

Understanding Attitudes on Mixed Reality Heritage

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Abstract

As Hypertext is applied to new domains and areas the potential for mixed reality Hypertext at culture heritage sites is increasingly evidenced. As with many other applications of Hypertext this in turn creates a need for accessible and powerful authoring tools for creating mixed reality experiences. In the spirit of both user centric and product centric design we seek to inform future technologies supporting mixed reality hypertext and games for cultural heritage by exploring both player and designer attitudes towards mixed reality and authoring tools. We present our findings from three studies exploring these attitudes, a survey of players (n=52), a set of interviews with players (n=12), and indepth interviews with mixed reality designers (n=5). Findings reinforced expectations for educational and functional experiences, with a shared preference for real-world history, but also collection patterns of play, and social experiences. The results further emphasised the need for novel authoring tools focusing on locative experiences with in-situ testing capabilities that might be used by varied teams of contributors at different project phases.

Keywords

Mixed-Reality Locative Games, Player and Designer Expectations, Game-Design, Cultural Heritage

1. Introduction

“Hypertext as lens” has become a fundamental part of the research language of this community, as we seek to understand a broad range of technology and society through the lens of linked systems: from creative media [1, 2], to social media [3, 4], and from news and debate [5, 6], to games [7, 8], and indeed as a method of inquiry itself [9]. Hypertext now also crosses the boundary of realities and *HyperReality* research on locative and Mixed Reality (MR) Hypertext considers how linked media may also be linked from the digital domain to the physical [10, 11].

Alongside the lens a fundamental part of Hypertext research is the question of authoring tools, and how technology can support the creation of Hypertext. Numerous Hypertext authoring tools have emerged from the community for fiction [12, 13, 14, 15], education [16, 17, 18], and indeed for locative MR hypertext [19, 20]. However, our work on creating authoring tools is often led by either the needs, or the possibilities, of the technology rather than necessarily the authors. As Hypertext becomes increasingly applied in new spaces, such as MR, we seek to go beyond informing this approach with the state of the art [21] and develop a better understanding of both author and reader (or player) attitudes to MR games. This duality of both user centricity (consulting designers on the potential of MR and authoring tools) and product centricity (consulting players on the form of mixed reality games) seeks to better inform future tools.

In this workshop paper we present the findings of three recent experiments exploring and documenting player and designer attitudes to MR games, along with designer attitudes to authoring tools in the space. As MR Hypertext is often applied in a cultural heritage [22, 23, 24] we further scope our study by specifically focusing it on this domain. Our experiments seek to gather evidence towards answering our research questions:

1. What are the expectations of players/users for location-based and MR games, specifically at heritage sites?
2. What are the expectations of designers for an authoring tool for creating location-based MR interactive experiences, particularly at heritage sites?

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2. Method

The subsequent stages of this study involved three distinct methods across two populations:

MR Game Players:

1. An online survey was administered to gather opinions on MR gaming and prevalent attitudes.
2. Semi-structured interviews were used to explore motivations for attitudes and expectations.

MR Game Designers:

1. Semi-structured interviews were conducted to understand tool usage, issues facing creation, and to comprehend perspectives on MR as a medium.

The initial stage was targeted at players to map the current landscape of MR games from their perspective. We applied a concurrent triangulation strategy [25] in which a combination of research methods were used to explore participants' attitudes, perceptions, and expectations towards MR games at cultural heritage sites. Our rationale behind it was to define relationships more accurately among variables of interest by applying quantitative and qualitative approaches to address our research questions. Thus, we applied a quantitative survey to map a number of aspects of our interest, and then explored them in a qualitative semi-structured interview.

Participants for this survey were restricted to individuals with prior MR game experience and were filtered based on their use of such experiences (i.e., only accepting responses from participants who had actually engaged with MR experience prior). The survey was distributed among popular forums relevant to MR, cultural heritage, and local contacts with an interest in the research topic, such as the cohort of the local games design degree program. A consent page at the start of the survey provided information and included a checkbox for consent. The survey aimed to gather information on players' experiences, preferences, and expectations when engaging with MR games, particularly at heritage sites. Its purpose was to identify the types of MR games players have encountered, their level of satisfaction, and the aspects they consider important in such experiences. The survey was formed of three stages. The initial phase focused on participant introductions, gathering crucial information to ensure their suitability for the study. The second stage delved into MR, probing participants about their experiences, feelings on specific aspects, and identifying prominent mechanics, frustrations, and themes. The final stage centred on cultural heritage and MR, investigating participants' encounters with MR in heritage spaces, their responses, preferences for MR integration in such settings, and their envisioned implementation of narrative elements. The survey questions were crafted to align with the overarching goal of exploring player expectations regarding MR within cultural heritage contexts.

