samuel's perspective resonates with our concept of TeleAbsence, which emphasizes the importance of personal histories—comprised of imperfect recollections and informal knowledge like family stories and inherited memories—as essential in enriching our understanding of the past and keeping it alive. This view also aligns with Ch'ng's emphasis on virtual spaces as powerful tools that transform how we preserve and share memories, further reinforcing the significance of these personal and communal narratives in maintaining a living connection to our history (Ch'ng, 2022). Building on the concepts of virtual memory anchors and memory palaces (Ch'ng, 2022; Fassbender, 2006; Peeters & Segundo-Ortin, 2019), the concept of TeleAbsence advocates personal narratives should be accessible, reconstructed, and revisited, allowing them to become part of our living, continuously evolving memories that extend and bridge the past with the present and future.

2.4 Remembering Loss in HCI

Our research draws upon several major themes in HCI related to the past, including technology for remembering and reflecting on the past (Axtell et al., 2022; Elagroudy et al., 2019; Isaacs et al., 2013; Kalnikaite et al., 2010; Siriaraya & Ang, 2014; Wallace et al., 2020a, 2020b).

2.4.1 Technology for Remembering and Reflecting on the Past. Reminiscence, defined as "the volitional or non-volitional act or process of recollecting memories

of one's self in the past" (Bluck et al., 2022), plays a crucial role in reducing social isolation and reinforcing self-identity, especially as people age (Axtell et al., 2022). Butler's life-review theory posits that people purposefully revisit past events to review them and resolve unresolved conflicts (Butler, 1963). While initially rooted in elderly research, this theory is recognized for its benefits across all ages, improving psychological well-being, self-esteem, and life's sense of meaning (Sedikides & Gregg, 2008).

Over the years, technology has become instrumental in facilitating reminiscence and life review through various digital media and systems to support a wider range of users in different contexts. For instance, leveraging technology to revisit experiences has positively impacted people with memory loss, including those with dementia (Isaacs et al., 2013; Siriaraya & Ang, 2014). Additionally, life-logging technologies like Echo enable individuals to record and reflect on their experiences, fostering technology-mediated reflections that contribute to overall well-being (Isaacs et al., 2013).

Building upon the established understanding that physical items evoke vivid re-experiences (Csikszentmihalyi & Rochberg-Halton, 1981), HCI researchers have explored integrating digital and physical methods to encourage reminiscence. For instance, digital photos have been utilized to spark conversation at the dinner table (O'Hara et al., 2012) and to facilitate communication between parents and teenagers (Golsteijn & van den Hoven, 2013). These studies show that technology-mediated reminiscence provides more reflective and meaningful experiences, offering individuals a space to pause and reflect while accessing distant memories beyond the constraints of physical objects or time limitations (Bagnara & Pozzi, 2012; Thomas & Briggs, 2014).

2.4.2 Expanding the Role of Design for Remembering the Past. The literature in HCI has traditionally focused on how technology can prompt reminiscence through artifacts of the past. However, there is a growing recognition of the need to allow individuals to co-design, curate, and personalize their memories for more meaningful reflection and reminiscence. Soro, Taylor, and Bereton (2019) advocate for broadening the role of design in HCI to embrace not only future-oriented approaches but also past-oriented ones that recognize the past as an ongoing presence and explore further ways to integrate it in HCI studies through design (Soro et al., 2019). They argue that the past is neither static nor immutable but exists dynamically within us as memory, continuously performed and renegotiated, helping us to imagine a better future and to reflect more profoundly on our past (Soro et al., 2019; Teal, 2011). This view of the past as an amendable part of our identity—crafted by us and capable of being redesigned to better meet our current and future needs—calls for a shift in design principles. Aligned with this perspective, we propose design principles that aim to foster presence from absence, offering not only additional avenues for technology-mediated remembrance and reflection but also empowering individuals to actively participate in determining what to remember, how to reflect, and how to sustain ongoing connections with departed loved ones.

This emphasis on personal agency in shaping how we interact with our past is echoed by other HCI researchers who have explored various design approaches for digital prompts. Axtell, Saryazdi, and Munteanu (2022) analyzed different design strategies for digital prompts like photos and discovered that many designs were less effective in triggering reminiscence, underscoring the crucial role of design in digital cue delivery (Axtell et al., 2022). McGookin, examining location-based reminiscence through personal photo collections, recommended that digital prompts should be selected carefully to avoid overwhelming users and to actively support constructive engagement with memories (McGookin, 2019). Additionally, Peesapati, Schwanda Sosik, Schultz, Lepage, Jeong, and Cosley (2010) noted the importance of timely prompts, such as emails with past social media content through Pensieve, emphasizing that without immediate cues, people might not engage in reminiscence at all (Peesapati et al., 2010). These studies collectively highlight the need for design approaches that accommodate the varied needs of individuals as they navigate their personal journeys of remembrance, facilitating their reflective practices

and enabling connections with the past in their present experiences.

Thanatosensitivity (Massimi & Charise, 2009), a term coined by Michael Massimi and Andrea Charise in 2009, is a design methodology that seeks to integrate the complexities of mortality, dying, and death into traditional user-centered design research. Applications include facilitating access to digital materials following death as well as developing technologies that address end-of-life needs. Thanatosensitvity seeks to create meaningful experiences for users by incorporating the experience of death and dying into the design process.

2.4.3 Remembering the Past for the Bereaved. Expanding on the theme of remembering and reflecting on past memories, bereavement studies in HCI explore these themes further (Albers et al., 2023). Klastrup (2006) suggested that relationships with the departed can persist beyond death. This concept aligns with psychological insights that coping with bereavement can involve maintaining connections with the deceased, for example, by preserving their belongings or talking to them (Bennett & Bennett, 2000). Beyond the grief associated with death, the pain of loss also manifests when individuals are irrevocably separated from their past, and reality offers no means of reunion with their former lives. For example, recent HCI research highlights the unique challenges of North Korean defectors who, upon defection, are permanently severed from their past lives with no safe avenue for return, presenting distinct difficulties of loss without the possibility of reunion in their current reality (Noh et al., 2024).

This notion of "ongoingness" has been incorporated into technology, such as through Calendara (Gulotta et al., 2013), which integrates deceased family members' entries into a calendar to encourage reflection. Additionally, ReFind, a smart photo viewer, helps the bereaved re-explore their relationships with the departed, fostering reflection on shared life experiences and sustaining these connections in the present lives of the bereaved (Wallace et al., 2020a). Similarly, "Story Shell" by Moncur, Bikker, Kasket, and Troyer (2012) explored the participatory design process of designing personalized digital memorials with a bereaved parent. They found that the design process itself served as a form of memorialization by allowing the participant to share detailed memories of their loved ones. These studies underscore the important role of remembrance and reflection on past relationships and shared experiences with the departed in supporting the grieving process, facilitating a sense of ongoing connection even in the absence of their physical presence (Klaas, 1996; Wallace et al., 2020).

In prior works, Klaas, Silverman, and Nickman developed the theory of "continuing bonds" (Klaas, 1996). "Continuing bonds" considers how, after a loved one's death, relationships with the deceased continue and evolve, rather than being permanently severed. Continuing bonds involve maintaining connections with a lost loved one through memories, objects, rituals, and digital platforms. Several HCI projects have explored the concept of continuing bonds applied to HCI research. For example, Massimi and Baecker (2011) discuss designing systems for the bereaved that help them cope with grief and maintain a bond with the deceased.

These projects and others highlight the importance of supporting ongoing relationships between the bereaved and the deceased, with an emphasis on the unique affordances of contemporary human-computer interaction systems (Brubaker & Hayes, 2011; Xygkou et al., 2023).

2.4.4 Afterlife in HCI. The internet and digital systems have made it easier for more people to participate in mourning and remembrance processes, such as creating online memorials or sharing information about ancestors (Gulotta et al., 2016). Many researchers have explored the idea of a digital afterlife, exploring the persistence of a person's digital traces beyond their life span (Kaptelinin, 2016). In both preparing for death as well as navigating the potential of the afterlife, modern technology has been used to extend life in various ways.

Research by Lombard and Ditton (1997) "Telepresence after Death" provided a survey of technologies that evoke the presence of people after death in the context of telepresence. Their analysis reviewed projects that applied contemporary technology to the treatment of bodies, grave markers, epitaphs, paintings, and statues, resulting in new emerging technologies, such as LifeLog

Table 1. *Fundamental Distinctions between the Design Considerations of Telepresence and Our Conceptualization of TeleAbsence*

Design Consideration	Telepresence	TeleAbsence
Time	Now (real time)	*Remote Time* (past and afterlife)
Users	Living individuals or groups of people who can communicate and respond in real time	Individuals and communities who wish to remember the loved ones who were lost or departed.
Mode of Communication	Interactive Communication	*Illusory* communication
Human Representation	Literal Audio, Video, or Avatar	Mediated or indirect poetic or symbolic media
Spatial and Temporal Dimensions Explored	Distant Space: Overcoming distance between geographically distributed places	Remote time: Traveling to remote moments in life

VR Eternity and Hanson Robotics's Philip K. Dick android.

Traditionally, mourning and loss relied on physical memorials, such as the global outpouring of condolences at Apple stores following the death of Steve Jobs, where hundreds of notes adorned the glass facades (Belk & Llamas, 2013). However, with the advent of social media platforms like Facebook, virtual mourning has become increasingly mainstream. This shift allows for collective remembering and grieving that transcends physical boundaries, potentially easing the process of overcoming loss. These contemporary practices raise questions to reevaluate the nature of virtual mourning, the dynamics between the living and the deceased in cyberspace, and how social behaviors surrounding death and bereavement might evolve.

In the past decade, exploring how technology mediates the end of life has received significant attention in the HCI community (Chen et al., 2020; Hemmert et al., 2022; Kaptelinin, 2016; Leitão et al., 2017). In 2023, Albers, Sadeghian, Laschke, and Hassenzahl (2023) wrote "Dying, Death, and the Afterlife in Human-Computer Interaction. A Scoping Review," a comprehensive overview of the state-of-the-art in HCI, death and bereavement practices (Albers et al., 2023). Gulotta, Gerritsen, Kelliher, and Forlizzi (2016) conducted an extensive survey of web-based services designed to support legacy-making, bereavement, and remembrance. Ashery and Giaxoglou (2019) discussed the concept of "digital death," which refers to how death, dying, and mourning are experienced through digital technologies.

3 From Telepresence to TeleAbsence

Telepresence technologies, such as video conferencing interfaces like Zoom, Google Meet, Microsoft Teams, Webex, or FaceTime, have reshaped digital communication, enabling remote collaboration and a sense of co-presence. Although they are new technologies for broad audiences, they have existed for a long time in the research community as a vision, for instance, in the 1980 with the famous telepresence manifesto by Marvin Minsky (1980). Despite being able to see and hear another person, this reliance on physical distance has given way to a culture of emotional distance, leading to social isolation and loneliness, issues ultimately more challenging to overcome.

