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FOREWORD

This document presents the proceedings of the VRIC - ConVRgence conference held on April 12-14, 2022. We would like to thank the authors who submitted their research works, as well as the reviewers for their contributions.

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Animal Embodiment: Embodying a beaver in immersive virtual environments to create empathy and teach about the impact of global warming in a playful way

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Abstract: The beaver is an internationally renowned symbol of engineering. Through virtual reality, users can reflect on how difficult it is for these animals to survive in the face of climate change and with an inability to control the natural conditions around them. An experiment in virtual reality gave rise to the possibility of embodying a virtual animal. The results of this experiment showed a significant effect of the visual body appearance on immersion, but no effects on animal embodiment and empathy. The upcoming investigation will allow an investigation of the effects of virtual hands and a more natural (i.e. not anthropomorphized) animal appearance on animal embodiment, immersion, and empathic learning through a virtual reality movie focusing on climate change and global warming.

1. Introduction

One of the main obstacles to modern education is that it largely remains uninspiring for students and teachers alike, despite major technological innovations. The teaching of climate change awareness through virtual reality presents an unflattering scenario. Markowitz et al. (2018) developed two exciting experiments: In the first of these, they created a combination of a scuba diving trip in a physical world with virtual reality simulation to present the acidification of the ocean, an issue caused by global warming. The results showed that knowledge gain (Ocean Acidification Knowledge) remains stable after weeks of the immersive VR experience. However, there is no significant effect on Environmental Attitude and Presence after using the VR simulation. The second experiment compared two self-avatar representation conditions: a coral avatar and a human scuba diver avatar. The data obtained show that these different avatar appearances or conditions do not improve knowledge gain, evoke no positive attitude toward the environment, and do not create a presence effect on students. A recent study developed by Barnidge et al. (2021) explored whether students learn more about climate change in three conditions: virtual reality (VR), text-with-images (TWI), and 360° video (360°). The results showed that there is no significant effect on learning outcomes in the VR Condition. This study leads us to wonder whether immersive learning with virtual reality simulation could be developed to teach climate change and global warming topics on the basis of virtual worlds.

Animal embodiment is one of the greatest challenges of virtual reality and Human-Computer Interaction Studies. One particular issue is the control of an avatar of certain animals, which have different postures, skeletal arrangements, and shapes compared to human bodies (Krekhov, Cmentowski and Krüger, 2019). Pimentel and Kalyanaraman (2021) described a lack of visuomotor synchrony in virtual reality, for example, when attempting to control a turtle's virtual tail. Likewise, a tiger has a significantly different posture from a

human, largely due to the fact that it walks on four legs (Krekhov, Cmentowski and Krüger, 2019; Škola and Liarokapis, 2021). As illustrated in Figure 1, this study of animal embodiment employed the design of a virtual beaver with anthropomorphic characteristics and mixed biological representations, in order to preserve the natural human posture of participants.

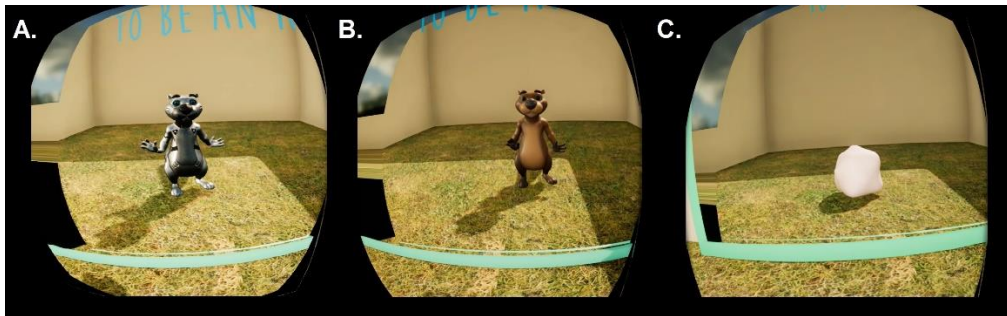


Figure 1. Animal embodiment with three conditions: (A) Virtual beaver, (B) virtual robot beaver, and (C) amorphous figure.

2. Methodology

In our research, we explored the virtual reality value of fostering an immersive and empathic experience where people can ‘walk in the shoes’ of the natural world. An interesting aspect is that the virtual scenarios and self-representation in virtual reality are entirely artificial, although they simulate the natural world. The experiment is called “Justin Beaver VR”, in which users could be a beaver with a natural (virtual beaver) or artificial (robot virtual beaver) body, or could instead be an amorphous figure (Sierra Rativa, Postma and Van Zaanen, 2020b). This experiment was designed in virtual reality, and haptic sensory feedback was included, whereby users could feel vibrations when swimming, eating branches, and receiving the impact of a bullet when being hunted. Previously, the same experiment was created in a desktop version (Sierra Rativa, Postma, and Van Zaanen, 2020a). In total, 90 participants were recruited from the university student population of the Netherlands. The participants were between 18 and 35 years old, and 57.8% male and 42.2% female. Each condition had the same number of participants. Before the experiment, the participants filled out a dispositional empathy questionnaire called the Interpersonal Reactivity Index (IRI) (Davis, 1980). After the virtual simulation experience, participants completed a post-questionnaire on their experience, containing questions on situational empathy Sierra Rativa, Postma and Van Zaanen, 2022) a perceived pain questionnaire (Das et al. 2005), an immersion questionnaire (Jennett et al. 2008), and an avatar embodiment questionnaire (Gonzalez-Franco and Peck, 2018). We referred to this avatar embodiment questionnaire as ‘Animal Embodiment’, and it was analyzed according to the method proposed by Peck and Gonzalez-Franco (2021).

