Assessment of Virtual Guides' Credibility in Virtual Museum Environments

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Abstract. Immersive virtual museum environments can play a crucial role for communicating cultural information in an engaging and educational way, especially when storytelling is involved. In this paper we explore and assess the impact that the status of three types of avatars (embodiments of a museum curator, a museum security guard and a museum visitor, respectively) may have on the credibility of their storytelling and the emotions they evoke to virtual visitors. Preliminary results derived from an experiment provide evidence that supports our initial hypothesis that the status of the avatar may indeed influence their credibility and the participants' emotions of sadness/worry, distress, shame, anger, relief and admiration.

Keywords: Virtual museum · Avatars · Virtual guide · Social presence · Credibility · Emotions

1 Introduction

Virtual Museums (VMs) are digital spaces that draw on the characteristics of a museum, in order to complement, enhance, or augment the museum through personalization, interactivity, user experience and richness of content [1]. They are mainly used as effective solutions for communicating cultural content and context via an entertaining and educational approach. With the help of ICT, they tell stories, they address the problem of accessibility, while also providing engaging experiences for different audiences [2]. Virtual museums adoption and experimentation range from interactive to immersive experiences involving cutting-edge technologies, such as Virtual, Mixed and Augmented Reality [3], and new concepts, such as virtual embodiment and storytelling by avatars in forms of Virtual Humans (VH) [4]. VH research explores social interactions between real and virtual humans [5]. The personality and the behavior of a VH can influence the quality of the virtual experience, make the stories presented more credible and perhaps influence the perceptions of the real human.

In this paper, we investigate the perceived credibility of three virtual avatars possessing different characteristics (with respect to their professional and social status) in an immersive virtual museum environment and the emotions they arouse. Within the

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context of this experiment the term credibility is not aligned to notions of truthfulness or trust, but refers to the avatars' ability to engage the responders, mostly at an emotional level. A dramatic story about a museum exhibit, the sculpture of Arria and Pætus, is narrated by two virtual avatars that have different social distance and by one that has the same social distance from the participant. The remainder of the paper is structured as following: Sect. 2 explores the related work on social presence and how various factors may influence the credibility and the persuasiveness of avatars. Section 3 details the experimental procedure. Section 4 presents and discusses the research results. Section 5 reports on our conclusions and suggests directions for future research.

2 Related Work

According to the media equation theory, media interaction is essentially no different to the interaction with an actual person in psychological terms. As a general communication theory delineated by Reeves and Nass [6] it provides insights into the fact that people tend to interact under the same mindset irrespective of whether they are dealing with, e.g., an avatar, a VH, or a real human. As Liew and Tan [7] put it, 'people will unconsciously treat media technologies as social beings, such that people's behavioral and emotional responses to computers would adhere to human-to-human social norms' [6, 8]. This understanding forms the basis of a discussion on credibility issues and power-relation balances which affect the interaction between the participants in the experiment and the three avatars, in the sense that the psychological as well as social mechanisms that are in place regarding these factors are no different in a virtual environment as they are in 'real life' situations. Hence, the responses of immersed users interacting with VHs are congruent if not identical to those that would ensue from interaction with real persons having the equivalent roles. This brings forth the issue of whether the avatars are indeed persuasive as entities representative of specific roles and/or social status, namely those of a curator, of a museum security guard and a visitor.

Appearance and congruence between the attire of an avatar and the assumed social role is a key factor as Parmar et al. [9] posit in their examination of responses to avatars of physicians with clothing ranging from casual to formal and strictly professional. This illustrates the fact that the more the image of the avatars adheres to the stereotype associated with their assumed professional role, the better they have been accepted with respect to credibility. Interestingly enough, the responses in terms of avatar persuasiveness from the persons involved in the experiment have been more positive towards the avatars stereotypically dressed (with attire most appropriate and expected from a physician) irrespective of how 'uncool' or 'different to them' the avatars have been in style (ibid). This shows that adherence to appearances signifying specialization are preferable even if they generate social distance between the style/appearances of the people involved in the experiment and, by extension, the users of a Virtual Reality (VR) resource where avatars communicate verbally an account or information from a position of those who possess specialists' knowledge. Embodied virtual agents are computer-generated visual characters that simulate assistants [10] and due to their exponentially increasing use (mostly in commercial context), a substantial body of

research on their potential, optimal characteristics and overall function is undertaken. As Liew and Tan [7] put it 'they are capable of conveying verbal and nonverbal cues through animated facial expression, body gestures, and text-to-speech dialogues' thus humanizing and rendering emotionally engaging and agreeable experience of the human-avatar interface [11–14]. Although this research has focused on commercially-oriented context, the findings and insights are applicable to human-avatar interfaces where persuasiveness and credibility is of paramount importance as is the case with the experiment findings on which our paper hinges on.

