The fastest growing demographic in the United States is the “oldest old” group, people aged 85 and older. From 1960 to 1994, this group increased 274%, compared with the 100% increase of persons 65 years old and over, and a 45% increase in the total population. The oldest old demographic is projected to continue to be the fastest growing segment of the elderly population into the next century. One quarter of the oldest old experience vision loss, due to age-related changes in their eyes and low vision disorders. These changes affect visual function, ability to perform daily activities and quality of life. Older adults with low vision report significant disability in leisure, work, social and mobility activities.

To effectively address leisure, work, social and mobility activities, vision rehabilitation professionals working with older adults must consider both environmental and personal factors. The Person-Environment-Occupation-Performance (PEOP) model illustrates how intrinsic and extrinsic factors interact to enable or hinder occupational performance and community participation (Figure 1). All components should be considered during the rehabilitation process because each client has individual valued roles, tasks and activities. A client’s functional vision and quality of life are affected by multiple factors and treating the person holistically is the ultimate goal. The following are components of the model that especially affect the oldest old cohort with low vision and their living situation: physiology (e.g. co-morbidities associated with aging, increased risk of falls),
Special Considerations for the “Oldest-Old” in Low Vision Rehabilitation

Jennifer Gendeman, OTD* **; Lauren Nisbet, OT; Kimberly Schoessow, OTD

Creating a Vision Rehabilitation Coalition in Five Steps

Sarah Hinkley, OD, FCOVD

Rehabilitation Services for Combined Vision and Hearing Loss

Walter Wittich, PhD, FAAO, CLVT

Neuro-Enhancement: A New Treatment for Optic Neuropathy

Ronald Siwoff, OD, FAAO, DPL-ABO

Special Considerations for the “Oldest-Old” in Low Vision Rehabilitation...

...continued from front page

As we age, the eye's ability to detect light levels decreases, reducing vision acuity, reduced visual field, and impaired color vision. Older adults' ability to adapt to different light levels is also impaired, making it more challenging to navigate dim and changing environments. Reduced acuity, reduced visual field, and decreased eye control in the elderly can lead to increased falls, decreased walking speed, and increased risk of postural instability.

Background: Intrinsic Factors Affecting Independence and Participation for the Oldest Old with Low Vision

The oldest old can greatly benefit from low vision rehabilitation, but growing empirical evidence demonstrates that there are factors in addition to low vision that affect their participation.1,2 Impairments in muscle strength and vision are associated with increased falls, decreased walking speed, functional dependence, and disability.3 From age 60 and beyond, there is a steady decline in muscle strength of 1-1.5% per year. Muscle strength decrements may impair activities such as lifting groceries and standing up from a chair.4 Reduced muscle strength, reduced visual field, and decreased eye control in the elderly can lead to increased falls, decreased walking speed, and increased risk of postural instability.5

Social support can be a facilitator and a barrier to participation in older adults with low vision. Higher social support is associated with increased activities of daily living (ADL) function, and reduced ADL function can cause depression. Older adults with low vision may experience negative psychological feelings due to fear of further visual decline, driving cessation, institutionalization, change of roles, or for any combination of reasons. Vision loss may not be the direct cause of depression; other factors should also be considered and appropriate referrals made.6

Background: Extrinsic Factors Affecting Independence and Participation for the Oldest Old with Low Vision

Social support can be a facilitator or a barrier to participation in older adults with low vision. Higher social support quality is associated with fewer depressive symptoms, more life satisfaction, and better adaptation to vision loss.7 Social support can be important to successful rehabilitation – providing transportation to and from appointments and encouragement. Driving retirement, occurring at an average age of 86, is linked to depression, social isolation and risk of long-term care placement. Older adults prefer driving to other modes of travel in their communities8 but often rely on informal transportation support from friends and family. These older adults may feel that they cannot fully reciprocate in social situations such as driving to and from activities9 but they may feel concerned about being a burden to others and thus limit their activities.10 Social support can lead to positive psychosocial effects because of the fulfillment of needs, but an overabundance of support can also cause caregiver burden, excess disability and learned helplessness. Education provided to clients and caregivers should emphasize community resources, autonomous decision-making by the client, and an optimal level of social support.11

The environment is external to the person and is where their chosen...
Continuing care retirement communities are residential settings that provide shelter, social activities and, as needed, healthcare and support services. They are usually campus-like complexes providing a continuum of care options.

