Virtual Reality in PTSD and beyond

Anna Roselle, **Carly Esteves**, **Matt Rusling** and **Ian Portelli** describe how virtual reality is helping people who are suffering from PTSD, as well as how IBM's Watson Health programme is focusing on changing the way healthcare is accessed and utilised more generally

Post-traumatic stress disorder (PTSD) is a devastating fear-based anxiety disorder that presents with negative cognitions and mood states, as well as disruptive behavioural symptoms, and affects nearly 7.7 million American adults, according to the US National Institutes of Health. Anyone can develop PTSD, but it is more commonly seen in veterans and those involved in traumatic events, including natural and man-made disasters, war, torture and rape. Since military and disaster response personnel are at higher risk of developing PTSD, it is imperative that reliable treatments are developed and are accessible to the community. Advances in cognitive computing and virtual reality (VR) therapy present novel opportunities for understanding and better treatment of PTSD, and open doors for future treatment of mental health disorders around the globe.

Historically, treatment for PTSD has focused on talk-therapy, combinations of cognitive-behavioural therapy (CBT), medication, and group therapy. One form of CBT is prolonged exposure therapy (PE), a psychotherapy that aims to relieve PTSD symptoms by gradually confronting trauma-related situations, feelings and memories by talking about the details of trauma in a safe space. Group talk therapy allows patients to discuss their trauma with others who have had similar experiences.

While these therapies have proved successful in helping to diminish the symptoms of various types of trauma, they are often not enough to fully eliminate the vast array of PTSD symptoms. Longitudinal research has revealed that in some patients PTSD may develop into a chronic disorder that can persist for a lifetime; it can also present symptoms similar to those of traumatic brain injury (TBI).

Although many returning war veterans and those working in war-torn or disaster areas have some level of TBI in addition to PTSD, the effects of PTSD alone can be detrimental to a person's physical and mental wellbeing. Symptoms that accompany TBI and PTSD include insomnia, detachment, aggression, and a decrease in physical activity. While the long term effects of TBI have been highly publicised and the focus of many research projects, those of PTSD are not as well understood.

More severe cases of PTSD may require a cognitive processing approach, which helps the patient to understand their trauma and reduce avoidance behaviours that impede them from overcoming the traumatic event. Making the traumatic event more approachable can help to diminish avoidance of the memory or the things that trigger it. This therapeutic technique has led researchers and clinicians to consider VR as a possible approach to reconceptualise trauma and treat PTSD more effectively.

Research and development of VR systems at IBM may hold the key to providing improved therapy to meet future needs. VR therapy is largely used to implement exposure therapy, thought to be one of the most beneficial treatments for those with PTSD and extreme anxiety.

Today, Virtual Iraq/Afghanistan exposure therapy, created by the Institute for Creative Technologies at University of Southern California, is used at more than 60 sites across the US and has been shown to reduce PTSD symptoms.

Inspired by the video game *Full Spectrum Warrior*, VR uses exposure-based therapy to allow patients to confront trauma using combat simulation scenarios in the safety of a doctor's office. Perhaps the most beneficial aspect of this VR therapy is that it can help to confront triggers directly.

PTSD symptoms are known to worsen when triggered, whether deliberately or accidentally. A trigger can be anything from a person yelling, to a car door slamming shut, and are unique to every individual. These triggers lead to flashbacks in which the person may see, feel, hear, or smell something from a traumatic event.

VR goes beyond talk therapy and medication by harnessing many of the patient's senses into the therapy session. Each session can be tailored to specific fears and points of anxiety, and include relevant context to the personal traumatic situations. This includes themed city and rural environments, vibrations, and auditory and olfactory cues. The integration of multiple senses makes this therapy a valuable tool in assessing every aspect of one's trauma. When a patient faces their trauma in a controlled setting, monitoring of vitals and emotional response to various cues is easier, allowing physicians to understand aspects of the individual's trauma and pinpoint areas in need of help via talk or other forms of therapy. Recent research has also revealed that VR therapy alone provides significant improvement of PTSD symptoms.

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Modern research testing the validity of PTSD treatments has relied on pre and post-test designs. While these studies do show overall improvement, they fail to pinpoint when a significant breakthrough in therapy occurs. Is the therapeutic progress happening all at once or manifesting itself over the course of many sessions? Researchers working with veterans asked this question and monitored patient changes throughout the entirety of their VR therapy. Results revealed that re-experiencing their trauma throughout therapy on repeated occasions led to a significant decrease in the symptom clusters associated with severe PTSD. This supports the theory that VR therapy is a gradual process in which repeated exposure leads to significant decreases in PTSD symptoms and may have applications for a variety of other mental health disorders.

Imagination

As the use of VR in therapy and non-therapy contexts increases and diversifies, companies such as IBM are working to make it more realistic and applicable in a variety of settings. IBM's Watson Health programme is focusing on changing the way healthcare is accessed and utilised, and on providing vision for innovative health technologies and practices. By integrating understanding, reason, interaction, and learning, Watson's systems may be a key to improving VR therapy.

Watson goes beyond the computer-generated simulation of images and space that we think of when we hear the term VR. During the Imagination Recognition Hackathon, Watson displayed its skills by manifesting objects that participants had drawn; bringing their ideas to life and allowing them to interact with their own imaginations. Watson can simulate human thought processes using its

self-learning systems, pattern recognition and language interpretation. Its cognitive computing abilities are said to be mimetic of the way the human brain works.

