

Domus: An On-Gallery Digital Museum Experience in Two Parts

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Abstract: *In September 2014, the Allard Pierson Museum, the archaeology museum of the University of Amsterdam, opened its new Roman gallery. Leading to the redevelopment, the Museum's NewMediaLab explored how interactive technologies, particularly virtual re-contextualization, could be used to aid visitor interpretation of the collections. Based on earlier studies, the Museum developed and tested an interactive prototype consisting of two parts. In the first part, visitors enter a virtual environment, exploring with gesture-based navigation. In this virtual Roman house they were challenged to locate and collect seven objects, all replicas of museum objects. In the second part, visitors could explore the original objects in a display case nearby and use a touch screen computer to uncover additional information. The study focused both on the effect of virtual contextualization, and the learnability of gesture-based navigation in the museum context. Through a series of observations and interviews with adult visitors, the Museum has examined the impact of instruction on the use of this kind of navigation. The study compared the ability for visitors to navigate the virtual space after receiving one of two forms of instruction and asked them about their instruction needs and ease of use of the installation. Furthermore, the Museum wanted to better understand how visitors see the relationship between both the virtual installation and the real objects. Through interviews and guided visits, the team examined whether the use of digital replicas and virtual environments in the museum served to support the interpretation of the physical collections. This paper will discuss the development of the installation, as well as the research outcomes, and will reflect upon potential future developments.*

Keywords: Virtual environment, re-contextualization, 3D models, instruction, museum, embodied virtual navigation, Microsoft Kinect, evaluation

Introduction

A bucket, a spoon, a jug, damaged through use or neglect, and their once shiny bronze surface has turned a greenish brown. They are every-day Roman objects from the Allard Pierson Museum's (APM) collection. Although not necessarily examples of great craftsmanship, they tell us about the lives of people that lived centuries ago. In preparation of the redevelopment of the museum's Roman gallery, which opened in September 2014, the APM expressed a desire to help visitors engage with objects that are physically less attractive, yet have interesting stories to tell. Re-contextualizing objects, showing them in (a representation of) their original context of use, is one way to achieve this.

The NewMediaLab of the APM carries out research related to the (digital) museum experience, both with regards to visitor engagement, and the usability of new tools. Building on previous research (Ray & Van der Vaart, 2013a; Ray, 2013), the NewMediaLab developed the Domus project, in which visitors were asked to collect seven virtual replicas of museum objects from a virtual Roman house. Afterwards, visitors could further explore the physical objects in a nearby display case.

One of the aims of this pilot was to better understand the relationship, as perceived by visitors, between physical museum objects and virtual environments. Secondly, the study wanted to investigate the impact instructions can have on the usability of novel digital tools.

Real objects and virtual environments

A virtual reconstruction of a Roman Domus-type house was projected on the wall of a cinema space near the Roman gallery. Seven virtual replicas of museum objects, modelled to look new, were placed in this virtual Domus. Visitors were invited to navigate the Domus and to 'collect' the replicas. Navigation relied on physical gestures. If visitors stepped forward, they moved forward in the virtual space. If they stepped back, they would move back. Stepping to the left or right meant a 90-degree turn in that direction. A Microsoft Kinect sensor was used to read visitors' gestures. The gesture vocabulary was developed based on earlier experiences with embodied virtual navigation (Ray & Van der Vaart, 2013b). One of the main challenges was to strike the right balance between autonomy and guidance. Visitors should be allowed freedom to explore the space, but be prevented from getting lost. The 90-degree angle turn was introduced to simplify navigation, as was blocking off spaces that did not contain any virtual replicas. Short audio clips gave hints that indicated where each object could be found. Visitors could collect objects by pointing at them. The object would then disappear from the virtual environment and appear in a bar at the top of the screen.



Figure 1. A visitor exploring the virtual Domus

Source: Merel van der Vaart, APM.

To emphasise the connection between the virtual and the real, it was important to present them in close proximity to each other (Ray & Van der Vaart; 2013b). The seven physical objects were placed in a built-in display case in the corridor adjacent to the cinema space. A touch screen was installed in front of it. Visitors who had successfully selected one or more objects in the virtual space were given a code with which they could unlock the touch screen content.

