# Do You Feel Better? The Impact of Embodying Photorealistic Avatars with Ideal Body Weight on Attractiveness and Self-Esteem in Virtual Reality

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**ABSTRACT**

Body weight issues can manifest in low self-esteem through a negative body image or the feeling of unattractiveness. To explore potential interventions, the pilot study examined whether embodying a photorealistically personalized avatar with enhanced attractiveness affects self-esteem. Participants in the manipulation group adjusted their avatar's body weight to their self-defined ideal, while a control group used unmodified avatars. To confirm the manipulation, we measured the perceived avatars' attractiveness. Results showed that participants found avatars at their ideal weight significantly more attractive, confirming an effective manipulation. Further, the ideal weight group showed a clear trend towards higher self-esteem post-exposure.

**Keywords:** Embodiment, body image, eating disorders

## 1 INTRODUCTION

Eating disorders and other body weight problems are among the most prevalent mental health challenges faced by adults today. These conditions can be accompanied by a negative body image and a feeling of unattractiveness, often resulting in low self-esteem [6]. Cognitive behavioral therapy supported by mirror exposure is widely used for treating these conditions [7]. Nowadays, mirror exposures can also be realized in VR, offering the potential to modify the visual appearance of the user by using photorealistically personalized avatars that can be dynamically adjusted in body weight [3]. Embodying and engaging with such modulated avatars can significantly affect the user's attitude, behavior, and perception by exploiting the sense of embodiment and the Proteus effect [10, 14, 15].

In such a VR mirror exposure, Wolf et al. [12] incidentally observed a significant positive correlation between the users' perceived attractiveness of their personalized avatar and self-esteem. This aligns with the findings of Bale and Archer [2], who identified self-rated attractiveness as a significant predictor of self-esteem. Other works showed that modifications of an avatar's appearance can influence its user's self-esteem. For example, Leung et al. [8] observed increased self-esteem after being represented by a taller avatar in VR. Moreover, Koen and Chen [5] found that the embodiment of a personalized avatar can improve the users' self-esteem.

Our pilot study extends prior work by systematically examining whether increasing the perceived attractiveness of the users' photorealistic avatars can impact their self-esteem. We increased the avatars' attractiveness by setting their body weight to the user's self-defined ideal body weight, reflecting their personal aspirations for attractiveness. In doing so, we aim to advance our understanding of VR's therapeutic potential for addressing body image issues and enhancing self-esteem.

## 2 METHOD

The following study protocol was submitted to the local ethics committee and received approval without obligation.

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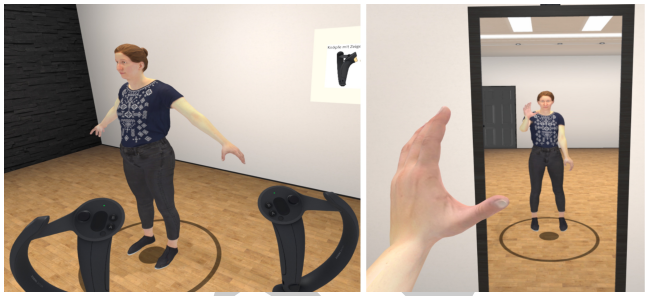

Figure 1: The left image shows an exemplary generated avatar during the body weight modification task, while the right one shows it during the body movement task with self-defined ideal body weight.

### 2.1 Design and Procedure

Our study employed a $2 \times 2$ mixed design, with the avatar's body weight (current vs. self-defined ideal) as a between-subjects factor and measurement time (pre vs. post) as a within-subjects factor. In the VR exposure, participants in both groups first faced their avatar in A-pose from a third-person perspective and performed the body weight modification task to determine their ideal body weight (see Figure 1, left). By completing the avatar transition task, they embodied their avatar with their self-defined ideal or their current body weight. Then, they performed body movement and confrontation tasks in front of a virtual mirror (see Figure 1, right).

### 2.2 Technical System

To reconstruct the photorealistically personalized avatars from the users, we employed the approach of Achenbach et al. [1]. For the VR exposure, we used the VR system developed by Döllinger et al. [3] running on a VR-capable workstation operating a Valve Index head-mounted display. It allows the user to embody and observe an avatar through a virtual mirror. The avatar reflects the user's body movements captured by a markerless body tracking system following the implementation by Wolf et al. [13]. Within VR, users can alter the avatar's body weight in real-time based on a statistical model of weight variation using gesture interaction.