### Table 1. Senior Care Facilities

<table>
<thead>
<tr>
<th>Definition</th>
<th>Services Provided</th>
<th>Inclusion/ Exclusion Criteria</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nursing Home</strong></td>
<td>Hospital-like settings that provide skilled nursing care and rehabilitative services to people with illnesses, injuries or functional disabilities. Generally house 40-200 residents and are licensed by the Department of Health Services. Patients rely on assistance for most or all daily living activities (such as bathing, dressing &amp; toileting).</td>
<td>Must have illness, injury, or a disability that limits ADL performance.</td>
<td>~ $84-300 per day private pay. Ancillary charges (i.e. laundry, personal laundry, etc.) may also apply. A majority of residents are registered to accept Medicare, Medicaid and long-term care insurance in addition to private pay.</td>
</tr>
<tr>
<td><strong>Assisted Living</strong></td>
<td>Bridges the gap between independent living and a nursing home. Service plans are developed and updated regularly for each person to ensure appropriate assistance as conditions change. Other common terms: Resi- dential Care, Personal Care, Adult Congregate, Living Care, Adult Foster Care, Retirement Residences</td>
<td>Assistance with a few ADLs and/or medication. 24-hour supervision not needed. NOT an alternative to a nursing home, rather an intermediate level for long-term care. Able to care for self despite some required assistance with ADL. Patient not able to live alone but does not require constant care.</td>
<td>~ $36-$160 a day. Medicare will NOT cover. Usually private pay. Some insurance plans may cover costs.</td>
</tr>
<tr>
<td><strong>Congregate Living</strong></td>
<td>Independent living, generally apartments, with added “hospitality” services (light housekeeping, meals). Community environment with an independent feel. No commitment to the facility, you can move if desired. Does not generally provide personal or healthcare. Also called: Congre- gate Retirement Community, Congregate Senior Community, Supported Housing, Resident- ial Care</td>
<td>Shared meals, transportation to shopping and appointments, housekeeping, laundry service, planned social and recreational activities, security, fulltime staff, social companionship, mental health monitoring. May be part of a continuing care community. 24-hour supervision not needed. For living independently with common “hospitality” services or socialization.</td>
<td>~ $800-$4000 per month (depending on facility). No Medicare coverage.</td>
</tr>
<tr>
<td><strong>Independent Living</strong></td>
<td>Apartments or townhouses to rent or own. Gathers people of similar ages and interests. Also called retirement community. Provides private living with communal activities and services.</td>
<td>May offer prepared meals, social activities and trips (book groups, baking classes, shopping trips), maintenance. On-call assistance, exercise programs. For healthy and self-sufficient people who can and want to live independently but do not want to stay at home.</td>
<td>Highly variable, from government subsidized up to luxury communities that require the cost of the home plus an activity fee of up to ~$2000 a month.</td>
</tr>
<tr>
<td><strong>Accessory Dwelling Unit</strong></td>
<td>Independent housing units developed within a single family home. Can also be an attached or separate cottage on the lot of a single family home.</td>
<td>Allows for informal support to an older family member or friend, while allowing the privacy of separate living quarters. Determined by home owner and occupant.</td>
<td>Determined by home owner and occupant. This type of arrangement can assist homeowners in maintaining their independence by providing additional income to offset property taxes and the costs of home mainte- nance and repair.</td>
</tr>
</tbody>
</table>

Extrinsic Factors Affecting the Living Situation of the Oldest Old with Low Vision

