Multisensory Interactive Storytelling to Augment the Visit of a Historical House Museum

Caroline Claisse
ADRC
Sheffield Hallam University
Sheffield, UK
c.claisse@shu.ac.uk

Daniela Petrelli
ADRC
Sheffield Hallam University
Sheffield, UK
d.petrelli@shu.ac.uk

Nick Dulake
ADRC
Sheffield Hallam University
Sheffield, UK
n.dulake@shu.ac.uk

Mark T. Marshall
Dept. of Computing
Sheffield Hallam University
Sheffield, UK
m.t.marshall@shu.ac.uk

Luigina Ciolfi
CCRC
Sheffield Hallam University
Sheffield, UK
l.ciolfi@shu.ac.uk

***Abstract*—We present an interactive and multisensory intervention designed for a house museum. Digital technology holds great potential for such heritage sites, but current use is limited to the pre- and post-visit experience. Interviews with museum professionals highlighted their concerns about technology placed in historic houses and suggested four design principles that we used to carefully integrate interactive technology, and the value of a bespoke installation. The installation, the *Interactive Tableaux*, shows a novel use of digital interactive storytelling where we combined both tangible qualities and informational aspects while respecting the aesthetic of the house and its home feeling. We discuss the process of crafting a conversation in and with a particular place and present evidence from our evaluations that the interactive multisensory installation encouraged observation, reflection and conversation.**

Keywords—design, digital storytelling, co-creation, house museums, multisensory

I. INTRODUCTION

This paper presents an intervention designed for a house museum – a particular type of heritage site where visitors engage with the past in embodied ways, by the simple act of walking through the house or leaning onto its walls [1]. Unlike traditional museums, artefacts in house museums are displayed in domestic settings, out of their protective cases and with limited written interpretation. Due to this unique layout, they need to be understood from an experiential perspective: "stepping back in time" or "standing in someone else's shoes" are evocative terms used to describe visiting such museums. Popular ways in which visiting house museums has been augmented include on site re-enactments of past lifestyles or professions, such as peat-fire heating or traditional baking [2]. Digital technology is conspicuously absent, apart from occasional interventions relying on mobile phones [2] [3]. While using mobile phones does not affect the aesthetics of the historical heritage, any other digital technology intervention needs sensitive design, careful integration and planning. This means that the gap between traditional museums and historic houses in terms of adoption of digital technology is widening, with museums progressively embracing and experimenting with the most advanced devices, while house museums lag behind and miss out potential benefits. The interactive installation we describe here is an attempt to close this gap. It was designed for the Bishops' House, one of the few surviving and best-preserved examples of Tudor timber frame buildings in Sheffield. We used embedded technology to focus the visitor experience on the material aspects of *being there* rather than on the device used to augment the visit. Design played a key part in the creation of five multisensory Interactive Tableaux depicting the everyday home environment of imagined characters that lived in the house over a period of 500 years from the 16th century (when the House was first built) up to the 1970s (when the house was last inhabited). The interactive installation was co-created in collaboration with the volunteers who look after the property, and it engaged visitors via interactive storytelling facilitated by tangible and embodied means. The paper is organized as follows: next, we review existing related work and introduce the particular setting of Bishops' House. A study to better understand the curatorial practice of house museums and how technology is perceived to fit (or not) into this peculiar context follows. We then describe design and installation of the Interactive Tableaux to bring the attention of the visitors back to the house itself, to invite observation, reflection and conversation. The evaluation is based on 577 interactive sessions recorded over 2 months in late 2017; direct observation and questionnaires complement the logs to explain visitors' behaviours. We conclude the paper by discussing aspects of our design in the context of interactive storytelling.

II. RELATED WORK

A. House Museums

House museums bring the past to the attention of the public in the form of domestic and personal life: they are domestic dwellings, which everyone is familiar with. Through them, visitors can learn about real people, their lives and thus wider history [4] [5]. As with the houses of today, house museums are diverse in scale and types with a different range of constraints and requirements than other museum types [6]. Indeed, they are looked after according to special practice identified as house museology [5]: exhibitions in historic houses require a particular approach as not just the contents or collections but the whole house is considered as a historic artefact, meaning that content and container are one [1][7]. While historic houses are turned into museums to celebrate particular ideas, they have more than one story to tell as many people have lived in them across time, often across centuries [8]. Spatial and aesthetic constraints mean curators have to choose which part of the story of the house is

