Traumatic Brain Injury: Re-integrating Vision, Hearing, Speech and Balance

BIANJ Conference 2017

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Learning to see with double vision.

Rebuilding the Brain, Building Bridges – Keynote Speech NORA 2014

In this segment from my keynote speech at the Neuro-Optometric Rehabilitation Association conference 2014, I briefly touch on mechanisms of plasticity and repairing neurons through a combination of synergistic therapy and brain building nutrition—including an analogy.

My Brain Injury Diagnosis – Keynote Speech NORA 2014

In this clip from my keynote speech at the Neuro-Optometric Rehabilitation Association conference 2014, I discuss my mother’s first receiving notice about my fall and the events surrounding my diagnosis of a diffuse

The Cerebellum – Keynote Speech NORA 2014

In this segment from my keynote speech at the Neuro-Optometric Rehabilitation Association conference 2014, I discuss an amazing region of the brain—central to my own diagnosis and recovery. Latin for “little brain,” the cerebellum plays an
In 2011, I fell two stories, was comatose for 12 days and was diagnosed with a severe traumatic brain injury. Approximately 90% of those with this type of injury never regain consciousness, and those who do will often remain significantly impaired or in a vegetative state.

I work to assist TBI survivors and individuals with neurological conditions. Join me on my journey to improve the conventional model of neurorehabilitation!
Disclosure of Conflicts of Interest

S. Moshe Roth, OD, FCOVD

No financial relationships and/or commercial interest in any products discussed.

Member: BIANJ
Brain Injury Alliance of NJ
Youth Sports Concussion Committee

Member: NORA
Neuro-Optometric Rehabilitation Association
NORA

- Neuro Optometric Rehabilitation Association
- Founded in 1990
- Mission is to:
  “Further the art and science of comprehensive neuro-vision rehabilitation for individuals with neurological impairments, in collaboration with health professionals in all disciplines”
Goals of Presentation:

1. To **expand** understanding of Visual Components of Brain Injury
   - Acquired Brain Injury
   - Traumatic Brain Injury
   - Concussion = Mild Brain Injury (especially as it pertains to young athletes). Cumulative effects of concussion.

2. To **explain** basic Neuro-Optometric diagnostic and therapeutic strategies that include ergonomics, lens systems, and therapies.
Goals of Presentation: 2

3- To explain how individuals being cared for by other disciplines, i.e.
   - medicine: physiatry, neurology, sports medicine,
   - psychology, neuropsychology,
   - therapists: physical, occupational, speech, etc..
   can benefit from Neuro-Optometric Rehabilitation

4- To explain how a team approach that includes Neuro Optometric Rehabilitation
   - enables individuals to regain visual skills, and
   - facilitates and enables patients to gain more from other therapies.
Brain Injury:

- Acquire Brain Injury:
  - Stroke
  - Brain Tumor
  - Embolism
  - Aneurysm
  - Hemorrhage
  - Ischemia
  - Lyme Disease
  - MS
  - CP
- Traumatic Brain Injury: a significant sub-classification
  - Penetrating - GSW
  - Non-penetrating – bicycle accident, car crash
  - Can be either with loss of consciousness OR no loss of consciousness
- Concussion: Mild Brain Injury
  - Football, bicycle, soccer, or other sport injury

These are the people who can benefit from a Neuro-Optometric Rehabilitation Evaluation

“Life is never the same after brain damage... but it can still be great”
Bird inflicts a TBI
Common Findings with Acquired Brain Injury

- Many patients with head injury have characteristic visual sequelae

- These include problems with:
  - binocular vision, c/o diplopia (double vision)
  - accommodation c/o blur
  - spatial localization, c/o easily becoming disoriented, dizzy, nausea
  - concentration, and c/o can’t attend, maintain “focus”, can’t remember
  - difficulty visual motor tasks c/o difficulty with coordination
Despite the **visual symptoms** that people experience, **most**

- **Do not** associate the TBI / ABI with the visual symptoms.
- **Are unaware** that these **visual problems** can be addressed by addressing the visual system.

