Effects of Varying Avatar Sizes on Food Choices in Virtual Environments

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ABSTRACT

The escalating global obesity crisis necessitates innovative interventions to promote healthier eating habits. This study investigates the potential of Virtual Reality (VR) as a novel approach to this challenge. We developed a VR simulation of a supermarket shopping experience, where the player's virtual physique changes immediately based on their dietary choices. The simulation was tested with seven participants, who reported high levels of immersion (mean score: 7.67 out of 10) and presence (mean score: 6.3 out of 10). Initial findings revealed a discrepancy in weight loss between genders, which was addressed by introducing a customization feature for gender-specific dietary adjustments. Notably, participants generally consumed fewer calories within the VR environment compared to their self-reported real-life habits. These preliminary findings suggest VR's potential as a compelling tool for promoting healthier eating habits and combating obesity. However, these results should be interpreted with caution due to the small sample size, and further research is warranted to substantiate these promising initial findings.

CCS CONCEPTS

• **Human-centered computing** → **Virtual reality**; • **Computing methodologies** → *Perception.*

KEYWORDS

Virtual Reality, Dietary Choices, Avatar Sizes, Obesity

ACM Reference Format:
Richard Chinedu Erem, Oyewole Oyekoya, and Margrethe Horlyck-Romanovsky. 2023. Effects of Varying Avatar Sizes on Food Choices in Virtual Environments. In *Companion Proceedings of the Conference on Interactive Surfaces and Spaces (ISS Companion '23), November 05–08, 2023, Pittsburgh, PA, USA.* ACM, New York, NY, USA, 3 pages. https://doi.org/10.1145/3626485.3626534

1 INTRODUCTION

The escalating global obesity crisis necessitates innovative interventions to promote healthier eating habits. This study investigates the potential of Virtual Reality (VR) as a novel approach to this challenge. VR's potential to simulate real-life experiences and modify behavior has been increasingly recognized in various domains, including health and wellness.

A growing body of research has explored the use of VR in promoting healthier eating habits and combating obesity (Phelan et al., 2021 [4]; Riva et al., 2001 [6]; Anastasiadou et al., 2022 [2]; Al-Rasheed et al., 2022 [1]).

Phelan et al. (2021) [4] demonstrated the feasibility of integrating VR into standard behavioral weight loss treatment, with participants reporting realistic experiences and satisfactory outcomes. Similarly, a study by Riva et al. (2001) [6] showed that VR-based experiential cognitive treatment significantly improved patients' body awareness and reduced problematic eating behaviors. Anastasiadou et al. (2022) [2] proposed a randomized control trial to assess the clinical efficacy of a VR intervention that uses embodiment and body-swapping techniques specifically developed to cover the needs of people living with obesity. Al-Rasheed et al. (2022) [1] conducted a systematic review on the use of VR in the treatment of obesity and overweight, suggesting that employing VR for self-monitoring of diet, physical activity, and/or weight is effective in supporting weight loss as well as improving satisfaction of body image and promoting health self-efficacy in overweight or obese persons.

Despite these promising developments, a significant gap remains in the exploration of VR's potential in simulating immediate body changes based on dietary choices. This research aims to fill this gap and advance our understanding of VR's potential in promoting healthier eating habits. We hypothesize that a VR simulation that allows users to see immediate changes in their body after making food choices can serve as a powerful motivator for healthier eating habits.

In this paper, we present a pioneering study involving a VR simulation that allows users to customize their avatar's gender, age, and body type, and see immediate changes in their avatar's body based on the food items they choose in a virtual supermarket. This research represents a significant step forward in the use of VR for health interventions, with the potential to transform our approach to combating obesity and promoting healthier eating habits.

2 METHODOLOGY

2.1 Simulation Overview

The virtual reality simulation used in this study was developed using the 2022 version of Unity3D. The simulation begins with the user spawning at the entrance of a virtual supermarket. A large main menu greets the user, offering several customization options, including the ability to change the user's gender, age, and body

