

Virtual Reality... Friend of Physical Activity?

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Michael Asare

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Advisor

Pedro A. P. Francisco, Department of Engineering and Society

Introduction / Background

Ever since the explosion of the modern computer, the way that society communicates and interacts with each other has changed drastically. From Steve Jobs unveiling the Apple I in 1976, to the advent of Wi-Fi in 1999, to finally the first iPhone in 2007, innovation has ceased to slow down (Linzmayr, 2004). It is all but guaranteed now that every human has or will have access to some physical screen or monitor. The overwhelming nature of the modern internet age has gotten to the point where it has almost become a necessary requisite to live our daily lives with lit up pixels nearby. News, movies, and work are all examples of previously analog manual activities that have now been trivialized to a mobile app or webpage. Following the frontiers of innovation, it comes to no surprise that virtual and augmented reality have become dominant talking points when speaking on what is the ‘next step’ in our seemingly unhinged inventive pace. Meta, one of the tech giants of the last 2 decades, has even decided to pivot research funds towards the advancement of the ‘Metaverse’, a place meant to fully embrace all the capabilities of virtual reality systems (Helmond, 2019). Make no mistake, the hype is undeniable for VR/AR.

However, as more things changes, more things stay the same. Despite all the technological advancements made in the last 50 years, humans have become more sedentary than ever. Specifically speaking, adult obesity in the United States still remains an epidemic (CDC, 2022). With technology seeming to prosper year after year, our health solutions seem to be as static as ever.

Significance

Adult obesity, which is described by the Centers for Disease Control and Prevention as a having a “BMI of 30 or greater,” was a condition that affected over “42% of Americans from

2017 – 2018” (CDC, 2022). Obesity is often directly or indirectly associated with the advent of multiple health and potential mental problems in one’s lifetime. The Centers for Disease Control and Prevention have linked obesity to a variety of health conditions, stating that those who are obese are at an “increased risk for many serious diseases and health conditions.” (CDC, 2022)

Motivation

In one study to analyze different technologies effectiveness in weight loss, it was found that the virtual reality experimental group “lost more weight, with significant group differences in one of them” (Ferrer-Garcia et al., 2013). With technology advancing as fast as ever, is there possibly a way that we can leverage these VR/AR technologies to improve or solve the obesity epidemic?

Methodology

In order to analyze the efficacy of VR/AR as potential obesity solutions, a literature review has been done. Current literature was reviewed to find social and technical context, and as well as the information needed to properly deliberate a conclusion. The literature review began by summarizing current findings on how obesity issues are solved in the first place. This included a summary of the most effective measure to prevent obesity, in the scope of applicability to VR/AR. After pinpointing an avenue of research to take within VR/AR systems and how they can be used to aid the obesity epidemic, additional literature was reviewed to investigate some of the properties of efficacy of this solution. Questions like, “why VR over other solutions”, “how this would be used”, and “how could this technology be accessed” were all asked under the motivation of acquiring current literature on this subject.

After the amalgamation of current literature, the efficacy of VR/AR for solutions was analyzed through the lenses of two STS frameworks—diffusion of innovations and technological stabilization.

Diffusion of innovations uses modernity and variable access as foundations for why innovations become widespread (Rogers, 1962; Geroski, 2000). In the scenario that VR/AR technologies are actually not the most up to date systems anymore, asking the question of modernity during research will be crucial. Even if it appears as if the field of virtual reality and its sister systems seem to change every single day, it is still something worth pondering over. Secondly, and more importantly, the access of the VR/AR systems will make a huge impact on the sociotechnical solution viability. A solution to a problem is no good if it cannot reach the actual audience needed—which here is the obese sector of America. Because this group is so large, and so varied, it is crucial that if this was to potentially become an aid of relief to the obesity epidemic that it be able to be diffused through the nation quite effectively. Through what means exactly is and should be determined in research.

Technological stabilization is a framework that almost goes hand and hand with the diffusion of innovations (Pinch & Bijker, 1984/2012). Technological stabilization is the process unto which one artifact becomes the prototypical design for a particular technology. In this use case, this would refer to the exact virtual/augmented reality system that would be used as the premier model. Because this field is extremely youthful, there has not been enough time to actually settle on to one specific version that is considered the ‘best’. With the many use cases that virtual/augmented reality has, there is currently the problem of not having enough commitment to one particular system to really be able to see true change. Gathering sources that

can tell the status of the current technological closure that is happening will be advantageous in determining the potential future availability of this technology to the masses.

