Journal of Diabetes Science and Technology
Volume 5, Issue 2, March 2011

SYMPOSIUM

New Directions in Virtual Environments and Gaming to Address Obesity and Diabetes: Industry Perspective

Barb Ruppert, M.A.Ed.

Abstract

Virtual reality is increasingly used for education and treatment in the fields of health and medicine. What is the health potential of virtual reality technology from the software development industry perspective? This article presents interviews with Ben Sawyer of Games for Health, Dr. Walter Greenleaf of InWorld Solutions, and Dr. Ernie Medina of MedPlay Technologies. Games for Health brings together researchers, medical professionals, and game developers to share information on the impact that game technologies can have on health, health care, and policy. InWorld is an Internet-based virtual environment designed specifically for behavioral health care. MedPlay Technologies develops wellness training programs that include exergaming technology. The interviewees share their views on software development and other issues that must be addressed to advance the field of virtual reality for health applications.

J Diabetes Sci Technol 2011;5(2):277-282

Introduction

Mr. Ben Sawyer, Dr. Walter Greenleaf, and Dr. Ernie Medina gave presentations at the symposium to share their view on the health potential of virtual reality technology from the software development industry perspective. In 2004, Ben Sawyer created the Games for Health project (*www.gamesforhealth.org*). Games for Health brings together researchers, medical professionals, and game developers to share information about the impact that game technologies can have on health, health care, and policy. In 2009 Walter Greenleaf, Ph.D., of InWorld Solutions (*www.inworldsolutions.com*), introduced an Internet-based virtual environment designed specifically for behavioral healthcare. Ernie Medina, Dr.P.H., of MedPlay Technologies (*www.medplaytech.com*) develops wellness training programs that include exergaming technology.

The presenters expanded upon the topic in an interview with Telemedicine and Advanced Technology Research Center science and technology writer Barb Ruppert.

Interview

Ruppert:

Virtual reality technology allows users to interact with computer-simulated environments in a variety of ways. Where do you see the potential for virtual environments and gaming in approaching the problems of obesity and diabetes?

Sawyer:

Video games offer experiential opportunities and new ways of interacting with information and choices in a

Author Affiliations: Telemedicine and Advanced Technology Research Center, Frederick, Maryland

Keywords: exercise games, exergames, gaming for health, medical virtual environments, virtual reality

Corresponding Author: Barb Ruppert, M.A.Ed., 271 Crum Rd., Fairfield, PA 17320; email address *ruppertwritingworks@earthlink.net*

context that is very difficult to achieve in other ways. Once we begin connecting them to traditional systems and approaches, such as using them with one's nutritionist, for example, we will be creating a set of interactions that may lead to better behavior.

Greenleaf:

Research has shown that using virtual environments can make a significant difference in treating anxiety disorders (**Figure 1**), drug and alcohol abuse, eating disorders, impulsive disorders, and more.[1–10] Because people are already using these systems for such purposes, I believe this technology could play a major role in changing behavior to prevent obesity as well as in diabetes management training.

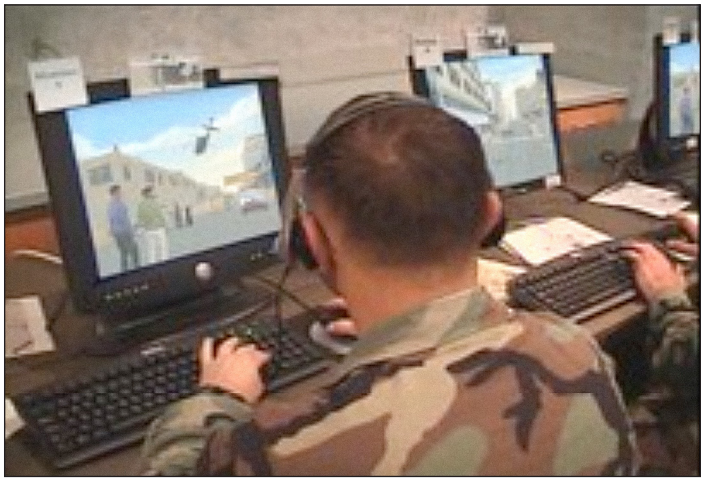

Figure 1. Virtual worlds are currently used in the military as part of treatment for traumatic brain injury and post-traumatic stress. They can be used with a flat screen (shown here) or a head-mount display. Image courtesy of InWorld Solutions.

