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Title	Hybrid interactions in museums: Why materiality still matters
Authors	Ciolfi, Luigina
Publication date	2021-07-01
Original Citation	Ciolfi, L. (2021) 'Hybrid interactions in museums: Why materiality still matters', in Champion, E. M. (ed.) Virtual Heritage: A Guide. London: Ubiquity Press, pp. 67–79. doi: 10.5334/bck.g
Type of publication	Book chapter
Link to publisher's version	https://doi.org/10.5334/bck - 10.5334/bck.ghttps://www.ubiquitypress.com/site/books/e/10.5334/bck/
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Download date	2026-11-04 13:00:11
Item downloaded from	https://hdl.handle.net/10468/11601

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CHAPTER 5

Hybrid Interactions in Museums: Why Materiality Still Matters

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Abstract

The importance of physical and tangible qualities in museum visits has been established by extensive literature exploring the importance of materiality (Dudley 2013) and multisensory experiences (Levent & Pascual-Leone 2014) of heritage. A challenge for digital technology design is to ensure that these dimensions are not lost to visually heavy virtual experiences. This chapter examines hybrid interactions in museums, outlining exemplars of successful physical-digital installations and defining the key aspects to consider for their design and evaluation. The goal is to complement chapters on virtual approaches to heritage with insights on how and why to successfully bridge the physical and the digital in hybrid designs.

Introduction

Museums are still for the most part physical places, where heritage objects and environments are displayed, and where even intangible heritage is exhibited

How to cite this book chapter:
Ciolfi, L. 2021. Hybrid Interactions in Museums: Why Materiality Still Matters. In: Champion, E. M. (ed.) *Virtual Heritage: A Guide*. Pp. 67–79. London: Ubiquity Press. DOI: https://doi.org/10.5334/bck.g. License: CC-BY-NC

and made available also as part of physical exhibitions (Bortolotto 2007). Despite this, interpretation strategies very often neglect the materiality that characterises the experience of heritage.

The importance of materiality in museums has long been stressed by some heritage scholars and practitioners; this includes the materiality of spaces, of artefacts, but also the sense of bodily immersion and close contact with the past that add to a memorable visitor experience (Falk 2009). These aspects are often elusive, and visually and textually heavy interpretation tools (i.e., information panels, labels, illustrative videos, and other similar devices) have trouble capturing and conveying them.

Sandra Dudley (2013) made the argument for re-thinking the nature and general approach to education and interpretation that museums have had and that gives primacy to visual and cultural content, in favour of an approach in support of materiality. She defines materiality as the 'summation of physical characteristics, sensory experience and meaning' (Dudley 2013: 15) of heritage, and therefore as a human-centred concept capturing not only physical heritage assets, but the way in which they are experienced, understood, and felt. This is extremely relevant to the use of digital and virtual heritage applications in museums, as technology design has long followed a similar approach to that applied to 'traditional' interpretation: 'the "information over object" approach has influenced also the use of digital technology in cultural heritage ever since computers started to populate the exhibit floor' (Petrelli et al. 2013: 60).

This concern about the limited focus on the materiality of heritage assets is also at the core of critiques of some approaches to virtual heritage that consider virtual platforms as ultimate solutions to suit digital interpretation needs (Petrelli et al. 2013). Technologies such as VR have shown their worth in many instances, particularly in bringing engaging games and educational narratives to life (Champion 2011, 2015; Roussou 2004), but some problematic issues emerged when they were evaluated (Gillam 2017; Pujol-Tost & Economou 2007).

An approach to extensive virtualisation can indeed be invaluable, for example when sites or objects are no longer existing or accessible; however, it can cause drawbacks, particularly in certain heritage contexts such as historic buildings, or living history sites, where engagement is not just about specific artefacts, but about the atmosphere of a place, including the sounds and smells surrounding visitors, which the use of digital means of interpretation should also be sensitive to. While virtual heritage applications can enable experiences that would not be possible otherwise (such as the exploration of reconstructed sites and objects that are lost or not easily accessed), the risk is that some of the material aspects of heritage are too readily erased or excluded from the design process. This is particularly critical for those heritage sites and those museums that rely particularly on tangibility, such as, for example, living history sites.