ISS Companion '23, November 05–08, 2023, Pittsburgh, PA, USA

ACM ISBN 979-8-4007-0425-3/23/11…$15.00
https://doi.org/10.1145/3626485.3626534

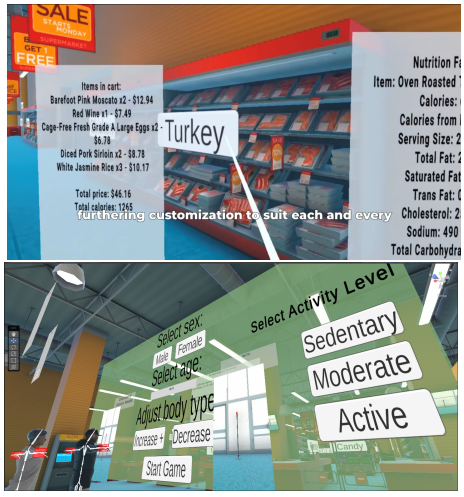

Figure 1: Main menu and food item scenes from simulation

size. The main menu also features two mirrors for self-inspection, with the player model rigged to track hand and head motion for a more immersive experience. An activity section allows the user to select between sedentary, moderate, and active lifestyles, which, in conjunction with the other factors, adjusts the user's caloric needs displayed above the left mirror. Once the user is satisfied with their settings, they can start the game, and the main menu disappears. The user then navigates the supermarket, using a raycasted laser to select food and drink items from the shelves. Each selection updates a virtual shopping cart, which keeps track of the current calorie and price totals. Nutritional facts for each item appear on the right side of the screen when the user hovers their laser over an item. When the user is ready to check out, they return to the origin point and click a checkout button while looking at a mirror. The user's avatar then changes to reflect the potential impact of consuming the selected items as a daily diet for a year.

2.2 Study Procedures and Measures

Upon arrival for the study, participants were briefed about the purpose of the study, the data collection process, potential benefits, and potential risks, such as motion sickness. The study was conducted with the approval of the Institutional Review Board of Hunter College, and all participants provided informed consent. Participants were then asked to describe their typical daily meals and estimate their daily caloric intake. They were then allowed to interact with the VR simulation, with the researcher observing and recording each item they added to their shopping cart, their final total calories, final price, and the final result of their player avatar. This interaction with the VR simulation is reminiscent of the approach taken in a study by Riva et al., 2000 [7]. In their research, they used virtual reality as a tool to immerse patients in a computer-generated virtual world, aiming to treat obesity and binge-eating disorders. The VR environment allowed patients to experience situations related to food and eating, which could be controlled and manipulated to facilitate the treatment process. After the simulation, participants were asked to provide immediate feedback and then complete an online survey at their convenience. The survey collected demographic information and asked participants to rate their experience, immersion, and presence in the VR environment on a scale from 1 to 10. It also asked about the factors influencing their dietary choices in the simulation, their opinions on the user interface, and whether they would use the simulation again. Participants were also invited to provide open-ended feedback on what they liked and disliked about the simulation and any changes they would recommend. In the study by Riva et al., 2000 [7], feedback from patients was also an essential part of the process. They found that the VR treatment significantly improved patients' bodily awareness, which was associated with a reduction in problematic eating and social behaviors. This suggests that the feedback and experiences of participants in our study could provide valuable insights into the effectiveness of the VR simulation and its potential for treating dietary and weight-related issues.

3 RESULTS

The study was completed by seven participants, comprising of three males and four females. The analysis of their dietary choices revealed an interesting pattern. On average, participants estimated their daily caloric intake in real life to be approximately 2171.43 calories. However, within the VR simulation, the average caloric value of the food items they selected was significantly lower, at around 1664.42 calories. This suggests a tendency for participants to make healthier food choices within the simulation compared to their reported real-life habits. In terms of specific food choices, a common trend emerged among the participants. Every participant opted for some form of meat and rice, with boneless and skinless chicken breast being a universal choice. This indicates a preference for protein-rich foods within the simulation. Notably, participants generally avoided unhealthy options such as soda and pizza, further supporting the trend towards healthier dietary choices within the VR environment. The participants' experience with the VR simulation was generally positive, with average immersion and presence scores of 7.67/10 and 6.3/10 respectively. This suggests that the participants found the VR simulation to be a relatively immersive and engaging experience. This aligns with the findings of a study by Waterlander et al. (2015) [8], which reported that participants experienced a medium-to-high sense of presence in a 3D virtual supermarket. This sense of presence is crucial in VR simulations as it enhances the realism of the experience, thereby potentially influencing behavior in a manner similar to real-world scenarios. However, the simulation's representation of body changes did not align with initial expectations. Despite the healthier food choices made by participants, many ended up with avatars that were skinnier than anticipated. This discrepancy was later addressed with the introduction of the main menu feature, which allowed for better customization of the avatar's body type and caloric needs. Feedback from participants highlighted several strengths and areas for improvement in the VR simulation. Participants appreciated the emphasis on nutritional values, the realistic supermarket layout, and the visibility of the shopping cart throughout the simulation. They also found the simulation easy to navigate and appreciated the detailed nutritional breakdown provided for each food item. However, they also reported issues with the user interface, including screen flickering and a lack of intuitive organization in the supermarket layout. Some participants also found the simulation to be glitchy, which affected their overall experience. Interestingly, the findings