Medina:

The U.S. Department of Health and Human Services released its first-ever physical activity guidelines in October 2008, and 50% of Americans are not meeting these guidelines. When we look at some of the reasons why people do not exercise, most will say lack of time, it's boring, they can't afford it, they don't know how to get started, or it's painful.

From my experience with patients and fitness clients, I believe video game-based exercise, or "exergaming" (also known as "active gaming"), can play a significant role in increasing physical activity levels in sedentary Americans. The current consensus among physical activity specialists is that the largest benefit to public health comes from getting sedentary people moderately active, and exergaming can accomplish this. Because one has to move one's whole body to play the game, the player gets much more immersed in the game. This helps overcome the boredom most people—especially children—find with many forms of traditional exercise. I have noticed that most people have so much fun playing these types of video games that they forget they are even exercising.

Because of the wide variety of exergames, the right type of game can be matched to the person's abilities and pain threshold. As for affordability, there is a wide range of exergaming hardware and games to fit most budgets.

Ruppert:

What about commercially available exercise games such as Nintendo's Wii Fit or Konami's Dance Dance Revolution? Would you count these as successes or failures, and why?

Sawyer:

We have seen some evidence that the people who respond to video game-based exercise are those who shunned other opportunities to exercise.[11,12]

But we need better products. For instance, a number of exergames simply take too long to set up. We need something more like typical gym equipment, where you get on, press "Quick Start," and go. There could also be better supporting frameworks around these games. A lot of exergames are not connected to your health record, a coaching service, or an assessment plan. Or we could add the ability to output your exercise information to Facebook so your peers could encourage you. We have to evolve the engineering side of the games themselves and simultaneously build supporting infrastructure that gets the most out of those games. I suspect that you will see work on these areas going forward.

It is hard to change behavior. Video games are not a silver bullet. They need to be tied to other technical and therapeutic infrastructure, and we are still at the beginning of that.

Medina:

The commercial success of the games you have mentioned has at least encouraged the development of new technology that allows for more realistic and immersive game play. The applications and games are endless as the technology improves. I am also excited about the move towards creating better content and games, and the possibility of combining that with exergame input. That way, players can get a workout and learn more about health.

Greenleaf:

The examples we are discussing do not have managed clinical protocols; there is no clinical guidance on how to use the game the right way to get the desired result. This is fine for motivating someone to engage in general exercise, but a lot of harm could be done if you are recovering from an injury and your exercise regimen is not monitored. I know clinicians who have patients who are not motivated to do their rehabilitation exercises, and there is a strong temptation to say, "Here's a Wii; go to it." But we do not have the software yet to manage a home exercise program correctly for clinical applications, and that is a matter of funding validation studies and developing protocols.

Several research scientists have developed scientifically based, managed exercise systems that could be used clinically,[13–17] but those are the ones that have not yet escaped the laboratory.

Ruppert:

Why do virtual environments work so well?

Greenleaf:

We need to validate this, but one theory is that it is easier to learn new skills because there is less of a cognitive load in the virtual environment; we can simplify the environment and then staircase it up to greater complexity.

Another theory is that it is easier to engage in repetition because we can make it interesting. If you are in an office practicing saying no to a dessert, after the first 10 times, you are going to get bored saying no to that piece of cake. But if we put the practice in the context of a game or a simulated party environment where there is a lot of noise and different people coming up, you might do it a thousand times (**Figure 2**); and it probably takes a thousand times before it becomes automatic.

With a virtual environment, individuals perceive less stigma, and it does not seem as clinical. If we offer the therapy online, there is a great deal of anonymity as well.

Being able to see yourself engaged in a certain behavior is potentially a very powerful tool. It can provide dramatic insights.