### 2.3 Measures and Tasks

We measured the participants' perceived attractiveness of their personalized avatar [9] and their self-esteem [11] pre- and post-exposure. When measuring the avatar's perceived attractiveness before exposure, the avatar always had the participants' current body weight, whereas the body weight in the post-exposure measurement depended on the condition.

Body Weight Modification Task Participants were asked to modify their avatar's body weight from a random set to their self-defined ideal and their current body weight. Body weight modifications were restricted to a body mass index between 18.5 and 30 to avoid exposure to a body shape considered underweight or obese.

Avatar Transition Task To realize a smooth transition between observing the avatar in A-pose and embodying it, the participants had to step into their avatar and align their spatial position and pose with the avatar. When stepping into the avatar, its transparency was

gradually lowered to reduce the feeling of inhibition while still being able to match the pose. After holding the pose briefly for calibration, the participants embodied and controlled the avatar.

**Body Movement Task** Participants were asked to perform five different body movements adopted from Döllinger et al. [3] in front of the virtual mirror to induce the feeling of embodying the avatar as a virtual body through visuomotor coupling [4].

**Body Confrontation Task** To direct the participants' attention to different parts of their virtual body, we adapted the mirror exposure instructions from Legenbauer and Vocks [7]. Participants had to focus their attention consecutively on the shape of seven different body parts for 30 sec each. While doing so, they were asked to move only within a circular boundary in front of the virtual mirror.

## 3 Results and Discussion

16 participants were included in the study (11 female, 5 male), with a BMI ranging from 19.27 to 29.90 ($M = 23.25, SD = 2.76$). The participants were equally distributed between groups and had ages ranging from 20 to 60 years ($M = 32.13, SD = 12.36$). By calculating non-parametric mixed ANOVAs, we found a significant main effect for attractiveness, $F(1) = 5.840, p = .016$. A contrast test comparing pre- and post-measurements for the ideal body weight condition revealed a significant increase between pre ($M = 6.25, SD = 1.28$) and post ($M = 6.88, SD = 1.25$) measurements, $W = 4, n = 16, p = .025$ (Figure 2, left). Hence, embodying an avatar with a self-defined ideal body weight significantly increased the perceived attractiveness of the avatar. For self-esteem, we found a promising descriptive increase between before ($M = 24.50, SD = 3.55$) and after embodying ($M = 25.75, SD = 2.96$) an avatar with idealized body weight, indicating great potential for interventions (Figure 2, right).

Besides the encouraging results, our pilot study revealed some limitations that need to be addressed in a main study. First, we captured attractiveness and self-esteem with explicit subjective measures prone to biases. Incorporating implicit measures could provide a more objective evaluation. Second, participants individually adjusted the avatar's body weight to their ideal body weight, leading to a non-uniform manipulation. Hence, the magnitude of the body weight modifications should be considered in the data analysis. Third, participants already reported relatively high self-esteem pre-exposure, limiting the effective range for improvement. Hence, a sample with initially lower self-esteem could reveal a larger effect. Lastly, we did not control the perceived eeriness of the photorealistic avatars, which may have affected their perceived attractiveness. Therefore, eeriness should also be captured.

## 4 Conclusion

Our work demonstrated that modifying a photorealistically personalized avatar's body weight to a self-defined ideal increases its perceived attractiveness. Furthermore, we observed an apparent descriptive increase in self-esteem when participants embodied the ideal-weighted avatar. These findings align with previous work that identified a link between perceived attractiveness and self-esteem [2, 12] and indicate that embodying more attractive avatars could significantly affect self-esteem [5, 8]. To confirm our results, we plan to perform a follow-up study with a sufficient sample size that also addresses the discovered limitations.

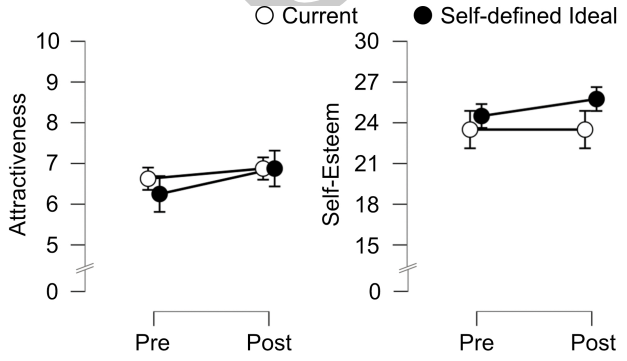


Figure 2: Interaction plots for avatar attractiveness and self-esteem. Error bars show the 95%-confidence interval.

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