Embedding virtual contextualization in the museum visit

As described, the Domus project had dual research aims. On the one hand, there were questions in relation to how visitors experience and appreciate the relationship between virtual environment and physical objects. Secondly, there was a desire to better understand how instruction could help visitors engage with novel technology, such as embodied virtual navigation.

The study consisted of observations of un-recruited visitors engaging with the virtual environment, as well as guided visits to both the virtual environment and the physical objects, combined with questionnaires and a semi-structured interview. For the guided visits, participants were recruited from visitors to the temporary exhibition of the museum. Over a period of three months, 40 visitors were observed using the installation and 17 guided visits took place.

The guided visits, followed by a structured interview and questionnaires focussed on the question: How do visitors perceive the combined offer of virtual environment and physical objects? The expectation was that allowing visitors to encounter the virtually restored replicas in their 'original environment' before being presented with the originals in a museum display would enable higher levels of visitor engagement. To test this hypothesis, participants were presented with one of two experiences. Nine participants (Group 1) first interacted with the virtual environment and looked at the physical objects afterwards. Eight participants (Group 2) were asked to look at the objects, before navigating the virtual space. While looking at the physical objects, all visitors were asked which objects they found interesting and what questions they would ask about these objects. They were then given time to interact with the touch screen application in front of the display case, which contained more in-depth information about the objects. Afterwards, participants were asked if they remembered where they had found the objects they had collected in the virtual space, and if they knew why the objects were located there.



Figure 2. The original museum objects on display together with touch screen application
Source: Merel van der Vaart, APM.

The visitors who participated in the guided visits matched the museum's general visitor profile. The age group 50 to 64 was well represented, with eleven out of 17 participants falling within that age bracket. Five participants were younger than 49, and one was 65 or over. Nine participants said they somewhat knew what

a Roman house looked like, while eight claimed to know outright. There were no great demographic discrepancies between Groups 1 and 2, except for the fact that six out of nine participants of Group 1 were male, while the genders were equally represented within Group 2.

The goal of virtually re-contextualizing, was to help visitors engage with the objects on display. Therefore, it was expected that participants who had explored the virtual environment first would ask more questions about the objects on display. Interestingly, the opposite was true. When asked what objects interested them and what questions they would ask about the objects, the participants from Group 1 together identified 13 objects they wanted to know more about. In total they asked 14 questions about these objects. The participants of Group 2 equally identified 13 objects, but asked a total of 21 questions. In addition, participants of this group asked more varied questions about the objects. Furthermore, participants of Group 1 spent less time with the touch screen application, which provided more information about the objects.

The study also showed that participants of the second group were slightly more successful at navigating the virtual environment. Together, the participants of Group 2 collected 27 objects, as opposed to 19 objects collected by Group 1. The individuals in this second group also had a better understanding of the navigation concept (e.g. the automatic 90 degree turn) and needed less guidance with regards to finding various objects. Although it must be said that almost all participants, of both groups, indicated they found navigating the virtual environment challenging. As the first group, which was least successful in navigating the virtual Domus, had a majority of male participants, the difference in gender balance must be taken into consideration. Interestingly, most research into gender differences in virtual navigation has identified men to be more successful than women (Tlauka *et. al.*, 2005; Tan, Czerwinski & Robertson, 2006), making the discrepancy between the two groups all the more striking.

In order to measure how much participants engaged with the content of the virtual environment, they were asked if they could remember where they found the objects they had collected and why they thought the objects were in that location (see table 1). Here, again the participants of Group 2 had an overall better score than those of Group 1. Not only were they able to describe the correct find location in more instances, they also described more locations in detail. There were also less instances when a participant could not remember where s/he had found an object, although there were slightly more instances when an incorrect room was described. It is important to note that for Group 1 more time passed between finding the virtual objects and answering questions about their location. However, in the interview it also became clear that the participants who had first seen the physical objects (Group 2) were better at linking the information they had acquired through the touch screen application to the virtual replicas in the Roman Domus. When discussing the objects in the virtual environment, after the guided visit, they were more likely to rely on information they had read in the touch screen application than those participants who had read the information *after* navigating the virtual environment.