Ruppert:

What do scientists need to demonstrate in the area of virtual reality technology for obesity and diabetes prevention that will interest industry partners to participate?

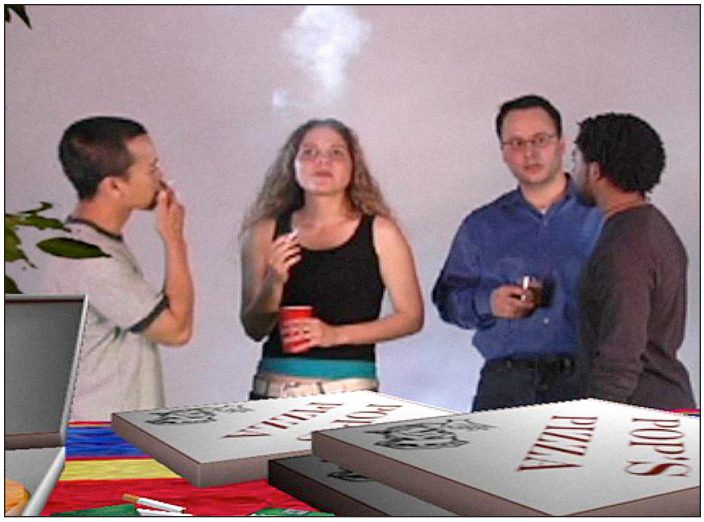

Figure 2. Virtual environments have been used for drug, alcohol, and nicotine refusal-skill training in a party setting. Image courtesy of Virtually Better, Inc.

Greenleaf:

Validation studies are critical. To make the use of virtual environments an accepted part of clinical practice, it is essential that we conduct solid clinical trials. When companies skip this step, no one buys the technology, because it has not been validated. If we want this to be a more cost-effective way of providing health care by, say, 2015, we need to start appropriate trials now; that will make the difference between technology that is a laboratory curiosity and technology that has become the standard of care.

Getting the word out will also make a big difference. Even though the use of virtual environments is an effective therapy, and there are some research publications validating it, it is not very well-known. Workshops such as this one are important. In a conservative medical environment, people have to know that other people are using this technology.

Sawyer:

When I talk to potential investors in health games and other virtual reality environments, their concern is that the delta between the moment you play the game and the moment you exhibit the changed behavior is quite long. That is why we have seen private investment in exergaming: the moment you are playing, you are already engaging in the changed behavior. So we need to create systems based on performing an action in the real world and being rewarded for that in the game.

In addition, there needs to be more risk-taking in design research. Sometimes the focus on specifying exactly what

is to be built for clinical trial reduces the amount of effort put into the process of engineering and reengineering to determine what is truly best to build.

We also need to develop common platforms in order to drive down the cost of "first playable." For example, why have we not built a standard software component for exergames that converts your individual data into a calorie burn report or that allows you to upload your exercise data to another entity? There is an opportunity to find common components needed in exergames or nutrition games and pour research into developing "best-of-breed" versions of software that developers can build upon inexpensively.

Ruppert:

So what other ideas or technologies should scientists be better leveraging in this area?

Sawyer:

Before we can build better games, we need to develop criteria for improvement, such as measuring perceived exertion or motivational factors. We also need to build contextual systems that connect games for behavior change to social and health infrastructures. For instance, research has shown the effectiveness of using text messages to remind people to take their medicine; how well might this method work with a health game?

Medina:

Ideally, exergames would be connected to a person's electronic medical record so that their usage would automatically be tracked in real time. If a patient does not reach a certain level of physical activity based on his or her input through the game, the record system would contact their health care professional, who would then contact the patient and intervene within the week rather than waiting for in-office follow-up, which could be a month down the road.

Greenleaf:

In our work with virtual environments for behavioral health care, it would be phenomenal to have better facial recognition technology so that we could map emotions to avatars (**Figure 3**). It would not be that difficult to use the Webcams that are on most computers to capture the nuances of nonverbal communication.

Psychophysiological data capture would also make a big difference. We should be able to extract data such as heart rate and respiration through a computer mouse, which would help measure a person's level of anxiety or engagement.

