



Snider Therapy Centers, Inc.

UNDERSTANDING THE RELATIONSHIP BETWEEN VISION DEVELOPMENT AND LEARNING

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Section 1

Vision: A Clinical Model

Three Component Model of Vision

- Refractive Skills
- Visual Information Processing Skills
- Visual Efficiency Skills

I. Refractive (Optical) Skills

This component of the three-part model of vision deals with the ability of the eyes to see clearly at all distances. This refers to optical conditions which may cause blurred vision at distance, near, or both distance and near.

1. Nearsightedness (myopia) is a condition in which vision is blurred at distance but clear at near. Unless severe, myopia generally doesn't interfere with learning. It may interfere with motor development and difficulty interacting with the environment in very young children if not identified early.

2. Farsightedness (hyperopia) is a condition in which the individual must use more effort to see at near. To see clearly a person with hyperopia must contract the ciliary muscle to change the shape of the lens in the eye and regain clarity.

Very high degrees of hyperopia cannot be overcome and result in blurred vision. If not corrected early such problems can lead to amblyopia (loss of vision) and difficulty interacting with the environment.

3. Astigmatism is a condition in which vision is blurred and distorted at both distance and near. Low degrees of astigmatism can be overcome by focusing the eyes. High degrees of astigmatism cannot be overcome.

If not detected and corrected early, significant degrees of astigmatism can lead to amblyopia and difficulty interacting with the environment.

Symptoms of Optical Problems

Nearsightedness

Squints

Complains of blurred vision far away

Gets close to board

Farsightedness and astigmatism

Discomfort associated with reading

Rubs eyes

Eyes water

Complaints of blurred vision

Relationship of Optical Problems to Learning

Nearsighted children tend to be the best readers and learners in school. Their vision is clear when reading and because they complain about not being able to see the board well, their needs are usually quickly addressed.

Children with farsightedness and astigmatism often go undetected because they have relatively clear vision. Because of the effort needed for them to see clearly, however, they can experience eyestrain, blurred vision when reading, inability to attend and concentrate for adequate periods of time, and reduced reading comprehension.

Note: Hyperopic children, even those with moderate hyperopia, are much more susceptible to delays in visual perceptual skills development than emmetropic children, and the latter in turn, are more susceptible than myopic children.¹

Treatment

Eyeglasses to correct the refractive error

Related Condition

Amblyopia – When the two eyes have significantly different refractive errors, the brain may respond by suppressing the information received from one eye producing an eye with decreased acuity. This is called **refractive amblyopia**.

Treatment – 1. Eye glasses to correct the refractive error

2. Vision therapy to restore visual acuity to potential

II. Visual Information Processing Problems

These are problems that interfere with an individual's ability to analyze and interpret visual information.

Visual processing disorders include:

Laterality and directionality disorders

Visual form perception disorders

Visual memory disorders

Visual motor integration disorders

A. Laterality and Directionality Disorders

Laterality relates to the internal awareness of the two sides of the body, directionality to projecting this awareness into external space.

Symptoms

1. difficulty learning right and left
2. reverses letters and words when writing or copying
3. may read either left to right or right to left

B. Visual Form Perception and Discrimination Disorders

This involves the ability to discriminate dominant features in different objects: for example, the ability to discriminate position, shapes and forms.

Symptoms

1. confusion of likenesses and minor differences
2. mistakes words with similar beginnings

3. difficulty recognizing the same word repeated on the same page
4. difficulty recognizing letters or even simple forms
5. difficulty determining what is significant from what is insignificant

C. Visual Memory

This is the ability to recall dominant features of a stimulus item or to remember the sequence of several items.

Symptoms:

1. difficulty visualizing what is read
2. poor comprehension
3. difficulty learning new material
4. poor spelling
5. poor recall of visually presented material
6. difficulty with tasks that require more than one step
7. difficulty with mathematical concepts

D. Visual Motor Integration

The ability to integrate visual discrimination with the eye-hand coordination system to motorically reproduce a pattern from a model.

Symptoms:

1. sloppy writing or drawing skills
2. poor spacing and inability to stay on lines
3. excessive erasures when doing written work
4. can respond orally but cannot get answers on paper
5. seems to know material but does poorly when tested

Relationship of Visual Processing Problems to Learning

Children with visual perceptual problems may be difficult to teach, failing to understand and grasp basic concepts and ideas. These problems interfere with efficient learning and may seriously impair an individual's ability to respond to standard instruction.