Augmented reality (AR) has been an important step forward to recontextualising the virtual in relation to objects and to the environment (Beheshti

et al. 2017), providing a way to embed virtual content in embodied and multi-sensory visitor experiences (Keil et al. 2013).

However, there is room for more experimentation with hybrid approaches (Bannon et al. 2005), where the virtual and the material (and the design thereof) are more tightly entwined. Hybrid approaches not only can be more mindful of augmenting (rather than substituting) material and tangible characteristics but can also extend the potential of digital technologies to a wider range of visitors and visitor experiences. For example, Dudley illustrates how powerful 'physical, real-time, sensory engagements – even those which may be imagined – with material things' (ibid.: 5) can be, and she argues that the material per se can be engaging where there are cultural barriers to, or limited interest in, other avenues of interpretation: 'through our sensory experience of them, objects have some potential for value and significance in their own right' (Dudley 2013: 8).

Museum visits are of course multi-sensory. Notably, the importance of touch has been widely recognised in heritage interpretation research and practice (Classen 2005), and it is something that can only be partially replicated through haptic technologies. There have been also examples where certain smells and foods to be tasted have been used to accompany exhibits (Levent & Pascual-Leone 2014). A notable example is the Sensorium exhibition at Tate Britain in London (Davis 2015), where several paintings in the museum were paired with multisensory exhibition content to be experienced together and complementarily by visitors. *Figure in a Landscape* by Francis Bacon was accompanied by an immersive soundscape and an olfactory display of bitter chocolate. *Full Stop* by John Latham was complemented by the sound of a heavy downpour and an ultrasound haptic device that made visitors feel the sensation of falling raindrops onto their hands (Vi et al. 2017).

Furthermore, it is important to consider tangible, material aspects of visiting museums not only in relation to specific artefacts (e.g., a painting, sculpture, historic space, etc.), but in terms of how they shape the experience of the wider context (e.g., a sequence of exhibits and the interrelations among them), and of the presence of others (e.g., companions, co-visitors, or other people who happen to be in the same space). Physical co-location is still key to engender and support social interaction: not only in terms of people being able to talk to or be close to companions, but also to be aware of others' physical proximity and presence in planning and practicing one's next moves, and spacing, pacing, and peripheral interaction in the exhibition space (Heath et al. 2002; Hornecker 2010, 2016).

The importance of materiality in digital heritage experiences extends to yet another aspect: the devices or artefacts that convey virtual content have their role to play as physical artefacts. The form factor, material, and feel of digital or hybrid devices also shape the experience of virtual content. For example, studies of tabletop installations (Block et al. 2015; Hornecker 2008) have shown that people's ability to cluster and gather around the display surface, and the gestures

that they learn and develop to interact with it, are as important in delivering a positive experience as the virtual content that is presented and the way that it is displayed (Hinrichs & Carpendale 2011). A comparative evaluation study of a mobile phone app, smart cards, and augmented replica objects created to convey the same content in an interactive exhibition showed that the tangible means of interacting (cards and replica objects) were favoured by visitors of all ages when compared to using the mobile app (Petrelli & O'Brien 2018).

Overall, there is ample scope and definite potential to experiment with more hybrid virtual-physical forms where successful immersivity (Kidd 2017) is not obtained by surrounding visitors with virtual content, but by engaging narratives that blend the digital and the material. For all these reasons, there have been many explorations of interactions bridging physical and virtual: notable examples are mixed reality (Benford & Giannachi 2011), tangible interaction (Hornecker & Buur 2006), and hybrid design where physical and virtual components are crafted together (Bannon et al. 2005).

Furthermore, there have been different approaches to designing actual interactivity in the context of these hybrid experiences: while with virtual reality, quite often the metaphor is that of traveling (in space or time) or of stepping into a different reality. Interactivity with hybrid installations is more 'digging deeper' in the here and now, revealing qualities or aspects of spaces or objects that are being held, handled, or occupied in real time. These forms of hybrid interactivity can be articulated in various ways.