Broadly speaking, a primary function of telepresence technology is to connect people who are alive and can respond to a sender's message, even though they are separated. However, once the mortal body of a partner is gone, loved ones and others lose the capacity to have any form of interaction with them. In Table 1, we discuss fundamental distinctions between aspects of telepresence and TeleAbsence. The timeframe of Telepresence focuses on now and real-time communication with

Figure 2. *Shadow of a human being captured on the steps of Sumitomo Bank in Hiroshima-city right after an atomic bomb explosion in 1945 ("Photograph by U.S. armed forces on November 20, 1945" by unknown author, public domain, "Human Shadow on stone by atomic bombing on Hiroshima" by Matsushige Yoshito, public domain).*

colleagues, friends, or family, TeleAbsence is concerned with people and communities that want to remember and connect to foregone times, which we call remote time. Instead of using communication to complete tasks, TeleAbsence emphasizes poetic and symbolic communications to evoke old memories and, as individuals grow older, allows for new interpretations from those memories. The stark contrast of users who are present versus users who are absent, or in the process of becoming absent, calls for novel human representation. While telepresence typically involves a video or avatar representing each participant (Walker et al., 2000), TeleAbsence focuses on poetic representations, creating an incomplete representation or abstraction of someone. This distinguishes our approach from using live video, conversational avatars, robotics, generative AI, and others (Lindemann, 2022) that focus on creating new content instead of mediating the absence itself.

4 TeleAbsence Principles

In the development of TeleAbsence principles, we drew inspiration from various aspects of human culture, specifically focusing on historical events that caused loss on large scales and highlighted the inherent mortality of human existence. By learning about memorials and installations that were built after these global events, we analyze how people across different cultures found ways to process, document, and cope with loss in a meaningful way.

We derived a set of five design principles, each of which reflects the core conceptual aesthetics shaping our thinking. These principles are not meant to be exclusive or exhaustive but rather serve as a framework for the exploration of TeleAbsence.

4.1 Presence of Absence

The site of the atomic bombing of Hiroshima in 1945 is a location marked by the presence of a tremendous loss, a place where at once both the presence of the past, as well as its profound and dominant absence, lingers throughout the vast perimeter of the landscape. One of the most striking historical relics from the tragic bombing of Hiroshima is the permanent "shadow" of a victim of the bombing (see Figure 2). Located 260 meters from ground zero, where the atomic bomb dropped, the silhouette remains transferred onto the stone steps of the Sumitomo Bank. We consider the human shadow etched on stone as one of the most

unforgettable examples of the first TeleAbsence principle, the *presence of absence*.

The stone from the Sumitomo steps, since relocated to the Hiroshima Museum as an artifact of the disaster, is now widely acknowledged as the last remaining trace of Japanese resident Mitsuno Ochi (1903–August 6, 1945). Ochi's family members eventually recognized her silhouette due to the location, time, and related activities of her day. The heat rays from the atomic bomb turned the stone of the staircase white, leaving the shape of Ochi darkened and etched into the stone. Without the body to remember or mourn, the shadow marks left in the stone are all that remain, in turn becoming a memorial for her family's mourning and remembering. The relationship between Ochi's family and the legacy of the shadow etched in stone captures the concept of TeleAbsence, as the identity of Ochi lives on through the physical absence left behind in the world.

Noticing someone or something's absence can lead to a reflection on the past, conjuring shared experiences and reinforcement of bonds, connecting the present and the past (Brubaker & Hayes, 2011; Holt et al., 2021; Wallace et al., 2020a). Similarly, the concept of negative-form monuments was introduced by scholar James E. Young (2023). Young observed a trend in memorials he described as "negative-form monuments," a design strategy where a monument is designed through the deliberate use of empty space as the focal point of the memorial. By way of this method, the idea of loss is memorialized through the use of space that depicts "loss" itself as the shape and, therefore, subject of the memorial. Instead of creating representative memorials, negative-form monuments encourage the strategic use of emptiness, vacant spaces, disappearing elements, or visual and auditory silence to create user experiences that remind users of what is missing or what has been forcibly removed from the environment.

In telepresence, the feeling of "being there" or "being together" is evoked through the real-time response of the person you are trying to communicate with. However, TeleAbsence aims to help users feel connected to moments and people who lost contact or have passed away. While telepresence relies on people's real-time response to conjure the feeling of "being together," TeleAbsence is limited to using the emptiness of "being absent" to create the feeling of connectedness. Similar to "absence is the highest form of presence" a quote commonly accredited to James Joyce (1935), we introduce the principle *presence of absence* allowing us to feel the absence of moments or people.

This principle can be implemented by applying the concept of "negative form monuments" to traditional methods of telepresence to inform best practices for how to design TeleAbsence interfaces. We propose *presence of absence* as an alternative to virtual humans or digital characters, as the function of absence integrates psychological elements of reminiscence, regret, longing, and invisibility directly into the user experience. Reminding individuals of what is absent rather than presenting them with a virtual substitute may elicit strong emotional responses similar to the effects found in negative form monuments.

4.2 Illusory Communication

In 2010, Japanese garden designer Itaru Sasaki created a telephone booth with a disconnected rotary phone. Sasaki, who was grieving the recent death of his cousin, named this project the "kaze no denwa" (Japanese), translated to English as "Wind Phone." Sasaki designed the Wind Phone to be a place where he could have one-sided "conversations" with his lost cousin to process his grief during the bereavement period. Of the project, Sasaki wrote, "Because my thoughts couldn't be relayed over a regular phone line, I wanted them to be carried on the wind" (Hester, 2017). A year after Sasaki installed the initial Wind Phone, the 2011 Tohoku earthquake and tsunami killed over 20,000 people in the Tohoku region. In response, Sasaki opened his Wind Phone to the wider public (see Figure 3). Initially, he designed the Wind Phone as a place for visitors to "talk" with their family and friends who were lost in the earthquake and tsunami. However, the Wind Phone began to inspire a wider public grieving, including international visitors, receiving over 45,000 visitors to date. In the years since, many replicas have been constructed around the world, including global destinations such as the Appalachian Trail in Fahnestock State Park,

Figure 3. *The Wind Phone was originally built by Itaru Sasaki in Otsuchi in Tohoku region, as a place where he could have one-sided "conversations" with his lost cousin. After the 2011 Great East Japan earthquake and tsunami in Tohoku, the Wind Phone was opened to the public. Then, it began to inspire a wider public grieving, including international visitors, and has received more than 45,000 visitors to date (2023). ("Wind phone in Ōtsuchi, Japan" by Matthew Komatsu, licensed under CC BY-SA 4.0, "Telephone on the Wind, Belle Gardia 2" by Kahokkurli, licensed under CC BY-NC-ND 4.0).*

New York; Olympia, Washington; Oakland, California; Quebec, Canada; and many others. This type of illusory experience of communication with lost loved ones inspired the second principle *illusory communications*. Similar to "Wind Phone," this principle aims to allow users to feel connected through intimate forms of presence, evoking a sense of subtle, ambiguous, and poetic connection despite the lack of any direct communication taking place.

Within the HCI community, Massimi and Baecker (2010) discussed how receiving a phone call from the number of a deceased loved one can evoke strong feelings of re-connection. In their study of digital legacies, a participant wrote of how she received a phone call from the office where her deceased mother once worked. Because the phone number was the same, it felt as if she was being contacted by her mother. Interestingly, the participant remarked, "I remember that terrified me, but how excited I was at the potential to talk to her."

Drawing from the above examples, *illusory communications* as a design principle refers to the creation of an interactive experience that, despite not being based on physical reality, is still perceived as real by the user. The design of interfaces can make use of familiar real-life experiences in order to evoke feelings, sentiments, and associations that motivate *illusory communications*. In the context of HCI, these experiences can be created through the careful use of design elements, visual and auditory cues, and tangible elements that guide a user's associations and perceptions towards the presence of a lost or drifted apart loved one. This principle is particularly relevant when designing systems for sensitive and deeply personal use cases.

4.3 Materiality of Memory

Objects are often used to remember past moments with loved ones. People associate personal objects, such as rocking chairs or tables, with memories of their loved

ones, which helps them feel connected (Tollmar & Persson, 2002). In memorial museums, artifacts and objects are used to support visitors' engagement with the past and evoke emotional responses (Opotow & Shemtob, 2018). An example of the third principle of *materiality of memory* is the National September 11th Memorial. The collections of the 9/11 Memorial Museum consist of over 74,000 material artifacts. Interwoven with documentation of the lived experience of the tragedy in the form of records, testimonies, and artistic installations, one can find a piece called "Impact Steel." "Impact Steel" is composed of the exact beams that supported the entire building (Ashery & Giaxoglou, 2019) and is exhibited as a twisted, partially decomposed beam to show the crush and the following collapse of the Twin Towers (see Figure 4). In addition, a range of everyday objects are displayed, allowing people to preserve and revisit memories of their loved ones (Massimi & Baecker, 2011). The desire for physical objects that bridge beyond the mortal world is evident among individuals seeking tools for memorialization (Chaudhari et al., 2016). We chose "Impact Steel" to illustrate the capability of materials to capture distinct and assignable moments that can be immediately evoked even after many years. This experience of objects that embed memory in their materials inspired our third principle, the *materiality of memory.*

The principle *materiality of memory* has been explored in a variety of relevant prior research. Artifacts and our reliance on them have been understood as a sacred ritual (Belk, 1988; Turkle, 2011), an evocative source of connection (Turkle, 2011), as well as a passageway to the past (Kirk & Sellen, 2010). Kirk and Sellen (2010) demonstrate that while everyday objects may be mundane and devoid of inherent value, they still harbor the potential for strong emotional and psychological meaning. Margaret Gibson (2004) discusses the idea of the "transitional object" but recontextualizes it as a "melancholy object," writing of how ". . . It is not just the grieving experience that undergoes transitions through objects, but the objects themselves also change in terms of their status, value, and significance."

While telepresence often uses real-time, pixel-based visualizations such as videos and pictures to represent a person, TeleAbsence works with objects that through their physical presence create a strong atmosphere of the past. These patinas embody a moment or even a person and evoke the feeling of "being together." As a design principle, *materiality of memory* encourages interactions and interventions with objects that hold symbolic, social, and emotional value in order to position meaningful artifacts as interfaces for preserving precious memories with loved ones. Objects and artifacts with personal symbolic value can be transformed, augmented, or changed, resulting in adapted interfaces that retain their original personal meaning and value. Such interactions create an ambiguous physical and digital space for reflection, favorable to both past and afterlife connections through the symbolic associations between physical objects and a missing element or person attached to them.

4.4 Traces of Reflection

On April 11, 2011, a poem by well-known Japanese poet Kenji Miyazawa, "Ame ni mo makezu," (Miyazawa, 1931) translated as "Be Not Defeated by the Rain," was read aloud by the President of the Cathedral of Samuel Lloyd III at a memorial service held at the National Cathedral in Washington to mourn the victims of the Great East Japan Earthquake. When Miyazawa originally wrote "Be Not Defeated by the Rain," it was not intended to be a poem, but mere notes of the poet's thoughts. After his death, scholars published these writings and they became one of his most influential works.