Table 1. Number objects for which the virtual location was described by participants

	Group 1	Group 2
Vaguely described correct room	8	10
Described correct room in detail	4	11
Describes the wrong room	1	3
Does not remember	6	3

Source: Domus research NewMediaLab APM.

To summarise, contrary to expectations, the participants who were first asked to look at the objects on display, and were asked to navigate the virtual environment afterwards (Group 2), appeared to be more engaged with the physical objects, were more successful in navigating the virtual environment, and seemed to remember what they had seen in the virtual space better than the other group. They also asked more questions about the original objects, spent more time with the touch screen application, and were also more likely to link information they had acquired through this application to the virtual experience.

Often, the museum visit is an act of browsing, rather than attentive engagement (Falk & Dierking, 1997; Serrell, 1997; Rounds, 2004). The guided visit that was part of this research, however, expected rather high levels of engagement from visitors. Of the two parts of the installation, engaging with the objects on display in combination with the touch screen application was the easiest task of the two. Failure was not a risk, as the task was based on visitors' interests and opinions. In comparison, navigating the virtual environment was more challenging and some visitors failed to navigate the space successfully. In this light, it might be helpful to use S. Bitgood's model for attention to explain the discrepancies between both groups described earlier. According to Bitgood, 'attention' has three main characteristics; attention is selective, attention is motivated, and one only has a limited amount of it (Bitgood, 2000). If one only has a limited amount of attention, it is to be expected that participants who first engage with a more difficult task will have less attention for their second task, than participants who are given the easier task first. This could explain why Group 1 was less engaged with the physical objects, after starting with the more difficult task of navigating the virtual environment. When we also take into account the second characteristic of attention, it being motivated, it seems logical that those participants who successfully completed their first task would be more motivated in the second. This explains why Group 2 was more successful at navigating the virtual Domus. Since all participants were given tasks as part of the guided visit, the selective nature of attention is less relevant in this case.

Instructions for novel technology

The aspect of the study that focussed on the impact of instructions on visitors' understanding of novel technology mainly focused on the effect of two different kinds of instructional videos. The first video, presented to 20 observation participants (Group A), aimed to engage visitors with the installation through a quest-like fictional narrative. This video was 1.46 minutes long and combined scenes representing a family archive, with spoken and ambient audio. The second video, also shown to 20 participants (Group B), consisted of three stills giving clear, step-by-step instructions of how to use the installation, with focus on navigation and object collection. This video did not use audio and lasted 15 seconds. This second video duplicated the instructions provided on a printed text panel on a wall to the right of the projection.

By replacing the storytelling introduction with clear and concise instructions for interaction, the authors hoped to observe a higher success rate in the navigation of the space and collection of objects, as well as a longer period of interaction among users. Surprisingly, the average length of observed interaction was relatively balanced; excluding the time of the instruction videos, Group A had an average interaction time of 2.38 minutes, while Group B had an average interaction time of 2.00 minutes.

The most significant difference was the observed use of supplemental instructions, notably the instructive text panel. Members of Group A were observed looking to the instruction text panel more consistently throughout their interaction, with 40% (8 of 20) of participants actively seeking the instruction on the text panel both before and during their interaction in the virtual environment. From Group B, on the other hand, only 5% (1 of 20) of participants were observed looking to the instructive text panel before and during their interaction. This seems to indicate that the instruction needs of Group B were satisfied through the instruction given in the instruction video, whereas Group A had to rely on the instructions given on the text panel in order to use the installation successfully.

Looking now from a perspective of instructional design, M. D. Merrill's principles of instruction provide a basic framework for the ideal approach to instruction for the purpose of learning. To paraphrase the five principles, learning may be best achieved through instruction that is (1.) demonstrated, (2.) applied, (3.) task-centred, (4.) activates relevant previous knowledge, and (5.) is integrated with everyday lives (Merrill, 2002). Developing instruction panels for a museum installation that can adhere to each of Merrill's principles is somewhat challenging, especially when the learning outcome is to be able to interact with a new or unfamiliar piece of technology in the museum context.