Embodied virtual agents conveying information as acting and knowledgeable subjects (as it is the case with the herein presented experiment) are not only perceived as able to persuade, in accordance to their specialization and relevance to the topic they present/convey, but all the more, their assumed specialization affects the very way they are perceived: peoples' perception tends to ignore elements that are incongruent or diverging from their perceived profile. Respectively, elements, information or aspects of their accounts which enhance or correspond to their perceived specialization are subconsciously foregrounded and given more attention by the experiment participants. This phenomenon which filters out - to an extend - what contradicts the expectations that human actors have form avatars or embodied virtual agents, develops in a heuristic way; thus, it changes reality that is contradicting expectations to the extent of 'ignoring information that is/are seemingly dissonant with the stereotype' [7]. In other words, the minor differences in register, tone and vocabulary used by the three avatars in our experiment which are expected to make their roles more persuasive as such, will be further altered upon perception to match the stereotypes of their assumed roles/identities. The fact that the museum visitor has no professional profile whatsoever, is hypothesized that will decrease that avatar's ability to take advantage of the added credibility automatically bestowed and subconsciously enhanced when authoritative, erudite and specialist embodied virtual agents are addressing human subjects. The added symbolic and social capital associated with the role of the curator is expected to attract more persuasiveness and attention.

However, given the nature of the emotionally charged account, there could be a question as to whether specialist knowledge will prevail over a more humanized and more socially similar and thus approachable generic avatar in the form of a museum visitor, which might elicit the element of perceived identification with the visitors of the virtual museum/exhibit who partake in the experiment. The hypothesis is that, given the prevalence of specialization over social proximity as illustrated by Parmar et al. [9], this is unlikely to happen even though the topic is not directly related to the transference of technical information or guidance but is more relevant to subjective emotional states generated by the touching story immortalized in the form of the statue presented in the virtual museum environment. Carrozzino et al. [15] explored a virtual museum with three alternatives of storytelling, including one featuring VH, and compared the research results in terms of engagement and understanding of the proposed content. According to them 'findings confirm the hypothesis that an embodied virtual agent is able to stimulate attention and involvement, and contributes to a better content delivery and learning [ibid, p. 301]. Despite the fact that this is not surprising as it confirms the initial hypothesis of their research, it nevertheless consolidates the

importance, value and potential of VHs as guides in virtual museum settings, which in turn, makes the research on how to optimize VHs in such contexts imperative.

The Expectancy Violations Theory [16] posits that when the expectations form an agent with specific social characteristics such as assumed expertise are not met (e.g. when an expert provides unconvincing information or even appears visually incongruent with her status or role) then strong negative emotions are elicited and distrust ensues as result. The opposite applies though: according to research [ibid], when expectations are exceeded as it is the case when a non-specialist provides accounts showing surprisingly high expertise that is beyond their, e.g., professional background, then an exceedingly positive response in terms of liking, credibility and trust might be generated at the human actors' level. Therefore, this factor can influence the response towards the only non-specialist avatar who nevertheless provides an account essentially of the same information-value as with those of the more expert/relevant roles. In other words, when an avatar which is supposedly, e.g. an art historian does not look or behave like one will engender disappointment, whilst an avatar which is not an art historian provides guidance of surprisingly high quality for a non-specialist might generate empathy and trust -a factor that complicates, yet, adds to the interest and value of this experiment.

3 Materials and Methods

3.1 Apparatus and Visual Content

The experiment has been conducted in the Laboratory of Virtual Reality of the Department of Cultural Technology and Communication, University of Aegean, Greece. The hardware used in this study included: (a) headphones, (b) a VR - Ready PC with Nvidia Geforce GTX 970 card, (c) an Oculus Rift™ [17], a Virtual Reality headset, with a field of view (FoV) of 100° that supported participants' head movement tracking, in order to facilitate them to look around the virtual museum based on their head movement (the frame rate has been 80 frames per second [fps] and the resolution 960 × 1080 per eye), (d) an Xbox 360™ controller, and (e) headphones for hearing the voice of the virtual guides. The experimental setup is presented in detail in [18]. For the case study, we have created a virtual museum room with one 3D exhibit, an artwork of the 17th century that depicts Arria et Pætus from Louvre Museum[1]. We prepared three variants of the same scenario during the visit to the virtual museum. In particular, three different high-detail human avatars narrate the story of Arria et Pætus: a female **curator** of the exhibition; a male **museum security guard** of the exhibition; a female **visitor** of the exhibition. Avatars behave accordingly to their status in order to engage the virtual visitors. To increase the level of realism we have added movement of the body, hands, and lips sync according to the spoken text. Additionally, the avatars make direct eye contact with the participants.

[1] The 3D exhibit has been downloaded from: https://sketchfab.com/models/e5dc1871b7654429b883b9e04c8418c4.