1. Visual processing problems tend to interfere with performance in the early grades. Even in kindergarten and first grade it becomes apparent that these children are experiencing difficulty.
2. Children with visual perceptual problems may be difficult to teach, failing to understand and grasp basic concepts and ideas.
3. Poorly developed laterality and directionality may result in significant problems with reversals.
4. Form perception and discrimination problems may result in the child having difficulty learning the alphabet, word recognition and basic math concepts of size, magnitude and position.
5. Visual memory problems may contribute to poor comprehension, spelling, and sight vocabulary.
6. Visual motor integration difficulties may manifest in poor written work or unusually long periods of time necessary to complete written assignments.

Treatment

Vision therapy to remediate the visual aspects of processing dysfunction

Occupational therapy to remediate fine and gross motor movements of the body

III. Visual Efficiency Problems

These are problems that interfere with an individual's ability to clearly and comfortably gather information through the visual system over long periods of time.

Visual efficiency disorders include:

Binocular vision (eyeteaming) problems

Accommodative (focusing) problems

Ocular motility (tracking) disorders

A. Eyeteaming Disorders (Binocular Vision Disorders)

Binocular vision or eyeteaming disorders refer to a variety of conditions in which the eyes drift inward, outward, upward, or downward. If such a turning occurs it may result in the experience of double vision. To prevent this double vision from occurring, the child will use excessive muscular effort. This muscular effort can lead to eyestrain, blurry vision, discomfort, inability to attend/concentrate, and poor reading comprehension.

Symptoms of Eye Teaming Problems

- Discomfort associated with reading
- Intermittent double vision
- Closes or covers one eye
- Letters or words appear to move
- Loss of place
- Inattentiveness
- Rubs eyes
- Complaints of blurred vision
- Eyes water

Relationship of Eye Teaming Problems to Learning

The effort associated with trying to overcome eyeteaming problems can lead to eyestrain, blurry vision, discomfort, inability to attend and concentrate and poor reading comprehension.

Binocular vision problems are more common in physically, mentally, and developmentally delayed children, learning disabled children and adults and children who have had CVA or TBI.²

B. Focusing Problems (Accommodative)

Focusing problems refer to a set of conditions in which the person has difficulty focusing or relaxing the focusing system of the eyes. There are three primary types of focusing disorders:

Focusing insufficiency – an inability to focus the eyes to see small detail at a close working distance.

Focusing excess – a condition in which the person is unable to relax the focusing system.

Focusing infacility – a condition in which both focusing and relaxing are difficult for the patient.

Symptoms of Focusing Problems

- Blurred vision when looking from board to book or book to board
- Holds things very close
- Headaches when reading
- Fatigue at end of day
- Discomfort associated with reading
- Rubs eyes
- Eyes water
- Complains of blurred vision

Relationship of Focusing Problems to Learning

Focusing disorders generally cause inattentiveness, eyestrain, and discomfort when involved in any task requiring precise vision.

C. Tracking or Eye Movement Disorders

The primary type of eye movement problem that relates to school performance is called saccadic dysfunction. This refers to a condition in which the person's ability to scan along a line of print and to move his eyes from one point in space to another is inadequate.

Symptoms of Tracking Problems

- Excessive head movement when reading
- Frequent loss of place
- Skips lines when reading
- Uses finger to maintain place
- Poor comprehension when reading
- Short attention span

Relationship of Tracking Problems to Learning

Eye movement problems can interfere with almost any school activity requiring vision. Performance will be affected because the child will be unable to consistently make accurate eye movements to look from one point in space to another. This will affect his ability to gather information and respond correctly.

Summary of Effect of Visual Efficiency Problems on Learning

1. All of these conditions have the potential to interfere with the ability to concentrate and sustain at any visual task such as reading. Children with visual efficiency problems complain of eyestrain, headaches when reading, blurred vision and occasional double vision.
2. Visual efficiency problems tend to interfere from grades 3 and older when children have already learned to read and are now reading in order to learn.
3. Children who only have these problems tend to perform acceptably for the first few grades.

Treatment

Vision Therapy

Adjunctive Occupational Therapy

Related Conditions

Strabismus – Strabismus is the name of the condition when a manifest (or cosmetically noticeable) eye turn is present. One or both eyes may be involved. The eye turn can be intermittent or constant. If constant, **strabismic amblyopia** may develop. Depth perception will be reduced or nonexistent.