Figure 3. Virtual avatars are looking more and more realistic. The ability to convey emotion plays an important role in their effectiveness. Image courtesy of Virtually Better, Inc.

Ruppert:

With the exception of a few small studies of clinical eating disorders,[7] there has been little research on virtual reality applications for common weight control factors such as food selection, portion control, cued eating, and physical activity. What are the major barriers to implementing studies and projects in virtual reality as a therapeutic approach to these issues?

Sawyer:

Because we are dealing with very rapidly moving technology, we may end up investing in modalities that are antiquated by the time we feel they have great enough efficacy and scale. That does not mean we should recoil from doing any of these things; just keep in mind that technology should be adaptable.

Talent is another key factor. It is vital to partner the best health researchers with the best game designers, rather than assuming that the same laboratory can simply do both because "it's just a game." Having the right talent in each area dramatically improves the chances of effective outcomes.

Medina:

While we have devices to monitor physical activity, such as pedometers, accelerometers, heart rate monitors, and GPS devices, we don't have similar devices to measure our eating as easily. Keeping a food diary, even one online, is still a very high barrier to logging intake.

Taking pictures of our food before and after we eat is but the first step towards automating food intake analysis. Once we have devices that make monitoring food intake easier, we will see an increase of virtual reality in working with weight control.

Ruppert:

What subgroups of individuals might require special emphasis or unique approaches?

Greenleaf:

Besides addressing the digital divide—which we can do through the use of cell phones or other low-cost portable devices—we must address the needs of the elderly. Older people may have access to technology for managing disease but no interest in using it or be suffering from depression, which is a major problem in this age group.

The answer is community. We need to build a virtual community that is easy to use, inexpensive, and very portable. Maybe it is a senior diabetes care group that meets every day at noon on your Apple iPad. You join the group, with an avatar representing you, and you engage in different activities each day that teach you the skills you need and, at the same time, connect you to a community. The social aspect has great power; it is why Alcoholics Anonymous works.

Medina:

In our work addressing pediatric obesity, our program involves the whole family. We use exergames to make exercise fun, and we teach children, their parents, and their grandparents health and wellness techniques. The first 45 minutes of each session is spent learning about a nutrition topic, while the second 45 minutes is spent exercising together on the exergames. Families and children keep track of their scores on the various games. As they get in better shape, their scores improve.

Children tend to play these games to the point where they are breathing hard and sweating. Parents comment that they haven't seen their children sweat this much before. If a child is in the middle of a game and it is time to leave, he or she does not want to stop playing. Research is needed, but exergaming within a whole-family wellness program appears to have great potential as an intervention for obese or overweight children.

Ruppert:

What databases are needed for virtual reality applications in this area?

Sawyer:

For nutritional and shopping applications, we need a better food database than what is currently available from the U.S. Department of Agriculture. When my firm worked with the *Let's Move!* campaign to fight childhood obesity, we could not create some of the games that we envisioned, because the database was not formatted properly. The database must also include every food on this planet in a way that can be universally accessed by every nutritional application, or we will be in the Tower of Babel for another decade.

Ruppert:

Where do you see virtual reality technology potentially having the greatest impact on the issues of obesity and diabetes?

Sawyer:

I see the greatest potential in creating new ways to engage people in sustained, low-impact exercise and in building new ways for people to participate together in community-based change.

Medina:

Exergaming could increase physical activity in the hardest-to-motivate populations, and could become a key component within the feedback loop of the digital health care system. Virtual reality technology could also be used to create safe environments for people to practice new behaviors and lifestyle choices.

Greenleaf:

There is so much potential for all kinds of behavior change, but the technology could have particular impact on researchers in regards to metrics. Right now, in behavioral medicine, it is the Wild West. Clinicians do not have a lot of reliable data and must go more on intuition. One of the wonderful side effects of using virtual environments for interventions is that it provides an outcomes database that we can examine to discover which approach worked best with which clients. The data would be invaluable in refining clinical protocols.

