Video-mediated participation in virtual museum tours for older adults

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Abstract This paper introduces a virtual tour, *Visit the Louvre*, designed specifically to engage older adults in an immersive visit through part of the Louvre by a distant real-life guide. An initial diary study and a creative workshop were conducted to understand the needs and values of older adults and how to support participation to virtual museum visits with a video-based communication system. Preliminary results show that 'virtual visitors' experienced high levels of social and spatial presence; immersion and engagement were quite high independent of the level of interactivity of the guide, or the presence of others.

Keywords *Older adults, Museum, Virtual visit, Social inclusion, Civic participation*

Introduction

The number of older adults is growing fast. Cognitive decline, physical isolation and lack of transportation can limit the ability of older adults to move around and to participate in public life as they did before (Winsted et. al, 2013; Berkowsky et. al, 2013; Cotton, 2012). Social connections can be lost due to retirements, relocation or widowhood. Engagement in social activities can be restricted by illness, physical and cognitive decline and mobility problems. Contact with friends and family is important for perceived social support (Wherton and Prendergast, 2009).

The Internet has the potential to enhance social connections and communication in a variety of ways. Recent studies show that information and communication technologies (ICT) can help older adults overcome social and spatial barriers (Winsted et. al, 2013; Berkowsky et. al, 2013; Cotton, 2012). In essence, the use of ICTs is seen as a means for older adults to 'reconnect or improve their connection with the outside world' (Selwyn, 2003). Previous research has shown that social support and the use of communication technologies can lower perceived life stress (Wright, 2000), and improve psychosocial well-being among older adults (White et. al, 1999).

Older adults are reported to have a stronger sense of social inclusion when they spend more time on using the Internet, as according to Nahm et al. (2003) they often have a larger social computer-mediated network and in turn, levels of connectedness. Mason et al. (2012) reported that older adults in assisted and independent living communities that used Internet, showed reduced levels of loneliness and increased social contacts. Using the Internet and technology as a means for communication may allow older adults to compensate for potential mobility loss and lifestyle changes associated with ageing. Winstead et al. (2013) reports on qualitative studies where older adults from assisted living communities used technology like Google Maps with Street View and virtual tours to "visit" places of interest that are no longer accessible to them. These online visits resulted in lower levels of loneliness and social isolation.

How older adults communicate online may also impact on their sense of social inclusion and social connectedness. According to media richness theory, the richer the communication medium is (in terms of social cues) the more effective the communication is (Kock, 2005). When communicating face-to-face, individuals are able to use words, vocal cues, and non-verbal behavior in order to communicate factual and social information in a fast and unambiguous manner (Dennis and Kinney, 1998). Therefore, a communication with video would be more 'natural' than an only audio communication. Moreover, video-mediated communication (VMC) systems have developed further and now present a rich form of communication (Bohannon, 2013) and a live window between remote spaces. Conventional VMC systems (like Skype) typically support users who want to interact in a face-to-face manner, but do not provide a seamless mediated space for social contact and shared activities. Although possible with current

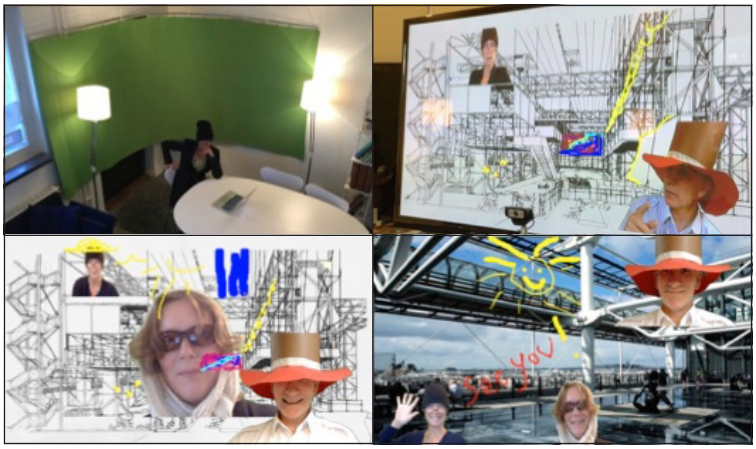

Figure 1. An impression of SharedSpaces: Each user is positioned in front of a green cloth (a) and users from different location are shown together in the same space by merging their independent video streams (b). Users can draw together (c) and or can change the backdrop (d).

technologies, there are very few communication platforms that facilitate creative interaction at a distance (Hunter, 2014).