- Symptoms are often disproportional to the injury
- Injuries can be cumulative. 1+1=2 or >2
- Athletes think they only have their “Bell Rung” and return to play sooner than they should.
  They are then more vulnerable to a second injury.
Team approach

In addition to PT, OT and SLP... 
... the Neuro-Optometrist is in the unique position of being able to address and treat the vision issues, in order to help the patient best recovery.

Treating the underlying vision issues facilitates
- more rapid recovery, and
- enables other therapies to be more effective.
What is “Vision”? 

Medical Problems

Sight
- Acuity
- Refractive status
- Visual Field
- Contrast Sensitivity
- Color Vision
- Glare Sensitivity

Visual Problems

Visual Skills
- Pupils
- Pursuits
- Fixation
- Accommodation
- Saccades
- Strabismus/Diplopia
- Vergence Problems
- Nystagmus
- Vestibular Ocular Reflex
- Aniesokonia
- Intermittent Central Suppression

Visual Processing

- Visual–Motor Integration Skills
  (Handwriting, Reach and Grab, Ambulating, Driving)
- Visual–Analysis Skills
  Visual Discrimination
  Visual Closure
  Visual Form Constancy
  Visual Figure Ground
  Visual-Spatial Relations
  Visual Memory
- Visual–Spatial Skills
  Visual Midline Shift Syndrome
  Unilateral Spatial Inattention (Neglect)
  Visual Multitasking
  Post-Trauma Vision Syndrome

Health Assessment: (cataract, glaucoma, retinopathy, tissue injury, dry eye, etc.)
Structure and Function

Analogy: Car after an Accident.

- Alignment may be off
- Can repair exterior and it may look fine
- Carfax

Person may appear fine externally.
Structure and Function

Some professionals (i.e. ophthalmology) investigate structural issues
Others (i.e. neuro-optometry) concentrate on function.

2 separate sub-specialists
Neuro-Optometry ≠ Neuro-Ophthalmology

Neuro-Optometry – REHABILITATES to improve what can be (future).

Understanding where the brain function centers are,
enable us to deduce area of brain that were impacted by a stroke / TBI
Physical symptoms

- Headache
- Nausea
- Lack of physical and mental energy
- Dizziness, light-headedness, loss of balance
- Blurred or double vision and sensitivity to light
- Increased sensitivity to sounds and ringing in the ears
- Change in sleep patterns, such as waking up a lot or sleeping too much
Cognitive Symptoms

- Difficulty concentrating and paying attention
- Trouble with learning and memory
- Problems with word-finding and putting thoughts into words
- Easily confused and losing track of time
- Slower in thinking, acting, reading and speaking
- Easily distracted
- Trouble doing more than one thing at a time
- Lack of organization in everyday tasks
Social and emotional symptoms

- Mood changes including irritability, anxiousness, and tearfulness
- Decreased motivation
- Easily overwhelmed
- More impulsive
- Withdrawn and wanting to avoid social situations
Concussion is an invisible injury

Changes in a student’s thinking, learning and behavior may be blamed on other causes.
For example, mental fatigue or difficulty concentrating might be misinterpreted as laziness or disinterest.
A student with concussion may:

- Get tired easily in class
- Be bothered by fluorescent light or loud noises
- Be easily distracted
- Have trouble doing more than one thing at a time
- Take longer and need more repetition to learn new material
- Remember something one moment but then not recall it later
Concussion and Mental Stamina

In general, concussion affects mental stamina more than intellectual ability.

The reason: the injured brain must work harder to accomplish anything, and so the student gets tired more easily.