Treatment:

1. Eye glasses if indicated
2. Vision therapy for amblyopia when present
3. Vision therapy to correct eye turn when indicated

Exotropia (outward eye turn) – high success rate
with vision therapy alone

Esotropia (inward eye turn) – moderate success rate
with vision therapy alone

4. Surgery – when indicated

Functional success rate – 11%

Cosmetic success rate – approximately 40%

Roughly 40-50 % of strabismic surgeries have to
be repeated at least once.

IV. Prevalence of Ocular Conditions for the Pediatric Population

Study Methods

- ◆ Mitchell Scheiman, OD, Journal of the American Optometric Association, April 1996
- ◆ Conducted at Eye Institute of the Pennsylvania College of Optometry
- ◆ 6-month period of time
- ◆ 2,023 consecutive patients
- ◆ Age range: 6 months and 18 years

Prevalence of ocular conditions for the pediatric population as a whole

- Hyperopia (24.8%)
- Astigmatism (22.5%)
- Myopia (17.6%)
- Non-strabismic binocular disorders (eye teaming, focusing, tracking)
(14.3%)
- Strabismus (11.9%)
- Amblyopia (7.1%)
- Ocular disease (3.4%)

Conditions with significant difference by race

	Caucasian	Black
Astigmatism	20.0%	24.3%
Convergence excess	8.4%	6.0%
Intermittent exotropia	2.8%	5.0%
Corneal problems	0.1%	0.8%
Retinal problems	1.1%	2.4%

Conditions with significant difference by age

	below age 6	greater than age 6
Hyperopia	33.0%	23.0%
Myopia	9.4%	19.6%
Convergence insufficiency	1.6%	5.3%
Convergence excess	2.1%	8.2%

Accommodative infacility	0%	1.5%
Accommodative excess	0.3%	2.2%
Intermittent esotropia	5.4%	1.4%
Intermittent exotropia	5.6%	3.3%
Constant esotropia	7.5%	3.9%
Retinal problems	0.5%	2.1%

V. Optometric Treatment Methods

A. Uses of Lenses

When are lenses effective?

- a. refractive error: nearsightedness, farsightedness, astigmatism
- b. some types of focusing disorders
- c. some types of eyeteaming disorders

B. Use of Prism

When is prism effective?

- a. some eyeteaming disorders
- b. used primarily during aggressive vision therapy procedures

C. Vision Therapy

What is vision therapy?

Vision therapy (also known as orthoptics, vision training, visual training, eye training) is an organized therapeutic regimen utilized to treat a number of neuromuscular, neurophysiological, and neurosensory conditions which interfere with visual function.

Vision therapy encompasses a wide variety of procedures to improve a diagnosed neuromuscular, or neurophysiological visual dysfunction. The treatment can be relatively simple such as patching an eye as part of amblyopia therapy, or it may be complex involving sophisticated instrumentation and computers.

Vision therapy usually involves a series of treatment visits during which carefully planned functional activities are carried out by the patient under close supervision in order to relieve the visual problem. The specific activated and instrumentation are determined by the nature and severity of the condition. The frequency and duration of treatments are dictated by the individual situation, although established guidelines are available suggestions appropriate length of therapy for various diagnoses.

When is vision therapy necessary?

Most vision problems can be very easily corrected with eyeglasses. In fact about 90% of the people who complain of vision problems are treated with glasses or contact lenses which enable them to feel and see better.

However, approximately 10% of the population with symptoms of blurred vision and eyestrain have vision problems which cannot be treated successfully with eyeglasses alone. It is this group of people who need vision therapy. Vision therapy is generally required to treat problems of eye teaming, focusing, tracking, lazy eye, strabismus (crossed eyes), and visual perception. Individuals with these problems experience eyestrain when reading or doing other close work, inability to work quickly, sleepiness, inability to attend and concentrate, double vision, and loss of vision. Even more significantly, children with “lazy eye” and strabismus face the possible loss of vision if an appropriate vision therapy program is not initiated in a timely fashion. Children with visual perceptual problems may have difficulty learning.

Is vision therapy effective?

There is extensive clinical and scientific support for vision therapy as a treatment modality. Most of this support is in the optometric literature

since most of the development of vision therapy has been done by optometrists. An article entitled “The Efficacy of Optometric Vision Therapy” addresses this issue. This study includes over 200 supporting studies of vision therapy. (If you would like a copy of this article, contact me at 408-4414).

This article and many others indicate that there is sufficient scientific support for the effectiveness of vision therapy in modifying and improving oculomotor (eye movement), accommodative (eye focusing), and binocular (eye coordination) disorders. Such improvement can be measured using standardized clinical and laboratory testing methods.

Visual skills

like all physical skills

can be taught, trained, practiced, and enhanced.