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presented to the public. Thus house museums tend to concentrate on a single period in their history where both the building and its interiors are restored or reconstructed to match a particular era or episode in time [7]. Such exhibition practice was recently criticized for limiting interpretation strategy to one linear narrative, often focused on a leading character [8]. To present alternative readings of the place, house museums have experimented with artistic interventions, but artworks can compete with the place and challenge visitors in ways that may lead to a confusing or disengaging experience [6]. Other challenges for historic houses turned into museums are the risk of no longer reflecting the intimate real-life use of the place [8]. This is problematic as recent research has shown a growing interest from visitors to learn about the social history embodied in the house [9][6], suggesting a shift toward immersive interpretation, which affords new ways of bringing the space to life: for example rooms that are re-organized to tell more intimate and one-to-one stories where visitors are invited to explore actively and become part of the story [9]. Digital technology offers new opportunities to bring these places to life. However, experiments have been limited to individual installations or temporary exhibitions [9]. We propose the innovative use of digital interactive storytelling as an overlapping tool to tell the stories of the many people who lived there across time.

B. Interactive Storytelling in Museums

In interactive storytelling, the author prepares units of content arranged into a network: each content unit is delivered to the user if the specific condition of the node is satisfied. Foundations are strategies from established storytelling domains such as theatre underpinning the design of interactive experiences with a beginning, a climax, and an end [10], as well as a new role for "the user" where it is the sense of immersion in the story and the agency of the user to make the story unique and personal [11]. Interactive storytelling is now the backbone of narrative-based computer games. When applied to cultural heritage, a similar content structure and delivery mechanisms are used, mostly via mobile devices. For example, at a historical palace, visitors use a mobile device: the character of a spider dressed in livery accompanies visitors and narrates historical facts and gossip depending on the room, and grows impatient if they linger too long [12]. At the Acropolis Museum, the mobile AR experience (via a tablet) starts from a visitor profile and is adjusted along the visit; the plot, prepared by curators, contains different elements, such as games for the profile of a child, more in-depth content for an enthusiast, etc. [13]. In general, the storyline changes by virtue of being in a specific place or having done a certain task. Interactive storytelling with multisensory items is usually limited to entertainment, see [14][15]. Indeed, heritage poses constraints to the creation of multisensory storytelling as the environment is set. However, the key principles to create a sense of immersion in the story and to give the user an active role and options to choose from [11] can be exploited in a heritage setting by carefully design for that place, as we discuss below.

C. Tangible Interaction in Museums

In tangible interaction people use their full body to interact with digital technology [16]: they manipulate smart objects or move in smart environments to trigger a reaction from a computational system. In museums, such new form of interaction has been sparsely used as part of research projects, such as when models of the statue of Augustus and the Ara Pacis in Rome were augmented with mini buttons to play multimedia content on a nearby display [17]. Tangibles make it possible to interact with soundscapes: replicas of historical cups told their stories when handled [18]. Tangibles have also been designed as bespoke interactive pieces within a traditional exhibition (e.g. a magic cauldron for engaging children [19], a home-like room with unusual objects to explore [20]), as a tool to trigger content throughout the visit (e.g. smart replicas representing different storylines as in [21]). Tangible interaction is effective in other ways too: when a mobile phone running an AR app was concealed within a gesture-operated wooden magnifying glass, visitors read for much longer text than expected [22]. Tangible interaction in museums is still in its infancy and more research is needed to better understand how visitors react to such novel ways of consuming digital content while visiting. However, there is a fine line between enriching a visit by bringing into play other senses and overdoing it: a lab experiment incorporating touch, smell and multimedia content delivery that required physical action (blowing) to operate proved to be overwhelming for some [23]. Careful design is needed to balance and orchestrate the different sensory modes. However, multisensory interaction has the potential to make storytelling in museum more engaging.

III. THE BISHOPS' HOUSE AND ITS VOLUNTEERS

Built around 1500 AD and inhabited for over 500 years, Bishops' House was turned into a museum in the early 1970s as a place to display artefacts documenting the local life and history of Sheffield. After the relocation of these objects to the main city museum in 2010, the House was saved from closure only by the intervention of a group of volunteers who established themselves as "The Friends of Bishops' House". Since then, the House's collection is curated by the city museum, but the House itself is entirely run by the Friends who manage to keep it open to the public most weekends and for special events. This reflects a current trend (particularly in the UK) with local volunteers becoming a valuable resource for most museums, and a life-line for small cultural institutions that could not function without them [24][25].

Central to our research was for the first author to immerse herself in the life of the museum by volunteering, thus gaining insider knowledge and understanding of volunteers' practices as well as visitors' attitudes, motivations and experiences. People who volunteer at the House are diverse in terms of age and background. They very much enjoy being part of a community and contribute their own expertise and knowledge for the improvement of the House and the benefit of the visitors. The volunteers' aspirations clash with the type of experience on offer: Bishops' House was restored back to its 17th century structure with a display focused on Tudor history, while volunteers aspire to present the House beyond the stereotypical view of a Tudor museum [25]. Today, visitors come to Bishops' House to see an old building and learn about the Tudors, often following the school curriculum. They are often unaware that people lived there until modern times. Thus, despite volunteers wanting to communicate the broader history of the place and offer more innovative visiting experiences, interpretation at the

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House is limited to a few information panels, display cases and Tudor period rooms, all installed long before the Friends took over. The project reported here gave the volunteers a voice and the power to co-design what the House should offer to visitors; working with exhibition designers, they embraced new forms of multiple and interactive storytelling based on presence, agency and object manipulation.