This paper describes the development of a new video-based communication system designed to support older adults in visiting a museum without having to leave their homes. Different methods were used to elicit information from potential users at each step of the design process. These methods were instrumental in developing the concept, establishing requirements and creating the virtual tour. We report on the design process, as well as on the results of a preliminary user test in which we studied how older adults experienced the designed communication.

System overview

SharedSpaces is a design prototype from the EU-funded FP7 project COMPEIT (Gullström, 2014). It was used as the basis for the video-based communication system we designed. SharedSpaces invites users from multiple locations to interact and seamlessly move between different real and virtual spaces by integrating separated media channels. It supports social dynamics, by allowing users to move and resize their real-time video streams, or to draw and paint together. It enhances the feeling of being in the same space, by representing users side by side in a shared virtual space.

Design process

The design process consisted of three main phases. First, a diary study was conducted to understand the problems being addressed, and to understand the social circles of older adults and places older adults would like to visit. Second, a creative facilitation session took place in which data from the diary study were fed to a team of design students, to identify opportunities for the SharedSpaces technology. These ideas were then discussed and 6 unified concepts were proposed. The third phase was a user study involving 8 older adults to establish design requirements and guidelines for good interaction practices within the SharedSpaces environment. In this section we describe each phase and highlight the main outcomes that guided the development of our system.

Diary study

In order to understand the values of our users, and to better inform the design process, we performed a diary study. The aim was to:

- *Understand the social networks of older adults and how social relationships are supported as of today;*
- *Understand the role of places they visit and their effect on social relationships;*
- *Understand the role of ICT and their role in supporting social relationships and activities.*

The design of the diary study was based on a method already developed and implemented for the needs of the COMPEIT project, where the values and needs for children as a target group for COMPEIT were investigated (Kort et. al., 2014). In the diary study, older adults were asked to fill out diaries for one week. The participants kept track of:

- *people they see from their social network (Figure 2);*
- *places they visit (Figure 3) and;*
- *ICT and social media they use;*
- *their activities (including with whom, where and why), and whether any technology was used.*

The aim of the diary study was to help the researchers better understand older adults and their behaviors (activities), goals, attitudes, as well as to identify the opportunities these provide for further designing and developing SharedSpaces solutions. Specifically, it focused on obtaining detailed insights into how older adults experience daily activities and communication with others, in combination with specific places that are important to them or that play a particular role in their lives. Next to keeping a diary on a daily basis for one week, we aimed to obtain insights in specific places, as well as in the group of people they would like to stay in touch with. Many of these assignments were based on storytelling and creative thinking (tell us how you liked a specific situation; how would you deal with it differently). Questions included:

What are the most fun and least fun things you did today and what made them fun or least fun? Can you think of two examples of two places you would like to

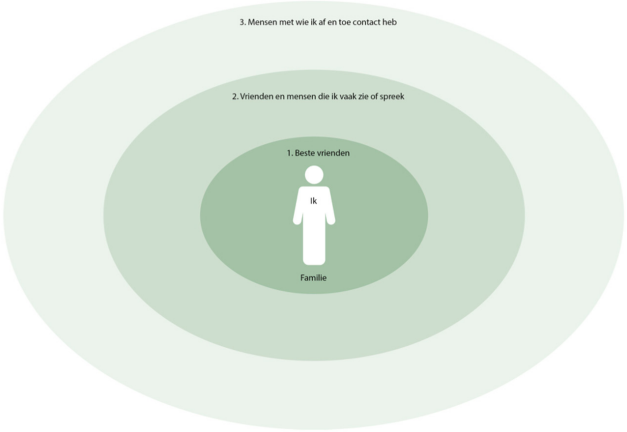

Figure 2. Social network page of the diary: participants fill in which people fit in which circle: family and best friends (1), people that I now and then meet (3). Designed by Bart! Grafisch ontwerp © UX Tools.