To honor Kenji Miyazawa, a Memorial Museum was built in the Hanamaki village, the home of Kenji Miyazawa. This museum holds a series of tormented tributes Kenji crafted to his late sister, Toshiko, who passed away on November 22, 1922. Entitled "The Last Farewell," (Museum, 1994) these evocative elegies are part of a series of poems commenting on loss and grief. In publications, "The Last Farewell" is printed as an evenly-spaced 9-point type, allowing readers to focus on the content of the poem. However, housed in the museum is an entirely different version of "The Last Farewell." Unlike the print version, the original manuscript, written in Japanese ink, carries Kenji's vivid physical presence across time (Belk, 1988). In

Figure 4. *"Impact Steel," the beams that were ripped apart when the hijacked United Flight 175 tore into the South Tower of the World Trade Center on September 11, 2001 ("Museum portion of steel facade North Tower floors" by Beyond My Ken, licensed under CC BY-SA 4.0).*

the manuscript, for each handwritten phrase, there is a rewriting; for every erasure, a new addition. As the words build on the page, they dance across the yellowed paper in the palimpsest of the written text. By viewing the handwritten form of poetry depicted in marks of ink on the manuscript page, one can almost envision the poet gripping a pen in quiet agony as he writes of the loss of his sister. The handwritten manuscript of "The Last Farewell" (see Figure 5) conveys a strong sense of presence, inspiring us to consider how traces of people's emotions and lives can evoke the feeling of being there with those who have drifted away or are no longer with us (Ishii, 1998). We chose Kenji Miyazawa's poem to illustrate how cognitive and emotional processes often

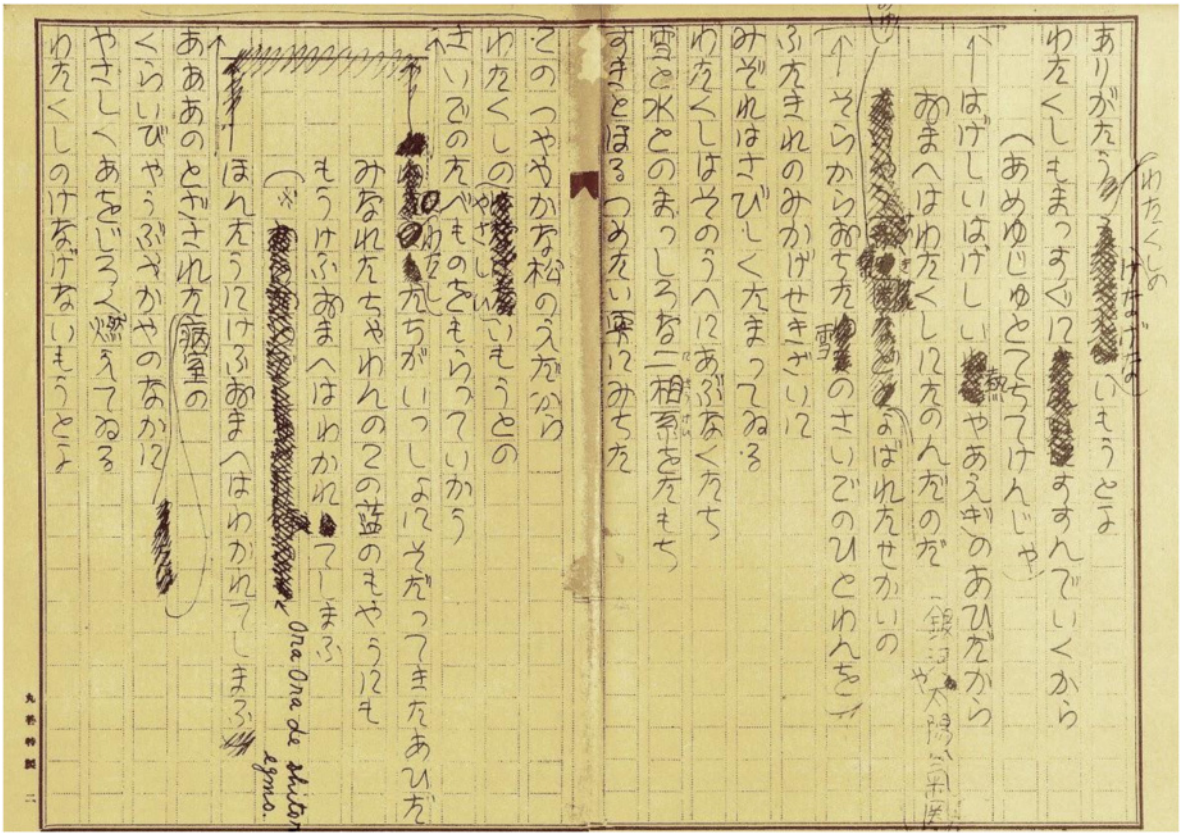

Figure 5. *The Last Farewell, original manuscript handwritten by Kenji Miyazawa in 1931. Courtesy of Miyazawa Kenji Memorial Museum in Hanamaki, Japan (Miyazawa Kenji Memorial Museum, written in 1922).*

leave traces behind that can be used to expand our understanding of a person even beyond their lifespan. This leads to our fourth principle *traces of reflection*.

In telepresence, the partner we are trying to communicate with can respond and engage in deep conversations, which helps us to understand and feel closer to each other. However, in the context of TeleAbsence, it might be undesirable or even impossible to generate such direct responses from friends who have drifted apart or passed away. Instead, we introduce the fourth principle *traces of reflection*. This principle invites people to look into media people left behind to retrace the inner life of a loved one. Without generating new content that a person might have never said before, traces of reflection allow people to feel closer emotionally by allowing them to take on the perspective of a lost loved one. In other words, *traces of reflection* is concerned with how we preserve the thought process of loved ones, manifested through the remaining remnants of their mark-making. It aims to capture cognitive processes, emotional journeys, the inscribed struggles and reliefs of interior life, embedded within objects left behind in the world.

As shown by Rosner et al. (2013), the process of reflecting on hidden layers of our emotional history through traces is a key part of human introspection. This process of reflection, which Rosner refers to as "emotional archaeology," is a practice that involves exploring the unconscious thoughts, feelings, and beliefs that shape our behavior and actions. By delving into these buried layers sedimented in our psyche, we can gain a deeper understanding of ourselves and our relationships with others. This process of self-discovery is often seen as a key aspect of personal growth and development, as

well as an important emotional coping mechanism while experiencing the loss or the departure of a loved one.

Traces of reflection as a design principle reminds of what is embedded in the history of expressions, rather than erasing the past mental processes that led to them. It encourages HCI researchers to make use of the accumulation of feelings and thoughts that turn into traces over the course of one's lifetime. They are mostly manifested in documents, ephemera, and belongings that are uniquely rich and give glimpses into precious moments, mental processes, and past interactions. These traces could be curated through the physical equivalent of a version control system, creating intricate narratives to invite the viewers to retrace the journey of a loved one.

4.5 Remote Time

Telepresence is fundamentally about connecting people across remote spaces. With TeleAbsence, we introduce the concept of *remote time*, the potential of media to evoke a sense of being back within moments when we were together with loved ones who are no longer with us. Specifically, *remote time*, similar to telepresence's connection to remote spaces, can connect us to remote past places, architectural or spatial environments stored deeply in one's memory. In the context of TeleAbsence, *remote time* is about using media to create a psychological connection to the past, re-evoking and revisiting past moments in which one's loved ones interacted with the world. Spaces can play a role in connecting to *remote time*, as they play a key role in encoding memories (Knez, 2006). Strolling through one's childhood neighborhood or the halls of one's alma mater can bring back many vivid memories of shared moments with dear family, friends, and mentors. However, these memory-laden places may not be easily accessible, particularly in cases where they are far away, irrevocably altered, or destroyed.

In April 2019, a structural fire collapsed the spire of the famous Notre Dame de Paris cathedral, starting from the roof and slowly severely altering the upper walls and inner scaffolding. Originally built in the 12th century, the spirit of this eight-hundred-year-old building—embodied in its form, vaulting, and timber—was nearly lost forever to the fire (see Figure 6). For centuries, visitors from across the globe were captivated by the aural environment created by the structural design of the spires, grafting a "sonic fingerprint" that was synonymous with the spirit of the space. We chose the space of Notre Dame to illustrate how TeleAbsence can be applied to essential places in one's life that may be lost, enabling the reconstruction of past states and structures through TeleAbsence mediation.

To reconnect with the inner space of Notre Dame, researchers created a computer simulation of the space's acoustics that can emulate different points in the cathedral's history. This simulation enables the experience of *remote time*, using real-time auralization, a method for capturing the sound characteristics of locations, which can recreate the acoustic ambiance of a building, to be later re-experienced through voice-based interactions (Eley et al., 2021). Speaking into an acoustic simulation, users hear auditory feedback that sounds as if they are in a particular space. When applied to the Notre Dame Cathedral in Paris, this technique can enable people with memories of Notre Dame to revisit those moments of *remote time*. The potential to impact emotions by evoking past memories through virtual acoustic environments related to past experiences has been demonstrated by one of the co-authors, who found that familiarity with the soundscape enhances the emotional impact (Algargoosh et al., 2022; Algargoosh, 2021).

In the context of TeleAbsence, we can imagine augmenting this experience by introducing the voices of lost loved ones with whom a person visited Notre Dame. The auditory ambiance acts as a transitional space, creating the illusion of a shared environment between living people and their lost loved ones.

We are especially interested in the phenomena of feeling transported into past memories, an experience famously described by the author Marcel Proust in "Remembrance of Things Past" (Proust, 1988). Upon biting into a madeleine, the narrator instantly found himself transported back to his childhood when his aunt offered him the cake dipped in tea when he went to

Figure 6. *A photo from the inside of Notre Dame before the 2019 fire ("France- Nave of Notre-Dame" by Dennis G. Jarvis, licensed under CC BY–SA 4.0).*

greet her. This act of sensory recall is a potent metaphor for how we understand *remote time*. Memories can be triggered simply by looking at photographs, but recalling memories is different from the feeling of being transported to a moment in the past. This distinction has been shown in brain scans, where regions associated with memory, emotion, and the senses can independently vary in their activation level (Daselaar et al., 2008). Listening to songs from one's younger years has been shown to increase the recall of memories in Alzheimer's patients (Lord & Garner, 1993). For example, the 1966 Simon and Garfunkel song "7 O'Clock News/Silent Night" featured radio broadcasts from the 1960s about the Vietnam War, political protests, and civil rights hearings mixed into the duo's performance of "Silent Night" on the piano. Even for listeners not alive in the United States in the 1960s, the song transports the listener to a different era.