The secondary stage of the player side of the study involved conducting 1 to 1 semi-structured interviews with participants from the survey section to further explore their expectations and preferences regarding mixed-reality games at heritage sites. The aim was to gather in-depth insights and engage in meaningful discussions that delved into the nuances of player expectations. The interviews explored topics such as immersive storytelling, interaction mechanics, and the impact of MR technology on their overall experience. Participant recruitment for this stage comprised of those who had filled out the survey and were willing to offer an hour of their time. The target scale for this stage was $n=15$ (conducted in individual sessions).

The designer aspect of the study consisted of semi-structured interviews conducted with game and/or narrative designers who ideally had experience in creating MR interactive experiences and using authoring tools. The aim of these interviews was to gain insights into the expectations and requirements of designers regarding authoring tools for MR experiences at heritage sites. The interviews explored topics such as the desired functionalities, ease of use, and potential challenges faced by designers. Each interview lasted up to one hour and participants for this stage were recruited through various connections that were established with the research team (a mix of digital and physical, XR, professional and academic), as well as seeking out specific designers who could provide valuable insights. The target scale for this was $n = 5-7$ in which a total of 5 participants were recruited.

3. Findings

Our research findings consists of the three key studies. Study 1A surveys player preferences, Study 1B conducts individual player interviews, and Study 2 explores the insights of game designers.

3.1. Study 1A: Player Survey

A summary of the survey findings can be seen in table 1. The survey (n=52), conducted in 2023, involved participants with diverse demographic characteristics. Specifically, half of the respondents were under 35 years old, and the sample was nearly evenly distributed by gender, with 46.2% male, 38.5% female, and 15.4% choosing not to disclose their gender. Regarding gaming habits, 53.8% reported playing digital games on a daily basis, while only 11.5% played a few times or less per month. No significant correlation was found between the frequency and duration of gameplay ($r(52) = .127$, $p = .369$).

A predominant preference for playing games on smartphones was observed among the participants, with 67.3% expressing this choice. In terms of game preferences, 46.3% indicated a preference for playing MR games, either with someone or alone, while 31.7% preferred playing with someone, and only 22% preferred single-player games. Younger participants displayed a higher tendency to engage in digital games more frequently ($r(52) = -.343$, $p = .013$) and for longer a duration per session ($r(52) = -.435$, $p < .001$). However, no statistically significant differences were found between gender and gameplay frequency ($\chi^2 = 2.893$, $p = .085$), or duration ($\chi^2 = 3.153$, $p = .235$) for digital games. Moreover, there were no statistically significant differences observed in playing MR games across gender types ($\chi^2 = 4.935$, $p = .085$) and in the choice of playing with someone or alone or both ($\chi^2 = 3.424$, $p = .489$).

Table 1

Summary of player survey including Motivations for playing MR games, and visiting Cultural Heritage, preferred XR Games, and Genres and Mechanics players feel work well in MR (n=52)

Games Motivation		Games		Genre		Mechanics		CH Motivation	
Challenge	23	Pokemon Go	33	Trea. Hunt	27	Collecting	30	Learning	44
Relaxation	23	Geocaching	8	Adventure	24	Building	29	Beauty	39
Killing Time	23	Ingress	8	Strategy/Sim	14	Spatial Puzzles	23	Relax	26
Stimulation	19	Jurassic Park	3	Puzzle	13	Chasing	23	Stimulation	14
Learning	9	Walking Dead	3	Action	7	Control	22	Killing time	10
		Beat Saber	3	Shooter	7	Int. NPCs	14	Accessibility	8
				Horror	7	Phys. Puzzles	14	Affordability	7
				Rhythm	3	TB Combat	12		
						RT Combat	11		
						Race	11		
						Trivia	9		

Across all participants, the predominant reasons for playing MR games were challenge, relaxation, killing time, and stimulation. Specifically, challenge and relaxation emerged as the primary motivations for male participants, while challenge and killing time were the primary reasons for female participants engaging in MR games. To capture broader attitudes on preferential forms of play the question regarding favoured games was adjusted to incorporate eXtended Reality (XR) games. The most popular game among participants was Pokémon Go (63.5%), while other games, including Geocoaching (15.4%), Ingress (15.4%), Jurassic Park (5.8%), Walking Dead (5.8%), and Beat Saber (5.8%), showed lower popularity. Notably, Pokémon Go stood out as the most enjoyable game for 50% of participants. In contrast, less enjoyment was reported for other games, with only 11.5% expressing enjoyment for Geocaching and 5.8% for Ingress. Participants enjoyed the interactive side of playing MR games, such as playing with family, friends, or other users, meeting new people, and being part of a local game community. The second most mentioned theme related to the active exploration of natural and historical places.