Directories of Optometrists with Expertise in Vision Therapy

College of Optometrists in Vision Development (COVD)

243 N. Lindbergh Blvd., Suite 310

St. Louis, MO 63141-7851

314-991-4007

www.optom3.com/covd/index.html

COVD is a professional organization of behavioral and developmental optometrists and has the authority to board-certify doctors of optometry in this field. A Fellow with the College of Optometrists in Vision Development, has proven his/her level of clinical expertise in the area of vision development.

American Academy of Optometry

4330 East West Highway, Suite 1117

Bethesda, MD 20814

301-718-6500

AAO is a professional organization of optometrists with the authority to test and board certify doctors in various areas of expertise including binocular vision and visual perception disorders. A Diplomate in Binocular Vision is earned by those doctors who have proven their level of expertise in the field of binocular vision and vision therapy.

Neuro-Optometric Rehabilitation Association, International (NORA)

3956 J Street, Suite 4

Sacramento, CA 95819

www.nora.cc

NORA is a group of professionals with the mission of increasing the awareness of the art and science of rehabilitation for the neurologically-challenged patient.

Parents Active for Vision Education (P.A.V.E.)

9620 Chesapeake Drive, Suite 105

San Diego, CA 92123-1324

619-467-9620

www.pave-eye.com/vision

PAVE is a non-profit resource and support organization whose mission is to raise public awareness of the crucial relationship between vision and achievement.

Optometric Extension Program Foundation (O.E.P.)

1921 E. Carnegie Ave., Suite 3-L

Santa Ana, CA 92705-5510

714-250-8070

www.healthy.net/oep

OEP is one of the main suppliers of brochures, textbooks and testing materials for vision and vision therapy related subjects in the optometric field.

Section 2

Vision: The Process - A Developmental/Behavioral Model

Goal: To understand that visual skills like all physical skills can be taught, trained, practiced, and enhanced.

Vision is learned!

Developmental Anatomy

The nerve layer of the eyeball develops from the same tissue as the brain cortex (neuroectoderm) which means that the eyeball is neurologically the end result of developing brain tissue.

The study of neurology has shown that there are more than one million nerve fibers that exit each eye.

This represents approximately 70% of the sensory nerve fibers in the entire body.

A major amount of information is received by the cortex through the eyeballs each second.

From this information, we can begin to understand the profound importance of *vision as a process* affecting the development of the child and the learning process.

Note: The term “vision” does not mean “eyesight”. Eyesight is an innate, physical characteristic of an individual. Eyesight simply means the level of visual acuity present with best optical correction.

Developmental Model of Vision

In the previous section, a clinical model of vision was presented. That model is useful in understanding the various anatomical components of the eye and associated visual dysfunctions as well as the affect of developing visual information processing skills.

Vision is an entity however that can be explored and evaluated using another model. The next model which will be presented is that of a *developmental or behavioral model of the vision process*.

According to researchers in the field of developmental psychology, the visual system is composed of not one but two components:

a focal process

an ambient process

The **focal process** also can be subdivided into two components – a central pathway and a peripheral pathway.

The **central focal process** is mediated primarily through an area of the retina termed the macula which has the potential for the highest visual acuity due to the high concentration of cone cells in this area whose primary function is in color detection. Nerve fibers from the central retinal leave the eye and emanate to central areas of the visual cortex.

The **peripheral focal process** is mediated by the peripheral area of the retina which is mainly composed of rod cells. The rod cells are more important in lower light situations and movement detection. Nerve fibers from the peripheral retina proceed to the peripheral areas of the visual cortex.

(To borrow a line from an infomercial - But Wait! There's More!)

The **ambient process** unlike the focal process is a subcortical pathway.

Eighteen percent (18%) of the nerve fibers from the retina do not proceed to the visual cortex of the brain but instead proceed to an area of the brain termed the midbrain and then continue to the higher areas of the cortex.

This means one –fifth of the retinal fibers are not involved with the process of eyesight! Instead, these fibers link up with nerve fibers from both the inner ear and somato-sensory signals. *(In plain English)* This means that signals from the eyes, ears, balance and muscle systems merge at this level of the brain. The body uses this information to orient itself in space through posture and movement.

The discovery of the ambient process with its sensory-motor feedback loop matching information from the eye to information from kinesthetic, proprioceptive, vestibular, and tactile systems reveals the intimate relationship that the visual process has with posture, movement, balance, and spatial orientation.

Why does an individual need three different retinal pathways?

