



Column Editors: Lili Liu and Masako Miyazaki

# Virtual rehabilitation with video games: A new frontier for occupational therapy

Jonathan Halton

As science and technology change, so do our occupational therapy practice methods - this is shown not only within our field, but also within health care. Certainly, technological advancements continually influence our current practice and occasionally they create new tools for intervention. Virtual rehabilitation is one of these areas of advancements, where changes have driven new and unique treatment methods.

Virtual rehabilitation is the use of virtual reality (VR) and virtual environments (VE) within rehabilitation. VR and VE can be described as a simulation of real world environments through a computer and experienced through a "human-machine interface" (Holden, 2005, p. 188). Virtual rehabilitation has received increasing attention from researchers and clinicians who recognize potential therapeutic benefits due to the immersive nature of the medium.

## Benefits of virtual rehabilitation

Virtual rehabilitation is able to provide a natural or real-life environment; individuals have the opportunity to forget about their surroundings and situation and focus directly on a task in the simulated environment (Schultheis & Rizzo, 2001). Clinical work often takes place outside individuals' normal environments - in hospitals, care centers or clinics. By facilitating therapy in a controlled virtual environment, we are able to offer functionally relevant and ecologically valid therapy and assessment (Rizzo, 2002). Ecological validity refers to how performance in an experimental context (i.e. VR) relates to and is predictive of behavior in the real world (Cooke, McKenna, Fleming & Darnell, 2006). In addition to immersion, there has been increased interest in VR due to its motivational nature; individuals using VR tend to have fun and are thus more motivated to continue therapy (Berger-Vachon, 2006).

Providing rehabilitation services from a distance via technology, known as telerehabilitation, has recently been coupled with the world of VR (Deutsch, Lewis & Burdea, 2007). Together, these two technologies have the potential to provide an alternative way to deliver therapy services to clients in rural settings

as well as therapy home programs. A particular obstacle to recovery post discharge is for clients to continue with home exercises and therapy programs; researchers now see the promise of using the motivational nature of VR via telerehabilitation to enhance compliance with occupational therapy interventions (Bowman & Speier, 2006).

## Challenges of virtual rehabilitation

The world of virtual rehabilitation is exciting and looks promising, but it is not without problems. Two challenges to the use of VR is the expensive cost of the systems and operation usually requires technical expertise (Burdea, 2003). These issues have led researchers and clinicians to consider more accessible commercial technology to provide VR therapy. This technology most often comes in the form of video game consoles, such as Microsoft Xbox and Sony Playstation 2 (Morrow, Docan, Burdea & Merians, 2006; Rand, Kizony & Weiss, 2004). Researchers have used modified versions of these consoles to create VR-like therapy systems. The goal is to get all the benefits of virtual rehabilitation without the cost and complication of true virtual reality systems.

## Introduction of the Wii game console

Nintendo released the Wii game console in North America, November 2006. Unlike previous gaming consoles, the Wii gaming system is based primarily around its wireless controller, the Wii Remote. The controller is a television remote sized device that uses accelerometers in three axes as well as an infra-red sensor bar to recognize gestures in an environment (Newbon, 2006). This technology creates a video game system that relies on three dimensional movements to cue real-time responses within the software. Previously considered separate to VR, the gaming industry has now merged into the world of VR through the development of the Wii.

### About the author –

**JONATHAN HALTON, BScOT(c)** is an occupational therapist at the Glenrose Rehabilitation Hospital, 10230 111 Ave., Edmonton, AB T5G 0B7. You can contact Jonathan by e-mail at [jonathan.halton@capital-health.ca](mailto:jonathan.halton@capital-health.ca)

With this physical based input interacting with a video game environment, suggestions have been made that the Wii could be used as a therapeutic device in the same manner as VR devices. Facilitated by a therapist, the movements required to play the game have the potential to work with rehabilitating individuals with physical and possibly cognitive impairments.

The Wii has several advantages. As a commercial product, it has graphics and interactivity driven by a competitive gaming industry where graphics, sound and play must be cutting edge. Furthermore, the video games are fun to play, which facilitates motivation for therapy and in turn will influence performance. The unit is affordable, with the cost of the Wii console currently listed at \$279 Canadian. Finally, the Wii has built in networking capabilities and then has potential to be used in telerehabilitation in the same manner as a VR system.

## Application of the Wii at the Glenrose Rehabilitation Hospital

Occupational therapists have begun to use the Wii with adults as a part of their regular treatment at the Glenrose Rehabilitation Hospital, a tertiary rehabilitation centre in Edmonton, Alberta. Using the principles of activity analysis, therapists use the Wii system and the Wii Sports software as a functional therapy task. Clients are oriented to the system and closely monitored by the therapist throughout the session.