The top two nominated genres were Treasure Hunt (51.9%) and Adventure (46.2%), while Simulation (26.9%) and Puzzle (25%) were popular but less commonly chosen by participants. The most frequently nominated mechanics perceived to work well in MR were Collecting (57.7%), Building/Creating (55.8%),

and Spatial Puzzles (44%). It is notable here that finding is a popular pattern of play, as seen in the response to hunts and collection, and that puzzles while popular as a mechanic are less popular as a genre (suggesting that players enjoy puzzles as part of a game).

The survey also gathered player frustrations with MR. This centred around two key aspects: payments for game progression and the social dynamics associated with playing MR games. Participants particularly highlighting challenges related to interactions with other players, such as difficulties in selecting opponents or instances of other players not adhering to rules. The subsequent themes revolved around connectivity issues (32.7%) and the inability to play games offline, with over a third of participants expressing frustration due to these challenges. Additionally, a proportion of participants (19.5%) conveyed dissatisfaction with the perceived lack of complexity in certain games, citing issues such as a lack of depth, repetitive elements, and games being too easy or hard (29.3%).

3.2. Study 1B: Player Interviews

A total of 12 participants were interviewed (50% were male and female). Participants in the study displayed diverse perceptions of their technological competency. Some considered themselves outdated in technology, associating their age with a perceived lack of up-to-date knowledge (23.08%). Conversely, others identified as outliers, feeling older yet still technologically current (46.15%). A subset positioned themselves outside the realm of gamers or tech enthusiasts (30.77%). Regarding occupation, the participant pool included students (43.75%), employed individuals (25%), and retirees (12.5%), reflecting a broad range of professional backgrounds. Three themes were identified in the dataset: *perception of mixed reality*, *favourable experiences* and *cultural heritage expectations*.

3.2.1. Perceptions of mixed reality

In the realm of MR, participants demonstrated varying engagement patterns. Some allocated dedicated time for gameplay, while others incorporated it as an additional activity to enhance walks or for relaxation. Regarding hardware preferences, smartphones were the most commonly used devices, with VR headsets less frequently utilised. Concerns related to MR included cybersickness, potential injuries from immersive gameplay in outdoor locations, the possibility of disturbing others, and apprehensions about living in a surveillance-oriented environment akin to 'Big Brother.'

3.2.2. Favourable experiences

Engaging with MR apps was marked by several positive experiences. The selection of applications, including Pokémon Go, Ingress, and Geocaching, played a significant role. Personal interest in game themes related to individual hobbies, past experiences, and nostalgia emerged as influential factors. The popularity of a game and its trendiness, with others actively playing, contributed to the appeal. The social aspect, such as the ability to play with others, form communities, and compete, was highlighted. Participants found immersive experiences, with a realistic and interactive virtual environment, appealing. Striking a balance between virtual reality (VR) and the real world, exploring various locations, and using apps for navigation and learning about the environment were factors that enhanced engagement. The active nature of gameplay, coupled with the fun factor, also contributed to favourable experiences.

Participants also reported reasons for disengaging from MR apps. Loss of the game's popularity, repetitive and predictable gameplay, associated costs, and intrusive ads detracting from the experience were cited. Some participants mentioned discontinuing app usage once it served its initial purpose or due to a lack of time and social aspects. Difficulty in understanding game mechanics and the desire for more diverse activities beyond simple tasks, such as chasing Pokémon, were also reasons for disengagement.

3.2.3. Cultural heritage experiences and expectations

Participants expressed a general inclination towards visiting cultural heritage (CH) sites and enjoying the experience, with a preference for group visits encompassing both indoor and outdoor locations. Some

participants believed the integration of MR components could potentially enhance the CH site visitation experience. While the use of MR in museums was considered a novelty that might encourage return visits, some participants maintained that nothing could replace the tangible experience of physically being present. Time constraints were cited as an issue for some participants.

Expectations for CH apps centred around interactive education, with a focus on memorability and a balanced presentation of information to avoid information overload. Visual representation of information, limited text, and high-quality, well-edited content were preferred. Tailored experiences for the specific space (rather than feeling generic) and using the specific affordances of the technology (such as being able to visualise the past) were also highlighted as valuable by the players. Social engagement was considered crucial, with features like treasure hunt/collecting seen as engaging activities. The notion of leaving a digital legacy, such as postcards that can be electronically sent to others, was viewed positively. Participants emphasised the importance of using CH apps in group settings, making them a social and shared experience.