4.6 Summary

In conclusion, the five principles outlined above—*presence of absence*, *illusory communication*, *materiality of memory*, *traces of reflection*, and *remote time*—are each described as guidelines for implementing the vision of TeleAbsence with non-representational approaches to remembering loved ones who lost contact or departed. The following section illustrates these principles through design narratives that speculate on their application scenarios.

5 TeleAbsence Through Design Narratives

Each of the investigations below, conducted by the authors, explores a different medium and design exploration of the principles sketched out above, focusing on specific interactive mediums that can evoke the

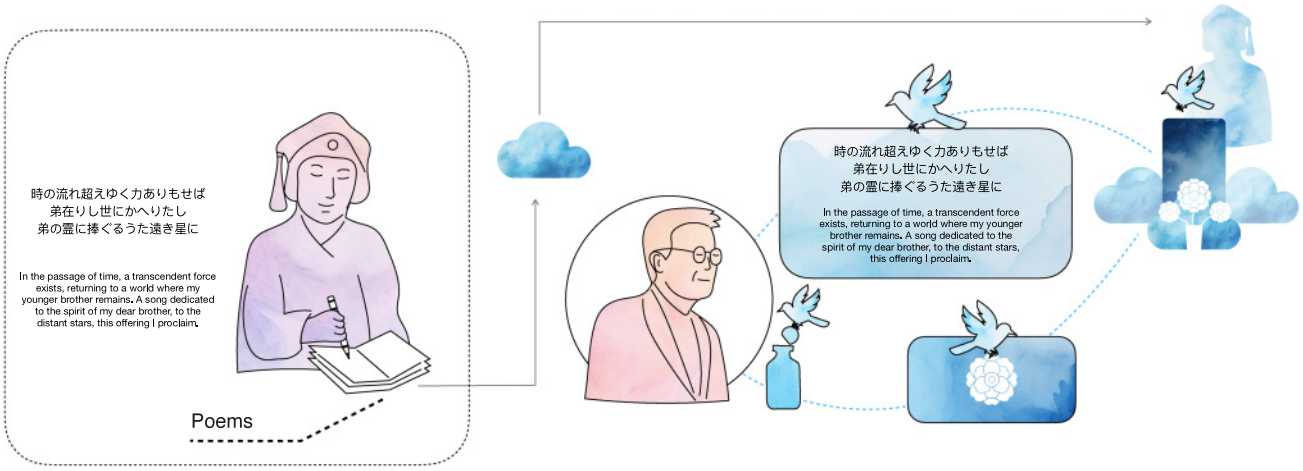

Figure 7. *An illustration of the exploratory design scenario: "I wish I could hear from you through your poetry." On the left, a departed mother writes poems in her notebook, and on the right, the son receives these poems years later through an illusory communication medium.*

principles of TeleAbsence. We acknowledge that the following narratives are drawn from research and design projects in various stages of imagination and prototyping. These exploratory narratives, each giving form and structure to the previously described principles, are intended to be a first step in developing our TeleAbsence vision.

5.1 POET: "I wish I could hear from you through your poetry"

The wish to hear from our loved ones through written words, such as reading their heartfelt poems or revisiting messages from the past, harbors a capacity to evoke an emotional response, creating a form of *illusory communication* with those we have lost.

The story of POET is a personal narrative that demonstrates the experience of TeleAbsence through online interaction, considering how it feels to remember a parent through poems they have left behind (see Figure 7). This narrative is inspired by one of the authors who had lost his mother in 1998. When the social media platform Twitter, currently known as X, was founded in 2008, the author decided to use Twitter to continue communicating with her. His mother was a prolific poet but had never published her poetry during her lifetime. After her passing, the son, who inherited her notebooks of poems, decided to create a Twitter account that at times posted lines from his mother's poetry. As the Twitter-bot posted autonomously, the son experienced a sense of real-time communication, an *illusory communication*, as if his mother was typing the tweets. Despite the timing of each tweet being random, the son felt as if the timing was meaningful. As the Twitter-bot posted tweets, the son felt communicated to by his lost mother, provoking the recollection of happy memories with the mother and times they had spent together. As time passed, Twitter followers of the son found his mother's account and started offering flowers digitally by posting photos in response to the anniversary day of her passing, giving the son the impression that his mother was remembered not only by him but also by a broader community. The son was very moved and delighted by the flowers at his mother's Twitter tomb.

In this design scenario, we imagine a tangible manifestation of TwitterPoet, namely a typewriter that prints poetic messages written by a loved one. Symbolizing the ephemerality of life, these messages would be printed with photosensitive ink and gradually fade when exposed to light. The sound of typing and seeing the keyboard move could have a similar effect as the automated posting of poetry, where the sound hints at the presence of a living individual as if the loved one was still typing.

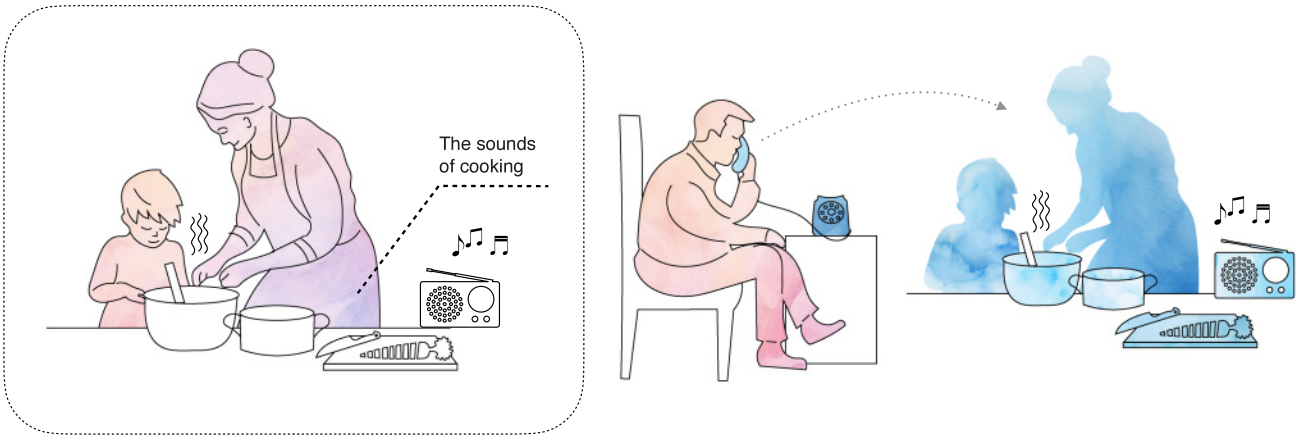

Figure 8. *An illustration of the exploratory design scenario: "I wish to feel the ambiance that brings back the memory of us being together in the kitchen." On the left a mother cooks with a child in a remote time. On the right, an adult dials the number of his former home, hears the sound of cooking via an antique telephone handset, and remembers these moments vividly.*

The TwitterPoet design narrative encapsulates many of the underlying principles of TeleAbsence, such as *remote time* by allowing the son to travel back to the moments when he first read his mom's poems, and *illusory communications* by letting the autonomous Twitter-bot decide when to receive his mom's poems.

It is especially interesting that the design scenario TwitterPoet, unlike AI-driven avatars, does not create or generate any new messages or content. It uses only poems or quotes the deceased person has written themselves. By sharing original poems or quotes from those who have passed away, TwitterPoet evoked the *presence of absence* of the departed individual—an acknowledgment that their existence is now confined to our memories rather than resorting to contriving false messages.

5.2 PHONE: "I wish to feel the ambiance that brings back the memory of us being together in the kitchen"

Listening to the audio through the handset of a vintage telephone is traditionally associated with interactions between the living. To build upon the concept of *illusory communications*, we explored the interaction design of the analog telephone to examine how its interface can connect individuals to *remote times in their lives.*

In this design scenario, we envision a son with many childhood memories centered around his family's kitchen (see Figure 8). Every day after school, he would settle at the kitchen table while his mother prepared dinner. Sometimes they shared stories from their day; other times, the boy did his homework while his mother hummed along with the radio. These memories were filled with ambient sounds of cooking such as chopping, pouring, stirring, sizzling, and simmering.

Years later, as an adult, the son dials the old number of his childhood home, now long gone. Instead of a person picking up the call, the phone connects him to a soundscape that evokes the family kitchen. He hears the sounds of cooking, the radio, and his mother's humming. He can even make out the contours of his own childhood voice—excitedly telling a story to the delight of his mother's responses—though the exact words are muffled and indistinct, lost to time.

This narrative illustrates the principles of *illusory communication* by making use of the telephone as a familiar interface to evoke emotions and sentiments, *remote time* by allowing the son to travel back to his childhood moments he misses, and *presence of absence* by using sound, an ephemeral medium, to represent fleeting beauty of memory.

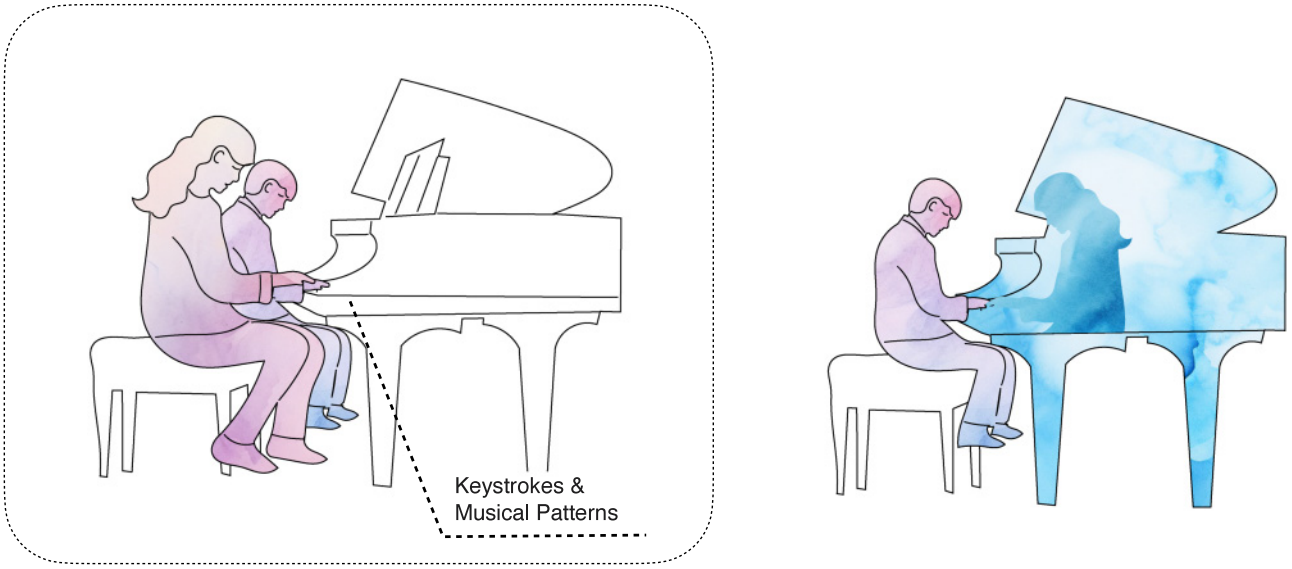

Figure 9. *An illustration of the exploratory design scenario: "I wish to watch you play the piano and join in a duet." On the left, two people are playing the piano together in a remote time. On the right, one person plays a duet with the ghostly representation of the departed piano player visualized inside the piano.*

5.3 PIANO: "I wish to watch you play the piano and join in a duet"

Music is one of the strongest ways to elicit and communicate emotions nonverbally (Kim et al., 2010). Xiao and Ishii (2010) created an installation called MirrorFugue where a piano "remembers" an absent player in the form of a virtual "reflection," inviting visitors to join in a musical duet (Xiao, 2016; Xiao, Aguilera et al., 2013; Xiao & Ishii, 2010, 2016; Xiao, Pereira, & Ishii, 2013; Xiao et al., 2016). Video of a pianist's hands and body are projected onto the keys and music stand of a Yamaha Disklavier player piano, synchronized with the actuated keys and acoustic sound. The life-sized video combined with the physical movements of the keys and creates a visceral sense of presence of an absent pianist.