The combination of personal and environmental factors affecting older adults with low vision often influences relocation to a senior housing facility. Eighty-six percent of adults 75 and older, surveyed by AARP in 2005, would like to age in place and continue living at home. Discussions of aging in place versus relocating to a senior housing facility become an issue of participation during rehabilitation. Therapists have the opportunity to assist clients and their families with determining the appropriate level of support and care to yield the best possible occupational performance. Different types of senior housing facilities and home and community-based services are outlined in Tables 1 and 2. The first topic that often comes to mind when considering aging in place versus moving to a senior housing facility is safety. Safety issues that arise during many instrumental activities of daily living (IADL) such as setting the right temperature, turning off the oven, managing medication and fall prevention during functional mobility. Senior housing facili- ties are more likely to have fewer stairs to navigate, more accessible bathroom equipment and personnel available in case of emergency. But are facilities always safer? Clinical observations made by occupational therapists at low vision rehabilitation facilities in Wichita, Boston and San Francisco found that 49% of 61 clients living at home and 45% of 22 clients living in facilities reported a fall within the last year. Those living in senior housing facilities may be more likely to fall due to physical co-morbidities and other extraneous variables, but the numbers suggest that moving to senior housing does not guarantee reduced number of falls. A second issue that is a consider- ation in aging in place versus facility living is social isolation versus social interactions. One of the many benefits of living in a senior housing facility is social capital. Social capital is defined as the resources available to an individual resulting from ties to social networks in the community. Examples of social capital available at senior housing facilities include transportation to community outings, art fairs, fitness classes and regular health monitoring. Neighborhood and facility designs that are more likely...
Table 2. Home and Community-Based Services

<table>
<thead>
<tr>
<th>Model</th>
<th>Definition</th>
<th>Services Provided</th>
<th>Inclusion/Exclusion Criteria</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>PACE – Program of All-Inclusive Care for the Elderly</td>
<td>The Program of All-Inclusive Care for the Elderly (PACE) model is centered around the belief that it is better for the wellbeing of seniors with chronic care needs and their families to be served in the community whenever possible. Seniors live in their own home but may attend a day program with activities and healthcare provided in the same location.</td>
<td>May include but are not limited to: primary care (including doctor and nursing services), hospital care, medical specialty care, prescription drugs, nursing home care, emergency services, social services/counseling, transportation, home care, physical therapy, occupational therapy, adult day care, recreational therapy, dentistry, meals, nutritional counseling, laboratory/X-ray services</td>
<td>55 years of age (65 in some states), meet the Medicaid nursing home eligibility criteria, live in a PACE service area, able to live safely in the community when they join with the help of the PACE services.</td>
<td>Medicare or Medicaid funded program. Some sites are Medicaid-only contracts.</td>
</tr>
<tr>
<td>NORC – Naturally Occurring Retirement Community</td>
<td>The NORC is a residential area in which a large percentage of individuals aged 65 and older reside. The federal government recognizes NORCs as communities in which at least 40% of the heads of households are older individuals. States vary on their definition of NORC.</td>
<td>Provides opportunities for meaningful community involvement and increased access to support services.</td>
<td>Varies community to community. St. Louis, example: Age, residency and current membership are the only criteria. If you are at least 65 years of age and live within approximately three miles of the Jewish Community Center campus in Creve Coeur, you may be a St. Louis NORC resident.</td>
<td>Supported by public and nonprofit organizations. Dues may apply based on ability to pay.</td>
</tr>
<tr>
<td>Personal Care Assistance</td>
<td>Provides services to persons who need help with day-to-day activities to allow them to be more independent in their own home. A personal care assistance program may be able to help if a person has a physical, emotional, mental or chronic illness or injury.</td>
<td>May include but are not limited to bathing, dressing, meal preparation and grocery shopping.</td>
<td>Elderly people with disabilities and individuals with chronic or temporary conditions. Varies state-to-state. Common qualifications are orders from a physician, services are medically necessary, the person is Medicaid eligible or state program eligible, lives in the community. Cannot be receiving services from their living arrangement.</td>
<td><a href="http://www.wid.org/publications/directory-of-publicly-funded-paraprograms/">http://www.wid.org/publications/directory-of-publicly-funded-paraprograms/</a> Medicaid waivers or state plans cover the cost of PCA services.</td>
</tr>
<tr>
<td>Consumer-Directed Model of Care</td>
<td>Home and Community-Based Service that gives clients control of recruitment, training, hiring, supervising and firing of the provider care. Improves consumer satisfaction, reduces unmet needs, and enhances quality of life without unduly compromising safety, competence, or amount of care.</td>
<td>May include but are not limited to bathing and dressing, meal preparation and grocery shopping.</td>
<td>Services are typically directed at a less disabled population that is not at risk for institutionalization. Must assume the responsibilities listed in the definition including handling financial tasks.</td>
<td>Offered by some Medicaid and state-funded programs.</td>
</tr>
</tbody>
</table>

