[POSTER] Social Augmentations in Multi-User Virtual Reality: A Virtual Museum Experience

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[POSTER] Social Augmentations in Multi-User Virtual Reality: A Virtual Museum Experience

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ABSTRACT

This work in progress report demonstrates a novel approach for behavioral augmentations in Virtual Reality (VR). Using a large scale tracking system, groups of five users explored a virtual museum. We investigated how augmenting social interactions impacts this experience, by designing behavioral transformations for behavioral phenomena in social interactions. Preliminary data indicate a reduction of perceived isolation, and a more thought-provoking experience with active behavioral augmentations.

Index Terms: H5.1 [Multimedia Information Systems]: Artificial, augmented, and virtual realities—; H.4.3 [Communications Applications]: —

1 INTRODUCTION

Social interactions strongly depend on human abilities to express and detect social signals through nonverbal channels such as proxemics, body motion, facial expressions, and eye gaze. Humans display, decode and process this information to establish and maintain interpersonal relationships. VR applications seldomly support the tracking and reproduction of fine grained human behaviors, and often only rotational and translational data are available. To this point, we argue that VR simulations can be used to actively mediate communication and to establish communicative possibilities beyond natural interactions [5]. For example, it was conceptualized that social interactions can be transformed [2] by decoupling representations from behaviors. By developing social artificial intelligences, these active mediations could, for example, be used to foster interpersonal understanding, to mediate inter-cultural communications or to help to integrate persons suffering from social disorders [5]. To achieve such an active mediation, behaviors could be modified or augmented on the level of *user appearance*, the *representation/display* of behaviors, and the respective *channels* for transmission that could be changed. In this ongoing work, we examine these possibilities by using data of the users' position and rotation to modify the visual representations of prototypical behavioral patterns. Our research questions in this work are whether augmenting virtual social interactions is beneficial for group experiences (RQ1), and whether it fosters the quality of relationship, presence and interactivity (RQ2).

2 APPROACH

In an initial step, we created a design space for potential augmentations that can be implemented with translational and rotational data (depicted in Figure 1) and which relates the input, the intermediate behavioral phenomena, as well as visual abstractions for the transformation, amplification, and substitution of the behavioral patterns. We decided upon three common behavioral phenomena of social interaction: (i) *Mutual Gaze* (directed gaze, eye contact) which usually signals that interactants pay attention to each other, (ii) *Joint Attention* which is a phenomenon of shared attention toward an object, and (iii) *Grouping*, which is derived from proxemics and encodes group affiliation, intimacy, or power [1].

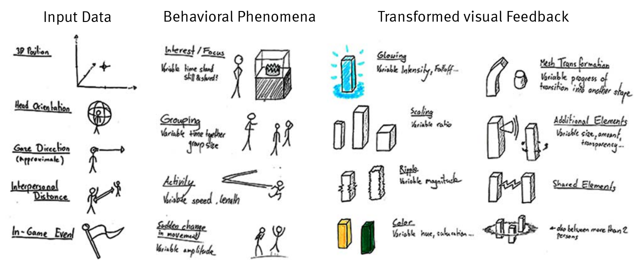

Figure 1: Design explorations for augmenting of social behaviors.

2.1 Implemented Transformations

Our final augmentations included visual feedbacks of substitutionary, amplifying and transformational character. As shown in Figure 2, we included i) an approximation of eye contact, abstractly visualized by floating bubbles and evoked if users did look (head rotation) at the direction of each other, ii) a highlighting particle system on an object if users were close to each other and looked at the same object to signal joint attention, as well as iii) a grouping color system, activated if users were within a 4m distance to each other (which can be considered the "personal space" [1]). To avoid any third variable bias from artificial social or behavioral cues such as postures or facial displays from static humanoid avatar models, users were represented as simple rectangular pillars in the simulation.

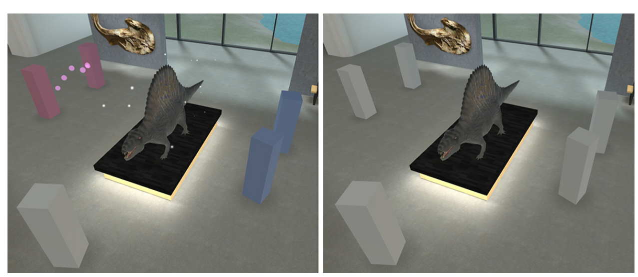

Figure 2: Left: condition with transformations for eye contact (floating bubbles), joint attention (particle highlights on object) and grouping (avatar colors). Right: condition without transformations.