Inspired by this interaction, we envision a TeleAbsence interface that enables duets with lost loved ones, allowing interactions with mentors, friends, and family members who are no longer alive or with whom contact has been lost (see Figure 9). We imagine a story of a young girl who was brought up by her grandmother, growing up playing the piano together. Though the granddaughter later moved far away, she continues to play the piano, associating it with her grandmother. Similar to Xiao's most recent empirical work (Xiao et al., 2025), we imagine inter-generational duets where children, grandchildren, and even further generations can play alongside their parents, grandparents, or people close to their family. These duets with lost loved ones would enable intergenerational relationships to persist across time, allowing descendants to feel close to their lost family members and friends even a century later.

These performances, "remembered" by the piano, embody the *materiality of memory* by allowing users to engage tangibly with the gestures of past pianists, *traces of reflection* by giving room to interpret the pianist's emotions while playing and *illusory communication* enabled through the tight-knit relationship between music and communication of emotions.

5.4 PEN: "I wish to feel the moment when you wrote me a letter on a sheet of paper"

When we come across writings left behind by friends or family, the written marks are immediately identifiable and convey a sense of familiarity about the

Figure 10. *An illustration of the exploratory design scenario: "I wish to feel the moment when you wrote me a letter on a sheet of paper" representing on the left two people, a girl and her grandfather practicing calligraphy together in a remote time, and on the right the girl later on, doing calligraphy on her own with the ghostly presence of her grandfather.*

people we hold dear. In the context of TeleAbsence, we are interested in how handwriting might evoke a sense of connection between the living and those who they have lost. The handwritten word, similar to the spoken word, is unique to a person and therefore can be used to evoke their presence.

Importantly, unlike other media, handwriting often captures the interior state of the person, as illustrated in Kenji Miyazawa's handwritten poems, which convey both psychological and physical meaning combined in language and personal style. Linguistic content gives space to expand our understanding of an individual's identity, while aesthetic style allows users to imagine their personality as well as their emotional state.

In the pen design scenario, we envision a "Memory Ink" that can reproduce the dynamic and emotive gestures of a lost loved one. Our vision is to recapture and replay the performance of handwritten communication through technologies such as "programmable droplets," to simulate the touch of the hand that held the pen, the strokes that wrote characters, and the emotions that stirred within the original author (see Figure 10).

This scenario illustrates the principles *materiality of memory* by using a physical medium to evoke emotions, *traces of reflection* by enabling users to retrace the pen movements and therefore retrace the physical act and cognitive process of writing.

5.5 Summary

We wrote each narrative to demonstrate the application of TeleAbsence's five principles. These exploratory narratives, each giving form and structure to the previously described principles, are intended to serve as a first step in the development of our TeleAbsence vision. Through these narratives, we explored stories that may inspire designers in the future to design new interactive systems.

6 Discussion

In developing the TeleAbsence vision, we also discovered new extensions for the potential evolution of future applications. Fundamental questions were raised, each of which we address in this final section.

6.1 Extensions of TeleAbsence: Beyond Family and Friends

The remembrance of "loved ones" can extend beyond immediate family and close friends to encompass beloved public figures. For instance, TeleAbsence could be inspiring to help an audience learn about an HCI pioneer such as Douglas Engelbart. One advantage of exploring a public figure's legacy is that there is a vast

archive of prior academic contributions (papers, patents, lectures, recordings, biography) and a great deal of anecdotal resources in the memories of former colleagues, students, and the community. TeleAbsence has the potential to educate the audience not only about historical figures but also to enable them to comprehend the individual's *traces of reflection*, giving insight into the existential thinking and emotional transformation of a historical figure.

6.2 Representational Strategy of TeleAbsence

Exploring the representational strategies of a person that we remember is a key design question posed by TeleAbsence. With recent advancements in Deep Learning, Generative AI, and DeepFake technologies, significant progress has been made in machine learning and artificial intelligence, enabling novel natural generation (Dale, 2021), speech synthesis (Chen et al., 2020), and character animation (Khalid & Woo, 2020), such that virtual characters can look and behave in the style of specific persons. In contrast to these developments, TeleAbsence avoids approaches that:

(1) directly represent a person's face, voice, and body with synthetically simulated images, animations, or robotics, and
(2) utilize generative AI to synthesize the utterances, facial expressions, and gestural language that the departed never spoke or expressed in the past.

TeleAbsence uses indirect approaches because abstract and incomplete representations of the "presence" of something stimulate a viewer's imagination, encouraging the user to fill the empty spaces in their memory through introspection. In robotics, Mori et al. (2012) introduced the uncanny valley concept. Mori hypothesized that as robots become more human-like, they appear more similar to a living person until they reach a point at which subtle imperfections of appearance make them look eerie. Similarly, we identify the same risk with TeleAbsence interfaces. In TeleAbsence interfaces, users are empowered to carefully define the degree of abstraction used to create representations that are appropriate for interacting with a departed loved one, especially for those lost in the recent past. Simplifying the representation allows people to invoke their memory and creativity to sustain the experience, much like books and radio let an audience participate in creating an artwork through their imagination.

Artificial intelligence technologies that generate human-like images, voices, or behavior of deceased people are a topic of debate in the field of media ethics and digitalization ethics. Many ethical concerns exist, for example, algorithmic bias, environmental impact, or cultural sensitivity. These aspects are particularly relevant to TeleAbsence.

6.3 Ethical Considerations for TeleAbsence

6.3.1 Psychological Impact. The introduction of individualized chatbots that mimic the speaking and writing behavior of a deceased loved one may pose challenges for those mourning, making it more difficult for them to emotionally and psychologically accept the reality of death. Psychologists argue that using "death bots" or "ghost bots" could potentially create situations where users find themselves trapped in an emotional loop that negatively affects their overall well-being (Kay, 2021; Lindemann, 2022; Morris & Brubaker, 2024). Another concern is the potential dehumanization of the deceased, as converting a person into computer code and data patterns can be seen as reductive (Massimi & Baecker, 2011). Furthermore, an avatar representation of a loved one no longer with us has suggestive solid and addictive powers that make users vulnerable to emotional manipulation. This differs from looking at photographs, reading old messages, or other traditional coping mechanisms. TeleAbsence, while inspired by conventional coping mechanisms, expands on them to develop new methods to assist people in processing the past. Recent CHI2024 paper "Let's Talk About Death" studied the use of a chatbot to incite existential conversations on Death. While the study shows the deceased's fear around death, however, it is of utmost

importance to design the technology carefully (Albers & Hassenzahl, 2024). Therefore, we strongly advocate for designing TeleAbsence technology to promote positive self-reflection, ensuring that users' mental health is prioritized to prevent any potential harm from revisiting past memories.

6.3.2 Manipulation and Misinformation. Another concern is misuse of information, which is a significant ethical concern when considering the susceptible information that is the subject of a person's medical record. Currently, legislative regulation is lacking, and people with manipulative desires may easily hijack avatars. The challenge posed by "death bots" is similar to existing issues with deep fakes, a realm where as much as up to 95% of circulating material can be forms of harassment, doxxing, manipulation, or theft of identity (Ruiter, 2021). Another concern is the potential for misrepresentation, where AI-generated characters could inaccurately depict historical figures or events, leading to the spread of misinformation and destabilizing trust in media (Maciel & Pereira, 2013; Pataranutaporn et al., 2021). TeleAbsence principles use ambient media; therefore, it is more difficult to use it for spreading misinformation. Nonetheless, we acknowledge the risks should not be underestimated.

6.3.3 Consent Issues. Another concern is the issue of privacy and consent, as the use of deceased individuals' data to create AI-generated characters raises questions about who has access to this technology and the potential of misuse for malicious purposes (Lombard & Markaridian Selverian, 2008). There are many potential violations of an individual's rights to privacy and publicity, mainly when AI-generated media is used without consent (She et al., 2021). Some studies have shown that subjects expressed concerns about the potential for exploitation, such as cybercriminals using data from deceased individuals to extort money from grieving families (Maciel & Pereira, 2013).

Like digital platforms and social media, TeleAbsence interfaces will concentrate large amounts of personally identifiable information, which could be manipulated or breached. For example, they are using these design frameworks to convince grandchildren that particular events did not happen to their deceased grandparents or occurred in a different way (genocide, war, etc.), as well as the creation of false memories. To avoid many of these issues, rather than generating new content from personal data, *traces of reflection* maintain the integrity of a person's data while helping their loved ones to reflect on loss poetically. Similarly, *illusory communication* evokes a sense of poetic connection without actual communication, avoiding the issues posed by generative interactions that falsify communications.

6.3.4 Mental Health and Confusion. TeleAbsence is designed to strengthen the relationship between people and the loved ones they lost. However, there are concerns about the impact on the grieving process, as the presence of a simulated version of a deceased loved one may delay recognition of their death and interfere with healthy bereavement (Kerkhoff et al., 2018). The process of re-experiencing memories through TeleAbsence may hinder the natural grieving process, fostering an unhealthy clinging to the past and complicating the journey towards acceptance and moving on. This could be especially true for later-life TeleAbsence users, who might be affected by neurodegenerative syndromes, such as Alzheimer's disease. We advocate for the necessity of psychological guidelines and emphasize incorporating mental health professionals' recommendations in designing and using TeleAbsence technology to foster positive self-experiences.

6.4 Reflections on Methods: Vision-Driven Research

TeleAbsence adopts a vision-driven research approach. While ample empirical data is not at its core, it is driven by a clear vision supported by a series of universally resonant historical references. The development of this design-oriented vision of TeleAbsence was deeply inspired and initiated during the COVID-19 pandemic when, despite the ubiquity of telepresence technologies, people experienced loneliness and a

sense of absence, highlighting a profound need for social and emotional connection to our loved ones. Over several years, we have gathered cultural and historical examples of how carefully designed interactions can help people express and cope with loss, such as the Wind Phone.