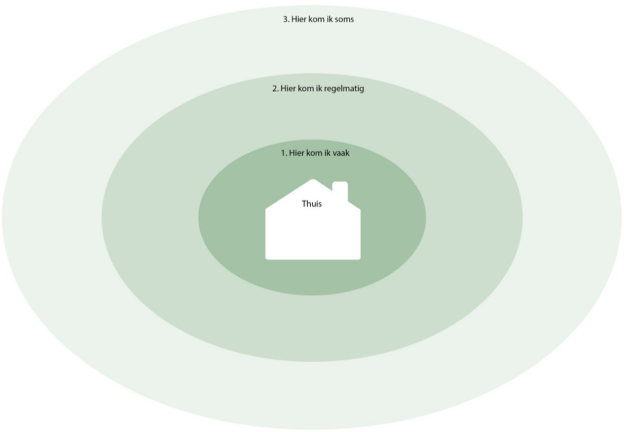

Figure 3. Places older adults visit: page in the diary where participants fill in places they visit often (1), regularly (2) and sometimes (3). Designed by Bart! Grafisch ontwerp © UX Tools.

connect to with a magic door and can you tell us why you want to connect to these places? Imagine you have a set of flying ears and eyes, where would you send them and why? If you had a machine that could take you anywhere, where would you go and with whom?

A total of 10 diary booklets were distributed via the social networks of the researchers. Five booklets were returned. Older adults that returned a fully filled out booklet received a voucher of 20,- euros. It was mandatory to sign a consent form stating they were informed about the research, and in which they acknowledged their participation.

Results from the diary study

Social networks of older adults. The inner social circle includes: sister(s), brother(s), partner(s), son(s), daughter(s), sister(s) in law, brother(s) in law. The middle circle (friends and people I often see or talk to, I am related to but not in the same way or as close as to the people in my inner circle) include: partners of the kids, friends, acquaintances through hobbies. The outer circle (people with whom I have contact every now and then) include: neighbors, old colleagues, ex classmates.

Places older adults visit. Places they often visit include: town, balcony, garden, friends' or brothers' or sisters' home, tennis club. Places they visit regularly include: sister or brother in law, aunts, friends. Places they sometimes visit include: daughter, grandchildren, and friends.

Technologies they use. Technologies for staying in touch: Facebook, Telephone, Google+, Facebook Messenger, Twitter, Skype. Technologies for pleasure: TV.

Examples of daily activity entries. Most common activities included: preparing and having breakfast, reading newspaper(s), preparing and having lunch, grocery shopping, staying in touch with family members, watching TV, preparing and having dinner, participating in cultural events or hobbies (tennis club) and having visits from the kids usually on weekends.

Most and least fun thing of the day. Among the most fun things that our participants did were: drinking tea with a friend, playing games on iPad, playing chess, cooking, organizing photos. When asked what made these fun, the participants provided the following reasons: because it was cozy and it is a pleasure to perform the activities, or in the case of playing games because they won the game. Among the least fun things participants mentioned: partner being sick, or mail that brings bad news, or not feeling good. On the questions what made them least fun participants responded that in the case when the partner or they were not feeling good, that they could not move around.

If they could connect two different places with a door, which places would they connect? Participants proposed different places to be connected, some of the ideas were: connecting the house to an island, Bali, coast, and places where kids live. Types of activities they want to perform when they would go to beach/ island/coast: walk, seat and read, listening to the waves, relax, ride a bike. In the case of connecting the house with the places where kids live: to catch up with people, drink coffee, be together with them.

If they would have pairs of 'flying eyes and ears' where would they send them? Participants expressed the desire to see grandchildren in order to see how they are doing, or brother and sister in law, and family members in general for the same reason.

If there's a machine that could take them and people they care about to any place, where would that be, and who would they take with them? Participants would like to go to visit a museum, or somewhere to eat or drink something. Some participants wanted to go to events where authors speak about books and sign books later. Also participants expressed a preference of walking

through the streets of unknown cities and admiring the architecture.

Reflections. Some participants reflected that when one gets older and sick the amount of friends is getting smaller; to go out is really important. The telephone and iPad are important to be and stay in touch. Some reflected that having family and close friends is really important and that they enjoy quality time with them.

Creative facilitation

The second phase focused on identifying technological opportunities from the material collected through the diary studies, in order to establish a design concept. We conducted a creative facilitation session, to translate the user insights into design ideas and conceptual designs for scenarios of using SharedSpaces that would match the user insights, in order to then select one scenario to further develop within the project. The creative facilitation session took place inside TU Delft, on Sept 18th 2015. The group consisted of 6 design students. The session lasted 4 hours and participants were paid 10 euros for their participation. Participants were asked to come up with ideas that would encourage and support older people to collaborate over a distance using SharedSpaces. The results from the diary study, as well as the possibilities of the SharedSpaces prototype were given as input for the session. The session resulted in the 6 different design concepts discussed below.