3.3. Study 2: Designer Interviews

Five designers, consisting of 2 males, 2 females, and 1 non-binary individual, were interviewed. Their diverse backgrounds spanned academia, research, escape room design, and technical development. Their experience in cultural heritage varied, with only one participant having extensive knowledge. While all possessed design experience, the levels varied, ranging from seasoned designers with numerous outputs to those with less experience and more focus on research. During the coding process, five main themes emerged: defining Mixed Reality and its gameplay potential, understanding MR experiences, navigating design intricacies, delving into development processes, and prioritising user experience.

3.3.1. Perceptions of mixed reality

Designers characterised MR games or experiences by their interactive and immersive nature, seamlessly combining aspects of both the physical, real world and the virtual, digital world. This convergence creates a distinctive and interactive environment, essentially bridging the gap between tangible reality and digital content. The utilisation of technologies such as augmented reality (AR) and virtual reality (VR) plays a pivotal role in integrating virtual elements into the physical world, enabling user interaction.

Narrative and storytelling are often integral components of cultural heritage MR experiences, and technology facilitating a seamless interaction between the real and virtual worlds. The transformative potential of MR is underscored by the experience of a participant who designs experiences for renowned heritage sites. After implementing VR headsets, they reported an over 50% increase in engagement.

The importance of locomotion and interaction in virtual and mixed reality experiences is emphasised in the same reference, highlighting potential issues like lag, motion sickness, and varied input devices impacting user comfort and familiarity. The use of controls for virtual reality experiences is discussed, suggesting that natural hand movements may be more suitable for applications targeting kids or older individuals unfamiliar with traditional game controls: "[experience comfort varies] depending on the way you interact with it, whether it's VR, whether it's mobile based; people's comfort level with that and how familiar they are to experiencing different things via that platform."

Designers with experience in VR games note user acceptance of the technology, with some initial hesitancy is overcome once users familiarise themselves. However beyond VR one designer specifically states: "...people won't engage with AR because there's not much need for it, but also because they don't like the experiences around public spaces... they don't want to embarrass themselves in front of strangers by holding the phone up or having a big headset on without seeing their surroundings". This indicates a design challenge for MR heritage in that there is a social anxiety to interacting with MR in public, though as our designers observed with VR, increased prevalence and exposure may reduce this.

Designers expressed their insights on the future of MR in the cultural heritage space, emphasising the need for hardware evolution to drive mass adoption. All designers advocated for the seamless integration of Augmented Reality (AR) through lightweight glasses, mobile devices, or projected visuals,

as opposed to bulky headsets. Additionally, there's a consensus among designers on the importance of delivering consistent experiences across different platforms without compromising quality.

3.3.2. Mixed reality design experience

Common principles and pitfalls guided designer processes, it's emphasised that each project is unique. Flexibility and adaptability to specific circumstances are deemed essential for successful design and development. The clarity emerged that every experience or tool had a specific end user, and the design process involved a comprehensive approach with multiple tools. The consensus among designers was that there is no one-size-fits-all tool; rather, the process involves the use of multiple tools tailored to the specific needs of a given end user or author. Even in specific cases, where a designer used a single tool for video generation, multiple team members utilised various tools to create audio and video assets. This highlights the collaborative nature of the process, with multiple team members contributing to the creation of a unique and tailored experience before authoring begins, especially for those lacking technical knowledge or not part of the core team.

Embracing an iterative development process allows continuous refinement of the project. One designer who had managed several projects with large teams spoke to this end. They spoke on how to communicate complex ideas as engineers to clients who may not share a similar background, often using simpler forms of media to highlight key changes and directions: "...sometimes you go down a road that might necessarily be a complex part of your pipeline but it means that the client is happy that things are happening and wants to see this progress...even just doing video demos of how it works and stuff, rather than sending them [the actual project files], you just send them a video demo of it for sake of transparency". Ensuring the feasibility of creative ideas within technical constraints is essential, and simplicity and clarity should be pursued in both design and functionality. Adaptability, responsiveness to feedback, thorough testing, and effective project management further contribute to a successful MR design endeavour. "[small iterations] are important, no matter how sort of lo-fi they are - getting it out on the street and doing that is very important because that's where you find out that this doesn't work or it doesn't work in the rain or at certain times [of the day]".