For an individual to interact efficiently with his environment, three questions must be answered:

- Where am I?
- Where is it?
- What is it?

“Where am I?” is answered by the **ambient** system for awareness of body sense.

“Where is it?” is answered by the **peripheral focal** system to make judgments of speed, movement, location, size, and shape.

“What is it?” is answered by the **central focal** system to make judgments of detail and color.

Each retinal pathway answers a separate question by electrical signals that travel at different speeds. Therefore, the sensory visual cortex receives three retinal pieces of information.

- The first piece is a reflex creating stability.
- The second is peripheral information helping organize space and time.
- The third piece of information regards detail and color.

Balance Pathway	Peripheral Pathway	Central Pathway
Ambient	Peripheral Focal	Central Focal
<i>Where am I?</i>	<i>Where is it?</i>	<i>What is it?</i>
Subcortical Reflex	Unconscious Cortical	Conscious Cortical
The fastest reflex signal	Fairly fast pathway	Slower pathway

Clinical Pearl: In learning-related vision disorders and dyslexia for example, the peripheral and central signal speeds are not in synchrony which impairs the individual’s judgment ability. Neuro-optometric rehabilitation can alter this asynchrony through the use of lenses, filters, and prisms.

(Because I have an intact visual system, I can use my ambient and focal vision to deal with the world around me, paying attention to a peripheral or a central stimulus according to my need at the moment. An example of this is being able to spot a garage sale sign while driving and carrying on a conversation with my mother-in-law at the same time.)

(Let me give you another example of the interrelationships between the various systems in the brain. How many of you have noticed that when you take your glasses off, you have a difficult time hearing? I know I do. This is an indication that the vision process is needed in order to match information coming in from the auditory process.)

(Another example concerns balance. I would like for you to all stand and balance on one foot. Now, I want you to close your eyes and continue balancing on one foot. Did the act of balancing become more difficult for any of you? It does for many people because the ambient visual system is such an important part of balance.

(As a child during church services, I loved to peek whenever the pastor asked us to close our eyes during prayer because suddenly a good many of the adults would start to sway. They couldn't maintain their balance with their eyes closed. All right, I'll admit it – I still occasionally peek!)

Example of child with poor ambient system – the child is unable to walk backwards/ no concept of the world that surrounds them.

Another example of the effect of the ambient system on the body. Research conducted on blind individuals has shown that even though blind their biological clocks are intact. However, if the blind individual's eyeballs were also removed, the biological clock malfunctions. This also is an indication of the importance of the ambient system on body function, even though sight was not present.

(OK, let's continue with how all of this information relates to vision development in the child.)

Normal Vision Development in the Child

The process of vision is established through the motor system. It is the motor component of vision that develops first and provides information about spatial position. The kinesthetic and vestibular systems are very important in developing ocular-motor control. This loop begins development at 4 months in utero with the development of the ambient visual system.

The eye is constantly in movement due to constant minor flicks and tremors of the ocular muscles. As a result, the image of the environment on the retina is never stable.

Researchers found that if the eye muscles are temporarily paralyzed with a drug, sensory imagery ceases. This is yet another proof that the sensory function of vision (eyesight) ceases when the motor component of vision is paralyzed.

An infant's earliest visual attention is normally directed at fixating a light source utilizing the focal system. The ambient visual process matches information in the sensory motor feedback loop and provides spatial orientation which enables the infant to develop a focalization on the outstretched hand. This is the first time the infant is able to match information received through one sensory modality (vision) with another (kinesthesia and proprioception). This begins process where the infant begins to develop the process of restricting visual awareness to a particular aspect of time and space rather than operating in a continued state of sensory scan. With time, an ability to control the ambient and focal states will develop.

In a newborn infant, the vision signals from the macula (focal system) are not as distinct as they will become several weeks later. Instead it is the infant's ambient system that is allowing the child to organize his motor function to gain control of limbs, head movements, etc.

As motor function becomes organized, the focal process of vision develops in an attempt to refine motor function. These motor experiences in turn later provide a base for higher level sensory discrimination. The ability to match information between the senses and the motor processes yields coordination of motor function.

Normal development continues in a series of cycles. When a cycle is repeated, the infant uses his newly acquired abilities to examine his environment in a new way.

Note: When development is abnormal, whether due to conditions such as chronic ear infections, trauma, disease, or structural defects, there is a mismatch between the ambient and focal systems. The two systems are not balanced.