IV. The Views of House Museums Experts

The collaborative process was informed by the outcome of an initial study: six semi-structured interviews with house museum experts (from visitor assistant, to museum curator, to property manager) addressed the nature of historic houses, exhibition design practices, visitor experience, and the role (if any) of technology at these museums. Each interview lasted between 30 and 45 mins and was transcribed verbatim and analysed thematically [26]; recurring themes where distilled into four design principles:

1) Maintaining the spirit of the House

House museums were described in terms of authenticity and uniqueness, as the only place in the world where visitors can experience significant features in a particular lived-in context. For example, at the Freud museum, visitors come to see Sigmund Freud's "real couch" and there is no other place that can offer the same experience. House museums create authentic experiences by engaging visitors with artefacts displayed in their original setting, or as if the inhabitants have just stepped out. They are defined as *extraordinary homes* where visitors become immersed in the lives of previous inhabitants. Interviewees described the synergy between the collection and the building, which are inseparable from each other, e.g., the Tenement House re-installed gas lighting for visitors to experience life conditions of a particular time, which in turn increased the atmospheric qualities of the place. As confirmed in the literature [1][5][6], an exhibition at a house museum goes beyond the individual display toward creating an experience as a whole where the building acts as a container for the lives of previous residents.

Design principle 1: Interactive exhibitions should be in keeping with the house's spirit by facilitating an immersive experience and a feeling of authenticity. The exhibits must engage visitors with the house as a whole, while drawing their attention to significant details of the place.

2) Building on the domestic nature of historic houses

As in the literature [4], house museums are described by our interviewees in terms of familiar environments (akin to visiting somebody's home) where the domestic setting encourages personal connections and a sense of nostalgia. The house manager at the Tenement House describes how visitors find personal resonance with the place as they recall personal memories of previous homes. Personal engagement with the place is encouraged by adopting exhibition strategies that increase closeness and exploration of the place: barriers are removed to support freedom of movement and allow visitors to feel part of the house. Rather than only reading or listening to information, visitors experience the place through embodied means, making it more memorable and inclusive. Interviewees emphasized how they want their visitors to be explorers rather than passive receivers of information.

Design principle 2: The domestic atmosphere of house museums should be part of the design, and embodied forms of interaction should invite visitors to actively engage with the place.

3) Telling stories about, for and by people

Visitors have an interest in the personal stories embodied in house museums [9]. At the Freud Museum, the curator recalls a popular exhibition featuring Freud's personal life alongside his intellectual work. Love letters and personal photographs succeeded in telling a more relatable and intimate story that aroused the visitors' interest. The more intimate side of the house was also brought to life at the Van Gijn Huis museum with the *24 hours project* where museum staff cooked, cleaned and dined as if they were living in the 19th century. The interpretive material generated from the project is now used on site for visitors to better understand the house in the life of people during that time. In some houses, volunteers become storytellers. Keen on their own specific interests, visitors hear different stories depending on which volunteer they talk to. Volunteers weave the story together and prompt visitors' curiosity by sharing a mixture of facts, speculation and anecdotes about the lives of previous residents.

Design principle 3: The exhibits should tell individual and intimate stories about ordinary people for visitors to empathise with on a personal level. Volunteers should be considered during the design process for their particular and diverse expertise. Social interaction and shared experience should be facilitated with stories told for and by people.

4) Designing for a seamless experience of technology

The interviews show that technology is mainly thought of as a detached or isolated experience based on screen- or button-based interfaces. Seen in this perspective, it is difficult for historic houses to adopt digital technology because of space limitations and disruption of the aesthetics of the place; when technology is available, it is usually in a separate room where visitors can interact without interfering with the main visit. Thus, digital technology is limited to pre/post-visit activities where, for example, visitors browse archive photographs via a digital picture frame or operate a listening station to hear memories of past residents. In house museums, technology is perceived as a barrier to the actual space: interaction on site is about the personal touch of people, it takes place on a human level rather than through the lens of technology. In our interviewees' opinions, visitors learn by walking around the place and talking to people. They don't come to stare at screens or use devices (such as their own phone).