There were no common game mechanics that could be identified or grouped together because each interviewee was unique and their experiences were reflective of this. As mentioned, all used VR in some capacity but rarely used AR; tangible interactions were perhaps a commonality. One designer had a poignant remark in which they claimed that experiences at sites of heritage should not attempt to mimic video games as users would simply play a video game; instead designers should focus on enhancing the site using technology at their disposal. This point was summarised nicely by the designer: "[if] The story of game is just going to be if it's as good as any other video game, effectively, why should they have to go to a place to experience it? It just limits it in terms of place. It doesn't add value to the place. You don't wanna create a bad video game that's also limited by location. You wanna create an experience that elevates the place that is already a special thing." Other designers focused on simple puzzles and quizzes, treasure hunts and creating rich narratives; whilst some designers also mentioned this would be an ideal mechanism for serious games at sites of heritage (reiterating the reference above). Additional mechanics and ideas were derived at this stage (these were formed from questions specifically relating to the most popular mechanics designers were requested to implement or what every designer found their users were frequently engaging in. Additionally, mechanics were derived from experiences that the designers had already created but framed for cultural heritage); as every designer had experience in creating specific experiences, this list of mechanics is a synthesis of the most common mechanics that were stated across all responses.

In the context of Narrative and Storytelling with MR, users express a desire for a clear understanding of the narrative before embarking on exploration, emphasising the importance of contextualising their experience; a designer claimed: "Because [users] relish narrative that is interesting relative to their experience... Not just, not just do this, do this do this. So it's then [about] presenting the story line so that characters convey the story before the user delves into the experience itself".

In the context of cultural heritage, a preference is voiced for narratives grounded in historical truths,

albeit with room for embellishments. Designers claimed that there was a lack of value in purely fantastical narratives: “I think if you were going to go fantastical in those kinds of things, I don’t know really how much value [users] would get out of it, because you’re really trying to combine two things that don’t aren’t the most comfortable playmates.” Structuring the experience into acts, each with plot points and tension-building moments, was then highlighted as a strategy to maintain user engagement through distinct phases of the story. Integrating elements of folklore, myths, and historical context into the narrative is seen as a means to enhance engagement and provide a unique experience. Smooth integration of the story with the physical site is deemed crucial, ensuring the MR experience enhances rather than imposes itself. Designers caution against superimposing unrelated elements, emphasising the need for a balanced approach that guides users through the narrative while allowing freedom to engage with the heritage site’s physical surroundings.

3.3.3. Expectations of authoring tools

In the development of each experience, multiple tools were employed, with those mentioned serving as platforms to compile assets generated by more specific tools, such as 3D modelling software and animation tools, integrated into a final game experience using Unity or similar game engines. Designers seldom worked solo, collaborating with technical professionals to implement specific features; “There’s the writing or the narrative side, there’s the and the concept side. Then there’s the visual side or the art direction side. And then there’s the technical side. And then at the end of this, there’s always wrangling with whatever hardware or whatever App Store”.

They emphasised using a variety of tools at different stages. Designers preferred flexibility, opting for either framework-specific tools or advanced game engines, but acknowledged the skill set required for the latter. The collaborative synergy between designers and technical experts was crucial, with the challenge lying in maintaining the initial creative spark for an impactful experience. Designers stressed that it is crucial to clearly define the end user and maintain their continuous involvement.

Towards enhancing site experiences there is a consensus on the significance of immersion, either through active engagement with the site or by authentically replicating its essence. However, challenges arise, primarily driven by inconsistent connectivity on these sites, necessitating upfront downloading of assets for prototype testing (flexible and rapid testing is an issue previously identified in authoring tool research [26]). Additionally, it’s acknowledged that developing for locations is challenging due to the disparity between remote development and on-site testing, often demanding significant time consumption and not fully reflecting the intricacies of the real space. This implies a demand that tools should support development for elegantly handling connectivity issues, but also flexible testing, and potentially even in situ authoring on site.

4. Conclusions

Insights to scope the design of technology to support MR Hypertext are apparent from our studies. We understand from both studies the experiences that players value and work with heritage sites. Stories and adventure focused games that can closely integrate with the narrative potential of the sites, and playful puzzles and collection/hunt patterns of interaction within this context. There is also a harmony from both perspectives on accessible MR such as those using phones rather than cumbersome headsets.

Collaborative and social issues were also a take away from the work - both in terms of play where there is value in social connections through experiences, and in development where tools need to support broad teams of varied professionals. Not only does this highlight a need for technology that supports features such as co-presence, but also flexible tools that integrate with MR pipelines.

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