Figure 1. Person-Environment-Occupation-Performance Model (PEOP)<sup>α</sup>

<table>
<thead>
<tr>
<th>Environment (Extrinsic Factors)</th>
<th>Occupation</th>
<th>Performance and Participation</th>
<th>Person (Intrinsic Factors)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Build Environment and Technology</td>
<td>Physiological</td>
<td>Occupational and Participatory</td>
<td>Social Support</td>
</tr>
<tr>
<td>Culture and Values</td>
<td>Cognitive</td>
<td></td>
<td>Social and Economic Systems</td>
</tr>
<tr>
<td>Natural Environment</td>
<td>Neurobehavioral</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Psychological</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Ultimately, each older adult has an individual set of barriers and facilitators that must be taken into account when advising about living situations.

Outpatient Low Vision Therapy Delivery for the Oldest Old

The oldest old cohort, in addition to vision impairment, is likely to have other age-related impairments (e.g. cognitive) and medical comorbidities. They are at high risk for depression, being caregivers, and having inadequate social support.

to promote social capital are those that are mixed use and pedestrian oriented. These neighborhoods and facilities enable residents to perform daily activities without the use of a car. Many of them have places of worship, a local tavern, a coffee shop, or restaurants within walking distance. Socialization happens by chance rather than by invitation. Many senior care facilities also have video magnifiers or host low vision support groups. Individuals with high levels of social capital tend to be involved politically, volunteer in the community, and get together more frequently with friends and neighbors. The increased social capital in a facility or retirement community, however, must be weighed against networks in the community such as local clubs or auxiliaries that may be lost with a move to a facility. Senior housing facilities are not necessarily safer than aging in place and social capital can be gained or lost by relocating. An older adult’s home may or may not be more static, familiar and simpler than a facility.
Case Study

Mr. S is an 87-year-old patient diagnosed with bilateral maculopathy, autoimmune retinopathy and a choroidal nevus. In his initial evaluation with the low vision ophthalmologist, he reported that he was no longer able to read his mail, read medication labels, write checks, or use his kitchen appliances, due to his vision loss. Mr. S presented with a ring-scotoma pattern of vision loss, sparing the foveal area of retina. His single letter acuity was good enough that he did not qualify for state services, such as rehabilitation teaching or social work. He was able to identify individual letters, but could not piece sentences together in order to read fluently. He had initially reported that he could measure his blood glucose level, but when the OT evaluated him in his home, Mr. S was unable to match the test strip to the drop of blood on his finger. He was highly motivated with excellent cognitive functioning, thus he was an excellent candidate for vision rehabilitation.

This patient lived 57 miles from the low vision clinic and was no longer driving due to the vision loss. He was a widower and his only daughter had become concerned about him living alone. His daughter was no longer able to read his mail, read books, or piece sentences together in order to communicate. If Mr. S was unable to receive low vision rehabilitation services in his home he would have been unable to pay his bills, cook meals or manage his diabetes. His quality of life and sense of independence would have decreased. He would be facing many of the same risks that cause many older adults to move to assisted living, at a high cost to both the individual and the healthcare system.

For these reasons, the rehabilitative strategies for older adults are different from younger adults. Jackson and colleagues found that the oldest old participants benefited from vision rehabilitation (i.e. initial consultation with an ophthalmologist with assessment of visual function and discussion of the rehab plan according to goals and visual function, and training with an occupational therapist as indicated) one year post rehab. The 25 oldest old participants in their study had significant gains in visual ability and reading ability. How do we increase access to services based on the intrinsic and extrinsic struggles of the oldest old clients with low vision? A review of data on the Vision Rehabilitation Center at the Massachusetts Eye and Ear Infirmary found that their oldest old clients failed to return for occupational therapy services more often than younger clients. This response is most likely due to the issues discussed earlier such as mobility difficulties, depressed feelings and lack of social supports to provide transportation. Based on this research, the occupational therapy delivery model was changed to involve more home visits for the oldest old and the number of oldest old clients participating in occupational therapy increased. Home visits, transportation assistance, companions, and receiving services in the home community will increase accessibility for the oldest old.

