Published in final edited form as:

Am J Phys Med Rehabil. 2015 April ; 94(4): e31–e32. doi:10.1097/PHM.0000000000000248.

Virtual Environments and Virtual Humans for Military Mild Traumatic Brain Injury and Posttraumatic Stress Disorder: An Emerging Concept

Charles E. Levy, MD, Shivashankar Halan, MS, Erin P. Silverman, PhD, Michael Marsiske, PhD, Leigh Lehman, PhD, David Omura, DPT, MHA, and Benjamin C. Lok, PhD

U.S. Department of Veteran's Affairs, North Florida/ South Georgia Veterans Health System, Gainesville, Florida (CEL, EPS, LL); Department of Occupational Therapy (CEL) and Department of Computer and Information Science and Engineering, College of Engineering (SH, BCL), University of Florida, Gainesville; Department of Physiological Sciences, College of Veterinary Medicine (EPS), and Departments of Clinical and Health Psychology (MM) and Occupational Therapy (LL), College of Public Health and Health Professions, University of Florida, Gainesville; and U.S. Department of Veteran's Affairs, Charlotte, North Carolina (DO).

Since September 11, 2001, the United States has deployed 1.5 million or more military personnel to Iraq and Afghanistan (Hoge et al, 2008). With increasing deployment, there has been a corresponding increase in the incidence of traumatic brain injury and posttraumatic stress disorder among returning personnel (Bahraini et al., 2014).

Deficits associated with mild traumatic brain injury and posttraumatic stress disorder include disturbances in attention and memory, depression, anxiety, impulsivity, emotional outbursts, intolerance of crowds, and hypervigilance. These render the demands of everyday life overwhelming. Many veterans with mild traumatic brain injury/ posttraumatic stress disorder become isolated as they withdraw from social contact. Cognitive behavioral therapy requires veterans to negotiate daily activities and interactions (e.g., attending appointments). Here, impairments associated with mild traumatic brain injury or posttraumatic stress disorder are most pronounced.

Virtual environments (VEs) and virtual humans (VHs) hold the potential to address these problems. VEs are computer-generated, immersive, and interactive virtual reality constructs for simulation and learning. VHs are specialized types of automated virtual reality human figures, which display lifelike movement, appearance, and gestures and are able to recognize and respond to human speech or textual communication. VHs are an excellent means to present social challenges, probe or train attitudes and beliefs, and teach social strategies and coping mechanisms.

All correspondence and requests for reprints should be addressed to Erin P. Silverman, PhD, Department of Physiological Sciences, College of Veterinary Medicine, University of Florida, PO Box 100144, Gainesville, FL 32610.

Financial disclosure statements have been obtained, and no conflicts of interest have been reported by the authors or by any individuals in control of the content of this article. 0894-9115/15/9404-e31

VEs/VHs provide opportunities for interaction between warriors and therapists in fully immersive, customizable, controlled, and low-threat environments (Fig. 1). These environments have the potential for infinite repetitions of assessment or training tasks. They have the capacity to provide customized sensory presentations, task complexity, and response requirements. The nature and pattern of the feedback are easily modified to suit the user. VEs/VHs are well suited for trial-and-error learning and errorless learning and may act as a bridge, facilitating reentry into everyday life. The authors are developing a VE grocery store (Fig. 2) that includes VH cashiers as adjuncts to traditional cognitive behavioral therapy. The V-Mart store allows therapists to select tasks (e.g., purchase items from a list, make change, purchase items) and set environmental parameters (e.g., noise level, number and appearance of shoppers, location, and availability of items). The therapist may choose to introduce additional stressors such as a collision with another shopper. Upon checkout, the therapist will be able to choose a virtual cashier and choose between different dialogue scripts, including scripts with uncooperative or rude content that simulate heated encounters, providing an ecologically valid and dynamic opportunity for assessment and training.

Acknowledgments

Supported by (1) W81XWH-08-2-0194 PT073664 Design of Effective Therapeutic Interventions for Mild TBI/PTSD using Interactive Virtual World Environments, CDMRP/DoD 9.15.08-9.14.09; (2) Development of Virtual Humans For PTSD and mTBI: Rehabilitation Outcomes Research Center 2010Y2011; and (3) 1101RX000339-01A3, Virtual Environments for Therapeutic Solutions (VETS) mTBI/PTSD Phase II, VA RR&D, \$824,835, 4.1.13-3.30.16.

REFERENCES

1. Hoge CW, McGurk D, Thomas JL, et al. Mild traumatic brain injury in U.S. soldiers returning from Iraq. *N Engl J Med*. 2008; 358:453Y63. [PubMed: 18234750]
2. Bahraini NH, Breshears RE, Hernandez TD, et al. Traumatic brain injury and posttraumatic stress disorder. *Psychiatr Clin North Am*. 2014; 37:55Y75. [PubMed: 24529423]

FIGURE 1. Navigation of the VE and associated tasks (here, inspecting nutritional information from a container of milk) is practiced by a research team member.

FIGURE 2.
View upon entering the VE V-Mart.