Building on that foundation, we articulated and illustrated design principles to invite designers and researchers in the HCI community to build upon and expand current approaches for addressing human longing and connection. These principles are by no means exhaustive but offer a starting point to explore and address the nuanced and deeply felt ways people experience absence. To give form to our vision, we defined design narratives to present unique interactions with technology through the lens of TeleAbsence.

This approach is rooted in the legacy of seminal works that focus on imagining in addition to building, such as Vannevar Bush's As We May Think (Bush, 1945), Marvin Minsky's Telepresence (Minsky, 1980), Doug Engelbart's Collective Intelligence (Englebart, 1960), Mark Weiser's Ubiquitous Computing vision (Weiser, 1986), and Ivan Sutherland's Ultimate Display (Sutherland, 1969). These visionary studies allowed researchers to imagine groundbreaking applications that ultimately shaped entire fields, guiding technology development toward meaningful, long-term outcomes rather than merely responding to immediate needs. In our previous works such as Tangible Bits (Ishii & Ullmer, 1997) and Radical Atoms (Ishii et al., 2012), we have also employed a vision-driven approach to imagine a new technological paradigm shift. TeleAbsence is an extension of our vision-driven research, inspired by our earnest hope to resonate with a broader audience and invite designers and researchers to address the universal longing for human connection and the desire to remember and be remembered.

7 Conclusion

This paper introduces TeleAbsence, a vision designed to address intrinsic human concerns such as fading memory, mortality, and the pain of losing loved ones. TeleAbsence offers a set of five design principles, *presence of absence, illusory communication, materiality of memory, traces of reflection*, and *remote time*, for designing interactions that foster an opportunity to revisit cherished moments shared with those we have lost. For example, individuals can recall and revisit memories such as cooking with a loved one in a cozy kitchen, strolling together along a seashore while collecting exquisite seashells, or traveling together on a nocturnal train.

TeleAbsence expands traditional telepresence to encompass the full spectrum of human existence, from birth to the afterlife, proposing approaches to engage with the memories and legacies of those dear to us. Through thoughtful human–computer interaction design, we envision a future where personal memories are preserved and reconstituted in meaningful ways, allowing individuals to reapproach their past selves and maintain bonds with departed loved ones.

8 Final Remarks

While reflecting on this paper's writing process, we realized it is an artifact of TeleAbsence vision. The act of writing this paper is akin to "academic afterlife planning," mirroring the process of self-reflection at life's end while providing a beacon of hope for future generations to continue exploring the future of HCI (Ishii, 2019).

This paper does not presume to offer a comprehensive understanding of existential dilemmas encompassing life and death. Instead, it presents a vision, principles, and supporting design narratives as an incomplete riddle and an intricate poem, crafted with the expectation that the next generations of researchers will contribute their own threads of understanding. This forward-thinking vision highlights the transient nature of technology which becomes obsolete in a year, and applications that become obsolete in a decade (see Figure 11). Yet, an artistic vision combined with human–computer interaction could transcend the constraints of existence and will endure beyond our lifespan.

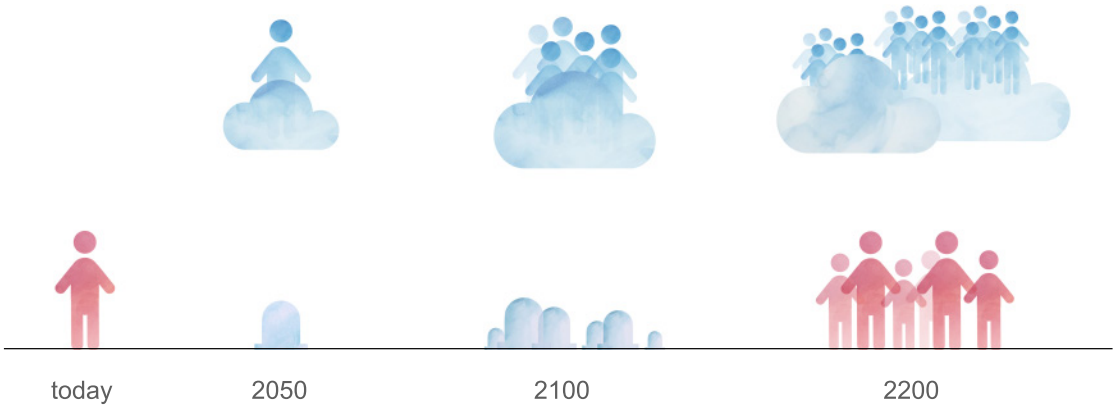

Figure 11. *A message to researchers to think about the year 2200. It is the responsibility of researchers to consider the impact of our work beyond our own lifespan. When thinking about what we want to pass on to future generations, it is essential to think beyond technological advancements and consider the broader implications of our actions. By extrapolation, some of the authors of this paper might be gone by 2050, and the majority of the current PRESENCE community may be gone by 2100. Nonetheless, the legacy of our decisions perseveres, impacting people living in 2200. 2200 is a symbol of the future where current researchers do not exist, but one we are responsible for, to care for future worlds and the legacy we leave behind. Life has a set endpoint, but the future is never-ending. That is why we believe that TeleAbsence is an important vision not only for grieving and for remembering our loved ones but for the future of the design community as well. The final messages and questions we want to share with you: 1. Life has a set endpoint, but the future is never-ending. 2. Technology becomes obsolete, but vision is everlasting. 3. What do you want to pass on to those living in 2200?*

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REFERENCES

Agah, A., & Tanie, K. (1999). Multimedia human-computer interaction for presence and exploration in a telemuseum. *Presence: Teleoperators and Virtual Environments*, *8*(1), 104–111. 10.1162/105474699566071

Albers, R., & Hassenzahl, M. (2024). Let's talk about death: Existential conversations with chatbots. *Proceedings of the CHI Conference on Human Factors in Computing Systems*, 1–14. 10.1145/3613904.3642421

Albers, R., Sadeghian, S., Laschke, M., & Hassenzahl, M. (2023). Dying, death, and the afterlife in human-computer interaction. A scoping review. *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*, 1–16. 10.1145/3544548.3581199

Algargoosh, A. (2021). *Aural architecture as affect: Understanding the impact of acoustic environments on human experience*. Doctoral dissertation, University of Michigan.

Algargoosh, A., Soleimani, B., O'Modhrain, S., & Navvab, M. (2022). The impact of the acoustic environment on

human emotion and experience: A case study of worship spaces. *Building Acoustics*, *29*(1), 85–106. 10.1177/1351010X211068850

Alves, S., Brito, F., Cordeiro, A., Carriço, L., & Guerreiro, T. (2018). Enabling biographical cognitive stimulation for people with dementia. *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems*, 1–6. 10.1145/3170427.3188693

Anderson, K. L., & Dimond, M. F. (1995). The experience of bereavement in older adults. *Journal of Advanced Nursing*, *22*(2), 308–315. 10.1046/j.1365-2648.1995.22020308.x

Ashery, O., & Giaxoglou, K. (2019). Digital death and the digital afterlife: Oreet Ashery in conversation with Korina Giaxoglou.

Axtell, B., Saryazdi, R., & Munteanu, C. (2022). Design is worth a thousand words: The effect of digital interaction design on picture-prompted reminiscence. *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*, 1–12. 10.1145/3491102.3517692

Bagnara, S., & Pozzi, S. (2012). Design for reflection. *Work (Reading, Mass.)*, *41*(Suppl 1), 1108–1113. 10.3233/WOR-2012-0289-1108

Barthes, R. (1981). *Camera lucida: Reflections on photography* (R. Howard, Trans.). Hill Wang, the Noonday Press.

Belk, R. W. (1988). Possessions and the extended self. *Journal of Consumer Research*, *15*(2), 139–168. 10.1086/209154

Belk, R. W., & Llamas, R. (Eds.). (2013). *The Routledge companion to digital consumption*. Routledge.

Bennett, G., & Bennett, K. (2000). The presence of the dead: An empirical study. *Mortality*, *5*. 10.1080/713686002

Beyond My Ken. (2016). Museum portion of steel facade North Tower floors [A front view of a portion of the steel from the facade of the North Tower, floors 93–96, of the World Trade Center in the National September 11 Museum at 180 Greenwich Street in the Financial District of Manhattan, New York City.]. Wikipedia. https://commons.wikimedia.org/wiki/File:2016_9-11_Museum_portion_of_steel_facade_North_Tower_floors_93-96.jpg (CC BY-SA 4.0).

Bluck, S., Mroz, E. L., Cogdill-Richardson, K., McDarby, M., & Carpenter, B. (2022). Even the good life has an ending: Virtue in the face of finitude. *Journal of Research in Personality*, *99*, 104238. 10.1016/j.jrp.2022.104238

Boelen, P. A., de Keijser, J., van den Hout, M. A., & van den Bout, J. (2007). Treatment of complicated grief: A comparison between cognitive-behavioral therapy and supportive counseling. *Journal of Consulting and Clinical Psychology*, *75*(2), 277–284. 10.1037/0022-006X.75.2.277

Boym, S. (2001). *The future of nostalgia*. Basic Books. http://archive.org/details/isbn_9780465007073

Brubaker, J. R., & Hayes, G. R. (2011). "We will never forget you [online]": An empirical investigation of post-mortem Myspace comments. *Proceedings of the ACM 2011 Conference on Computer Supported Cooperative Work*, 123–132. 10.1145/1958824.1958843

Bush, V. (1945). Memex. https://en.wikipedia.org/wiki/As_We_May_Think

Buss, M. (2004). Advances in interactive multimodal telepresent systems, Guest Editor's introduction. *Presence: Teleoperators and Virtual Environments*, *13*(1), iii–v. 10.1162/105474604774048180

Butler, R. N. (1963). The life review: An interpretation of reminiscence in the aged. *Psychiatry*, *26*, 65–76. 10.1080/00332747.1963.11023339

Carlsson, M. E., & Nilsson, I. M. (2007). Bereaved spouses' adjustment after the patients' death in palliative care. *Palliative & Supportive Care*, *5*(4), 397–404. 10.1017/S1478951507000594

Chaudhari, C., Prakash, A., Tsaasan, A. M., Brubaker, J. R., & Tanenbaum, T. J. (2016). Penseive box: Themes for digital Memorialization practices. *Proceedings of the TEI '16: Tenth International Conference on Tangible, Embedded, and Embodied Interaction*, 398–403. 10.1145/2839462.2856552

Chen, T., Kumar, A., Nagarsheth, P., Sivaraman, G., & Khoury, E. (2020). Generalization of audio deepfake detection. *Odyssey* (pp. 132–137).