Acknowledgement:
The author would like to thank Dr. Abby Ershow and Dr. Charles M. Peterson for their editorial assistance in the preparation of this article.

References:

1. Parsons TD, Rizzo AA. Affective outcomes of virtual reality exposure therapy for anxiety and specific phobias: a meta-analysis. J Behav Ther Exp Psychiatry. 2008;39(3):250–61.
2. Ferrer-García M, García-Rodríguez O, Gutiérrez-Maldonado J, Pericot-Valverde I, Secades-Villa R. Efficacy of virtual reality in triggering the craving to smoke: its relation to level of presence and nicotine dependence. Stud Health Technol Inform. 2010;154:123–7.
3. Girard B, Turcotte V, Bouchard S, Girard B. Crushing virtual cigarettes reduces tobacco addiction and treatment discontinuation. Cyberpsychol Behav. 2009;12(5):477–83.
4. Fleming M, Olsen D, Stathes H, Boteler L, Grossberg P, Pfeifer J, Schiro S, Banning J, Skochelak S. Virtual reality skills training for health care professionals in alcohol screening and brief intervention. J Am Board Fam Med. 2009;22(4):387–98.
5. Cho S, Ku J, Park J, Han K, Lee H, Choi YK, Jung YC, Namkoong K, Kim JJ, Kim IY, Kim SI, Shen DF. Development and verification of an alcohol craving-induction tool using virtual reality: craving characteristics in social pressure situation. Cyberpsychol Behav. 2008;11(3):302–9.
6. Riva G, Bacchetta M, Cesa G, Conti S, Molinari E. e-health in eating disorders: virtual reality and telemedicine in assessment and treatment. Stud Health Technol Inform. 2002;85:402–8.
7. Gorini A, Griez E, Petrova A, Riva G. Assessment of the emotional responses produced by exposure to real food, virtual food and photographs of food in patients affected by eating disorders. Ann Gen Psychiatry. 2010;9:30.
8. Cho BH, Kim S, Shin DI, Lee JH, Lee SM, Kim IY, Kim SI. Neurofeedback training with virtual reality for inattention and impulsiveness. Cyberpsychol Behav. 2004;7(5):519–26.
9. Miyahira SD, Folen RA, Stetz M, Rizzo A, Kawasaki MM. Use of immersive virtual reality for treating anger. Stud Health Technol Inform. 2010;154:82–6.
10. Gerardi M, Cukor J, Difede J, Rizzo A, Rothbaum BO. Virtual reality exposure therapy for post-traumatic stress disorder and other anxiety disorders. Curr Psychiatry Rep. 2010;12(4):298–305.
11. HopeLab. Ruckus research: behavioral profiles, design principles. *http://www.hopelab.org/wp-content/uploads/2007/11/ruckusresearchoverview_20090305.pdf*. Accessed January 11, 2011.
12. Murphy E. The effect of aerobic exercise on endothelial dysfunction in overweight children. Dissertation, West Virginia University School of Medicine, 2007. *http://wvgamesforhealth.wvu.edu/r/download/11552*.
13. Lange BS, Flynn SM, Chang CY, Liang W, Chieng CL, Si Y, Nanavati C, Rizzo AA. Development of an interactive stepping game to reduce falls in the elderly. J Dis Hum Dev. Forthcoming 2011.
14. Rizzo A, Lange B, Suma EA, Bolas M. Virtual reality and interactive digital game technology: new tools to address childhood obesity and diabetes. J Diabetes Sci Technol. 2011;5(2):256-64.
15. Lange B, Flynn S, Proffitt R, Chang CY, Rizzo AS. Development of an interactive game-based rehabilitation tool for dynamic balance training. Top Stroke Rehabil. 2010;17(5):345–52.
16. Lange B, Flynn S, Rizzo A. Initial usability assessment of off-the-shelf video game consoles for clinical game-based motor rehabilitation. Phys Ther Rev. 2009;14(5):355–63.
17. Lange B, Flynn SM, Rizzo AA. Game-based telerehabilitation. Eur J Phys Rehabil Med. 2009;45(1):143–51.