Conclusion

Currently, one quarter of the oldest old (85+) experience low or reduced vision. Simultaneously, this population’s quality of life, performance and participation are impacted by a series of unique factors including physiology, psychology, social support, social capital and physical environment. Occupational therapists and other vision rehabilitation team members have an important role in identifying the barriers and facilitators in the client’s environment and providing interventions to modify activity performance or educate the client of alternative options such as senior housing facilities.

References:
Creating a Vision Rehabilitation Coalition in Five Steps

Sarah Hinkley, OD, FCVD

You have heard the proverb “It takes a village to raise a child.” As someone with a passion for getting the word out about vision rehabilitation amongst doctors’ offices and the general public, I offer my own interpretation, “It takes a village of professionals to maximize independence for patients with visual impairment.” That sentiment was the impetus behind the formation of the Michigan Low Vision Rehabilitation Coalition. It started with a big idea — to bridge the communication gap that exists between vision rehabilitation professionals and foster teamwork for the good of patients across the state. Although no large and worthwhile idea is easy, I am sharing the steps taken in initiating the Coalition, along with my joys and struggles, in hopes that it may inspire you to do the same.

WHAT: The Michigan Low Vision Rehabilitation Coalition is a task force of individuals from different areas throughout the state of Michigan who communicate about the projects and services of their organization or profession, as well as brainstorm and implement ways to enhance public, doctor and patient education on available low vision rehabilitation services. This Coalition represents a wide variety of doctors, organizations, professionals and patients in order to gain a wide perspective and universal agreement. The diversity of membership also allows the Coalition to identify the most commonly encountered barriers to education about and utilization of low vision rehabilitation services.

HOW: The Coalition developed a mission statement at its first meeting, as well as goals and objectives that guide its use of funding. A secretary was appointed to keep minutes and send communications. Once the coalition reached agreement on the best way to promote and educate the public, patients and doctors about low vision rehabilitation, we created projects that utilize grant funding to accomplish the stated objective (for example, the production of printed materials). Grant funding was also used to facilitate meeting costs and travel, since many of the members have to travel great distances. Virtual or web-based meetings are being explored to save cost.

The Coalition’s first project was the production and distribution of a statewide, large print brochure educating doctors and the public about low vision rehabilitation services, including a list of eye care providers across Michigan who practice low vision rehabilitation. Ophthalmologists and organizations across the state were mailed a kit containing a letter of introduction, brochure holder and brochures. Support was provided for ordering refill brochures. The mailing reached 185 offices.

Here are my suggested steps for creating your own Coalition.

**STEP 1: DEVELOP YOUR IDEA.**

Decide on a preliminary mission for your coalition. What is its purpose? What type of membership should it contain? Which professionals will be represented? Should a patient representative be included? Are there influential organizations in your state that should be involved? My advice is to create a document that answers the following questions on paper: What? Why? When? How? Who? If you can successfully answer these questions then you are ready to proceed to step 2.

**STEP 2: ENLIST SUPPORT FOR YOUR IDEA.**

Contact individuals or organizations with influence in your state and pitch your idea. Ask for support in the pursuit of grant funding or donations. Request an official letter of support that you can use in your grant applications. My experience in obtaining grant funding is that the support of influential organizations is a necessity. For our Coalition, I received letters of support from the Michigan Commission for the Blind, our state agency, and the Association for the Blind and Visually Impaired, an influential non-profit organization.