Design principle 4: Technology should be part of the experience rather than a detached element of the visit. Efforts should be put toward designing solutions to offer a unique experience that is bespoke to the museum and that facilitates interaction between people and throughout the museum.

V. The Collaborative Design of the Tableaux

A. Design and Implementation

The four principles derived from interviews with the staff of house museums guided the design of the interactive intervention. A volunteer at Bishops' House herself, the first

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author engaged the Friends in a process of co-design. From early in the process, volunteers expressed their vision, hopes and ambitions for the House [25]. They stressed the importance of the museum being understood beyond Tudor history; of offering a multisensory experience of what the House might have felt like as a home in the past. They wanted to provoke visitors with questions and make them look at the place with new eyes, rather than passively receive information; and they wished for multiple forms of engagement for different audiences.

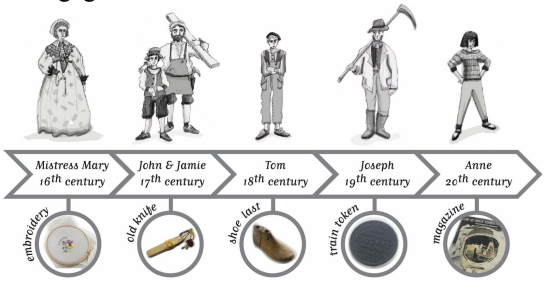


Fig. 1. The five characters, their objects and time periods.

The concept of an embodied interactive storytelling experience for the visitors was not there at the beginning. Rather, the characters, their stories, their objects and the visitor interaction ideas emerged organically from the co-design process and the activities the first author organised to harvest the creativity of the volunteers. In an iterative collaborative process, multiple design ideas were initially explored and a few concepts selected, such as that of stories from multiple periods told at the same time, or found objects forgotten by the previous inhabitants of the house. The selected concepts were then refined for the final installation. The characters, their lives and their comments were imagined by volunteers in two co-creation workshops. These contributions were then refined into the script that was recorded for the final installation.



Fig. 2. Visitor selecting Mary's embroidery - 1 of 5 objects for her visit (left) Visitor listening to Anne's tableau while holding Tom's shoe last (right).

In the *Interactive Tableaux* installation, five fictional characters represent the five centuries of the House, from when it was built in the 16th century, to when it was last inhabited in 1970s (Fig. 1). Their presence in the house is marked by their "portraits", the tableaux, placed in different rooms on the two floors of the Bishops' House. Each tableau is a domestic scene, a possible view of the House in that century, as if the character lived in it: Anne's tableau is a family room from the 70s, with a TV set and orange wallpaper (Fig. 2, right), while Tom's tableau is a bedroom shared with domestic animals (a mechanical cockerel) as it was common in the 17th century. Five smart objects match the period of the characters (Fig 1, bottom) and were placed by the reception desk (Fig. 2). When entering the House, visitors were invited to select one object, e.g. Anne's magazine, and to take it with them during their visit to provoke different reactions from the characters in each Tableau. By "showing" the object to the characters (by scanning the object's tag on the stand, Fig. 2), visitors were mixing the different times of the House and prompted the characters to react either by saying something about the object or in more unexpected ways, e.g. an unnerving response from Mary (16th century) who was startled by and unable to read the magazine. Tableaux and objects were focal points for conversations between the visitors and the House, mediated by its previous inhabitants. Different objects triggered different reactions from the characters, and visitors could show the same object to the same character many times to keep the conversation going. This aimed at shifting the visitors' attention back to the House by engaging the visitors in observation, reflection and conversation with the characters. The tableaux, the objects and the voices of the characters were designed as an ensemble, crafted to create a coherent yet surprising experience. Rather than on developing technology, our efforts focused on designing and implementing interesting content and engaging reactions from the Tableaux when an object was detected, including stories, noises, smells and mechanical movements.



Fig. 3. A volunteer showing us the hidden/witches' marks on the back door (left). Witches' marks featured in the set design (centre and right).

The technology used to implement the Interactive Tableaux was simple to use yet robust, as the volunteers would manage and use the installation independently from the development team. We used NFC tags (attached to the objects) and readers (in the stand, see Fig. 2) to control each Tableau. A WiFi communication system allowed us to register the visiting path followed by each object. Via these logs we were able to see if an object was reused at the same Tableau in sequence, or if it was coming back after having been taken to another Tableau.

B. From Principles to Practice

The design of the Tableaux followed the principles identified in the interviews (see section IV) as follows:

Maintaining the Spirit of the House: The Tableaux were designed as if the characters had just stepped out. Theatrical techniques created a feeling of depth and immersion and built the Tableaux as miniature sets of interior scenes. We used archive images to inform the design of the scenes but also relied on the volunteers' expertise. For example, a volunteer shared his knowledge of "witches' marks" on doors (to keep ill spirits away), later used as a key element in the set design (Fig. 3). This in-depth knowledge helped us to make connections between the bespoke scenes presented in the Tableaux, the places in the House that were meaningful to the volunteers and the stories told by the characters.