Time, Space, and Movement

The development of concepts of space and timing are important to the overall development of the child. Depth perception has been studied for years, certain factors are innate (Kitten-plexi glass experiment) Other experiments showed that the visual process of depth perception was established through the structure and reinforcement of the motor system.

Movement is critical to the development of spatial-visual relationships. Movement must also be related to the development of time relationships. Time is represented by how long it takes the child to go from one point to the next. This information is then matched with new auditory and/or visual information to enable him to judge how long it will take to move from one point to another. This process uses higher level sensory processing. However, the basis of this interpretation lies in the experiences that were matched between motor and sensory processes. Once again, this shows that **vision is learned**.

A multi-handicapped child who has lacked the appropriate experiences with time and space will not be able to match information appropriately between the motor and sensory process, particularly vision.

Posture and Vision

In order for the eyes to develop good-quality movement, they also need a stable base which is provided by motor control of the neck in all positions of space. The growing ability of the baby to monitor the position of the head permits more consistent visual examination of interesting objects in the environment. As adults, we adapt the head position to meet our visual needs by means of change in the neck alignment.

As the infant is more upright in space, vestibular reactions begin to lead the balance or equilibrium together with the ambient visual process. A child with impaired vision or with distorted functional vision will not exhibit proper postural control and may experience fear of new situations that lack predictability for the child. This in turn may reduce the child's desire/ability to experiment with postural control which is a part of normal development. **The world does not automatically beckon such children to participate.** These children need to be

given vestibular proprioceptive experiences in play that stimulate their interest in movement and build confidence in their own body.

Without an organized postural system, the sensory-motor data acquired by the child from his environment remains fragmented and fairly disorganized. The problem is seen clearly in children with learning problems who demonstrate postural disorganization. Their central nervous system has never succeeded in relegating postural reactions to the automatic level. These youngsters are constantly distracted from an immediate task by their need to concentrate on maintaining body balance on a chair or moving themselves across the room.

The child's style of vision continues throughout life. Whatever patterns are established by the way a person utilizes the focal and ambient functions are reinforced through motor relationships. Perceptual aspects of vision are very much influenced by the motor functions of this process. This creates a dynamic model of vision which is quite different from the sensory or classic medical model which is often used to describe vision.

(Actually, the medical model does not describe "vision", but "eyesight".)

What is the benefit of understanding this model of the vision system?

(To paraphrase, why have you sat through this lecture)

This dynamic model of vision, which is a developmental or behavioral model, can provide us with new insights into posture and movement which are of primary importance when considering the development of a child or of multi-handicapped and traumatic brain injured individuals.

The medical model of vision (which has reigned for decades) categorizes vision and visual deficits based on the structure of the eye and its affect on eyesight without taking into consideration the function of the eye as a part of the whole body.

For example, using a medical model, the condition of strabismus is generally described as an eye turn due to an over- or underacting eye muscle. Therefore, the only obvious treatment to correct a structural defect is surgery. Never mind that strabismic surgery is functionally successful in only one of ten patients!

A medical model is unable to explain the following scenario. It has been noted that many times a strabismic eye will straighten for a short period of time when the child grasps the examiner's hand and is lifted off his feet. What happened to the over- or underacting eye muscle that supposedly required surgery? A developmental model, being aware of the relationship between balance and function, would suggest that an anomaly of visual development had occurred and can possibly be treated by changing sensory and motor relationships.

Of Clinical Interest: Many individuals with acquired brain-injury suddenly develop strabismus and eye teaming disorders. Rarely were the ocular muscles actually injured, instead the injury occurred in an area of the brain vision involved with vision processing. Obviously, strabismic surgery would not (or should not) be indicated for these patients. The same holds true however for most strabismic patients, whether acquired during normal development or from prenatal/postnatal brain injury.

Facilitating Understanding through the Manipulation of the Visual System

The ambient visual process first facilitates postural information matching with kinesthetic, proprioceptive and vestibular information. The focal visual process then offers higher sensory reinforcement together with vestibular orientation.

Understanding time and space relationships is important in understanding the concept of neuro-optometric rehabilitation. When a mismatch of information occurs between the sensory and motor processing, particularly vision and motor processing, distortions in experience occur. When any type of impairment, particularly a motor impairment is involved, processing of information will be interfered with or distorted. Therefore experience concerning time and space for a multi-handicapped child will be affected because he will not be able to match information appropriately between the motor and sensory processes, particularly vision.

Any distortions that occur between time and space relationships due to mismatches with the visual system may manifest as anomalies in the visual processing system. With time, these distortions affect future judgments.