**STEP 3: LOCATE POTENTIAL FUNDING SOURCES.**

There are two primary ways to fund a Coalition. The first is through corporate or individual monetary donations. If you have a personal connection with a company involved with vision rehabilitation, use your contacts to pitch the program. Consider an individual benefactor as well, particularly someone with a passion for vision rehabilitation. The other option is application for grant funding. Online searches for available grants are a good way to start. Professional associations or societies may also be an excellent resource connecting you to open grants. Experience with grant-writing is helpful, but with thorough planning and attention to detail, anyone has the potential to be funded. Submit your grant applications in a timely fashion along with your letters of support.

**STEP 4: AFTER FUNDING IS RECEIVED OR WHILE YOU WAIT, BEGIN TO BUILD YOUR COALITION MEMBERSHIP.**

Start with individuals from associated rehabilitation professions other than your own. Consider a patient representative as well. I strongly encourage the membership of at least one optometrist and one ophthalmologist who are specifically involved in low vision rehabilitation or at least a strong supporter of referrals for rehabilitative care. Include a representative of any influential organizations in order to keep them apprised of your activities. Ask the members to commit to meetings and small amounts of time in between meetings for project activities. I have found email or an interactive online worksite to be the easiest methods of communication for members. Our Coalition includes a vision rehabilitation optometrist, a Veteran’s Administration representative optometrist, a retinal specialty ophthalmologist, a vision rehabilitation ophthalmologist, a representative of the Michigan Commission for the Blind, a representative of the Association for the Blind and Visually Impaired who is a rehabilitation teacher, a Teacher of the Visually Impaired (TVI), an occupational therapist (OT) specializing in vision rehabilitation, an OT specializing in driving rehabilitation, a patient with visual impairment and a professor of blindness studies and rehabilitation. Your coalition should be small enough to work as a functionally integrated team while large enough to be representative of a diverse array of professionals, organizations and patients. I suggest between five and fifteen members.

**STEP 5: SCHEDULE YOUR FIRST MEETING.**

The first is the most difficult and I felt it was important to have one face-to-face meeting prior to beginning our conference calls or emails in order to get to know each other. At the meeting, introduce the services provided by the member’s... (continued on page 14)
Rehabilitation Services for Combined Vision and Hearing Loss

Walter Wittich, PhD, FAAO, CLVT

Dual sensory impairment (DSI) generally refers to any level of combined vision and hearing loss, independent of age, severity or time/order of onset. Historically, the term deafblind has been more commonly used to describe this population, consisting mostly of children with severe sensory impairments or adults with progressive loss due to conditions such as Usher Syndrome. However, in recent years, research regarding the growing number of older adults with both age-related decline in vision and hearing has brought the term DSI into the literature.

The population prevalence of DSI has been reported to range anywhere from 1.6% to 22.5%, depending on the definition and measurement technique of sensory loss. Subgroup analyses for persons over the age of 55 report prevalence ranges from 7.0% to 35% (see 1 for a more detailed review). The increase of DSI with age has been estimated to rise from 1.6% or 3% in those ages 65 to 69 and 13.6% or 21.9% in those ages 70 to 74. It is estimated that 65% of DSI clients are over the age of 65, with the majority of older adults presenting with a sensory profile that reflected residual vision and hearing for them to benefit from low vision rehabilitation and hearing-assistive technology services in order to maximize their functional abilities.

Traditionally, rehabilitation services for vision loss and hearing impairment have been offered separately. The demographic tsunami is changing how rehabilitation services are being provided as professionals in both domains begin to consider the needs of this particular population and how to adjust service delivery.1,4 This trend requires that rehabilitation agencies prepare new methods of service provision, specifically in programs where clients are potentially affected by more than one impairment. Saunders and Echt? have pointed out that the loss of visual and auditory capacity is not simply additive but has a multiplicative effect because clients with DSI cannot compensate for the loss of one sense with the other. Therefore, uni-sensory rehabilitation approaches need to evolve to become more appropriate for dealing with DSI clients.