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Building on the domestic nature of historic houses: The aim of each Tableau was for visitors to get a glimpse of life at the House in a particular era. Discussions with volunteers inspired us to consider the sensory qualities of home: the changes of light throughout the day, the crackling fire keeping people warm, smells and noises both inside the house (e.g. creaking floorboards at night), and in the surroundings (e.g. the train in the distant valley). This variety of sensorial experiences typical of a lived-in home was captured in the Tableaux via coloured LEDs with different behaviours (e.g. pulsating or still); sounds (e.g. snoring, fire crackling); smell (e.g. lavender); and movement (e.g. the cockerel pecking). The interviews emphasized the importance of exploration and discovery at house museums, as visitors tend not to be forced into any pre-defined path, and for visitors to not be told what to think. With the Tableaux, visitors took on the role of explorers: they were questioned and challenged by characters to look for things in the House before coming back to be rewarded with additional stories.

Telling stories about, for and by people: Inspired by the *24 hours' project* described by one interviewee (see Section IV), we used roleplay to imagine and then step into the shoes of fictional characters who could have lived in the House. The characters, that then inhabited the Tableaux (Fig. 1), fostered the creation of more personal and, in some case, emotional content reflecting the volunteers' personal interests and attributes: they were inquisitive, friendly and funny. Five volunteers offered to be the character's voices and acted out the different stories for the Tableaux. Rather than delivering facts, the characters told secrets, gossiped and questioned visitors; their stories were a mixture of information, anecdotes and speculation. This created an experience where it felt like visiting somebody's house instead of a museum.

Designing for a seamless experience of technology: Key to our approach was to bring digital technology into Bishops' House in a way that was sensitive to the place and would not become a distraction. Technology was concealed as to bring life into the Tableaux when the visitors presented their object. What each tableau would do at every point in time was not obvious and at times surprising: most of the time the character would talk, but often there were only domestic sounds such as the clattering of cutlery during lunch. Only Anne's Tableau from the 1960s featured a screen, which was embedded in the scene as a TV set to play videos (Fig. 2, right). Other characters had something special too: Mary's Tableau sprayed a lavender fragrance, while Tom's cockerel moved its head and wings. Digital technology was therefore used to create an experience that was unique, multisensory and bespoke.

C. *Crafting Content*

The stories in the Tableaux were generated by the volunteers in activities that elicited interesting content to fit the scenario of characters having a conversation with visitors. The responses of the five characters were not thought of in isolation but in relation to the different people that inhabited the same place. For example, characters referred to each other to invite visitors to show their object to other characters at their respective Tableaux and get different reactions. When visitors showed Mary her embroidery, for example, she told them about her skills first, then mentioned Anne, the character from the Sixties: […] *Go and see Anne, at another station and show her the embroidery. I bet she won't believe you when you'll say it's made by hand! Don't forget to come back later! I have more to tell you!*. Anne, the 1970s character, acknowledged Mary's talent for embroidery, then provoked visitors by mentioning the modern way of doing things: *Woow! That's a beautiful flower! I really cannot believe it was made by hand. Why would you spend so much time embroidering when you can use a sewing machine?* […]. When Mary's embroidery was shown to her a second time, Anne shared her personal taste in fashion, which she displayed on her TV set: *I prefer printed fabric. Look! What do you think?! When I am older, I want to become a fashion designer! What about you? I want to design beautiful clothes like Mary Quant…do you know her?*. The third time the embroidery was shown to Anne, a clip of an interview with Mary Quant would play on Anne's TV (Fig. 2, right). Thus, the objects were used as a prompt for conversation and the characters responded with themes (e.g. fashion) that would resonate with their era or personal story.

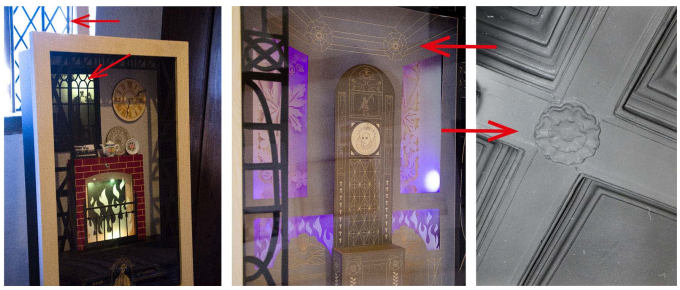


Fig. 4. Joseph's Tableau with the window (left) Mary's Tableau with detail of a Tudor rose on the ceiling (centre and left).