3.2 Participants

Forty-five (45) volunteers (22 males, 23 females, age range: 22–41) mainly post-graduate students from the University of Aegean, Department of Cultural Technology and Communication, participated in the experiment. Three experiments have been conducted and homogeneous groups of 15 users that belong to the same age group and possess similar cultural background, knowledge and VR experiences (medium knowledge in History of Art and 1–3 immersive experiences) participated in each of them. In this way (i.e., through assigning different experimental scenarios to disjoint participant groups) we have avoided: (a) biased attitudes and opinions - towards the different virtual guides - induced due to the repetition of the same experimental scenarios (i.e., earlier VR experiences would affect the subsequent ones); (b) fatigue (due to participating in many experimental sessions and having to fill-in many questionnaires) which would compromise the validity of participants' feedback. It is noted that participants have been ignorant as to the purpose of the experiment.

3.3 Experimental Procedure

Three steps have been undertaken: briefing about the experiment (users start with a plan of the tasks to be accomplished), exploration (users explore freely the virtual space and test their capabilities and affordances of the virtual environment) and assessment (users interpret the avatars' stories and assess their credibility). The experiment has been conducted in a comfortable museum room with one door and only one exhibit, the sculpture that depicts the story of Arria and Pætus, artificially lighted. We decided to keep the room as simple as possible, without windows and other exhibits, to avoid complexity that could distract participants' attention. Firstly, each participant is invited to complete a demographics questionnaire with information about their age, gender, education, knowledge about art, number of immersive experiences, whether they visit museums and how often. Then, they are briefly informed about the context of the experiment (less than 1').

Then the participant may freely explore the virtual museum room. The narration opening is not sudden, since it starts after the eye contact of the immersed user with the avatar. When the user approaches the exhibit, an avatar is introducing itself and starts narrating a story about the exhibit (duration of 1–2 min). Specifically, the avatar narrates the dramatic story of Arria et Pætus in ancient Rome (AD 42). Pætus, a Roman senator, was condemned to death for his role in a revolt against emperor Claudius. A suicide would be a noble death; however, he was afraid to commit it. His wife, Arria visited her imprisoned husband, stabbed herself first to encourage him and then passed the dagger to her husband saying *Pætus, non dolet!* (Pætus, it doesn't hurt!) [19].

On each experimental session, one of the three avatars assumes the role of a guide and starts his/her narration. The avatar of the curator conveys the story of the couple in a flat way and she emphasizes to the historical information, formal analysis of the artwork, and the description of the sculpture's features using scientific terms. The avatar of the museum security guard tells the story of the couple using simple words underlining the courage and the internal power of Arria. The avatar of the visitor provides some personal information about the couple (e.g. the fact that their son had

died, while Pætus was in prison, but Arria never told him the truth, in order not to worsen his sentimental condition) highlighting the emotions, such as love, sadness, fear etc. Having completed the immersive experience, each participant filled in a second questionnaire to specify his/her impressions about the story s/he has heard and more specifically, in what degree s/he experienced the emotions of sadness/worry, distress, shame, anger, relief and admiration, how convincing the story was, and if s/he considers that the narrator had broad and/or deep knowledge of the artwork.

3.4 Methods

The presented study investigates the impact that the status of three types of avatars (embodiments of a museum curator, a museum security guard and a museum visitor, respectively) has on the credibility of their storytelling and the emotions (sadness/worry, distress, shame, anger, relief and admiration) they evoke to virtual visitors. More specifically, our research explores whether there is: (a) a correlation between the three avatars, (b) a correlation between emotions, (c) a correlation between the avatars and emotions. The statistical package SPSS v.21 has been used for the data analysis. The primary aim of the analysis was to study the influence/effect of each of the three avatars to the six emotions under study (1): Sadness/worry, (2): Distress, (3): Shame, (4): Anger, (5): Relief, (6) Admiration. For this purpose, the repeated measures design ANOVA[2] [20] has been used. If sphericity is violated, then automatically correction methods of F-ratios are applied. We have considered the Greenhouse–Geisser correction. All the tests have used a significant level of .05.

4 Results and Discussion

According to the descriptive statistics of the sample, the emotions of shame and anger appear lower mean scores, whereas admiration is the predominant emotion regardless the type of the avatar. The results of repeated measures ANOVA, with corrected F values (Greenhouse-Geisser), have shown that there is no important effect of the type of the avatar ($p = 0.269$). However, there is a significant effect of the type of emotion ($p = 0.000$) and of the interaction between the avatar and the type of emotion ($p = 0.031$).

(a) *Correlation among the avatars*
The pairwise comparisons with the Bonferroni correction for the three avatars show that there is no significant statistical difference between them ($p > 0.05$), even though in Fig. 1 the curator seems to have the lowest mean of emotions from the other two avatars (museum security guard and visitor).

