Aging&Vision

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LIGHTHOUSE INTERNATIONAL

HOPE WHEN VISION FAILS™

Orientation and Mobility: Crucial to Adapting to Life with Vision Loss

by Cynthia Stuen, DSW

Aging and vision professionals serve an ever-growing older population who turn to the Lighthouse for strategies to cope with normal age-related vision changes, as well as those that are not normal and result in vision impairment. To maintain functioning and quality of life, older adults must learn to adapt to changes in visual status, and not let them reduce mobility or increase their risk of falls.

Having the freedom and independence to get around safely — to perform daily tasks, visit friends or keep medical appointments, for example — is one of the most crucial factors in adapting well. Riding public transportation, detecting curbs and crossing streets are all activities that older adults with impaired vision may need help relearning to increase independence and safety. Taking advantage of training and support from orientation and mobility specialists, as well as keeping informed of the latest developments in mobility research, can assist older adults — and their families — in taking control and adapting successfully to life with vision loss.

Orientation and mobility professionals strive to maintain, and increase, quality of life for the older population through work as diverse as research, eldercare and rehabilitation.

In this issue of **Aging & Vision**, we offer gerontological professionals information about safe travel for older adults with vision loss. Dr. Eli Peli and Henry Apfelbaum, from The Schepens Eye Research Institute, introduce exciting research in the field of low vision mobility with revolutionary vision devices to address mobility problems. Dr. Rein Tideiksaar, an expert in fall prevention, provides an overview of how vision impairment influences the risk of falls in an older population, along with fall prevention strategies. And Martin Yablonski, Clinical Director of Orientation and Mobility at Lighthouse International, underlines the importance of vision rehabilitation — in particular, orientation and mobility training — in restoring functioning and quality of life for older adults.

Cynthia Stuen, DSW, Senior Vice President for Education, Lighthouse International

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Low Vision Mobility Research in the 21st Century

by Eli Peli, MS, OD, and Henry Apfelbaum, AB

While difficulty reading may be the first thing that comes to mind when thinking about living with low vision, it is mobility that represents a major problem for most people with impaired vision. Even those normally considered to have few problems with mobility — people with age-related macular degeneration, for example — frequently are mobility impaired. While they usually can walk satisfactorily from place to place, they frequently struggle with driving.

The Low Vision Rehabilitation Laboratory at The Schepens Eye Research Institute, an affiliate of Harvard Medical School, has a number of projects underway to address mobility problems among older adults with low vision. These involve basic and applied research in partnership with companies that help the Institute develop novel vision aids, as well as with a number of other academic organizations that assist in the evaluation of these aids. Aids fall into two major categories: those for people with central vision loss; and those for people with reduced peripheral visual fields, often caused by retinitis pigmentosa, glaucoma or stroke. We then test these aids under real-world and simulated, virtual environment conditions.

Central Field Loss (CFL)

Age-related macular degeneration reduces central, detailed vision — often to the point that reading is difficult, or impossible, without magnification. Such loss generally does not pose a mobility problem when walking, as the remaining peripheral fields provide adequate warning of impending obstacles and stumbling blocks.

However, loss of central visual detail can restrict the ability to drive, because it can be hard to read road signs. Small telescopes attached to spectacles above the normal center of gaze — in the "bioptic" position — can help; the wearer gets a magnified view of road signs by tilting his/her head down slightly. The telescopes, however, do add weight to spectacles and are rejected often because of their cosmetic impact. The Low Vision Rehabilitation Laboratory is developing a new telescope, the "in-the-lens telescope," which uses mirrors embedded within the spectacle lens itself to create an optical path long enough to provide adequate magnification (see Fig. 1). These telescopes also should permit the user to see both the magnified view and the unmagnified view at the same time.

While bioptic telescopes can, in principle, add to the number of years a person with CFL can drive safely, state driving regulations regarding their use vary greatly. A newly published

Fig. 1: in-the-lens telescope

book by Dr. Eli Peli, **Driving with Confidence: A Practical Guide to Driving with Low Vision** (World Scientific, River Edge, NJ), surveys the vision requirements and acceptable aids for drivers in each of the 50 states and the District of Columbia. Remarkably, no two states have identical requirements. Some allow the use of bioptics while others forbid it, and the variations with respect to peripheral field loss are even wider. The book is designed to help people with low vision, as well as their doctors and lawmakers, decide on a rational basis when it is acceptable to drive, and how vision aids affect that decision.

To evaluate existing and new vision aids, we are testing their use by drivers with low vision, both in a "virtual reality" driving simulator, as well as in the real world — on real streets in actual traffic — using specially modified cars and specially trained instructors. Needless to say, ensuring safety during real-world tests and getting permission from the authorities to carry them out was a significant challenge that we have now overcome. On-road tests will be conducted in the coming year in Rhode Island, Alabama and The Netherlands.