Fatigue and over-exertion will often be accompanied by a temporary worsening of post-concussion symptoms.
Post-Sports concussion

Treatment:
- Physiatry
- Ophthalmology
- Neurology
- Occupational and Physical Therapy for Motor Skills
- Ophthalmology: Tx-Wear a Patch
- Neuropsychology
- Cognitive Therapy
What is 20/20?
What is Vision?
Does 20/20 = Vision?
The Myth of 20/20 Vision

Most vision problems are not detected because most people think:

20/20 = perfect vision.
“Reading” The Eye Chart

- Please pair up with the person sitting next to you.
- One person reads the middle line.

- As you read that line, notice what your eyes are doing.
- Observer: notice how the reader’s eyes move.
- Then switch.
- Please do this as quickly as you can.

Notice:
1. How much do your eyes move?
2. Where do your eyes point or aim?
3. How much “stuff” is there for you to look at?
What is 20/20?

You are looking at the eye chart that is 20 feet away from you.

You can see a certain size letter you should see from 20 feet.
Now “Read” the paragraph

As we did before,
• pair up with the person sitting next to you.
• One of you should read the paragraph.

• Notice what your eyes are doing.
• Observer should notice what the how your eyes move.
• Then switch.
• Please do this as quickly as you can.

Notice:
1. How much do your eyes move?
2. Where do your eyes point or aim?
3. How much “stuff” is there for you to look at?
Was there a difference when “Reading” The Eye Chart versus “Reading” a paragraph?
Reading a Paragraph

- Eyes move from left → right
- As the eyes move, print has to stay
  - clear
  - single
- When you reach the end of one line you have to swiftly and precisely move to the beginning of the next line.
Is there a difference when “Reading” The Eye Chart vs. Reading a paragraph?

<table>
<thead>
<tr>
<th></th>
<th>When Viewing The Eye Chart</th>
<th>When Reading a Paragraph</th>
</tr>
</thead>
<tbody>
<tr>
<td>How much do your eyes move?</td>
<td>little</td>
<td>A lot</td>
</tr>
<tr>
<td>Where do they point?</td>
<td>Straight</td>
<td>In</td>
</tr>
<tr>
<td>How much volume of material?</td>
<td>little</td>
<td>A lot</td>
</tr>
<tr>
<td>Do you need to shift your eyes to the next line?</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Is there a difference when “Reading” The Eye Chart vs. Reading a paragraph?

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<thead>
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<th></th>
<th>When Viewing The Eye Chart</th>
<th>When reading a Paragraph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital or Small case?</td>
<td>Capitals only</td>
<td>Both, plus punctuation.</td>
</tr>
<tr>
<td>How many lines?</td>
<td>One</td>
<td>Many</td>
</tr>
<tr>
<td>Type of information</td>
<td>Symbols</td>
<td>Concepts</td>
</tr>
<tr>
<td>Spacing ?</td>
<td>Equal</td>
<td>Not equal Words of different length</td>
</tr>
</tbody>
</table>
Is there a difference when “Reading” The Eye Chart vs. Reading a paragraph?

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<thead>
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<th>When Viewing The Eye Chart</th>
<th>When reading a Paragraph</th>
</tr>
</thead>
<tbody>
<tr>
<td>How much time did it take ?</td>
<td>Little time (seconds)</td>
<td>Considerably longer. The time it takes to complete an assignment or test.</td>
</tr>
<tr>
<td>How was this done ? 1 eye ? 2 eye?</td>
<td>One eye at a time</td>
<td>Both eyes together.</td>
</tr>
<tr>
<td>At what distance was this done?</td>
<td>Distance</td>
<td>Near</td>
</tr>
</tbody>
</table>
Is this test sufficient?

...to determine if someone has ALL of the visual skills for reading?

What does this tell us about...
- Peripheral (side) vision?
- Depth Perception?
- Color Vision?
- Eye Health?
- The ability to use the 2 eyes together as a team?
The Eye Chart test is a measure of how little we can see, rather than how much we can see.

All it means is that you can see and identify small letters when looking at the chart from a distance of 20 ft.

The eye chart is testing our central, fine detail system.