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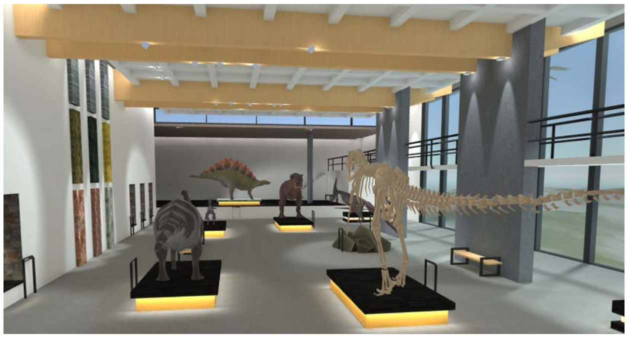

Figure 3: The virtual dinosaur museum. Six dinosaur exhibits included a short audio information displayed to users close (<4m) to the object. The physical and virtual spaces had identical dimensions.

Figure 4: Left: Users immersed in the simulation. A RedFIR sensor tracker was attached to each user for position tracking. Right: Overview of the tracking space and physical scenario.

3 Method

3.1 Rationale and Apparatus

We chose the scenario of a virtual dinosaur museum visit (see Figure 3), representing a shared social space. Subjects were told to examine the virtual museum in a natural way, and learn about the exhibits. Groups of five subjects started the simulation at the same time. Subjects were blind to the actual goal of the experiment.

We implemented motion tracking using the large scale RedFIR real-time location system, which operates in the 2.4 GHz band, to cover a tracked area of approximately 20x30m (see Figure 4). The system itself returns positional data, which was combined with the Samsung S7 Gear VR rotational tracking. The simulation was implemented in Unity 3D using a server-client network architecture. Audio information was provided with a one-ear headphone.

3.2 Design & Procedure

We used a between-group design. User groups experienced the museum either with or without behavioral augmentations. Amongst other measures we measured aspects of Presence [3], Enjoyment, Thought-provocation [4], and Group-accord [6]. In this evaluation we focus on the latter three and qualitative comments as evaluative indicators for our approach. We applied the following procedure for the experiment: (1) Welcome, form consent, pre-study questionnaire, (2) task instruction and technical setup, (3) 15 minute VR simulation exposure, (4) post questionnaire (measures), (5) compensation, post-experimental information and farewell.

4 Preliminary Results

The preliminary sample ($N = 45$, $m_{age} = 31.03$, 10 females) consists of 17 students, 25 employed, and 3 other. 20 subjects performed the "augmented" condition (AA), 25 subjects performed the "non-augmented" condition (NA). Questionnaires were presented in written form, leading to occasional missing values. Exploratory independent-samples t-tests were conducted. Data analysis showed similar ratings of enjoyment [4] for the AA condition ($M = 5.73$, $SD = .97$) and the NA condition ($M = 5.88$, $SD = 0.92$). The dimension "isolation" from the group-accord measure [6] evaluating how isolated individuals were from the group, revealed a significant higher value for NA ($M = 4.46$, $SD = 1.81$), than for AA ($M = 3.21$, $SD = 1.51$, $t(41) = -2.404$, $p = .021$). Furthermore, users in the AA condition found the experience to be more thought-provoking [4] ($M = 4.14$, $SD = 0.83$), compared to users in the NA condition ($M = 3.25$, $SD = 1.37$, $t(42) = 2.561$, $p = .014$). Our preliminary analysis did not reveal further significant differences.

Qualitative comments indicate that in general, users were enjoying the experience very much, which could explain the potential ceiling effect. Observations and user comments indicate that users did detect and explore the behavioral augmentations present in the AA condition. Most users reacted positively surprised (laughter, gaggling), and commented e.g. "nice effects when viewing dino together/bubbles when speaking with each other". Some users figured that there might be underlying principles whereas others did only understand the rules but not the underlying intention (e.g. "would liked to have explanations for the [interaction effects]"), which might indicate why users in the AA condition perceived the environment to be more thought-provoking.

5 Discussion and Conclusion

In this paper, we presented a system design, implementation and exploratory evaluation for the augmentation of behavioral phenomena in VR. To our knowledge, it is the first (multi-user) VR system supporting behavioral augmentations in this form. Preliminary results indicate the potential of behavioral augmentations for multi-user computer-mediated VR simulations to facilitate social interactions. We believe that these results should be interpreted with care, taking into account the relatively small sample size. The project is work in progress which is why general conclusions shall be drawn at a later point. With the transformations, we aim at a method to increase social presence in multi-user simulations with restricted behavioral input. Future work will include the analysis of a larger sample size and the users' behaviors during the task, as an implicit measure. Overall, we see this as a promising exploration of possibilities for future mediated communication systems using augmented, mixed, and virtual realities.

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