Approaches to Designing Hybrid Interactivity

Broadly, hybridity means that the interactivity blends the virtual with the physical and material; however, this can take different forms and therefore lead to different approaches to design affecting different sides of the experience of heritage. We identify four broad approaches to designing hybrid interactivity: virtual-physical overlay; hybrid objects; virtual-physical assembly; and hybrid takeaways.

Virtual-Physical Overlay

In a virtual-physical overlay design approach, the virtual and material layers overlap in some way in real time. A well-known example of this is augmented reality (AR), where the visitor unearths the virtual content by means of a 'see-through' device. This can be an off-the-shelf device such as a mobile phone or tablet, but also a specially crafted object with embedded electronics, whose physical form supports interactivity in different ways. One example is The Loupe (van Dijk 2019; van der Vaart & Damala 2015), where the AR device took the form of a magnifying glass, and the virtual content was triggered not just by pointing The Loupe towards an object, but also by handling it through a range of physical gestures that made it behave in different ways.

Another example of virtual over physical overlay are projection mapping installations. These can be realised on walls, or in entire rooms, such as for example in the Immersion Room installation at the Cooper Hewitt Smithsonian Design Museum in New York City (USA) (https://www.cooperhewitt.org/events/current-exhibitions/immersion-room/). Bespoke physical structures can be designed to be not only a projection surface for the virtual content, but to carry meaning and to shape the way visitors physically arrange themselves in relation to the installation and how they interact with it. A well-known example of this that was mentioned earlier are tabletop interactives (Hornecker 2008), which allow for multi-user interaction, shifts in physical orientation, and cooperative behaviours around the table (Hinrichs & Carpendale 2011). Another example in commercial exhibition design is the Weaving Time installation on traditional weaving patterns, realised as part of an exhibition on the Inca civilisation held at Pointe-à-Callière Museum in Montreal (Canada). In this case, the virtual content is displayed on and can be interacted with through a physical structure replicating a loom (https://gagarin.is/news/designing-tangible-interactions-from-across-the-ocean). In these examples of overlay, the interaction with the virtual can be more embodied and retain aspects of materiality and physical experience that virtual experiences through devices such as headsets or handheld tablets or phones could not replicate.

Hybrid Objects

Another approach is the creation of hybrid objects within which some aspects of the virtual and the material co-exist or are linked via real-time interaction. Bespoke hybrid objects have also crafted to suit period settings, such as historic houses, and to augment their atmosphere. For example, the Interactive Work-Table and Escritoire at Dr Johnson House museum in London (Patel et al. 2015) was designed to aesthetically resonate with the house, while offering visitors a novel interactive experience.

Another example are the smart replica objects designed for the historical exhibition The Hague and the Atlantic Wall held at Museon (The Netherlands). In this case, the hybrid replicas were small objects that could be carried in one's hand, and each object was the replica of an authentic museum artefact on display and corresponded to a different theme of virtual content (visual and auditory) to be unlocked during the visit (Marshall et al. 2016) (Figure 13).

In the Interactive Tableaux installation at the Bishops' House Museum in Sheffield (UK), replica objects were also used, but with an added layer of hybrid interactivity. They activated a set of diorama-like tableaux representing different historical periods in the life of the house and its inhabitants. Every tableau reacted with different behaviours when activated: from playing a sound or light to emitting a smoky smell from its frame, displaying a video on a miniature screen inside the diorama, or making an automaton inside the diorama move (Claisse et al. 2020) (Figure 14). Evaluation of the installation shows that visitors enjoyed the



Figure 13: The smart replica objects for The Hague and the Atlantic Wall at Museon (inset). Each replica reproduced an authentic object in the exhibition (inside glass case in photo). Replicas of each object could be picked up by visitors (left of exhibition stand in photo) to explore the exhibition and trigger virtual content representing different points of view. Photographs by Daniela Petrelli and Nick Dulake, used with permission.



Figure 14: The Interactive Tableaux at the Bishops' House Museum. Each tableau reacted with different behaviours when activated with replica objects. Photographs by Caroline Claisse, used with permission.

multisensory aspects of the experience because they resonated with physically exploring a fascinating and atmospheric ancient house (Claisse et al. 2018).