The rehabilitation system available in Montreal has the advantage that dual impairment rehabilitation services are provided through combined programs offered at agencies that also provide uni-sensory rehabilitation. This involves a multi-disciplinary approach, including optometry, audiology, social work, occupational therapy, psychology, low vision rehabilitation, speech and language pathology, orientation and mobility, hearing-assistive technology, special care counseling, computer accessibility, Braille and sign language instruction. This spectrum of professionals allows the rehabilitation service providers to address (continued on page 14)

References:
9. Gordon ID. The "metaphoric hearing". How demographic and epidemiologic projections can prepare us for the provision of vision rehabilitation services to the baby boomer generation. AER 2009;21(2):12-5.
Creating a Vision Rehabilitation Coalition in Five Steps… continued from page 10

- Dr. Sarah Hinkley is an Associate Professor and Chief of Vision Rehabilitation Services at the Michigan College of Optometry at Ferris State University.

- The mosaic of sensory aging is complicated by the fact that a sensory neuron behaves like a single strand of copper wire, and if you damage a sensory neuron it would not degrade the bundle. The ability to transmit much more information than the copper strand and they would be tunable. The ability to tune would mean that changing the angle of the beam of light would allow many signals to travel through the fiber optic bundle at the same time. Damage to some of the fibers in the bundle would not degrade the signal.

- The purpose of this study is to demonstrate that the transmission and function of the human visual system with optic atrophy can be improved by changing the angle of the light entering the eye.

- Walter Stanley Stiles and Brian Hewson Crawford first described the directional sensitivity of cone receptors in the human eye in 1933. They were looking at a retinal explanation for the phenomenon they observed: light entering the center of the pupil appears brighter than light entering from the periphery of the pupil. The knowledge of neural processing occurring throughout the entire visual system would not occur until much later.

- David Hunter Hubel and Torsten Nils Wiesel greatly expanded our knowledge of sensory processing in their historic experiments of 1959. Their work established the foundation for neurophysiology. Orientation-sensitive fields were described in their study. They demonstrated that vision is a brain function and not an eye function.

Neuro-Enhancement: A New Treatment for Optic Neuropathy

Dr. Sarah Hinkley is an Associate Professor and Chief of Vision Rehabilitation Services at the Michigan College of Optometry at Ferris State University.

Her significant didactic responsibilities include course and laboratory instruction in Developmental Optometry, Treatment of Binocular and Accommodative Dysfunction, Low Vision and Clinical Problem Solving. Additionally, she instructs clinical interns at the Ferris State University Eye Center and Cherry Street Health Services in the areas of primary care, contact lenses, pediatrics and binocular vision, vision therapy and vision rehabilitation. She writes frequently on her subject expertise and research for statewide and national publications, including articles in national peer-reviewed journals and serves on the review board of the Journal of Behavioral Optometry. She is a frequent lecturer at national and state continuing education seminars and is a certified Michigan Low Vision Specialist.

- The large variability of functional and diagnostic categories in the DSI population, many of which are rarely discussed in the research context due to low incidence. For example, a growing segment of the DSI spectrum are adults who adjusted to living with a single sensory impairment in later life. Their rehabilitation needs are not necessarily entirely clear and less often addressed during the training of rehabilitation professionals. Their priorities may depend on which impairment occurred first and which one developed later in life; however, presently there is very little experimental data or expert clinician knowledge to guide their rehabilitative services.

- The mosaic of sensory aging is further complicated by the fact that other age-related health issues can arise, such as heart and respiratory conditions, arthritis and mobility impairments, and cognitive decline. All these and other comorbidities will influence to which degree clients will prioritize their choice to access sensory rehabilitation. The client profile in vision and hearing impairment has changed – and so must the services we provide.
from 5 years old to 97 years old, with a mean age of 60.7 years old. * See Figure 1.

Distance vision was tested on each patient with The Original Distance Chart for the Partially Sighted, arranged by William Feinbloom, OD, PhD. Near acuity was measured with The Light-house Near Acuity Test (Second Edition) Modified ETDRS with Sloan letters. Snellen distance and near acuities were converted to a decimal form to facilitate statistical analysis. Visual acuity varied from 20/20 to no light perception (NLP). Two people had one eye with NLP. One person had two people had light perception (LP) in one eye. Two people had two people had one eye with NLP. Two people had one eye with 20/20. Two people had one eye with 20/20. Two people had one eye with 20/20. Two people had no light perception (NLP). Two people had one eye with 20/20.

