Eli Peli

A new device for tunnel vision

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A NEW high-tech device that gives patients with tunnel vision both a minified view and normal view of the environment improved their visual performance significantly, an American pilot study finds.

"It's quite ingenious stuff. It's so novel because they have been able to integrate optics and electronics in one package, which opens up opportunities that we could not have with just conventional optics," said Henry Greene OD, clinical professor of ophthalmology at the University of North Carolina, US.

The novel system functions under the principle of multiplexing, which involves the interchange between the function of central vision, that is resolution, and the function of peripheral vision, that is a wide visual field.

To receive the two visual messages, patients wear an optical see-through head-mounted display system, which superimposes minified contour (edge) images of the ambient scene with a field of view of 16∞ (horizontal) by 12º (vertical) over their natural vision.

The apparatus gives the patients a minified preview of objects outside their visual field, and then allows them to turn to the object for closer inspection with their natural central vision, said the device's inventor Eli Peli MSc, OD, DSc (Hon), professor of ophthalmology at the Schepens Eye Research Institute, Harvard Medical School, in an interview with *EuroTimes*.

To test the device's efficacy, Dr Peli and his colleague, Luo Gang, PhD, selected 12 patients with tunnel vision (11 with retinitis pigmentosa and one with choroideremia) with an average age of 52 years. All but one of the participants still had a single patch of central vision. For the experiment, patients wore the device on only one eye.

Courtesy of Graham Ramsay

After receiving a one-hour training session, the patients were divided into a group of three and a group of nine and participated in two visual search tasks. In both tasks, the participants sat in front of rear projection screens while black circles, squares or triangles that contained grey, low-contrast letters were presented outside their visual field at different eccentricities.

In task A, the patients sat 32 inches away from a screen, which spanned 90º (H) x 74º (V), and the targets were presented at eccentricities of 20º, 27º or 35º. In task B, the participants sat 50 inches away from a screen that spanned 66º (H) x 54º (V) and the targets were presented at 15º, 22º or 29º eccentricity.

The researchers had selected target size and contrast so the edge detector recognised only the frame but not the letter in the minified view. Once the patients had detected the frame with the help of the edge detector, they had to search for it and once found looked through the display to view the target foveally, which enabled them to identify the letter.

The participants carried the tasks out with the head-mounted device and also without it.

The patients who performed task A all found and identified the letters significantly faster with the device, and the device improved the search directness. However, the performance of the participants who sat at a 50-inch distance with a smaller screen (task B) varied. The device only hastened the search time in patients with a visual field larger than 10º.

The results suggest that the eccentricities tested in task B were too difficult for the patients with visual fields smaller than 10º. In addition, those patients might have benefited from the device if the targets were presented at smaller eccentricities that are still far relative to their smaller visual field, the authors suggest.

In the last 20 years, researchers have tested various approaches to assist patients with tunnel vision. The new device appears a clear improvement over other solutions such as telescopes that expand the visual field through minification but lose too much resolution.

"We don't have any other compelling treatments at all, and I'm hopeful that this will be something that we can offer patients. I'm cautiously optimistic that this can be helpful. One thing that we know about people with constricted visual fields is that it's quite variable how they've adapted functionally to their vision loss, and it is also quite variable how they adapt to these high-tech solutions," said Dr Greene.

"There will be people who will not make that adaptation and will not find it useful," concurred Robert Massof PhD, professor of neuroscience and ophthalmology at the Wilmer Eye Institute at John Hopkins Hospital in Baltimore, Maryland.

Despite variations in individual adaptability, Dr Massof believes that the creator of the device is on the right track with this approach of multiplexing.

"It's a very clever and innovative approach. There have been a lot of people who have tried various strategies in the past. The whole idea of creating a part of the visual field that would have superimposed imagery and to be able to do it electronically so you can enhance it, is probably the right way to do it. It looks like it's going to be successful," he said.

There seems to be some evidence that people adapt to it fairly quickly. They seemed to stop noticing the nature of the image and used the information almost spontaneously, he added.

In the last five years, Dr Peli has worked on "shrinking" the device from the size of a Kleenex box to that of a cigarette pack, but he still would like to make it more user-friendly.

To address the question of whether patients could wear and use the device while walking around the house, Dr Peli is currently completing a study that involves participants judging the position of a moving object while walking on a treadmill. "There is more work to be done," Dr Peli said.

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