It is a good screener for certain refractive disorders.
The take home point is that:

The 20/20 chart evaluates only SIGHT, = Visual Acuity.

It does **not** evaluate the other visual skills necessary for reading and learning in the classroom, or functioning in the real world.
Example:

- Driving a car, seeing tail lights of car in front of you,
- Vision addresses the question: “what do I need to do?”
in the classroom...

- The child, sitting at his/her desk has to
  1. Look at the board,
  2. Then look at his notes on his desk,
  3. Remember what he saw on the board and then
  4. Write his notes
  5. Look back up at the board
  6. He has to look at the teacher

The child uses his eyes ALL DAY LONG.

Need a visual anchor.
Vision is our dominant sense.

- 80% of all sensory information is visual.
- Vision gathers more information per unit time.
- Vision enables us to gather information from distance.
- Vision tends to override other senses.
  (Prism demonstration on doorpost)

When vision works well, the benefits are synergistic

When it does not, the detriments are antagonistic
There is more area of the brain dedicated to vision than all of the other sense modalities combined.

- Peripheral = where is it?
- Central = what is it?

(Detail)
Vision Overrides All Senses

When there is a conflict between what a person sees and what the tactile and proprioceptive senses conveys, visual function determines the perception.
Demonstration: please stand

1. Place heal to toe
2. How do you feel?
3. Now close your eyes.
4. What happened?
Bimodal System

Central
Peripheral
Focal System

- Focal system = **Central** Vision
- Much **slower** than the ambient system

- Cells that react to
  - stationary
  - small targets,
  - Detail and Color
The Ambient Visual System Periphery responds to large and fast moving stimuli.

- Unconscious
- Movement
- Black and White
- It derives information from:
  1. the visual system
  2. the vestibular system
  3. the other senses (i.e. hearing, smell.)
Focal and Ambient Systems
Figure / Ground

- Need to work in harmony
- They are not isolated systems
- A disconnect in the ambient system will cause problems with spatial orientation
  - Symptoms include: balance problems, bumping into things, difficulty navigating
1. Cover your LEFT eye WITH your LEFT hand.
2. Use your right index finger and point to one letter. (keep your finger pointing at that letter)
3. Now MOVE your LEFT hand to cover your RIGHT eye.

What letter are you pointing to now?

- Do you realize now that each eye gives you a separate or different image?
Eyes Have to Point to the Same Place
Once upon a time, there was a very ugly duckling. One day a beautiful princess came along and rescued him from a horrible fate. She picked him up into her hands and was ready to kiss him when….

Imagine the impact on a child to be told that their vision is fine, yet when they go to read it looks like this...

Once upon a time, there was a very ugly duckling. One day a beautiful princess came along and rescued him from a horrible fate. She picked him up into her hands and was ready to kiss him when….

...or someone that had suffered a brain injury and was told that there is nothing wrong with them anymore.
Accommodation

- Accommodation = the mechanism that enables us to focus at near and de-focus when looking at distance,
- Problems with Accommodation can also bring about symptoms and problems that simulate ADHD.
- If someone cannot physically focus (as we would focus a camera) then it will be difficult for them to mentally focus, meaning, to concentrate.

We are looking for the individual to demonstrate
  1- the strength and
  2- the ability maintain that.
    1- Can you pick up a 5 lb. bag of sugar?
    2- how long can you hold it?

Demonstration: Hand / fist
Eye Tracking Skills = Pursuits

Pursuits is the ability of the eyes to track across a page or to track a ball being thrown or a car driving down the road.

Paullik esto take his purplet oy truck to the playground and share it with his friends. At the playground Paulen joys swing ing and climb on the jungle gym.
To use vision effectively, we must use central + peripheral

Demonstration

- Look straight ahead and cover your left eye
- Notice what you can see to your right
- Notice what you can see to your left

- Now cover only your right eye
- Notice what you can see to your right
- Notice what you can see to your left

Q: Do you see the same picture with each eye?
• No!
• You see a different picture with each eye.
• There is one area in the middle where the 2 are overlapped (where they are the same)
• It is because of that overlap that you can then fuse the 2 images together to make one big picture.