3. Results

In Figure 2A, we can see that the subscales of Animal Embodiment had a higher mean in the virtual animal compared to the virtual robot beaver and amorphous figure. Moreover, as shown in Figure 2B, we observed a statistically significant effect of character appearance on immersion, $F(2, 89) = 3.284, p = 0.042, \eta^2 = 0.070$. However, no significant effect of character appearance was discovered for self-reported Situational Empathy $F(2, 89) = 2.057, p = 0.134, \eta^2 = 0.045$, or Animal Embodiment $F(2, 89) = 1.578, p = 0.604, \eta^2 = 0.012$.

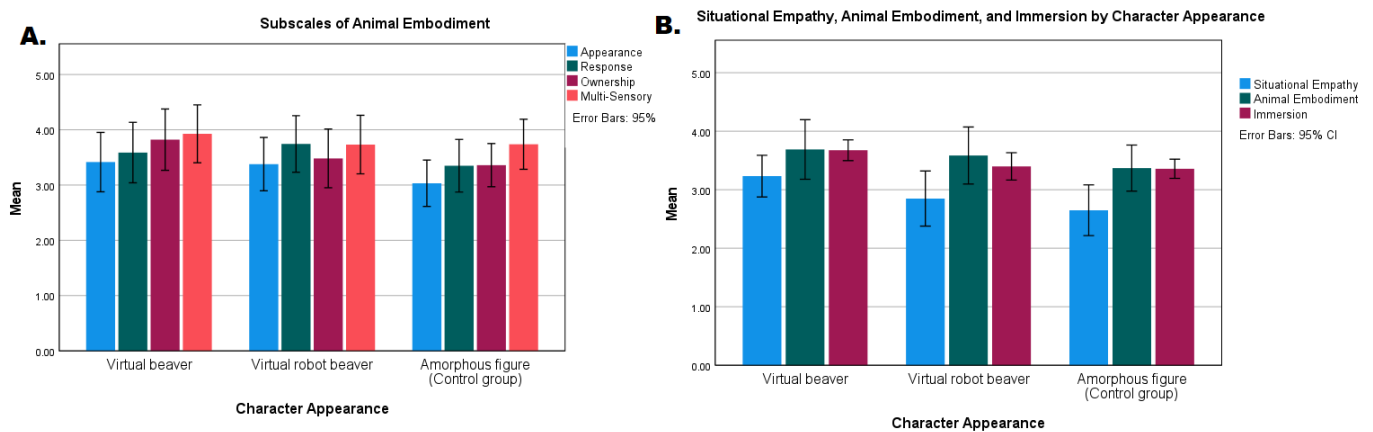


Figure 2. Animal Embodiment: (A) Subscales of Animal Embodiment questionnaire, and (B) Comparison between Situational Empathy, Animal Embodiment, and Immersion, depending on character appearance.

4. Future work on animal embodiment in an Interactive Virtual Movie

The results showed that bodily appearance is not the main factor affecting animal embodiment. A possible aspect relating to this can be explored when users view their embodied avatar in front of a mirror in the virtual reality movie environment with their new virtual animal body, moving their animal appendages, as illustrated in Figure 3. Future research will use two conditions to investigate whether real-life hands – as opposed to the appendages of the virtual animal – can affect animal embodiment. We will use an interactive movie called “Justin Beaver Survivor” for this purpose. Moreover, we will explore whether the storyline of this virtual reality movie can affect the learning outcome and empathy of the users. This new understanding can help improve expectations of the impact of virtual reality on natural and environmental education.

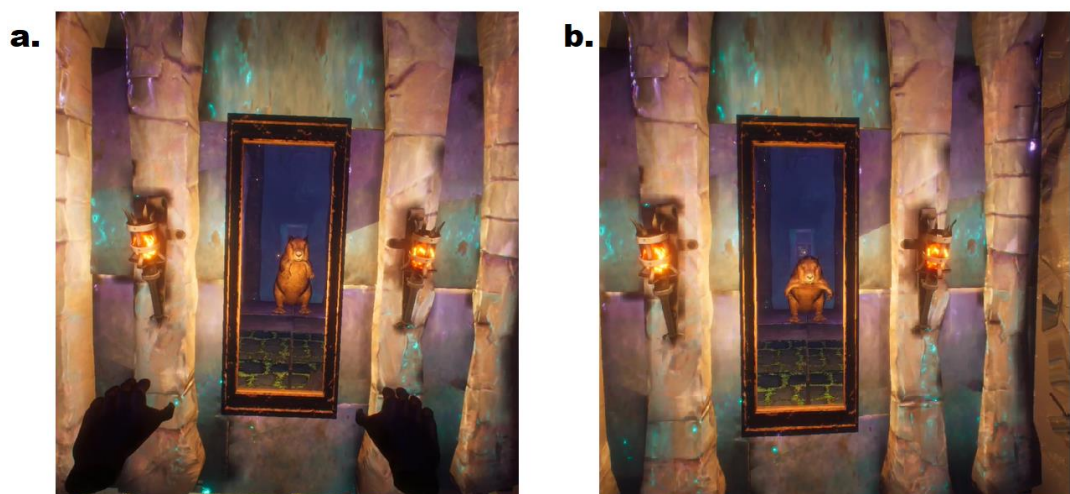


Figure 3. (a) Virtual animal representation where participants can move their animal hands (<https://youtu.be/KRa-DQVB0RE>), and (b) Virtual animal representation where participants only visualize their virtual animal body in the mirror during the interactive movie (<https://youtu.be/u2yNRIHR9gc>).

5. Data repository

Our contribution to Open Science and a transparent Community, our data about "Justin Beaver VR", and our experimental video about the “Justin Beaver Survivor” movie is publicly available on the Zenodo platform, restricted only for academic purposes. (<https://doi.org/10.5281/zenodo.6390959>)

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