The content was also crafted to resemble a real conversation between two people in front of each other. For example, a character would be curious of what object the visitors held in their hands: *What do you have here? That's my old shoe last!* (Tom when shown the shoe last), *Oh! Is that heavy?* (Mary when shown the train token), *Wow is that embroidered flowers?* (Tom when shown the embroidery). Open-ended questions aimed to make visitors question themselves or their companions e.g. "What about you?". In some cases characters would not know much about an object, they would then direct visitors to the right character or person to talk to: *I wish I could have time to learn about history! If you go see Anne, one of the characters from the 20th century, she will tell you about the Tudors, she said she was learning it at school! Lucky her!* (John & Jamie, when shown the embroidery). Here, the flower on Mary's embroidery prompted John and Jamie to talk about Tudor roses – an iconic symbol in their time period (17th century). For more they sent visitors to Anne, the character from the 1970s who has studied the Tudors at school. Other characters would also direct visitors to volunteers for more explanation: *I think you should ask one of the 21st century people in this house, they know more than I do about shoes!* (Mary, when shown the shoe last). This invitation builds on the existing volunteer-visitor interactions.

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Part of its mission is for Bishops' House to be a way to appreciate the history of Sheffield in a broader context. The characters often referred to the city's wider history and invited visitors to look and reflect. For example, when shown John and Jamie's knife (17th century), Joseph (19th century) spoke about the way cutlery was made in Sheffield during his time: *That is a very nice knife you are showing me, it must be made in Sheffield. Did you know in my days we exported a lot of Sheffield cutlery to America! If you look at the window, you will see a thick cloud of smoke on the other side of town, that's where they produce all the cutlery and steelwork* […]. This invited visitors to look through both windows, the one in the Tableau where they could see the smoke of the factories as it was in Joseph's time, and the one in the House from which they can see the city today (Fig. 4, left). While characters referred to the wider context of the House, they also pushed visitors to look around to find significant details that were important to the volunteers. For example, when talking about her inspiration for the embroidery, Mary says: *Did you see the flower ornaments? Look up in the Parlour of Bishops' House! Two beautiful flowers are part of the decorative plaster* [...]. Those were featured in both the actual parlour and the one in Mary's Tableau (Fig. 4, right). A volunteer in the co-design sessions expressed their wonder at why, instead of the traditional Tudor rose with five petals, the ones at Bishops' House have seven. This curiosity became part of one character: *They are called Tudor roses! Look closer and you will notice that instead of five petals these have seven. I wonder why?* […] (Anne, when shown the embroidery).

Characters would be more familiar with some objects than others. Objects from the future could scare them, such as Anne's magazine featuring an astronaut on the front cover: *So how is this book made? I am very confused! I don't know what it is and it frightens me! Please take it away from me!* (Mary); *Ahh! This frightens me! Are you not scared? A suit of armour with no face! Is it some sort of witchcraft?* (Tom). Other characters would joke about it: *That newspaper is The Sunday Times! Ah! That's what posh people read* […] (Joseph, when shown the magazine). When content was exhausted, some Tableaux just played noises, which subtly told visitors that characters were busy. Others asked visitors to come back later as it was time for their nap, and then started snoring. In some cases, they would also reward visitors when they came back by playing them a special piece such as their favourite song.

VI. The Evaluation of the Visitor Experience

The Tableaux were displayed during *Curious House: Meet characters who bring Bishops' House to life* – a two-month exhibition that was organized with the support of the volunteers at the museum. The five stations were installed in different rooms on two floors, while the digitally-augmented objects were at the reception desk, where the volunteers introduced visitors to the Tableaux and invited them to choose an object for their visit. Records show that over 800 people visited the House, and our logs show the objects were used in 577 unique sessions. During the exhibition, we collected 120 post-visit questionnaires and conducted observations every weekend. We integrate these different data sources (logs, questionnaires and observations) to evaluate the impact of the Interactive Tableaux on the visitor experience.