Peripheral Field Loss (PFL)

Peripheral field loss can occur as a result of retinitis pigmentosa (RP), glaucoma or brain injury, such as trauma or stroke. In the case of RP or glaucoma, there can be a fairly symmetrical concentric peripheral reduction in vision (tunnel vision), although central vision and acuity can remain good. Frequently, this type of loss is accompanied by a reduction in night vision.

Vision loss due to brain injury generally affects just one half of the field of view, with a sharp line of demarcation between the right and left sides (hemianopia). When looking straight ahead, a person with hemianopia may see everything on his/her right clearly and see nothing to the left (or vice versa). We have developed new spectacle-mounted prism devices for both types of field loss.

For tunnel vision, two prisms replace one of the spectacle lenses while the other lens carries a normal prescription. The prisms are arranged symmetrically, so that one brings into view portions of the left periphery while the other brings into view parts of the right periphery. Fig. 2 (below) illustrates the increase in visual field this provides. With the increase, however, there is confusion — at any time, the two eyes see entirely different portions of a scene.

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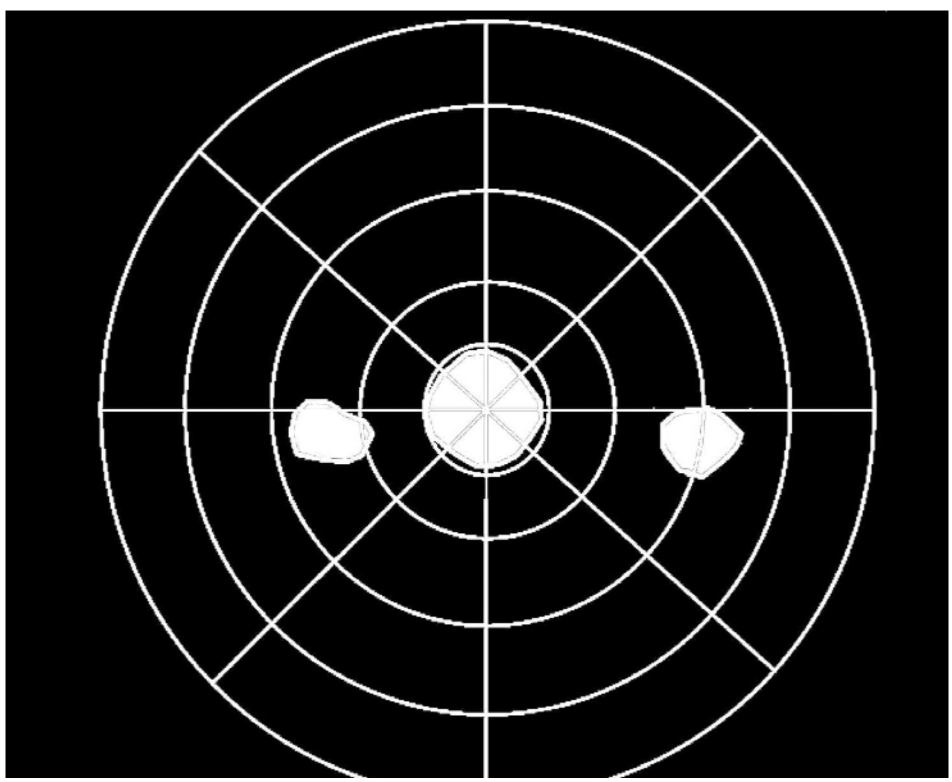

Fig. 2: increased visual fields for RP

Loss of Vision Mobility Research in the 21st Century

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Tests currently underway are helping us determine how well the brain can deal with this situation and how effective it will prove.

While driving may be possible for people with moderate symmetric PFL, driving is out of the question for people with advanced loss. When vision is restricted to less than 20 degrees or so, the primary concern is walking, not driving. This is the condition for which the symmetrical prisms are primarily suited. To test them, we have established, in collaboration with Boston College, real-world walking tests in a crowded shopping mall and at a nearby intersection. In our lab, we created a virtual model of the same mall and show its image on a rear-projection screen in front of a treadmill (see Fig. 3). When a person walks on the treadmill, we use head and eye tracking to control what is seen on the screen and to determine exactly what the person is looking at. This will let us know if obstacles are noticed by chance or through the use of the prisms.

In the case of hemianopia, our studies have progressed further. For hemianopia, small prisms placed on one spectacle lens above and below the normal view bring in some of the field from the blind hemisphere. Below, Fig. 4 shows such spectacles, while Fig. 5 shows the resulting field improvement.

While many satisfied people with hemianopia suggest that this approach is helpful to them, we are completing a study to assess adaptation to the spectacles, as well as the functioning of subjects while walking in a shopping mall and attempting to cross a busy intersection.