The newest VR technologies use game-like controllers to move around and function in the virtual world. IBM, however, is experimenting with using speech as the control. Many find it easier to be immersed in the virtual space by natural means alone, rather than operating a gaming switch. Using speech-to-text technology, the user can have conversations within the session, making the experience more realistic and immersive.

Watson's ability to understand and interpret audio and visual stimuli, as well as reasoning through problems based on the user's tone and emotion, presents exciting new avenues.

Gaining a better understanding of trauma and being able to interpret how the brain reacts to traumatic events, means that VR therapy can progress into a highly reliable treatment method for those with PTSD.

Watson's health solutions for individualised care focus on engaging patients in their own therapy or treatment plans and in providing value-based solutions. This idea of value-based care means a lot when thinking about PTSD, because every VR therapy session is so intricately personal, and trauma can affect a person's values in regards to daily life. For example after a traumatic experience, many people experience changes in their assumptions of everyday life, including beliefs about where is safe, and in misinterpreting situations or the actions of other people. By taking a more comprehensive view of each patient, physicians will be better informed before and during treatment, leading to more effective therapy. A comprehensive look at each person would be achieved by examining all factors that influence the patient's health, not just information in medical records, as is current practice. These factors include, but are not limited to: Environment; socioeconomic status; social support system; and access to healthcare. IBM's Watson Care Manager programme addresses some of these areas.

As it can mine massive amounts of data and combine results with medical literature, Watson Health may also be able to uncover possible connections and make proactive treatment plans that help physicians provide the best care possible in a holistic manner. It will allow them to develop individualised and comprehensive plans that fit the clinical and health-related social needs of each patient. Combining physicians' insight, VR therapy, and predictive analytics based on past and present mental state, medical providers will be able to provide proactive care to those suffering from PTSD, and other life altering conditions.

Looking beyond the use of VR in PTSD therapy settings, Watson Health technology has the ability to be applied across a variety of medical fields and research areas. Watson is transforming how healthcare is provided and how it is received. In the US, competition among hospitals has led many institutions to investigate technologies to improve the healthcare experience for their patients and staff. Physicians and administration at Thomas Jefferson University Hospitals throughout Philadelphia have examined the use of 'Smart Hospital' technologies. The Thomas Jefferson University hopes that implementation of Watson-IoT speakers will improve the hospital's connection with its patients. Using voice recognition and interpretation technologies, patients in smart rooms can speak in their native language and communicate directly with their physician without an interpreter.

Future outcomes

Watson's predictive analysis capabilities with big data present another advancement. The ability to use past and present data to predict future outcomes is a valuable tool for many areas of healthcare, enabling workforce optimisation, more efficient use of space, and provides cost-efficient changes to hospitals based on employee skills, energy use, and environmental impact.

The application of Watson Health analytics also provides a promising future for application in clinical research. For example, vast data sets collected over years and across countries may hold valuable information regarding different diseases, but the ability to interpret, understand and derive meaning from different formats remains difficult. Cognitive computing provides a quicker and more in-depth method of addressing healthcare needs than a physician or researchers can do alone.

A 2016 study examining the effectiveness and reliability of Watson to accelerate pattern identification in big data sets suggests that its cognitive computing may provide novel insights that could be applied to medical development in a variety of areas. Utilising big data, this pilot study suggests Watson can greatly reduce the time it currently takes to find suitable candidates for drug development and drug targets. By examining data from animal studies, human trials, and post-marketing safety studies, research will be able to take a more holistic view of new drugs and devices and how they may affect people.

Cognitive computing could also benefit doctors in their offices. It is predicted that about 30 per cent of physicians will utilise cognitive analytics for patient diagnosis by 2018. For example, a person visiting their physician could have their symptoms entered into a computer, which would then find the latest research regarding how to diagnose and treat the condition. The computer would also quickly scan the person's medical records and those of their family and plan the best course of diagnosis and treatment. If diagnosis required tests such as an MRI, the computer could help the physician to detect problems a human might miss.

Alongside this increase in data production and data sharing, Watson also addresses the need for advancements in cybersecurity. The need to protect healthcare records as adoption of electronic records becomes more widespread is one of the main challenges to new technologies. Health records are particularly valuable items that contain social security numbers, personal history and other information that makes identity theft easy. Watson cognitive computing improves the use of these electronic records while reducing the time they are exposed to possible risk. Watson IoT devices send data to private blockchain databases, which allows for secure sharing of records. A case study at McGill University Health Center used a new security intelligence platform based on Watson, which contains in-depth global intelligence capabilities. The case study demonstrated that hospitals can quickly detect and respond to possible attacks or breaches in security.

As the healthcare industry continues to grow, it becomes increasingly dependent on technology to aid in the delivery of high-quality, efficient care. Watson Health is designed to provide efficient analysis of data from large sets of electronic health records, physician records, and social determinants to provide population and patient specific care that is both individualised and high quality. By seemingly constant connection between records, new treatment, and emerging patterns of pathology, the world of healthcare can advance past merely treating the symptoms of disease, instead getting to its cause. The Virtual Iraq/Afghanistan exposure therapy for PTSD and Watson Health are an important part of the process. CRJ

Sources

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All images: The Virtual Iraq/Afghanistan Exposure Therapy allows patients to confront trauma in the safety of a doctor's office

Images courtesy Albert 'Skip' Rizzo, PhD, Director, Medical Virtual Reality – Institute for Creative Technologies; www.ict.usc.edu

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