(b) *Correlation between emotions*
In the sample we observe that the greatest mean is in admiration (4.178) and the lowest in shame (2.000). Then, we examine correlations between emotions,

[2] Repeated measures design is a research design that involves multiple measures of the same variable taken on the same or matched subjects either under different conditions or over two or more time periods. ANOVA is a commonly used statistical approach to repeated measure designs.

independently from the type of avatar factor. Most of the emotions are positively correlated between them, besides the admiration that is negatively correlated with all the emotions, except the emotion of sadness/worry.

(c) *Correlation between avatars and emotions*

As it is shown in Fig. 1, there is an interesting observation that the effect of the three avatars' narrations to participants' emotions, as well as the changes in each emotion depends on the type of the avatar.

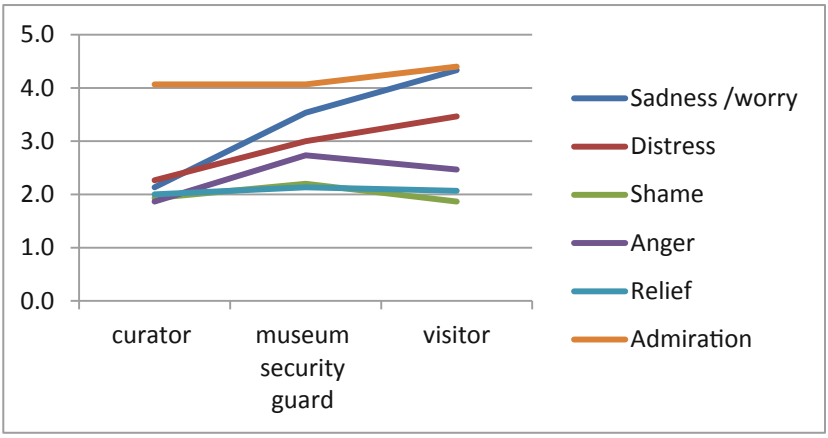

Fig. 1. Interaction graph between avatars (vertical axis) and types of emotions (horizontal axis)

Thus, it is clear that the curator yields the lowest scores on all types of emotions. Our initial hypothesis has been confirmed and we conclude that the museum curator is perceived as the most indifferent narrator. Her narration may attract more persuasiveness and attention. However, the fact that she chooses to highlight the historical information, formal analysis of the artwork, and the description of the sculpture's features using scientific terms, does not have any effect on participants' emotions.

It seems that the museum security guard's and the visitor's stories arouse participants' emotions. The museum security guard's description provokes more intense feelings, compared to the curator, apart from admiration, in which they are on the same level. Finally, the visitor's narrative, that discloses personal information about the couple, has an even greater impact on increasing sadness, despair, and admiration. But in feelings like shame, anger and relief, the curator and the visitor score lower than those of the museum security guard. In order to better interpret this difference between the three narrators, the question "What impressed you most in the story you heard?" has provided insightful results. It was observed that in the description of the museum security guard, words such as "drama", "sacrifice", "suicide" have been spoken, while during the narrative of the visitor, emphasis was mostly placed on "drama", while some participants stated that they were attracted by the graphics and the design. This means that the character of the curator was fond rather indifferent, the museum security guard very dramatic and the visitor attractive and more natural.

5 Conclusions

This paper presents the initial results of the experiment concerning the credibility of various types of virtual guides in a virtual museum environment. These high-detail human avatars (a female museum curator; a male museum security guard; and a female visitor of the exhibition) narrate in different ways (using scientific terms, underlining the courage, and highlighting the emotions respectively) the dramatic story of the sculpture that depicts Arria et Pætus. We have tested the emotions of sadness/worry, distress, shame, anger, relief and admiration they have felt in each case, which provided insights in respect to how convincing every narrator-avatar was and more importantly what specific effect every VH seemed to have in terms of persuasion which accrues from avatars' potential for emotional engagement. Some interesting information has been revealed concerning the fact that the narration of the museum curator has not evoked strong emotions to the participants. Although admiration (for the brave action of Arria) is high irrespective of virtual narrator, emotions such as anger, and especially distress (sense of despair and helplessness), sadness/worry (feelings of sadness) were far more common and prevalent when the narrator was the virtual museum visitor. This means that when the narrator is perceived as a specialist, feelings of admiration or appreciation are almost equally present, but the narrator who is closer to the status of the responders (something reflected to her more communicative style that does not convey higher status or level of expertise), elicit stronger emotions of empathy and personal emotional involvement. These differentiations can inform practices of virtual museums and help them to optimise the characteristics of the virtual guides they might wish to use, according to what they want to achieve in terms of audience engagement. As future research directions they are planned more experiments that will use more experimental variables, like additional visitors, duration of narration, while they will be recorded and analysed more quantitative metrics, like proximity and duration of eye contact among the user and the virtual guide.

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