Fig. 3: virtual mall

Fig. 4: hemianopia spectacles

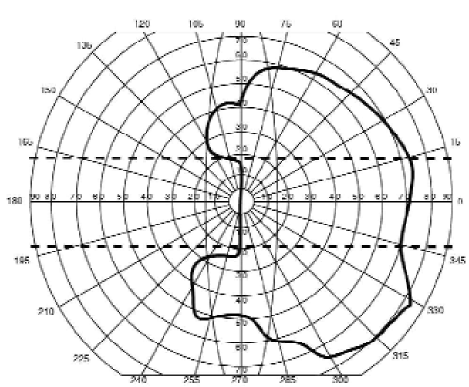

Fig. 5: increased visual fields for hemianopia

Losing the ability to drive is of great concern for many people with hemianopia, especially because many also suffer from paralysis on the affected side. Tests soon to be commenced on the road and with a driving simulator will assess the value of this hemianopia prism device for driving.

Video-Augmented Vision

In addition, we are investigating the use of tiny spectacle-mounted video cameras and displays to mitigate the loss of peripheral vision. A wide-field "minified" image can be overlaid on the normal view seen through one or both spectacle lenses (see Fig. 6).

The minified view provides context for orientation and safety, while the remaining normal vision provides the resolution needed to fill in the details. The video image can be processed to show a cartoon-like version of the scene, by detecting and presenting just the edges of objects in view. This type of presentation makes it easier to distinguish the normal and minified views, and reduces the interference of one view with the other.

To aid night vision, we are experimenting also with video cameras that operate in very low light conditions. Significant progress has been made in making these devices comfortable and cosmetically acceptable (see Fig. 7).

In summary, we believe that creative research, design, development and testing on many fronts will lead to devices that will relieve some of the significant visual impediments to mobility among older adults.

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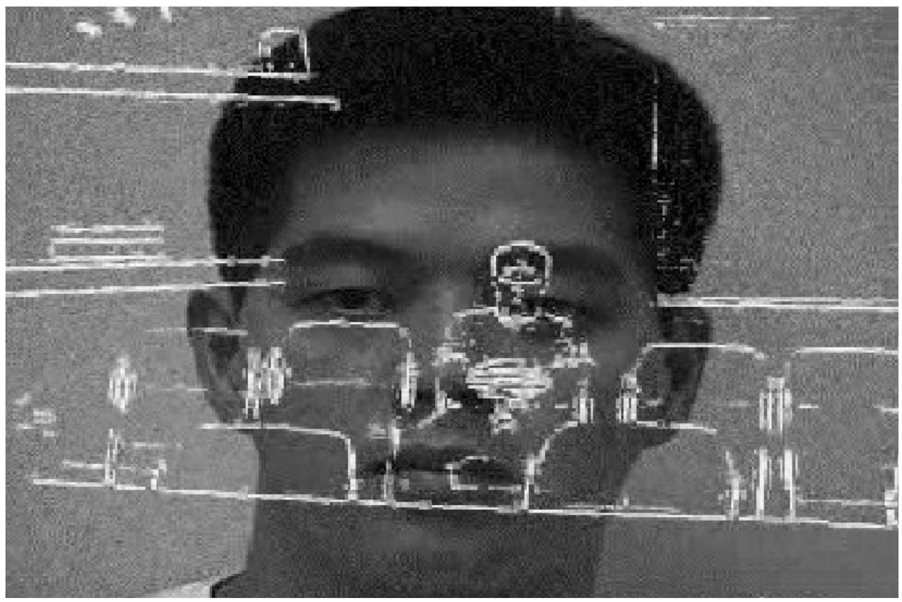

Fig. 6: minified context

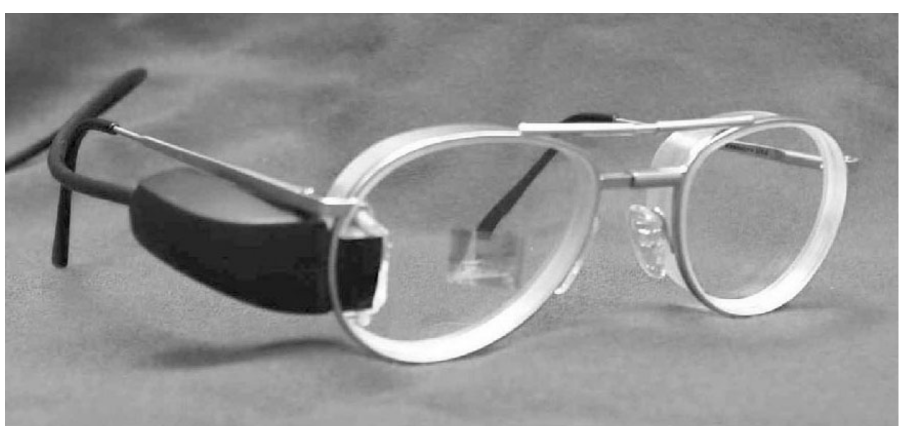

Fig. 7: video-augmented spectacles