Ch'ng, E. (2022, April). Virtual environments as memory anchors. Springer Cultural Computing Series. 10.1007/978-3-030-77028-0_26

Csikszentmihalyi, M., & Rochberg-Halton, E. (1981, January). The meaning of things: Domestic symbols and the self. *Contemporary Sociology*, *12*. 10.2307/2067526

Daggett, L. M. (2005). Continued encounters: The experience of after-death communication. *Journal of Holistic Nursing*, *23*(2), 191–207. 10.1177/0898010105275928

Dale, R. (2021). GPT-3: What's it good for? *Natural Language Engineering*, *27*, *1*, 113–118. 10.1017/S1351324920000601

Daselaar, S., Rice, H., Greenberg, D., Cabeza, R., LaBar, K., & Rubin, D. (2008). The spatiotemporal dynamics of autobiographical memory: Neural correlates of recall, emotional intensity, and reliving. 10.1093/Cercor/Bhm048

Davis, H., Irwin, P., Richardson, M., & O'Brien-Malone, A. (2003). When a pet dies: Religious issues, euthanasia and strategies for coping with bereavement. *Anthrozoös*, *16*(1), 57–74. 10.2752/089279303786992378

Demiray, B., Mehl, M. R., & Martin, M. (2018). Conversational time travel: Evidence of a retrospective bias in real life conversations. *Frontiers in Psychology*, *9*. 10.3389/fpsyg.2018.02160

Deml, B. (2007). Human factors issues on the design of telepresence systems. *Presence: Teleoperators and Virtual Environments*, *16*(5), 471–487. 10.1162/pres.16.5.471

Eggins, S., & Slade, D. (2004). *Analysing: Casual conversation*. Equinox Book Publishing Ltd.

Elagroudy, P., Khamis, M., Mathis, F., Irmscher, D., Bulling, A., & Schmidt, A. (2019). Can privacy-aware lifelogs alter our memories? *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*, 1–6. 10.1145/3290607.3313052

Eley, N., Mullins, S., Stitt, P., & Katz, B. (2021). Virtual Notre-Dame: Preliminary results of real-time auralization with choir. 10.1109/I3DA48870.2021.9610851

Englebart, D. (1960). NLS. https://en.wikipedia.org/wiki/NLS_%28computer_system%29

Fassbender, E. (2006). The virtual memory palace. *Journal of Computational Information Systems*, *2*(1), 457–464. https://www.tandfonline.com/journals/ucis20

Fish, R. S., Kraut, R. E., & Chalfonte, B. L. (1990). The VideoWindow system in informal communication. *Proceedings of the 1990 ACM Conference on Computer-Supported Cooperative Work*, 1–11. 10.1145/99332.99335

Gibson, M. (2004). Melancholy objects. *Mortality*, *9*(4), 285–299. 10.1080/1357627042331329812

Golsteijn, C., & van den Hoven, E. (2013). Facilitating parent-teenager communication through interactive photo cubes. *Personal and Ubiquitous Computing*, *17*. 10.1007/s00779-011-0487-9

Gulotta, R., Gerritsen, D. B., Kelliher, A., & Forlizzi, J. (2016). Engaging with death online: An analysis of systems that support legacy-making, bereavement, and remembrance. *Proceedings of the 2016 ACM Conference on Designing Interactive Systems*, 736–748. 10.1145/2901790.2901802

Gulotta, R., Odom, W., Forlizzi, J., & Faste, H. (2013). Digital artifacts as legacy: Exploring the lifespan and value of digital data. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 1813–1822. 10.1145/2470654.2466240

Haraldsson, E., & Houtkooper, J. (1991). Psychic experiences in the multinational human values study: Who reports them? *Journal of the American Society for Psychical Research*, *85*, 145–165.

Harrison, S. (2009). An introduction to media space. In S. Harrison (Ed.), *Media space: 20 + years of mediated life* (pp. 1–8). Springer. 10.1007/978-1-84882-483-6_1

Hemmert, F., Görts, A., Horst, J., Park, S. J., & Sion, T. (2022). Life-death interfaces: Tangible ways of legacy-making, grief, and remembrance, 323–327. 10.1145/3543758.3547533

Hester, J. L. (2017). The phone booth for Japanese mourners. *Bloomberg*. https://www.bloomberg.com/news/articles/2017-01-10/japan-s-wind-phone-is-a-site-to-mediate-on-life-and-loss

Hirst, W., & Echterhoff, G. (2012). Remembering in conversations: The social sharing and reshaping of memories. *Annual Review of Psychology*, *63*, 55–79. 10.1146/annurev-psych-120710-100340

Holt, J., Nicholson, J., & Smeddinck, J. D. (2021). From personal data to digital legacy: Exploring conflicts in the sharing, security and privacy of post-mortem data. *Proceedings of the Web Conference 2021*, 2745–2756. 10.1145/3442381.3450030

Isaacs, E., Konrad, A., Walendowski, A., Lennig, T., Hollis, V., & Whittaker, S. (2013). Echoes from the past: How technology mediated reflection improves well-being. 10.1145/2470654.2466137

Ishii, H. (1998). Reflections: "The last farewell": Traces of physical presence. *Interactions*, *5*(4), 56–ff. 10.1145/278465.278474

Ishii, H. (2019). Sigchi lifetime research award talk: Making digital tangible. *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*, 1–4. 10.1145/3290607.3313769

Ishii, H., & Kobayashi, M. (1992). ClearBoard: A seamless medium for shared drawing and conversation with eye contact. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 525–532. 10.1145/142750.142977

Ishii, H., Kobayashi, M., & Arita, K. (1994). Iterative design of seamless collaboration media. *Communications of the ACM*, *37*(8), 83–97. 10.1145/179606.179687

Ishii, H., Lakatos, D., Bonanni, L., & Labrune, J.-B. (2012). Radical atoms: Beyond tangible bits, toward transformable materials. *Interactions*, *19*(1), 38–51. 10.1145/2065327.2065337

Ishii, H., & Ullmer, B. (1997). Tangible bits: Towards seamless interfaces between people, bits and atoms. *Proceedings of the ACM SIGCHI Conference on Human factors in computing systems*, 234–241. 10.1145/258549.258715

Jarvis, D. (2014). France- Nave of Notre-Dame [Notre-Dame Cathedral or simply Notre-Dame, is widely considered to be one of the finest examples of French Gothic architecture and among the largest and most well-known church buildings in the world.]. Wikipedia. https://commons.wikimedia.org/wiki/File:France-000233_-_Nave_of_Notre-Dame_%2814524739110%29.jpg (CC BY-SA 4.0).

Joyce, J. (1935). Absence, the strongest form of presence. Attributed to James Joyce: Letter to his daughter, Lucia, May, 1935.

Kahokkurli. (2012). Telephone on the Wind, Belle Gardia 2. Flickr https://www.flickr.com/photos/kanjouaru/8197186799/in/photostream/ (CC BY-NC-ND 4.0).

Kalnikaite, V., Sellen, A., Whittaker, S., & Kirk, D. (2010). Now let me see where I was: Understanding how lifelogs mediate memory. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 2045–2054. 10.1145/1753326.1753638

Kaptelinin, V. (2016). Making the case for an existential perspective in HCI research on mortality and death. *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems*, 352–364. 10.1145/2851581.2892585

Kay, G. (2021). Microsoft has patented a chatbot that could imitate a deceased loved one, celebrity, or fictional character. https://edition.cnn.com/2021/01/27/tech/microsoft-chat-bot-patent/index.html

Kerkhoff, H., Pfender, C., & Jiang, S. (2018). Black box, a concept design: Grief work and the digitized self. *Proceedings of the 10th Nordic Conference on Human-Computer Interaction*, 832–837. 10.1145/3240167.3240280

Khalid, H., & Woo, S. S. (2020). OC-FakeDect: Classifying deepfakes using one-class variational autoencoder. *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops*, 656–657.

Kim, S. J., Oh, Y. J., Kim, K. J., Kwak, Y.-L., & Na, S. (2010). The effect of recorded maternal voice on perioperative anxiety and emergence in children. *Anaesthesia and Intensive Care*, *38*(6), 1064–1069. 10.1177/0310057x1003800617

Kirk, D. S., & Sellen, A. (2010). On human remains: Values and practice in the home archiving of cherished objects. *ACM Transactions on Computer-Human Interaction*, *17*(3), 1–43. 10.1145/1806923.1806924

Klaas, D. (1996). *Continuous bonds*. Taylor and Francis.

Klastrup, L. (2006). Death matters: Understanding game-world experiences. *Proceedings of the 2006 ACM SIGCHI International Conference on Advances in Computer Entertainment Technology*, 29–es. 10.1145/1178823.1178859

Knez, I. (2006). Autobiographical memories for places. *Memory*, *14*, *3*, 359–377. 10.1080/09658210500365698

Knoll, A. (Ed.). (2007). Guest Editor's introduction: Toward high-definition telepresence. *Presence: Teleoperators and Virtual Environments*, *16*(5), i–iii. 10.1162/pres.16.5.i

Komatsu, M. (2018). Wind phone in Ōtsuchi, Japan. Wikipedia. https://commons.wikimedia.org/wiki/File:%C5%8Ctsuchi_wind_phone_5.jpg (CC BY-SA 4.0).

Leitão, C. F., Pereira, V. C., & Maciel, C. (2017). Exploring the communication of cultural perspectives in death-related interactive systems. *Proceedings of the XVI Brazilian Symposium on Human Factors in Computing Systems*, 1–10. 10.1145/3160504.3160527

Lindemann, G., & Schünemann, D. (2020). Presence in digital spaces. A phenomenological concept of presence in mediatized communication. *Human Studies*, *43*(4), 627–651. 10.1007/s10746-020-09567-y

Lindemann, N. F. (2022). The ethics of "deathbots." *Science and Engineering Ethics*, *28*(6), 60. 10.1007/s11948-022-00417-x

Liu, Y., & Van Schalkwyk, G. J. (2019). Death preparation of Chinese rural elders. *Death Studies*, *43*(4), 270–279. 10.1080/07481187.2018.1458760

Lombard, M., & Ditton, T. (1997). At the heart of it all: The concept of presence. *Journal of Computer-Mediated Communication*, *3*(2), 321. 10.1111/j.1083-6101.1997.tb00072.x

Lombard, M., & Markaridian Selverian, M. E. (2008). Telepresence after death. *Presence: Teleoperators and Virtual Environments*, *17*(3), 310–325. 10.1162/pres.17.3.310

Lord, T., & Garner, J. (1993). Effects of music on Alzheimer patients. *Perceptual and Motor Skills*, *76*, *2*, 451–455. 10.2466/pms.1993.76.2.451

Maciel, C., & Pereira, V. C. (Eds.). (2013). Digital legacy and interaction: Post-mortem issues. Springer International Publishing. 10.1007/978-3-319-01631-3

Mahr, J. B., & Csibra, G. (2020). Witnessing, remembering, and testifying: Why the past is special for human beings. *Perspectives on Psychological Science*, *15*(2), 428–443. 10.1177/1745691619879167

Mantei, M. M., Baecker, R. M., Sellen, A. J., Buxton, W. A. S., Milligan, T., & Wellman, B. (1991). Experiences in the use of a media space. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 203–208. 10.1145/108844.108888

Massimi, M., & Baecker, R. M. (2010). A death in the family: Opportunities for designing technologies for the bereaved. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 1821–1830. 10.1145/1753326.1753600

Massimi, M., & Baecker, R. M. (2011). Dealing with death in design: Developing systems for the bereaved. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 1001–1010. 10.1145/1978942.1979092

Massimi, M., & Charise, A. (2009). Dying, death, and mortality: Towards thanatosensitivity in HCI. *CHI '09 Extended Abstracts on Human Factors in Computing Systems*, 2459–2468. 10.1145/1520340.1520349

McGookin, D. (2019). Reveal: Investigating proactive location-based reminiscing with personal digital photo repositories. *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, 1–14. 10.1145/3290605.3300665

Minsky, M. (1980). Telepresence manifesto. https://spectrum.ieee.org/telepresence-a-manifesto

Miyazawa, K. (1931). Ame ni mo Makezu. Retrieved January 19, 2025, from https://en.wikipedia.org/wiki/Ame_ni_mo_Makezu.