Q: If the 2 eyes don’t fuse the images, (i.e. don’t work together as a team) what do you see?
A: 2 different pictures!
If the 2 line up together, you see one picture.
You are able to FUSE the 2 pictures into one
If they don’t, you see... 2 pictures!
If I see 2 pictures, it leads to CON-fusion
To avoid seeing 2, someone may suppress (turn off) the image from one eye.
Suppression requires effort an additional energy.
It is not the absence of the 2\textsuperscript{nd} image.
Exotropia
Symptoms of Strabismus

If strabismus occurs after a sports injury, the child may have intermittent double vision.

They may
- close or cover one eye
- say that letters or words appear to move
- lose place
- requires energy to suppress and avoid seeing double.
- or extra energy to keep the eyes aligned.
- this additional effort draws energy and makes it more difficult to
  - process information,
  - maintain attention,
  - comprehend.
Symptoms of Strabismus

It may produce symptoms such as
- inattentive
- rubbing eyes
- watery eyes
- complaints of blurred vision
- poor reading comprehension
Binocularity:  

Convergence Insufficiency & Convergence Excess

- **Binocularity** = the ability to use the two eyes together as a team.  
  (Bi-cycle.  Bi-plane)

**Demonstration:**
- Right palm facing you
- Left palm, (just a little closer than your right) facing away from you.

Convergence Insufficiency or Convergence Excess.

- Convergence Insufficiency:  the inability to sufficiently point the eyes IN, *and* difficulty **maintaining** that position.
- Convergence Excess:  pointing the eyes IN excessively, *and* not easily being able to point the eyes out.
Binocularity

Why is it important to be able to be binocular?

• In a classroom, the child must
  • Point their eyes straight to look at the board
  • Point their eyes in to look at notes
  • Point their eyes straight to look at the teacher
  • Point their eyes straight to look at a book
• Need to be able to do this hundreds of times each day.
Binocularity

- When doing a reading assignment in school, or homework assignment, or taking a test, we need to not only point in, but must be able to **maintain and sustain** that for the duration of the task.

- If not able to sustain that effort, then the child needs to allocate additional energy and effort to do that.
- The child then has less energy available for processing, and cognition.
Binocularity

- The more visual energy a child needs to use in order to physically focus the eyes and fuse the 2 images together, the less energy they have for higher level functions.

- The goal is to minimize the energy draw for the visual component so have more energy for reading and learning.
Binocularity

- The purpose of reading is to be able to
  - Absorb what the person has read
  - Recall what has been read
  - Cognate = derive new concepts from that.
- If difficult to use the 2 eyes together, then the individual must expend more energy and effort than need be. Inefficient.
- Phonics is important but it does not enable us to understand what we have read.
- The purpose of reading is to COMMUNICATE in a non-verbal way.
- It is NOT to “bark” at words.
- **Goal:** to reduce the energy needed in the visual component of reading so have more energy for the mental and higher level portion of reading.
Binocularity

- If it difficult for an individual to *physically* fuse the image from each eye together, the individual then has difficulty to concentrate.

- Mental “focus” = concentration = Attention
- Difficulty = Deficit
- Difficulty concentration = **Attention Deficit**
- This is why someone who has vision problem due to a brain injury, may then have difficulty with attention and may be given medication for (or a diagnosis of) Attention Deficit Disorder.
- Often, the vision problem is the source.
- When solving the underlying vision problem, the deficit in attention goes away.
Binocularity

- Medicating for ADD (Ritalin, Adderrol, Concerta, Strattera, Focalin, Intuiv, etc.) does not solve the problem, but rather, masks the problem.

