Evaluating the response to virtual characters by using a social behavioral task

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The understanding of how virtual characters are perceived in virtual reality environments is an area of much interest, since their interactive role in these environments is increasing. Creating a character which would be perceived appealing and engaging is a difficult task as they can vary in appearance and motion realism, voice, agency, and levels of interaction, to name a few. Measuring peoples' response to these characters is equally challenging. Virtual reality gives a unique opportunity to study the behavioural response to virtual characters in ecologically realistic experiments with high level of control. In our research, we used the proximity measure to asses if the comfort of approaching the character will be mediated by its appearance and agency. We showed that proximity could be used to investigate aspects of the character which were not considered in research before and thus provide a valuable resource for character design.

1   Introduction

Computer generated characters are a part of many 3D applications, such as games, movies, training simulations, and with the ever growing field of virtual and augmented reality the interactive component of virtual characters is developing. We are currently witnessing an increasing demand for understanding of how to effectively build virtual characters for communication in a form of a shared virtual space (Social VR, Oculus Connect conference, 2016 [1]) where knowledge of adequate perception of social signals will define an engaging user experience. Understanding how the characters are perceived is therefore of crucial importance, since a poor design choice could result in impaired communication and/or negative reaction from the viewer.

We introduce a proximity-based behavioral task (see [Bailenson et al. 2005]) for assessing the perceptual effects of virtual characters in virtual reality. We combine this measure with subjective responses to the questionnaire to evaluate possible relationships between behavior and subjective experience of the participant while viewing the character. Specifically, we use the proximity task to evaluate the effects of manipulation of two factors: agency (control or lack of control over the character) and appearance of the character (render style).

2   Stimuli Creation

We developed a simple game-like environment, where participants could explore and interact with virtual characters by walking through the virtual environment (HTC Vive system). For this purpose, we used characters of different render styles and placed them in a virtual environment, where participants could either observe or trigger character's motions.

The virtual scene was realised using Unreal Engine 4.9.2. The virtual environment consisted of a simplistic space with one virtual room for the training session and three virtual rooms for the experiment session. Each room contained one of the virtual characters, rendered in a particular style: training

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Figure 1: Render styles used for the experiment (from left): Realistic, Toon CG, Toon Shaded.

character with no textures, *Realistic*, *Toon CG* or *Toon Shaded* (see Figure 1), and a red spot on the floor, which was placed a couple of meters away from the virtual character. The distance from the character was kept at $3.0m$. This position was chosen as an optimal observation distance, which would give some personal space to the viewer, but at the same time details of the character could still be visible on the headset display. We chose a simplistic environment setup with no decoration, in order to avoid distraction of participants view from the virtual characters.

The characters we used were animated using motion capture of one actor, who we instructed to do a set of exercising motions. The motions were exported to Autodesk 3ds Max 2015 in the BVH format and to Unreal Engine as FBX, where they were assigned to the characters. Animations would trigger in a random order during the experiment through an algorithm, or trigger through button presses of the participants. We chose the exercising motion, since it is realistic behavior which can be performed by the character on spot to ensure a constant distance from the viewer, without acknowledging his presence.

3   Experiment Design

We conducted a set of experiments in virtual reality using the HTC Vive system. We divided our participants in two groups - observing and controlling, where each group saw characters in three render styles (Realistic, Toon CG, Toon Shaded) with an additional training example. The three render styles were placed in the rooms for participants in a counter-balanced order.

We used behavioural and subjective measures. For the behavioural response, we used proximity [Blascovich 2002, Bailenson et al. 2003] and to ensure participants would approach the character, we used an altered version of a label reading task that was presented in the study of Bailenson et al. [Bailenson et al. 2003]. For the subjective response, the questionnaire was administered, containing 5-point Likert scales, measuring the feeling of agency (e.g.:"Overall, I felt I was causing the movements of the virtual character in the room to happen."), realism (e.g.:"I found the character's appearance realistic."), affinity (e.g.:"I found the character appealing.") and co-presence (e.g.:"The character appeared to be sentient, conscious, and alive to me.").

Participants were first explained the specifics of the virtual reality system and were then given the headset and motion controllers to start with a training session in order to familiarize with the task. They were instructed to move inside the virtual room and place themselves on the red spot. Then they would observe or use the motion controllers to trigger the character's exercising motions. When the observation period was over, instructions to look for the labels around the character appeared on the screen. We used one label, which appeared at the front of the character. As the participant was moving towards the character, trajectory data of the camera movement was saved. On exiting the room, a screen with instructions appeared and participants named the labels and continued to answer the items of the questionnaire.

During the proximity task, the Euclidian distance of the current camera (user) position and the

virtual character position in the virtual space was calculated for each moment. For the measure of proximity, we used the minimum distance. No participant came so close to the character to intersect the first-person camera view with the character mesh, therefore no data was discarded.

4 Conclusion

The results of our experiments so far have shown that proximity is affected by agency. Specifically, the perceived level of control over the character was associated with reduced distance from where the label reading task was performed. This is probably because a controlled character (or an avatar) does not exhibit unpredictable behaviour therefore is safe to approach closer. We also noticed slightly larger average distances across participants when performing the label reading task after observing the character (agent) as opposed to controlling it, but these differences were not found significant with our chosen statistical analysis.

Overall, proximity was not directly related to render style, however, the participants who reported a higher level of "aliveness" of the character, stayed further away from it as well. The perceived aliveness and co-presence with the character, was higher for the realistic render style, indicating that even though aliveness of the character is subjective, it could potentially be manipulated through character's appearance realism. Higher realism of the render style was also preferred over lower levels of realism.

Further testing is needed, where introducing different levels of motion realism, changing the environment render style and interaction would give a stronger indication of how proximity is related to characters in virtual reality. We are confident however, that our results show an indication of how proximity could be used as a measure of investigating various aspects of character perception and could be a useful guide to creating appealing characters.

References

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