However, since the vision process is learned, this means that vision can also be trained. (Remember, we are not talking about eyesight, but vision.) Vision therapy as discussed in the first lecture is one such means of intervention used to train certain aspects of vision. Neuro-optometric intervention uses vision therapy techniques as well as other procedures which can change an individual's perception of space, orientation, and time in an effort to rehabilitate the neurologically-challenged patient.

In discussing neuro-optometric intervention, an important aspect is the use of guided activities using specific lenses and prisms that will activate and develop the potential to learn through vision. The concept of the total person is given priority so it is important to provide opportunities to integrate responses that demand more and better function of the somatic-proprioceptive-vestibular experiences that can be linked to vision. Vision is not an isolated function.

When a person is given a guided experience in which the body has to make a postural change for a brief period of time, therapy is challenging the adaptability of the balance and equilibrium systems which intensifies the visual-motor learning process.

Therapy directed to the organization of postural responses results in positive behavioral changes as well as improved fine motor coordination. For example, handwriting control and better organization of school work is often noted after therapy to correct postural control.

Persons who have suffered a traumatic brain injury (TBI), cerebrovascular accident, aneurysm, cerebral palsy, autism, multiple sclerosis, etc. will frequently have associated neurological and physical disabilities. These disabilities may be in the form of a hemiparesis (a dysfunction of the right or left neuro-motor components of their body) or a hemiplegia (a total dysfunction of one side of the body). States of flexion (a tendency for persons to lean forward and contract the anterior portion of their body) or states of extension (a tendency to lean backwards) are common observations of persons who have a physical disability.

Persons with such affected neuro-motor impairment have been viewed as having a dysfunction of neurological impairment. Due to the research on the focal and ambient visual systems, it has

become apparent that after neurological impairment such as a TBI or CVA, mismatches in neuro-motor/ambient visual processing centers result in what has been termed the **Visual Midline Shift Syndrome**.

An individual's concept of his/her visual midline can shift laterally or anteriorly/posteriorly. This in turn will cause the person to visually attempt to shift their own body to a point in space either laterally or anteriorly/posteriorly affecting his/her balance and posture.

One of the most valuable tools for neuro-optometric rehabilitation is yoked prism. Yoked prism are a type of lens system that when placed over a person's eyes have the effect of shifting the person's center of gravity. The hips shift and the person leans toward or away from objects depending on the type of yoked prism used. Therefore, yoked prism can be used to counter the effects of a visual midline shift when used in a prudent, therapeutic program prescribed by a optometrist trained in neuro-optometric rehabilitation.

Prism also has the effect of altering space. Depending upon the orientation of prism, prisms make the perception of space appear to constrict or to expand. This optical characteristic of prism makes yoked prism a useful tool in the neuro-optometric rehabilitation of the individual with a mismatch in perception of time-spatial relationships.

Of Clinical Interest:

Neuro-optometric rehabilitation should be undertaken in conjunction with physical and occupation therapy programs, causing rehabilitation potentials to be maximized. Many occupational therapists have noted that an individual's balance greatly improved once neuro-optometric rehabilitation was initiated which greatly aided the OT's ability to train the child how to jump and hop.

Actual cases:

EC, a 4 year old girl diagnosed with autism, had been a toe walker since 3 years old, viewed out of the side of her eye, unable to color, was clumsy, could not catch or throw a ball. Upon initiating neuro-optometric intervention, the following changes in behavior were noted:

While wearing yoked prisms, EC can catch and throw a ball

Within two weeks, EC's mother reported that the child was now starting to draw and to color independently.

By the 6th session, EC voluntarily jumped over the balance beam in the therapy room. Mother reports that EC can now hop, a skill that the OT had been unable to develop until yoked prism therapy was initiated.

KA – is a 6 year old boy tentatively diagnosed with pervasive developmental delay. Easily distractible by any noise or activity in the room, he was diagnosed with accommodative insufficiency, overconvergence, and developmental visual information processing delays. KA rarely communicates with more than a grunt or a clearing of the throat.

After a session where yoked prisms were utilized, KA suddenly began to speak in a normal conversational fashion with complete sentences for the remainder of the therapy session.

SP – a 6 year old girl with cerebral palsy has farsightedness and strabismus. With the correct optical prescription, the strabismus had been controlled. However, the glasses no longer had the same affect, nor did a subsequent pair. Upon the addition of yoked prism to the prescription to correct for a midline shift noted during a neuro-optometric eval, the strabismus once again was controlled.