Wii Sports includes five different activities: tennis, baseball, bowling, golf and boxing. If the player has difficulty operating the game, it can provide continuous instruction. Each sport requires the player respond with specific movements to play the game. For example, movements required for the tennis game include shoulder abduction, flexion, extension, horizontal abduction and adduction as well as elbow flexion and extension. The trunk requires movement



L to R – As part of her occupational therapy program, Eileen Beryl McManus works with occupational therapist Jonathan Halton using the Wii game console.

side-to-side and front to back. The feet can be moved and body direction switched. For those with less physical function, the movements for the games can be graded, as the Wii Remote can respond to smaller amplitude movements. Clients can participate while standing or sitting. The therapist facilitates movement through verbal encouragement or by providing hands on guidance and support.

**“With benefits paralleling those of virtual rehabilitation technology, the low cost and intuitive nature of the Wii make it an exciting new therapy device.”**

Initial responses from clients and occupational therapists have been positive. Clients report they enjoy playing the Wii and work longer at therapy. An unexpected benefit is the positive group interaction between clients. Clients stay in therapy session longer than usual, engaging in social interaction and meaningful occupation. Some clients report that as their focus turned to the game, there was a less negative focus on the affected limb.

The response from occupational therapists has also been positive. They report that they can continue to work on identified client-centred goals while using the Wii; it is not entertainment alone. According to therapists at the Glenrose, clients appear to enjoy the Wii and it is a welcome occupational therapy tool.

While there have been no significant problems or disadvantages to date, it is important to acknowledge potential drawbacks to the Wii system. It will be important to develop evidence supporting the therapeutic use of the Wii so therapists can understand the types of clients and conditions who experience benefits. Overexertion is an important aspect to be considered; with motivation observed to be higher than conventional therapies, individuals have the risk of harming themselves from either too much use or exaggerated movements within a short time. Therapist monitoring is essential for client safety.

### **Future directions for the Wii**

The above observations support the utilization of the Wii as a therapeutic occupational therapy tool. With benefits paralleling those of virtual rehabilitation technology, the low cost and intuitive nature of the

Wii make it an exciting new therapy device. However, the therapeutic effects of the Wii must be empirically investigated for an evidence-based practice. In addition, the potential application of the Wii as a telerehabilitation device and for service delivery in client homes and in rural settings is an area worthy of investigation.

Partnership between rehabilitation, engineering, computing science and industry would be a strategy that brings together the necessary expertise to examine the therapeutic benefits of and further develop VR and related technologies.

### **References**

- Berger-Vachon, C. (2006). Virtual reality and disability. *Technology and Disability, 18*, 163-165.
- Bowman, T., & Speier, J. (2006). Videoconferencing, virtual reality and home-based CIMT - Opportunities to improve access and compliance through telerehabilitation. *2006 International Workshop on Virtual Rehabilitation*, New York, 121-125.
- Burdea, G. C. (2003). Virtual rehabilitation - Benefits and challenges. *Methods of Information in Medicine, 42*, 519-523.
- Cooke, D. M., McKenna, K., Fleming, J., & Darnell, R. (2006). Construct and ecological validity of the occupational therapy adult perceptual screening test (OT-APST). *Scandinavian Journal of Occupational Therapy, 13*, 49-61.
- Deutsch, J. E., Lewis, J. A., & Burdea, G. (2007). Technical and patient performance using a virtual reality-integrated telerehabilitation system: Preliminary finding. *IEEE Transactions on Neural Systems and Rehabilitation Engineering, 15*, 30-35.
- Holden, M. K. (2005). Virtual environments for motor rehabilitation: Review. *Cyberpsychology and Behavior, 8*, 187-211.
- Newbon, B. (2006). Virtual reality: Immersion through input. *6th Annual Multimedia Systems, Electronics and Computer Science*, University of Southampton, UK.
- Morrow, K., Docan, C., Burdea, G., & Merians, A. (2006). Low-cost virtual rehabilitation of the hand for patients post-stroke. *2006 International Workshop on Virtual Rehabilitation*, New York, 6-10.
- Rand, D., Kizony, R., & Weiss, P. L. (2004). Virtual reality rehabilitation for all: Vivid GX versus Sony PlayStation II EyeToy. *Proceedings of the 5th International Conference on Disability, Virtual Reality and Associated Technologies*, Oxford, UK, 87-94.
- Rizzo, A. (2002). Virtual reality and disability: Emergence and challenge. *Disability and Rehabilitation, 24*, 567-569.
- Schultheis, M. T., & Rizzo, A. A. (2001). The application of virtual reality technology in rehabilitation. *Rehabilitation Psychology, 46*, 296-311.