Miyazawa Kenji Memorial Museum. (1922). The last farewell. Courtesy of Miyazawa Kenji Memorial Museum in Hanamaki.

Moncur, W., Bikker, J., Kasket, E., & Troyer, J. (2012). From death to final disposition: Roles of technology in the post-mortem interval. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 531–540. 10.1145/2207676.2207750

Mori, J., Gibbs, M., Arnold, M., Nansen, B., & Kohn, T. (2012). Design considerations for after death: Comparing the affordances of three online platforms. *Proceedings of the 24th Australian Computer-Human Interaction Conference*, 395–404. 10.1145/2414536.2414599

Morris, M. R., & Brubaker, J. R. (2024, January). Generative ghosts: Anticipating benefits and risks of AI afterlives. https://arxiv.org/abs/2402.01662v2

Museum, M. K. (1994). The last farewell. *Courtesy of Miyazawa Kenji Museum in Hanamaki.*

Noh, H., Yoon, S., Jo, H., Van Kleek, M., & Kang, Y. (2024). Starting a new life after crossing the Tumen River: How North Korean defectors use digital technology in transition. *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems.* 10.1145/3613904.3642892

O'Hara, K., Helmes, J., Sellen, A., Harper, R., Ten Bhömer, M., & van den Hoven, E. (2012). Food for talk: Phototalk in the context of sharing a meal. *Human–Computer Interaction*, *27*, 124–150. 10.1080/07370024.2012.656069

Opotow, S., & Shemtob, Z. B. (Eds.). (2018). *New York after 9/11*. Fordham University Press.

Pataranutaporn, P., Danry, V., Leong, J., Punpongsanon, P., Novy, D., Maes, P., & Sra, M. (2021). AI-generated characters for supporting personalized learning and well-being. *Nature Machine Intelligence*, *3*(12), 1013–1022. 10.1038/s42256-021-00417-9

Peesapati, S., Schwanda Sosik, V., Schultz, J., Lepage, M., Jeong, S.-y., & Cosley, D. (2010). Pensieve: Supporting everyday reminiscence. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, *3*, 2027–2036. 10.1145/1753326.1753635

Peeters, A., & Segundo-Ortin, M. (2019). Misplacing memories? An enactive approach to the virtual memory palace. *Consciousness and Cognition*, *76*, 102834. 10.1016/j.concog.2019.102834

Pociunaite, J., & Wolf, T. (2023). I will keep your memory! Reasons for remembering lost loved ones. *Applied Cognitive Psychology*, *37*(6), 1397–1408. 10.1002/acp.4132

Pongrac, H., Leupold, J., Behrendt, S., Färber, B., & Färber, G. (2007). Human factors for enhancing live video streams with virtual reality: Performance, situation awareness, and feeling of telepresence. *Presence: Teleoperators and Virtual Environments*, *16*(5), 488–508. 10.1162/pres.16.5.488

Proust, M. (1988). *Du côté de chez Swann*. Gallimard.

Rosner, D. K., Ikemiya, M., Kim, D., & Koch, K. (2013). Designing with traces. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems.* 10.1145/2470654.2466218

Ruiter, A. (2021). The distinct wrong of deepfakes. *Philosophy and Technology*, *34*. 10.1007/s13347-021-00459-2

Samuel, R. (1994). *Theatres of memory* (Vol. 1). Verso.

Saudade. (2021, May). https://en.wikipedia.org/w/index.php?title=Saudade&oldid=1021072565

Sedikides, C., & Gregg, A. P. (2008). Self-enhancement: Food for thought. *Perspectives on Psychological Science*, *3*(2), 102–116. 10.1111/j.1745-6916.2008.00068.x

Serena, K. (2023). The eerie shadows of Hiroshima. https://allthatsinteresting.com/hiroshima-shadows

She, W.-J., Siriaraya, P., Ang, C. S., & Prigerson, H. G. (2021). Living memory home: Understanding continuing bond in the digital age through backstage grieving. *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, 1–14. 10.1145/3411764.3445336

Siriaraya, P., & Ang, C. S. (2014). Recreating living experiences from past memories through virtual worlds for people with dementia. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 3977–3986. 10.1145/2556288.2557035

Skarbez, R., Frederick P. Brooks, Jr., F. P., & Whitton, M. C. (2017). A survey of presence and related concepts. *ACM Computing Surveys*, *50*(6), 1–39. 10.1145/3134301

Soro, A., Taylor, J. L., & Brereton, M. (2019). Designing the past. *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*, 1–10. 10.1145/3290607.3310424

Steffen, E., & Coyle, A. (2011). Sense of presence experiences and meaning-making in bereavement: A qualitative analysis. *Death Studies*, *35*(7), 579–609. 10.1080/07481187.2011.584758

Stroebe, M., & Schut, H. (2010). The dual process model of coping with bereavement: A decade on. *Omega*, *61*(4), 273–289. 10.2190/OM.61.4.b

Sutherland, I. (1969). Ultimate display. https://www.wired.com/2009/09/augmented-reality-the-ultimate-display-by-ivan-sutherland-1965/

Teal, R. (2011). Foundational history: An integrated approach to basic design, history, and theory. *Journal of Architectural Education*, *64*(2), 37–45. 10.1111/j.1531-314X.2010.01125.x

Thomas, L., & Briggs, P. (2014). An older adult perspective on digital legacy. *Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational*, 237–246. 10.1145/2639189.2639485

Tollmar, K., & Persson, J. (2002). Understanding remote presence. *Proceedings of the Second Nordic Conference on Human-Computer Interaction*, 41–50. 10.1145/572020.572027

Turkle, S. (Ed.). (2011, September). *Evocative objects: Things we think with* (Reprint edition). The MIT Press.

Waggoner, B., Bering, J. M., & Halberstadt, J. (2023). The desire to be remembered: A review and analysis of legacy motivations and behaviors. *New Ideas in Psychology*, *69*, 101005. 10.1016/j.newideapsych.2022.101005

Walker, G., Bowskill, J., Hollier, M., & McGrath, A. (2000). Telepresence: Understanding people as content. *Presence: Teleoperators and Virtual Environments*, *9*(2), 119–136. 10.1162/105474600566673

Wallace, J., Montague, K., Duncan, T., Carvalho, L. P., Koulidou, N., Mahoney, J., Morrissey, K., Craig, C., Groot, L. I., Lawson, S., Olivier, P., Trueman, J., & Fisher, H. (2020). ReFind: Design, lived experience and ongoingness in bereavement. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–12. 10.1145/3313831.3376531

Wallace, J., Odom, W., Montague, K., Koulidou, N., Sas, C., Morrissey, K., & Olivier, P. (2020a). HCI at end of life & beyond. *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*.

Wallace, J., Odom, W., Montague, K., Koulidou, N., Sas, C., Morrissey, K., & Olivier, P. (2020b). HCI at end of life & beyond. *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–8. 10.1145/3334480.3375143

Weiser, M. (1986). Ubiquitous computing. https://en.wikipedia.org/wiki/Ubiquitous_computing

Xiao, X. (2016). *Reflecting music through movement: A body-syntonic approach to playing with the piano*. Ph.D. dissertation, Massachusetts Institute of Technology.

Xiao, X., Aguilera, P., Williams, J., & Ishii, H. (2013). MirrorFugue III: Conjuring the recorded pianist. *CHI '13 Extended Abstracts on Human Factors in Computing Systems*, 2891–2892. 10.1145/2468356.2479564

Xiao, X., Hantrakul, L. H., & Ishii, H. (2016). Mirrorfugue for the composer, performer and improviser. *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems*, 12.

Xiao, X., & Ishii, H. (2010). MirrorFugue: Communicating hand gesture in remote piano collaboration. *Proceedings of the Fifth International Conference on Tangible, Embedded, and Embodied Interaction*, 13–20. 10.1145/1935701.1935705

Xiao, X., & Ishii, H. (2016). Inspect, embody, invent: A design framework for music learning and beyond. *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, 5397–5408. 10.1145/2858036.2858577

Xiao, X., Pereira, A., & Ishii, H. (2013). MirrorFugue III: Conjuring the recorded pianist. *Proceedings of New Interfaces for Musical Expression*.

Xiao, X., Noh, H., Lefevre, A., Li, L., McKee, H., Algargoosh, A., & Ishii, H. 2025. ReMirrorFugue: Examining the emotional experience of presence and (illusory) communications across time. *Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems.* 10.1145/3706598.3713328

Xygkou, A., Siriaraya, P., Covaci, A., Prigerson, H. G., Neimeyer, R., Ang, C. S., & She, W.-J. (2023). The "conversation" about loss: Understanding how chatbot technology was used in supporting people in grief. *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems.* 10.1145/3544548.3581154

Yamaguchi, T., Foloppe, D. A., Richard, P., Richard, E., & Allain, P. (2012). A dual-modal virtual reality kitchen for (re)learning of everyday cooking activities in Alzheimer's Disease. *Presence: Teleoperators and Virtual Environments*, *21*(1), 43–57. 10.1162/PRES_a_00080

Yates, F. (2000). *The art of memory.* Pimlico.

Yoshito, M. (1946). Human shadow on stone by atomic bombing on Hiroshima - Sumitomo Bank, Hiroshima branch - around December 1946, Wikipedia https://commons.wikimedia.org/wiki/File:Human_shadow_on_stone_by_atomic_bombing_on_Hiroshima_-_Sumitomo_Bank,_Hiroshima_branch_-_around_December_1946.png#/media/File:Human_shadow_on_stone_by_atomic_bombing_on_Hiroshima_-_Sumitomo_Bank,_Hiroshima_branch_-_around_December_1946.png (Public Domain).

Young, J. E. (2023). *The stages of memory at Ground Zero.* University of Massachusetts Press.