In its original version, the storytelling video was meant to introduce visitors to three things: the storytelling narrative, the virtual Domus environment, and the task of collecting objects within the virtual Domus. All of this was presented in less than two minutes, culminating in the visitor being placed in the virtual Domus environment with the expectation to collect objects in a limited amount of time. Unfortunately, what this introduction failed to do was instruct visitors on the interactions they would need to navigate through the virtual environment and collect the objects. The authors came to the conclusion that the storytelling introduction was not suitable for instructing visitors, as it only provided the task-centred instruction described by Merrill (2002). Observation showed that visitors seemed to know *what* they were meant to do in the virtual Domus, but the introduction film was not instructing *how* to navigate.

In creating the second introduction video, to be shown in place of the storytelling introduction, the primary goal was to provide visitors with instructions for navigation and object selection. The team wanted to be certain that visitors would understand *how* to interact in the virtual Domus (i.e. navigation) before providing information about *what* should be achieved in the virtual environment (i.e. object collection). The gesture-based interactions required for navigation and object selection were demonstrated through the text and figures used in the instruction introduction. Through visual and textual demonstration of the interaction, followed by application of the interaction, the first and second of Merrill's principles of instruction are met, albeit in a limited way. The instruction for object selection also provided an opportunity to reintroduce the task of collecting objects located throughout the virtual Domus, meeting the third principle of instruction.

The two remaining principles of instruction, activation of previous knowledge and integration with everyday lives, are more difficult to incorporate into museum instruction relating to on-gallery digital technologies. The context of a museum creates a unique learning environment and offers learning opportunities that most visitors do not experience on a regular, let alone daily, basis (Falk et al, 2011). Additionally, the activation of previous knowledge is challenged by the use of new (approaches to) interaction technologies that visitors may be unfamiliar with.

The differences in interactions between the two groups who experienced the two different introductions are especially noted in the success of user navigation. Group A participants, who had to read the text panel for instruction on navigation, were observed to be much more cautious with their physical movements and were more likely to walk away from the installation when navigational errors occurred. For Group B participants, the observed attempts at navigation were made with more confidence and were met with greater success and fewer errors than those in Group A.

While the change in instructional approach had an impact on the success of navigation, it also had an unexpected impact on the objects collected within the virtual Domus. Participants in Group A, who experienced the storytelling introduction that emphasized the task of collecting the objects for a family archive, were likely to collect more objects (and a wider variety of objects) than participants in Group B. Although navigation for Group A participants was problematic, the storytelling introduction provided clear instruction for the task of object collection. Alternatively, participants in Group B were more successful at navigating through the virtual space, but only ever collected the most obvious and easily collectable object. Despite being more confident and capable with navigation, the task of object collection was not prioritized by Group B participants, as it had been by those in Group A. This suggests neither introduction video was completely successful in instructing and motivating visitors.

Conclusion

This research set out to answer two questions. First, it wanted to better understand how visitors perceive the relationship between physical objects and their virtual re-contextualization. Secondly, it asked how instructions could influence the usability of novel digital installations.

Findings from the guided visits and interviews seem to indicate that virtual re-contextualization can help visitors engage more deeply with museum objects. Also, it shows that visitors are able to link information about the physical objects to the experience of navigating a virtual space. However, the research also shows that the level of engagement is highly influenced by the ordering of content and experiences within the visit as a whole. A higher level of engagement with both the virtual environment and the objects seems attainable when visitors are first encouraged to engage with an exhibit's content in a way that is easy and without risk of failure, before being confronted with more complex and demanding tasks, such as virtual gesture-based navigation.

Through observations it has become clear that although different types of introduction video might not influence the time visitors spend interacting with a virtual installation, it can influence their level of confidence and the way they interact. Although a fictional narrative can stimulate deeper engagement with the task at hand, a lack of practical instructions as to *how* to complete a task might result in visitors being less confident about their abilities.

The results of this study have influenced the final design of the APM's new Roman gallery. The fictional narrative and practical instructions, which are both part of the introduction video of the gallery, have been separated. Also, rather than starting the gallery visit by virtually navigating a Roman house, this experience is now used to finalise the visit. Future research will explore other ways in which visitors can be encouraged to engage with, and closely look at, museum objects that are less visually attractive.

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