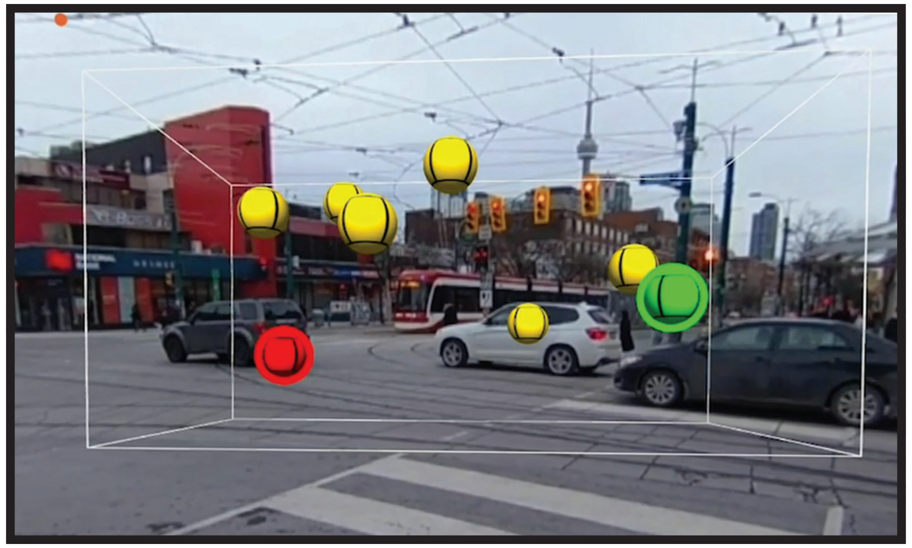
Follow the bouncing ball

Dr. Michael Reber is harnessing the power of virtual reality to retrain the brains of people with low vision

By Anna Sharratt



A GAME WITH PURPOSE

Using a VR headset, low-vision patients see yellow balls moving around a streetscape

Similar to the concept of a "shell game," patients need to track the balls that briefly turn colour, then use a pointer to identify them

Ever since the words "virtual reality" entered our lexicon, humankind has been fascinated with the concept. We imagined visiting far-flung worlds in our very own *Star Trek*-style holodeck, without ever leaving home.

Holodecks haven't come to fruition just yet, but virtual reality, or VR, is being put to very practical use: transforming the lives of people with low vision.

One of the leaders in this cutting-edge area of research is Dr. Michael Reber, senior scientist at the Donald K. Johnson Eye Institute. He's using VR to solve complex vision challenges, enhancing sight for patients of all ages who had virtually given up hope.

At the heart of Dr. Reber's treatment program is the Oculus Go, a device normally marketed to gamers looking for an immersive experience. Here, the headset and a specialized program are used to treat people with peripheral vision loss.

Low vision patients wear the headset and perform visual exercises at home. A series of animated yellow balls move around a realistic environment (such as a city street); the patient follows and identifies the balls when they change colour. The game gets more challenging as the patient progresses.

"With the Oculus Go, you're repeating over and over a variety of visual tasks – following targets with different colours and speeds," Dr. Reber explains. "You stimulate those brain areas that can compensate for the loss in another area. You train the brain to use what is left of the visual information it gets."

The patient's performance is recorded and sent to members of the team, who can remotely tweak the exercises to enhance progress. "We can fine-tune the stimulation in real time," says Dr. Reber. "It's personalized medicine."

He notes that the Oculus Go's portability allows more patients to benefit from the treatment in their own homes. Patients only need to visit the clinic every two to three weeks for a visual assessment, rather than coming in daily.

"I think it's extremely powerful and convenient for patients," says Dr. Reber.

Tom Roberts* knows the benefits of the system first-hand. Due to aggressive brain and spinal-cord tumours that were first diagnosed at age eight, Roberts went through years of surgeries and chemotherapy. Residual tumours around his optic nerves affected his peripheral vision, and he had resigned himself to a lifetime of poor vision.

When one of his doctors told him about groundbreaking low-vision research at the Donald K. Johnson Eye Institute, Roberts was skeptical. "For 20 years, I was told that this was something I had to live with," he says.

After a thorough assessment by Dr. Reber, Roberts took the device home and spent three months doing visual exercises, performing them every other day for 15 to 20 minutes.

It made a difference right away. "There was a noticeable difference in my visual field," says Roberts. "Before, I would sometimes walk into things on my left side – and now I'm doing that much less."

Dr. Reber notes that Roberts's reading ability has improved, and he has become more comfortable going out than he was before.

"It was absolutely astounding to me that using this device could improve vision," says Roberts.

Dr. Reber is keen to scale up the use of the Oculus Go for people with low vision. He says the successful experience of patients like Roberts shows how life-changing it could be for others dealing with similar vision challenges.

"He improved on many objective measurements," says Dr. Reber. "This is proof the stimulation [exercises] work." V

**Name has been changed to ensure patient privacy.*

How to feed a hungry neuron

Eye diseases such as glaucoma can starve optic neurons of nutrients, causing them to die. Once that happens, the neurons, also known as retinal ganglion cells, stop building pathways with other neurons and the eye stops relaying messages to the brain. Once a critical number of these neurons is lost, vision loss sets in.

But what if there was a way to keep those neurons from degenerating?

Dr. Michael Reber has built a nutrient-filled scaffolding of sorts for the eyes, using silk. The silk is reprocessed and then made into tiny fibres printed on a 3D printer.

"We take the silk filaments, we dissolve them and then from that we reprocess them as fibres," says Dr. Reber. "When we engineer these fibres, we add the molecules the neurons need to survive and grow."

The idea is that when the fibres are surgically implanted in the eye, "the neurons will climb on the fibres and chew on the nutrients," he says. Providing the neurons with both support and food will allow them to build new neural pathways and may allow patients to restore their vision.

The approach will require transplants into preclinical models before it can be tested on people, Dr. Reber says. But he is excited at the prospect of successfully treating diseases that lead to blindness. "Every day, we know a little bit more. It's giving us hope."

Dr. Michael Reber operates a specialized 3D printer that can make tiny silk fibres for use in the eye