Literature Review

The biggest change that an obese person can make towards improving their wellbeing is by engaging in physical activity. Ali (2012) goes as far to say that “the bottom-line lifestyle change” is physical activity. Additionally, Ali clarifies that “physical activity” can be incredibly inclusive. “This physical activity ranges from simple walks to heavy workouts using gym weights and other tools. The goal of increasing your physical activity is not only to burn off the extra calories but also to help maintain muscle tone and bone strength” (Ali, 2012). Ali is not the only source of literature that has found these conclusions. The U.S. Department of Health and Human Services suggests that there is “strong scientific evidence” showing that physical activity helps people “maintain a healthy weight.” More specifically speaking, “physical activity helps people maintain a stable weight over time and can reduce the risk of excessive weight gain and the incidence of obesity” (U.S. Department of Health and Human Services, 2018). Simply put, in the context of weight-loss and obesity prevention, “some physical activity is better than none” (NIH, 2023).

Gaming has recently become a real alternative solution to staying active. Hayre describes many reasons for why this is may be. For one, it is possible that people find a lack of engagement in typical exercise. Exercises may be found “boring”, with “little personal engagement”, and are often difficult to maintain “adherence” because “the clear benefits of physical activity are often not enough” (Hayre et al., 2021). This also seems to be corroborated by Bac (2012), who also makes the similar observation that “people are not exercising for intrinsic reasons” that are “defined as pursuing tasks out of pure enjoyment or pleasure.”

Virtual reality technologies have shown the ability to cover this so-called intrinsic gap in desire to exercise. Hayre et al. (2021) argues that active video games (AVG) can, under a framework dubbed the “Flow Experience”, can invoke an experience with “a high level of engagement.” This “Flow Experience” not only is something that maintains “a want or need to continue said activity” (Hayre et al., 2021), but it is also generally associated with a state of wellbeing (Seligman, 2011).

Virtual reality systems that support active gaming is the target of this research as that is clearly in line with what has already been discovered from other similar systems. Speculatively, it should seem likely that virtual reality systems, with the right capacities for active gaming, should encourage a level of engagement higher than regular exercise. With this supporting research, VR can be used to cover this apathy for activity seen in adults.

Despite the speculation on what may be the best way to use virtual/augmented reality systems to depress the current obesity epidemic, there is concrete literature already on the use of VR and its effects on one’s health. One particular study found many positive outcomes from applying virtual reality head-mounted systems to an overweight middle-aged women population, stating that it “is an effective home exercise program for obesity management in this population” (Seo et al., 2023). For starters, Seo et al. indicates that there was some level of weight loss that occurred during the study with the claim of “virtual reality exercise program positively affected the BMI”. Additionally, there was a positive effect found in “exercise fun” and “exercise immersion” (Seo et al., 2023). This is seemingly, and maybe even unsurprisingly, endorses to the “Flow Experience” theory cited by Hayre et al (2021).

Not only are there already studies out on the effects of virtual reality systems and physical exercise levels, there has even been studies on what forms of physical exercise is

preferred during the use of virtual reality systems. One such study, Khudam (2021) compared two “video games for exercise aimed at making exercise more fun.” Between a more aerobic-centric game and a strength-centric game, participants found that over a long period gameplay that they preferred the more aerobic game as it was generally more “comfortable” (Khudam, 2021). On the contrary, the strength-based game was favored in shorter game cycles, because users felt like they had a “higher exertion” (Khudam, 2021). Regardless, between the two, the study concluded that alternating between aerobic and anaerobic poses were best to “avoid feeling bored while also reducing injuries from the same pose for a long time and supporting the challenge to exercise.”

Discussion

Solving the obesity epidemic is challenging. The obesity epidemic is a complex and multifactorial issue, which makes it difficult to solve. There are many factors that contribute to obesity, including genetics, environment, lifestyle, and socioeconomic status. Therefore, to totally address the obesity epidemic, there is exist some comprehensive approach that considers all of these factors. Unfortunately, that is outside the scope of this paper, however, there is ground to make on this approach with virtual reality. One of the biggest challenges in solving the obesity epidemic is changing people's behavior. Obesity is often a result of poor dietary choices and sedentary lifestyles, which are deeply ingrained habits that are difficult to break. Changing these behaviors requires a sustained effort and a willingness to make lifestyle changes, which can be difficult for many people. How does one break the habits that are already so set in stone? There is strong evidence that physical activity is the number one way to reduce obesity in America, however, how does one even attempt to do this?