Sightseeing: A guide gives a tour of a city while the older adults sees it and participates in the tour, live from home. For example, the guide can show the Eifel tower or the Louvre in real time. Older adult can also attend a conference.

Get together: The family goes on a biking trip, the older adult joins from home on static bike. One family member is equipped with a camera on the bike and the older adult at home sees the stream and is projected in the video of the family.

Recipe sharing at distance: An experienced older adult cook gives an online lesson and guides a cooking session. All other participants are close to the cook, see the cook and learn how to cook from the older adult cook.

Virtual waiting room and virtual medical examination: The older adult can go for a medical visit from home. The older adult waits in a waiting room together with other older adults that wait for a medical visit.

The crafting room: The older adults give a tutorial for knitting, the participants are interested young adults that want to learn how to knit.

Let's discuss: People participate in political gatherings in public spaces (squares) through big screens where they are projected in the crowd.

The design opportunities were reviewed afterwards. Some of the ideas were presented in the form of a storyboard, which included 4 to 6 frames depicting the solution.

Afterwards, we decided to proceed with the **Sightseeing** concept because of our background and knowledge of the domain. As the setting in the SharedSpaces prototype, we chose a virtual representation of a room inside the Louvre and implemented an approach based on storytelling. Enriching visits through storytelling is a proven practice for museums: it both educates and entertains and provides a more engaging, adaptive and fundamentally enjoyable visitor experience (Giaccardi, 2006; and Wyman et al., 2011). In order to develop the tour we followed the storytelling suggestions presented in (Pujol et. al, 2013).

We envisioned a solution as realistic as possible and in which people would thus stand while they participate. In our scenario, the guide meets the participants at the meeting point in the virtual room, and brings them to the presented statues one by one, by changing the background to a zoomed in presentation of the statue of interest (see Figure 4 (c) and (d)). Participants interact with the guide while having the possibility to point to the detail of interest and ask additional questions.

User study

As a third step, we performed a small-scale study in a research lab in order to understand how the participants would experience the concept. One guide (in our case a researcher) was involved in the experiment. We studied:

1. *interaction techniques:* the guide gives either a *free exploration tour* i.e. the guide does not require any further participation by the participants and participants interact only upon their own request, or *guided participatory tour* where the guide asks the participants for collaboration at certain points of the tour;
2. *group size:* the participant does the visit alone (only with the guide) or two participants do the visit together at the same time (from two different locations, both accompanied by the guide)

The study was conducted inside the Usability lab, in TNO, Groningen and inside TU Delft University, the experimental setup is shown in Figure 4 (a) and (b).

Once the participants understood how to use the tool, they were guided in a visit of the five exhibited statues (Figure 4 (c)), one after each other (Figure 4 (d)). In the free exploration tour the guide was just showing the statues, telling more information about the story behind them. In the beginning of this setting, the participants were welcomed to interrupt the guide in the tour and ask questions if they had any additional questions about the content. In the guided participatory tour the guide triggered a small reflection talk or a small collaboration task about the content after each presented object. After the experiment participants were presented with a questionnaire and the personal opinions of the participants were discussed in semi-structured