Hybrid objects can also be crafted for educational hands-on installations. For example, one exhibition by Maquil et al. (2017) for the Tudor Museum in Luxembourg resembled a scientists' workbench where visitors learned how a battery can be built. They could choose and assemble components such as electrolytes, plates, and active paste, test the battery by revving a handle, and view its performance on a simulated graph paper displayed on an embedded screen.

Virtual-Physical Assembly

In this approach, the experience of virtual behaviours and content is designed side by side with the physical/material one, within the time frame of the visit. In this case, the *assembly* (as defined by Fraser et al. 2003) is a blend of virtual elements and material ones, including portable objects that are low-tech and do not offer any virtual experience per se, but that become part of one at some point by virtue of an underlying narrative of interactivity. These components are all linked together by a unifying activity that follows the narrative and introduces virtual elements at various points.

One example is *The History Hunt* at Nottingham Castle (UK) (Fraser et al. 2004), where low-tech paper worksheets were used to collect and file clues in the grounds of the castle and were subsequently augmented with RFID tags to activate mixed reality exhibitions in the castle gatehouse. Another example is *Reminisce* (Ciolfi & McLoughlin 2017); in this case, visitors exploring an open-air museum could collect 'tangible tokens' – small packages containing meaningful objects as well as digital audio snippets representing each of the historic cottages they visited on the trail. In the final building of the trail, the tangible tokens became activators for a separate installation concluding the visit.

Hybrid Takeaways

In this approach, material or virtual artefacts relating to an exhibition or site are available to visitors pre- or post-visit as *hybrid takeaways*. Therefore, the strategy is to realise a blending of the virtual heritage experience with a relevant material component that features either before or after the visit. Time becomes an important variable in this approach, as the hybrid experience becomes fully realised beyond the frame of the actual visit. How the takeaways are designed and their degree of digitality varies. One example is *The Chantry*, a freely available VR ambient game that is intended to be played before or after a visit to Dr Jenner's House museum (UK). The game's environment is a 3D model of Dr Jenner's House; however, the game is not intended to be played while physically visiting the site but as a companion experience to be enjoyed at a different moment and possibly encourage repeated visits (http://revealvr.eu/2018/09/17/the-chantry-launched-on-european-playstation-store/).

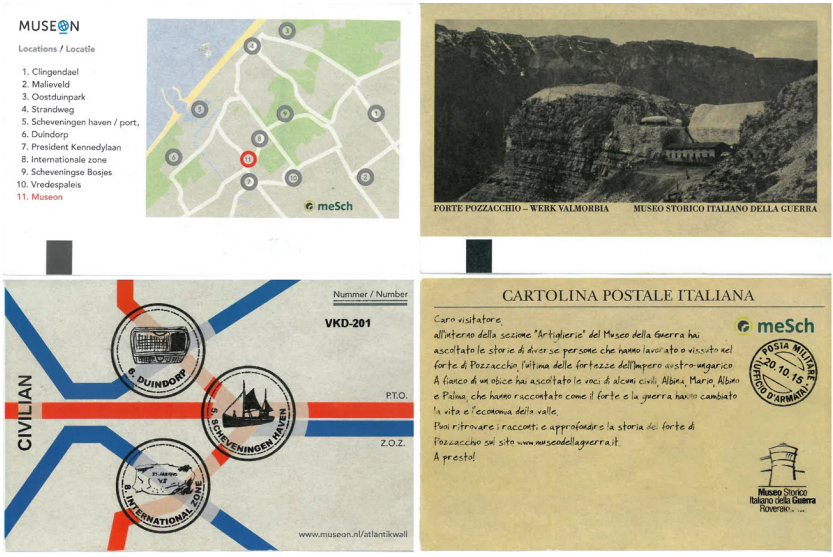


Figure 15: The souvenir postcards (front and back) realised by the meSch project for Museon (left) and the Italian Historical War Museum (right), rematerializing virtual aspects of individual visits. Photograph by Luigina Ciolfi. Postcard design by Paddy McEntaggart for meSch.