The Visual Evoked Potential (VEP) was performed on each patient. Gold cup electrodes (Grass Model F-E56 H Astro-Med Inc., West Warwick, R.I.) were applied to the scalp with EEG paste. The electrodes were placed 4 cm above the brow on midline. The ground electrode was placed midway between the other electrodes. The impedance of the electrodes, measured prior to testing, was performed in compliance with the 2009 ISCEV Standard.

A Diopsys Enfant™ System (Diopsys Inc., Pine Brook, New Jersey, USA) was used with a checkerboard reversal pattern at 85% contrast viewed at one meter. First the check size with the biggest amplitude was selected. See Figure 2.

Contrast was set to Michelson 85%. Mean luminance was 66.25 cd/m2. The checkerboard reversed at 2/seconds. Testing was performed monocularly with best correction. The amount of prism chosen was determined by the patient’s visual acuity, as follows: See Figure 3.

Each patient received keratometry with a Haag Streit ophthalmometer and a trial frame refractor. The ensuing best spectacle correction in the trial frame was used for the VEP testing. The four checkerboard sizes were analyzed to determine what size produced the largest amplitude. The selected prism was put in the trial frame and the VEP was performed with the prism base up, base patient’s left, base down, and base patient’s right (clockwise). After the VEP data was collected, the landmarks were marked on the wave form. The N50, N75 and P100 were identified. The orientation of the prism that produced the largest amplitude with the shortest latency was selected. If two orientations resulted in the largest amplitude, the prescribed orientation was placed between both original orientations. If three orientations resulted in large amplitudes, the orientation was 180 degrees away from the center of the three orientations. If there was no increase in the amplitude and no decrease in latency, no prism was prescribed.

RESULTS

Paired-samples t-tests were conducted on the mean score for VA DIST, VA NEAR, AMP and LAT, comparing each variable between the prism and without prism conditions.

There was a significant difference in the VA DIST scores for the without prism (M = 0.16, SD = 0.19) and with prism (M=0.35, SD = 0.29) conditions, t (194) = -11.95, p<.001, 95% confidence interval for the difference (-0.22, -0.25).

There was a significant difference in the AMP scores for the without prism (M = 0.16, SD = 0.19) and with prism (M=0.49, SD = 0.32) conditions. t (194) = 15.05, p<.001, 95% confidence interval for the difference (-0.32, -0.25).

There was a significant difference in the VA NEAR scores for the without prism (M = 0.21, SD = 0.23) and with prism (M=0.35, SD = 0.29) conditions, t (194) = 5.37, p<.001, 95% confidence interval for the difference (0.22, 1.47).

There was a significant difference in the LAT scores for the without prism (M = 106.41, SD = 17.70) and with prism (M=96.07, SD = 28.44) conditions, t (194) = -11.95, p<.001, 95% confidence interval for the difference (-0.22, -0.25).
with profound visual loss, two eyes with no light perception did not improve, three of four eyes with light perception improved (two improved to hand motion and one to 5/300), two of two hand motion eyes improved to 5/400 and 1/600.

DISCUSSION AND SUMMARY
Initially, it was expected that using a prism in various directions would objectively map the locus of greatest retinal sensitivity by moving the image off a scotoma produced by optic nerve disease. We had previously described the use of prisms, called RIT therapy, when there was retinal disease, so we were looking for similar results. We expected to see an increase in the amplitude of the VEP.

A decrease in latency was a better predictor of improved vision than an increase in amplitude. One might assume that the latency would decrease because of an improvement in visual acuity. An improvement in acuity should result in an increase in amplitude and a decrease in latency. This is not what we found. Latency did decrease, as predicted, but amplitude also decreased. This finding suggests that the improvement in vision resulted from a change in the brain and not in the retina. Additional studies are currently underway that are looking at the importance of coding visual information temporally.

The use of neuro-enhancement with prismatic spectacles measured by VEP in patients with optic nerve disease is an important adjunct therapy to be used in combination with traditional medical and surgical management. The improvement in sight results in clearer distance and near functional vision.

References:
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