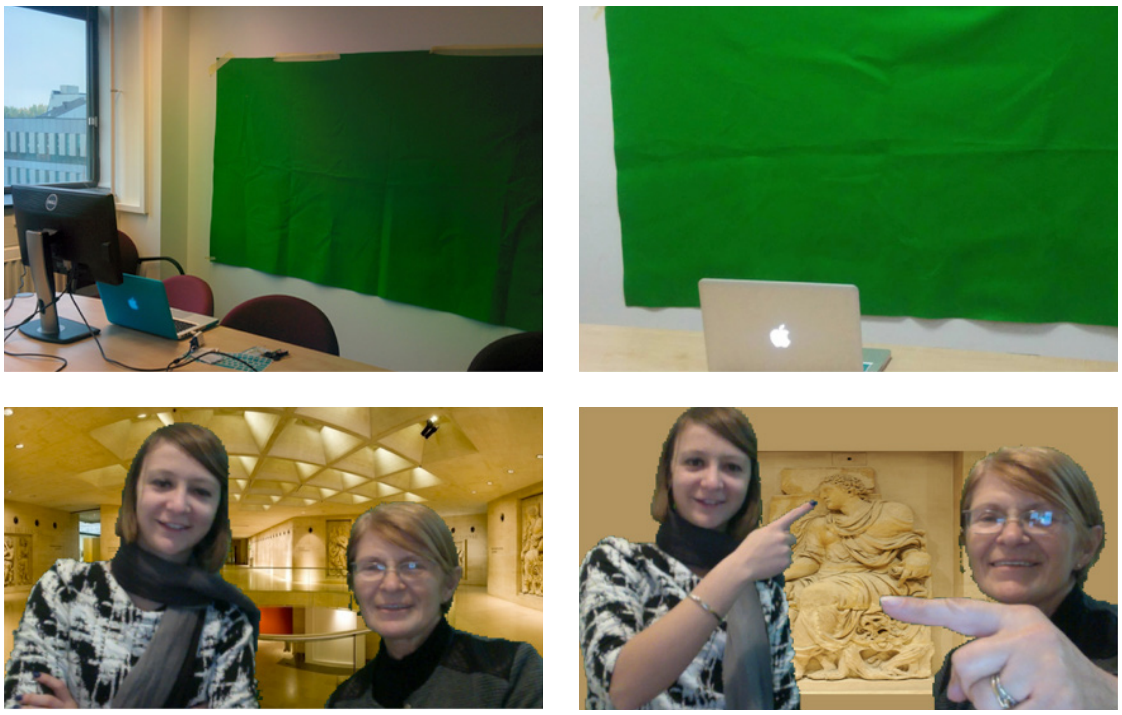

Figure 4. The look of the stations used for testing (a) and (b), the Rotonde Hall, place where the guide initially meets the participant(s) (c) and a closer look at one of the exhibited statues (d).

interviews at the end of the session.

We used a validated questionnaire created in previous research for measuring the constructs of social, spatial presence, immersion, engagement and naturalness (Kort et. al, 2010). The questionnaire contains 13 items, each item is a statement, and we invited participants to state the level up to which they agree or disagree with the statement on a 5-point Likert scale, with 1 = "totally disagree" and 5 = "totally agree". During the experiment, the researcher was taking observation notes on the predefined observation sheet. The researcher took additional observation notes immediately after the experiment, when the participants were filling in the questionnaire. In the semi-structured interview in the end, we discussed with participants what they liked, what they would like to see different, and what problems they encountered.

We recruited 8 older participants for the study, through word of mouth (5 males and 3 females). Five participants reported prior use of communication technologies like Skype or Google Hangouts. The participants again received a 20,- euro voucher for their participation. We had 4 participants participating in groups of 2 (and the guide), and 4 participants participating alone with the guide. One of the groups followed the guided participatory tour, while the other followed the free exploration tour. Two of the individual participants followed the guided participatory tour and two followed the free exploration one (Table 1).

Table 1. Overview of participants and variants.

	Free exploration tour	**Guided participatory tour**
Individual	P3 and P4	P5 and P6
In pairs	P1 paired with P2	**P7 paired with P8**

Results of questionnaire

Mean experience assessment of presence was 3.91 (SD = .76), immersion and engagement 4.29 (SD = .80), and naturalness 3.91 (SD = .88) (Figure 5). We conclude that participants felt presence, naturalness, and immersion and engagement. Because of the small numbers of participants we decided to pursue a qualitative approach for analyzing possible differences between conditions. We didn't observe any noticeable effects of the freedom of interaction on constructs; participants across both conditions (free exploratory or guided participatory) commented that they felt as if they were in the same space. Also, we didn't observe any particular effect of the number of people participating in the tour.

Insights from the interview

Participants in the test commented on various issues around the virtual visit. They discussed how they experienced the virtual visit as compared to a real visit, the role of a guide, the duration and interestingness of the tour and they provided suggestions for tailoring the tour. We frame the discussion in form of guidelines for future designers/ researchers developing similar interventions.