Four objects were used almost equally: the shoe last (21%), the train token (21%), the embroidery (21%) and the knife (20%). The magazine was less popular (17% of use). While it is difficult to know why, we observed visitors selecting objects for their tactile qualities and three-dimensional form: for example, enjoying the weight of an object in their hands, or being attracted by its shine. One visitor who picked Tom's shoe last told us after the visit: *I really enjoyed holding it and the feel of the smoothness as I walked around* (visitor34[1]). Visitors also liked objects because they were evocative of personal memories. For example, many who chose the embroidery were reminded of their hobbies, of childhood memories of learning such craft at school or seeing others practicing it: *Actually of my mother – she was called Mary and did do needle work* (visitor36); *My mum, this is something she sat doing when I was younger* (visitor55). A few visitors who chose the magazine remembered the moon landing: *The 1960s! It made us think of where we were when the moon landing happened* (visitor109). The most visited Tableau was Mary (27%), which was higher than Tom, Anne and Joseph (22%, 21% and 18% respectively). The Tableau of John & Jamie was brought into the exhibition two weeks after the opening and displayed upstairs in the Bedchamber, thus receiving substantially less visits (11%). The popularity of Mary could be due to the exhibition layout as her Tableau was placed in the Parlour – the first room after the Reception: once they had picked their object, visitors were invited by volunteers to go to Mary at the first station. To confirm if Mary's popularity was the result of a "politeness effect"– where visitors used their object to please the volunteers that could be looking but not throughout their visit – we counted how many objects were used only at one tableau. Single use was by far more frequent for Mary than for any other tableau accounting for 6%, thus reducing Mary to 21% and so in line with all the other tableaux.

The questionnaires showed a similar trend to the logs with 32% of visitors preferring Mary, then Tom and Anne both with 23%. Therefore, it is likely their position in the House only marginally affected visitor behaviour, with personal preference being more important. Indeed, visitors liked some characters more than others because they related with them: *I liked Anne best because she had a history so close I can relate to it as if it were one of my parents talking* (visitor74). Visitors also enjoyed the characters for their human qualities and temperament: *Mary had a dry sense of humour!* (visitor84); *Tom seemed like a nice Sheffield lad* (visitor27).

The snippets that were listened to the most were the ones featuring noises. Those were played once visitors had exhausted the characters' reactions. For example, when showing the embroidery to Mary a third time, visitors would only hear the sound of fire crackling as if she had left the room, which suggested to move on to another character. In some cases, visitors would keep playing content despite repeating the same

[1] Numbers in brackets identify different respondents from the questionnaire.

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last snippet. Particularly, we observed how children presented Joseph with the same object many times to hear the sound of the train over and over again. Others kept activating the moving cockerel in Tom's Tableau, which generated a lot of laughter and excitement. The log data confirms this observation with visitors triggering the cockerel up to 14 times in one visit.

An object was most used at its tableau, that is to say the object belonging to one character (e.g. Mary's embroidery) was the most used at the Tableau of its owner (e.g. Mary's Tableau). Although it is difficult to know precisely why, we believe this is due to a successful design as the characters, their objects and the stories they tell have been purposefully created as intertwined. As such, they augmented one another: *I really liked exploring and discovering the stories. The way the characters relate their experiences of the objects to their respective time periods is fascinating* (visitor31).

Observations suggested that visitors spent much more time visiting the House than average. This was confirmed by the logs that showed 69% of visitors interacted with all or almost all the Tableaux (38% visited all of them, and 31% visited four) and about 5% of visitors listened to all available snippets of content for their chosen object. This is a clear indication of an active attitude of making the most of the visit. Volunteers also noticed that many visitors came back to try another object or listen to new stories; often they brought friends and family who had not visited the installation yet. As described above, the Tableaux invited visitors to go on and explore before coming back for more. We analyse one example in depth to illustrate how articulated the movements in the house could be (Fig. 5, red arrow): the visitors with the magazine first completed Mary and Anne downstairs before moving on to Tom who sent them on a mission to find out what the magazine was about: *Please come back with something to reassure me so I don't have nightmares tonight!* They then went to the Bedchamber to see John & Jamie who told them a bit more before sending them off, asking them to come back later.

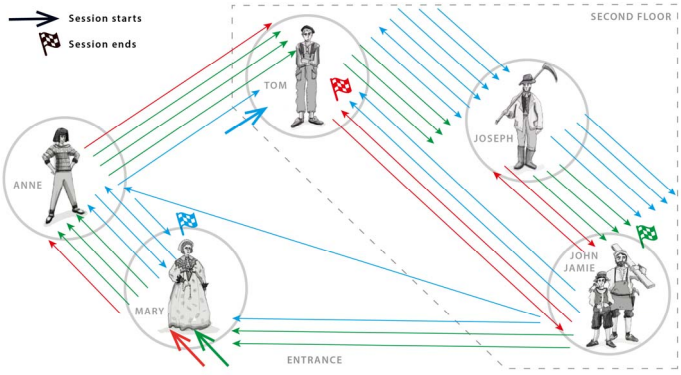


Fig. 5. Paths taken by three objects that consument all the content.