Virtual reality obviously has its points of appeal. It's seen as fun, novel, and most of all, attractive to a wide base of people. These systems are already being used to further people's training. Virtual reality technology has found many commercial applications across a range of industries. One of the most well-known examples is in the gaming industry, where VR technology has been used to create immersive gaming experiences that transport players to virtual worlds. Many popular games now offer VR versions, allowing players to experience the game in a more realistic and immersive way. Beyond gaming, VR is being used in other industries such as healthcare, education, and retail. In healthcare, VR technology is being used for medical training and patient therapy. Medical students can practice procedures and surgeries in a virtual environment, allowing them to gain experience without putting patients at risk. Additionally, VR is being used for pain management and anxiety treatment for patients. In education, VR technology is being used to create immersive learning experiences that allow students to explore historical events, scientific concepts, and other topics in a more engaging and interactive way. VR is also being used in employee training for industries such as manufacturing, where workers can practice safety procedures in a simulated environment. In retail, VR technology is being used to create virtual stores that allow customers to browse and purchase products in a virtual environment. Customers can explore products and see how they look in a virtual space before making a purchase. This technology has the potential to revolutionize the shopping experience and change the way retailers do business.

Overall, VR technology has already found many commercial applications, and it is likely to continue to expand into new industries and use cases in the future. As the technology improves and becomes more accessible, it has the potential to transform the way we work, learn,

and play. Most importantly, and most prevalent for this research, is how the eventual accessibility of VR can be used to help reduce the obesity epidemic.

VR has the potential to revolutionize physical activity by offering a new and innovative way to exercise. Traditional forms of physical activity such as going to the gym or jogging can be monotonous and unengaging for some people, leading to a lack of motivation and adherence. VR can provide a more exciting and immersive experience that makes exercise more engaging and enjoyable, leading to increased adherence and better health outcomes.

One of the most obvious applications of VR for physical activity is in the realm of gaming. Many VR games require physical movement, such as boxing, dancing, or even playing virtual sports like basketball or tennis. These games can provide a fun and engaging way to exercise while also challenging the user's physical skills and endurance. In addition to traditional games, VR fitness programs have been developed specifically to encourage physical activity. These programs often include guided workouts, challenges, and progress tracking, making them an effective way to promote physical activity.

Beyond gaming and fitness, VR can be used to create virtual environments that encourage physical activity. For example, virtual hiking or biking trails can be created that simulate the experience of being in nature, providing a motivating and engaging way to exercise. This technology can also be used for rehabilitation and physical therapy, allowing patients to perform exercises in a safe and controlled virtual environment.

Another potential application of VR for physical activity is in group exercise classes. Virtual group classes could be hosted from anywhere in the world, bringing people together to

exercise and socialize. This technology can also be used for personal training, allowing trainers to work with clients remotely and provide customized exercise programs.

One of the advantages of VR for physical activity is the ability to track and measure progress. VR systems can provide real-time feedback on a user's performance, such as heart rate, calories burned, and distance traveled. This feedback can be used to set goals, track progress, and motivate users to continue exercising.

In this paper it has become evident that VR can be used as an additive for physical activity. Additionally, it is already a technology that is used in industries right now. The next step in having this technology take off is in how we eventually integrate this technology everywhere. How do we diffuse this technology, and increase its availability?

The diffusion of innovations theory describes how new technologies or ideas are adopted and spread throughout a society over time. It suggests that the rate of adoption is influenced by factors such as the perceived benefits of the innovation, its complexity, and the level of social influence or peer pressure. Innovations typically follow an S-shaped curve, with a slow initial adoption rate, followed by a rapid increase, and then a plateau as saturation is reached.

This theory can be applied to VR technologies, as the adoption and diffusion of VR is influenced by similar factors. The perceived benefits of VR, such as its potential to improve education or healthcare, can encourage adoption. However, the complexity and cost of VR equipment can also act as a barrier to adoption, particularly for individuals or organizations with limited resources. Supplementally, one of the biggest challenges is the cost of the technology. VR systems can be expensive, and not everyone has access to the necessary equipment. Additionally, there is a learning curve associated with using VR technology, which may be a

barrier for some users. Furthermore, another challenge is the risk of injury. VR systems require physical movement, and there is a risk of injury if users are not careful. It is important to provide proper guidance and instruction to users to ensure that they are using the technology safely and effectively.

Social influence can also play a role in the adoption of VR technologies. For example, early adopters or opinion leaders can influence the perceptions and behavior of others, leading to faster adoption rates. Additionally, the development of VR applications with broader appeal, such as social media or entertainment, can increase adoption rates by reaching a wider audience.

In order to promote the diffusion of VR technologies, it is important to understand the factors that influence adoption and to develop strategies that address these factors. This could include focusing on education and awareness, making VR technologies more accessible, developing applications with broader appeal, collaborating with industry and business, and implementing regulatory and policy measures. By addressing these factors, the diffusion of VR technologies can be accelerated, leading to increased adoption and greater integration into society.

While addressing the diffusion of VR technologies is good, there also is a need to address the rapidly changing environment around VR. To many, it feels like the field is changing so quickly, year by year. The turnover rate at times with a embryonic technology can be daunting to the consumer. The technological stabilization theory posits that as new technologies become more widespread and integrated into society, they also become more stable and less susceptible to rapid change or disruption. This process of stabilization occurs as the technology becomes standardized, regulated, and better understood by users and stakeholders.