Virtual visit versus real visit. Our system allowed older adults to not be bothered by crowds around objects (as they would in real museums), which sometimes can be experienced as too tiring. In this way visiting exhibitions and museums in general can

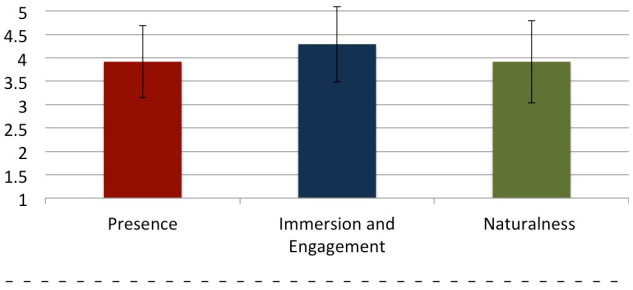

Figure 5. The means and the standard deviations of the constructs.

become more enjoyable and cozy. To visit the museum from home, without having to leave your own seat was found really appealing. One of the participant commented:

"In a real museum they write all the information on a plate near the object and you stand close to the plate and you have to read. In this scenario, you visit from home, and someone tells you all this information. Additionally, you can consult on Wikipedia immediately if something seems really interesting."

Some participants commented that this approach is more suited for seeing paintings and other more 2D objects. The participants encountered problems with trying to point out to some specific parts of the statues in the room.

Role of the guide. One of the participants that recently traveled to Israel, commented:

"The first day I walked without a guide. It was such a waste of time to walk around and not to understand all the important things that I was surrounded with. The second day I joined a guided tour and I realized that the previous day I passed next to a place where the hand of Jesus was placed and I didn't even know! Having the person to point out the details is important, otherwise it is really easy to miss important information."

Participants commented that in busy places as museum one can easily miss an important object just because one doesn't know that it is an important object. Having a guide helps, because you are sure that you get to know all the important things.

Duration and interestingness of the tour. Some participants found the topic of the exhibition interesting and some said that it did not fit their interests in general. Some of the participants showed additional curiosity and asked to have the names of the statues and asked the presented content to be sent by email, so they could inform themselves more from home. Mostly, they found the duration of the explanation quite adequate for the purpose: *"I think for me it was just the right amount of information, not too much not too less"*

Suggestions on the general tour level. Some participants commented that in a huge museum like the Louvre there won't be stories behind each presented statue. They proposed to have a longer version of the tour, uniting more statues, connecting them across similar themes. Additionally they suggested to have the approach tailored for kids, commenting: *"Kids like scary stories"*

They commented that it would be nice if one can discuss before and agree with the guide what kind of tour to have. Different people can have interests in different type of information about the content: more details about the style and materials, the story behind it, or more information about the author. Participants also asked for a more connected approach: to highlight the connection between objects in museum, and to connect different arts on the same topic (poems, paintings, music inspired by the same theme). They proposed to present information across 4 dimensions: content of the object, context (historical and physical), the artist details, and technique. We believe that if incorporated, these presentation aspects can significantly influence the level engagement and immersion.

Observing interactions. Different patterns of interactions between participants or with the setup emerged in the sessions. Some of the people were negotiating their positions between themselves or/and the guide in the way that it leaves space for the statue to be seen. Some other participants were less sensitive to the change in the background and did not try to adjust, so the guide was supposed to specifically point out that there's a statue just behind them.

In one of the group sessions (with two participants at the same time) the room became too crowded since the participants were quite corpulent. This left no space for the participants to see the objects. The involved participants tried to move behind each other, but since the videos are overlapping it was difficult to find the right position as the person positioned behind another person was disappearing from the scene and tried to reach out from behind the person, which didn't always feel comfortable. Providing the right spatial affordance proved to be an important factor influencing the experience.

Lessons learned and conclusion

We developed a video-mediated communication tool that allows older adults, suffering from mobility loss, to visit a museum with a real guide. The guide takes the visitors along the sculptures whilst presenting small stories about them. Our participants in the user study found the tour appealing and interesting. The stories provided an additional meaning to the presented content and it immersed participants into the subject. We believe that stories were important for subject's immersion. Participants in general talked with the guide and talked on topic of the exhibition. Many of them tried to reach out and point to specific details of the presented content. The experienced levels of presence, immersion and engagement and naturalness were rather high, which showed us that we are on the right track. Differences in experience between the conditions (interaction technique and group size) as measured by the questionnaire were not found. A wider sample of participants may be needed to further explore possible effects of the conditions.

We understood that we can significantly improve the approach if the guide can discuss beforehand with the participants and tailor the tour based on the interest of the participants according on the following dimensions: content about the object, historical and physical context around the object, the artist details, and technique. The sense of orientation could be improved by having a video stream that is not mirrored. Future design research could focus on exploring how the approach can be made to accommodate differences in interest between participants, as well as on verifying whether not-mirroring the video stream is a solution to the loss of orientation that sometimes occurred in pointing to the displayed objects.

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