of this study resonate with the "allocentric lock theory" proposed by Riva (2011) [5]. According to this theory, individuals with obesity Effects of Varying Avatar Sizes on Food Choices in Virtual Environments Conference acronym 'XX, June 03–05, 2018, Woodstock, NY or eating disorders often have a negative body image that is locked in an allocentric (observer view) perspective, which their sensory inputs can no longer update even after significant weight loss or dietary changes. This theory could potentially explain the discrepancy observed in our study between participants' healthier food choices and the unexpected thinness of their avatars. The VR simulation, in its current form, might not have been able to adequately update the participants' body representation based on their healthier food choices, leading to a mismatch between their expectations and the resulting avatar appearance. This insight underscores the importance of further refining the VR simulation to ensure a more accurate and responsive representation of body changes based on dietary choices. Moreover, the study by Waterlander et al. (2015) [8] also highlighted the need to improve the functionality of certain food categories in their virtual supermarket, particularly fruits and vegetables and dairy. This is a valuable insight for our study as well, as it suggests that enhancing the representation and functionality of various food categories in the VR simulation could potentially influence participants' food choices and provide a more realistic

4 CONCLUSION AND FUTURE WORK

The pilot study conducted herein underscores the potential of virtual reality (VR) as an innovative medium for fostering healthier dietary choices. Although the participant pool was limited, the results obtained offer a promising foundation for further exploration and substantiation of this novel approach. The tendency of participants to opt for healthier food choices within the VR simulation, as compared to their self-reported real-life habits, suggests that VR could serve as an influential platform for modifying dietary behavior.

Nevertheless, the study also unveiled areas that require improvement within the VR simulation. Participants indicated certain issues with the user interface and observed discrepancies between their dietary choices and the consequent changes in their avatars' bodies. These insights underscore the necessity for additional refinement of the simulation to enhance user experience and ensure a more accurate depiction of body changes based on dietary choices.

The findings of this study align with previous research that has underscored the potential of VR in the realm of health and nutrition. For instance, a study by Al-Rasheed et al. (2022) [1] conducted a systematic review on the use of VR in the treatment of obesity and overweight. They found that VR was effective in supporting weight loss, improving body image satisfaction, and promoting health self-efficacy. This aligns with our findings, suggesting that VR could be a powerful tool in promoting healthier dietary choices.

Another study by Ferrer-Garcia et al. (2013) [3] reviewed VR-based treatments for eating disorders and obesity. They found that VR-based interventions, usually combining exposure to VR environments with cognitive therapies, were particularly effective in reducing body image disturbances and increasing self-esteem and self-efficacy. This further supports the potential of our VR simulation in addressing dietary and weight-related issues.

As we look to the future, several avenues for enhancement emerge. One such area pertains to the user interaction with food items in the simulation. The current version of the simulation does not allow participants to physically pick up, inspect, and add items to their cart, which could potentially limit the immersive experience. Future iterations of the simulation could incorporate these interactive elements to augment user engagement and realism.

Moreover, future work could delve into the integration of more personalized dietary recommendations based on individual health profiles. This could involve the incorporation of data on participants' specific dietary needs and restrictions, thereby making the simulation a more effective tool for personalized nutrition education.

This pilot study provides a promising starting point for the use of VR in promoting healthier dietary choices. With further refinement and development, VR simulations like the one presented in this study could become powerful tools in the fight against obesity and other diet-related health issues. The potential of VR in this context is vast, and the journey to fully realize it is just beginning.

ACKNOWLEDGMENTS

This work was supported in part by a grant from the National Science Foundation, Research Experience for Undergraduates program (Award No. 2050532, Principal Investigator - Oyewole Oyekoya).

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