In the case of virtual reality technologies, the stabilization process has been ongoing for several decades. Initially developed in the 1960s, VR has undergone significant changes and improvements in terms of hardware, software, and content. However, it is only in recent years that VR has become more widely adopted and integrated into various industries and applications.

The stabilization of VR technologies has been driven by several factors. First, the technology has become more standardized and accessible. VR equipment, such as headsets and controllers, have become more affordable and user-friendly, making it easier for individuals and organizations to adopt and use the technology. Additionally, the development of VR platforms and ecosystems, such as Oculus or SteamVR, have created a more consistent user experience across different devices and applications.

Second, VR technologies have become more regulated and standardized. This has occurred through the development of industry standards and best practices, as well as through the introduction of regulatory frameworks that address issues such as data privacy and content moderation. For example, the Virtual Reality Industry Forum (VRIF) has developed guidelines for VR content production and delivery, while organizations such as the Global Virtual Reality Association (GVRA) have established best practices for VR hardware and software development.

Third, the development of VR technologies has been driven by user feedback and input. As the technology has become more widely adopted, users have provided feedback on issues such as usability, comfort, and content quality. This feedback has driven the development of new

features and improvements to existing technology, helping to stabilize and improve the user experience.

While VR technologies have undergone significant stabilization in recent years, there are still challenges that need to be addressed. For example, issues such as motion sickness and discomfort can still be a barrier to adoption for some users. Additionally, the cost of VR equipment can still be prohibitive for individuals or organizations with limited resources.

To further stabilize VR technologies and drive adoption, several strategies could be employed. One strategy is to continue to improve the usability and comfort of VR equipment. This could include the development of more lightweight and ergonomic headsets, as well as the integration of haptic feedback and other sensory technologies that enhance the user experience.

Another strategy is to develop more diverse and high-quality content for VR applications. While there has been significant growth in the development of VR content in recent years, there is still room for improvement in terms of the quantity and quality of content available. By investing in the development of VR content across a range of industries and applications, VR technologies can become more appealing and accessible to a wider range of users.

Collaborations with industry and business can also help to stabilize and drive adoption of VR technologies. For example, partnerships with retail stores or healthcare providers can help to integrate VR technologies into everyday activities and improve access for users. Additionally, collaborations with hardware and software developers can help to ensure that VR technologies are standardized and interoperable, improving the user experience and reducing the potential for fragmentation within the industry.

Lastly, regulatory and policy measures can play a role in stabilizing VR technologies and driving adoption. For example, governments can provide incentives for the development and adoption of VR technologies, such as research grants or tax credits. Policies can also be put in place to ensure that VR technologies are safe and accessible for all users, such as regulations on content or data privacy.

In conclusion, the technological stabilization theory provides a framework for understanding the process of stabilization and integration of new technologies into society. In the case of VR technologies, stabilization has been driven by factors such as standardization, regulation, and user feedback. To further this stabilization is to further the out reaching availability.

Conclusion

Is it possible to leverage VR/AR technologies to aid the obesity epidemic? It is clear that obesity issues can be aided through physical activity. Physical activity for many is also blocked by some amount of behavioral characteristic. These behavioral characteristics are seen to be circumvented through VR technologies. So, transitivity speaking, it does seem like if VR can aid obesity issues. However, logistically speaking, it's evident that the efficacy of VR alone will not be the issue here. The much larger issue is the rate of adoption, and how users feel about continuing to use these systems.

In conclusion, VR has the potential to be a game-changer for physical activity. By providing an engaging and immersive experience, VR can make exercise more enjoyable and increase adherence. With the ability to create virtual environments, track progress, and provide feedback, VR can be an effective tool for promoting physical activity and improving health

outcomes. However, there are also challenges to implementing VR for physical activity, including cost, learning curve, and risk of injury to name a few. As the technology continues to improve and become more accessible, it is likely that VR will play an increasingly important role in the future of physical activity. Even though VR systems are not a household item like color television and other multimedia systems, there is some path available for VR to make its way done to join these other household names. Just like these other pieces of technology, VR has its novelty and impressiveness that captivates the consumer, which seemingly is just enough to be well-known even if it is *not* currently present everywhere.

There is some work to be done, whether through word of mouth or concerted efforts, like in research or lobbying, to diffuse and stabilize VR technology. However, once that is done, and done to its fullest extent, there should be no reason why your household VR system can't encourage you to lose weight similar to how your phone can teach you how to fix a faulty windshield wiper. The power is in the technological system. It is our job as researchers to put that power into everyone's hands.

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