Summary

- Visual disability is the fourth largest handicap in the United States.
- Vision is not just 20/20 eyesight and healthy eyes.
- The ambient visual process first facilitates postural information matching with kinesthetic, proprioceptive and vestibular information. The focal visual process then offers higher sensory reinforcement together with vestibular orientation.
- Vision affects the child's overall development. Vision is a dynamic, interactive process of motor and sensory function **mediated by the eyes** for the purpose of simultaneous organization of posture, movement, spatial orientation, manipulation of the environment and to its highest degree, perception and thought.
- Neuro-optometric remediation, through the use of guided activities with specific lenses and prisms, can alter the relationship between the central, peripheral, and balance pathways to activate and develop the potential to learn through vision.
- **Since vision is learned, visual skills skills like all physical skills can be taught, trained, practiced, and enhanced.**

Neuro-optometric Rehabilitation/Remediation

Neuro-optometric intervention has been shown to be effective in the treatment of vision and vision-mediated dysfunctions related to the following conditions:

Amblyopia – refractive and strabismic

Accommodative dysfunctions

Autism

Binocular vision disorders

Cerebral palsy

Developmental Visual Information Processing Delays

Down's syndrome

Ocular motor dysfunction

Nystagmus

Strabismus

Traumatic brain injury

Appendix A

Additional Visual Developmental Milestones in the Young Child

When an infant seizes an object with his hands, it is drawn immediately to his mouth – response indicating the development of form and substance perception. The infant is using tactile information to reinforce vision. As his visual experiences are reinforced by other senses, he will no longer need this added tactile input to derive meaningful information about an object.

24 weeks - the infant immediately releases the object upon touching it to his lips as he now relies on his visual interpretation of the object and has less need for other sensory reinforcement.

32 weeks - the infant is able to localize sounds beyond his reach which reinforces the infant's visual projections into his space environment. Depth perception however will need additional experiences in order to develop, which is evident when four weeks later the infant now has better orientation in space.

Development continues in a series of cycles. When a cycle is repeated, the infant uses his newly acquired abilities to examine his environment in a new way.

40 weeks - the infant begins to explore the relationships of three dimensions and by one year the child shows a basic understanding of his three dimensional domain. At this age, he also shows auditory perception of distant objects. The basic understanding of three-dimensional space develops through an interweaving of multisensory experiences.

For example, the child sights an object visually, reinforces this sighting with motor movement involving tactile and kinesthetic input, while integrating auditory perception of sounds with visual and motor perception of distance. The child's perception of space is also observed with the child's ability to move objects alongside or above another object.

15 months - the awareness of the relationships between sights and sounds becomes more acute as evidenced by a child demonstrating interest in a moving toy especially if accompanied by sounds. Also by this age, the child is able to grasp an object but look towards the point at which he is directing his movement instead of having to keep his eyes on the object the entire time.

VISION AS THE DOMINANT SENSE LEADS MOTOR DEVELOPMENT.

Vision allows the child maximum efficiency and a conservation of energy in his movements.

18 months - the child is strongly driven by motor movement. In fact this drive is so strong that it would appear that motor is leading vision.

2 years - the child may use words such as "where" to gain information concerning spatial perception. Language skills have developed to a point which allows the child to reinforce visual experiences. There is also increased eye-hand coordination.

2 ½ years – the child is easily distracted by the slightest movement in his peripheral vision, thus to keep a child's attention to a task, the child has to stay involved manually and visually. He also has difficulty planning ahead. This age child demonstrates increasing ability to discern differences through vision and the other senses.

3 years - eye-hand coordination is more accurate, the child is not as easily distractible, and the ability to plan and organize in advance has developed significantly. The 3 year old tries to organize things in symmetrical relationships, becomes upset when organization is broken, and shows a preoccupation with the wholeness of things – a concept called perceptual closure.

Appendix B

Recommended Childhood Routine Eye Examination Schedule (American Optometric Association):

6 months of age - First dilated eye exam with an optometrist or ophthalmologist (not a semi-professional at the pediatrician's office or a school nurse)

3 years old – Dilated eye examination with an optometrist or ophthalmologist

5 years old – Dilated eye examination with an optometrist or ophthalmologist

Biannual exams thereafter

(Note: this schedule would be modified as necessary depending on the result of the eye examination)

Visual skills

like all physical skills

can be taught, trained, practiced, and enhanced.

1. Garzia, R, *Vision and Reading*, Missouri, 1996, Mosby-Year Book, Inc.
2. Scheiman, M, *Understanding and Managing Vision Deficits*, New Jersey, 1997, SLACK Incorporated, 70

Padula