Conversely, the hybrid takeaway can be a physical token or object that is related to a virtual experience in some way. Instances of this are personal souvenirs that re-materialise virtual or intangible aspects of a visit. For example, Nissen et al. (2014) facilitated the making of takeaway objects by visitors themselves. The objects creatively represented what they had seen at a digital art exhibition. As part of the EU meSch project, takeaways took the form of personalised postcards that were automatically generated to represent the experience of virtual content that each visitor had, through the use of log data (Petrelli et al. 2017; Not et al. 2017) (Figure 15).

One of these postcards would be printed with different 'stamps' corresponding to virtual heritage installations that were interacted with in a large exhibition (Figure 15, left), or contain a written summary of the digital audio that a visitor had listened to at various points (Figure 15, right). In both these examples, the postcards also displayed unique URLs that each person could use to access further digital content through an online visit, leading the way for more interaction with virtual content.

Conclusion: Contextualising Virtual Heritage

These approaches to hybrid design, and the examples provided to illustrate them, show that there is a wide range of possibilities to blend the virtual and the material in interactive installations at museums and heritage sites. Indeed,

we can argue that no interactive installation is ever fully virtual, simply given the fact that it is approached and experienced by people who have bodies and sensory capacities and who need to manipulate some kind of device in order to activate it. There is, therefore, no opposing dichotomy of virtual versus material; rather, they exist on a continuum of possible embodied experiences of digital and indeed virtual heritage, with varying degrees of overlap and interrelationship.

Practical instances of designing for human-computer interactions in museums demonstrate that there is no 'one size fits all' approach to realising pleasurable, effective, and meaningful virtual or hybrid heritage experiences (Hornecker & Ciolfi 2019). Therefore, understanding and thoughtfully responding to the heritage context is essential; a hybrid approach including elements of tangible interaction might be more relevant or feasible for certain types of museum or of heritage than others. Similarly, such contextual complexity should inform the decision of how the virtual should blend with the material and which instance of interactivity should be offered. Furthermore, the interpretation strategy of an institution is also an important factor. An institution's emphasis could be on historical aspects, or material culture, design, and crafting, or on intangible yet materially and bodily experienced aspects of folk traditions and oral history.

All these considerations also weigh on the approaches to evaluating hybrid experiences: for example, whether the focus of evaluation should be on the educational aspect of exhibits or on the empathic experience of encountering and appreciating traditions and cultures. Overall, the evaluation of hybrid experiences almost always puts a strong emphasis on their evocative nature, striving to document felt aspects of the visitor experience, as well as other more traditional indicators of memorability, flow, and learnability (Damala et al. 2016). Qualitative methods are very commonly used to capture emotional and embodied aspects of engagement, and naturalistic studies allow for documenting and reflecting on these experiences in context (Ciolfi & McLoughlin 2012; 2017). Furthermore, evaluation studies also might be concerned with the interweaving of the installations with the broader material context, from the hybridity and embeddedness of interactive behaviours in context (Hornecker 2010), to the aesthetic delight and surprise around hybrid exhibits (Taylor et al. 2015), and the environmental and atmospheric setting of hybrid interactions (McGookin et al. 2017).

As digital technologies and platforms become more and more powerful and cheap and are more pervasively used in museums, awareness of their material, cultural, and organisational fit with heritage institutions is even more paramount. Approaches to designing and evaluating digital interpretation, therefore, might need to align to these strategies, meaning different roles for virtual or tangible instances of interactivity and for any possible blend thereof.

In conclusion, this chapter particularly argues for the need to consider the key role that material (physical and tangible) facets of experience play when people approach museums, heritage sites, and heritage artefacts. While this is

acknowledged by numerous heritage studies experts and practitioners, interpretation strategies often neglect these aspects, and so do digital designs. Due to the fundamental embodied, sensory, and embedded elements (as well as the emotional and intellectual ones) of the human experience of technology (McCarthy & Wright 2004), the practice of designing encounters with virtual heritage must be cognizant of this complexity.

Acknowledgements

The writing of this chapter has been supported by the H2020 project CultureLabs – Recipes for Social Innovation, under Grant Agreement 770158 (2018–2021). Thanks also to all the colleagues and collaborators who took part on the FP7 project meSch – Material Encounters with Digital Cultural Heritage (2013–2017), particularly Eva Hornecker and Daniela Petrelli.

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