The magazine was then taken into the next room to Joseph, who joked about the cover before falling asleep. They listened to Joseph snoring twice, then went back to John & Jamie first, to listen to the rest of what they had to say and, finally, back to Tom who was reassured by seeing them again. In summary, these visitors followed the suggestions of the characters to move on and come back, and were rewarded by carefully prepared acknowledgements of their actions. In some cases, the Tableaux pushed visitors to go up and down the stairs several times and some did it (Fig. 5, blue and green arrows). The questionnaires confirmed the visitors who followed the characters' advice enjoyed exploring around the house before coming back for more: *I love how you needed to keep re-visiting them to build up the story* (visitor24); *having to look around the rooms and then go back to the installation once you'd found what they* [the characters] *were speaking about for more info* (visitor90); *It was somehow addictive – we wanted to make them talk again and again and we went around a second time with a second object* (visitor84).

The characters were designed as if they all were inhabiting the House at the same time and talked to visitors about each other, which increased a feeling of belonging: *I really liked the way they had conversation together. It felt like you were part of the conversation* (visitor93). The content was created in such a way that it was never repeated. We implemented two options: (1) when a character finished their sequence of storytelling, only the same sound was played such as the whistle of the train or the snoring (e.g. playing snippets A, B, C, D then repeat D); (2) two snippets were alternated – first playing snippets A, B, C, D, and then, alternatively only B, D. This careful crafting of the content contributed to make the experience different from other technologically-enhanced museum visits: *It did not say the same thing again and again like you usually expect with computer-programmed objects […] creating the feeling of history using technology* (visitor92); *I was amazed by at the intricate nature of the actual design work. At the same time, the stories helped me to think of history as something human in a way displays of artefacts and written history don't* (visitor74).

VII. Discussion

In designing the Interactive Tableaux, we aimed to create an experience centred on *being there*: bringing the visitors' attention back to the House and leading them to imagine as it was lived in across the centuries In doing so, we used the principles of interactive storytelling [11]: to give a sense of immersion in the story, to empower the user/visitor to be active and to choose among options. This was achieved by carefully crafting the experience around five imaginary characters from different centuries, but that now inhabit the house at the same time (DP#1[2] to hold the House's spirit). Each Tableau, described by visitors as a work of art in its own right, was a detailed scene, a portrait of the house as it might have been, and created a feeling of authenticity and uniqueness. By building on the domestic nature of historic houses (DP#2), the experience was designed as if visiting someone's home: choosing an object at the entrance challenged any passive behaviour and promoted an active exploration of place where visitors were not forced into pre-defined paths and were not talked at. Instead, they took on the role of explorers and became part of a conversation involving both the characters and the House. The content of what the characters said was also carefully crafted. They talked about their present (our past) capturing nuances of everyday people and everyday life; they talked visitors into gossip and jokes; they

[2] DP# stays for a Design Principle described earlier in the paper.

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invited to observe details in the House, they made reference to the city and the society of their time. They also questioned the visitor, talked about other characters and the volunteers. By telling individual and intimate stories (DP#3), the characters engaged visitors at a different level than when just reading panels or looking at objects. Indeed, by bringing together multisensory interaction with compelling stories, the Tableaux engaged visitors on personal and emotional levels. Key to this was the input of the volunteers, who acted as storytellers through their imagined characters. Our efforts focused on designing a bespoke experience for Bishops' House where technology was seamlessly integrated (DP#4) and did not distract visitors from the place: instead it was used to encourage repeated visits and extended engagement. When coming back, visitors were rewarded with additional content. Rather than a distraction or barrier to the place, we used technology in ways that became addictive, getting visitors' attention and making them linger longer in the rooms. In essence, by carefully bringing to life multiple periods of the house via the characters; by telling engaging stories that weave together the House, the history of Sheffield and of society; by offering objects to handle, voices, sounds and smells we created a multisensory environment where visitors created their unique stories by moving and acting in the physical space.

VIII. Conclusion

We described our process of crafting a conversation in and with a particular place, the Bishop's House. We adopted an inclusive approach by engaging museum volunteers in co-creating novel experiences of heritage at this house museum. The Interactive Tableaux show that it is possible to generate and organize content to engage visitors in immersive, embodied and personal ways. The Tableaux are a form of digital interactive storytelling, where content is crafted as a conversation in and with a specific place: the web of content is not embedded in a device, but distributed all around the house as objects and rooms, characters with their portraits, and the story they tell. It is the visitors moving around the House triggering content, observing and discussing that make this an interactive storytelling in place. Our design challenged current settings of house museums, e.g. frozen in time and focused on a single character [8]. We used technology to augment the House and overlap stories about multiple periods and from different perspectives. The Interactive Tableaux also enabled the museum to understand the potential of tangible interaction in sustaining volunteers' interest whilst increasing visitors' engagement over time. This inclusive and bespoke design approach can be adopted at other house museums: it gives opportunities for volunteers to take ownership of the place and sustain participation over a longer period of time by generating new content and uploading new stories.

Acknowledgments

We thank all the volunteers at the Bishops' House for their time and contribution to this research.

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