- Medication does not improve learning.
- Convergence Insufficiency is commonly associated with Attention Deficit disorder.
- If an individual cannot use their eyes effectively, it is difficult for them to then:
  - Input information,
  - Process that information, and
  - have good Output.
- Garbage in. Garbage out.
Binocularity

- Convergence Insufficiency is a common post concussion or brain injury.
- Leads to difficulty in maintaining attention.
- ADD does NOT cause Convergence Insufficiency
- Convergence Insufficiency causes Deficits in Attention
- If it is difficult for the child to use their eyes effectively as a team, or difficult for them to physically focus, it will be difficult for them to maintain attention, hence this may be misdiagnosed as an attention deficit.
We must ...

- 1st determining that the eyes are healthy,
- Then determine if the individual has the vision skills to
  (1) Fixate (look and lock onto an object)
  (2) Follow (track)
  (3) Fuse (eye coordination) and
  (4) Focus (getting a clear image)

This must occur in order to get a good image to the brain.
The next step is to make sense out of what one has seen.
Skeffington’s 4 circles
A diagrammatic model of vision

Anti-Gravity
Where am I?
(midbrain)

Speech-Auditory Communication
1- (Werneke’s area)
2- (Broca’s area)
3- internal speech

Centering
Where is it?
(Dorsal)

Identification
What is it?
(Ventral)

Vision
The 1\textsuperscript{st} part of vision is: Visual Efficiency getting the information IN

The 2\textsuperscript{nd} part of vision is: Visual Processing making \textit{sense} of that information
Yoked Prism Demonstration

- Walk
- Walk with prism

Audience: What do you observe?

Notice:
- Gait
- Rhythm of walk
- Using tactile information
- Ease and fluidity of walking
What is Visual Processing?

- Visual Processing is making sense of what we see.
- Auditory Processing (CAPD)
- Visual Processing VPD
- Demonstration (next slide)
- Will show this slide for 5 seconds.
I
Like
Paris In
In the Spring
What did you see?

- This is an example of Visual Processing:

- How quickly you can
  1. absorb / assimilate the information and
  2. exclude unnecessary information
I
Like
Paris In
In The Spring
• This demonstrates how the brain eliminates unnecessary information.

• Visual Processing = how quickly we absorb information and make sense of that information. Think of traffic flow.

• When someone has a vision problem that impacts reading and learning, the ability to absorb information is slowed.

• This causes frustration and can then lead to avoidance.
Visual Perception = the mental processing and manipulation of the image so it can be understood and interpreted correctly.

Only then is the individual prepared for cognition and comprehension.

Visual Processing = “how quickly is traffic moving?”
Signs of Vision Problems

1. Skips words
2. Rereads lines or phrases
3. Reads too slowly
4. Uses finger to guide eyes
5. Reverses words or letters
6. Unusual fatigue or restlessness after maintaining visual concentration
7. Complains of letters or lines "running together” or “jumping around”
Signs of Vision Problems

8. Complains of blur while reading or writing
9. Moves head while reading.
10. Moves more to one side consistently or bumps into objects always on the same side
11. Poor ability to remember what is read
12. Writes up or downhill on paper
13. Misaligns both horizontal and vertical series of numbers.
The 3 O’s

Ophthalmologist
Optometrist
Optician
What is the Difference?

Optician
What is the Difference?

Ophthalmologist
What is the Difference?

Optometrist

- Evaluate how we use vision in our daily life.
- Diagnose, treat, and manage eye disease.
- Write prescriptions for medications and eyewear.
Optometrist and Ophthalmologist

Vision
- Eye Exams
- Rx EG & CL’s
- Tx disease

Surgery

Dentist
Pediatrician
Cardiologist
Neurologist

Oral Surgeon
Pediatric Surgeon
Cardiothoracic Surgeon
Neurosurgeon
Developmental Optometry and Neuro-Optometric Rehabilitation

SPECIALTY WITHIN OPTOMETRY –

Specializes in diagnosing and treating vision problems that interfere with reading and learning, and solving life’s visual problems, whether due to a delay in development, a head/brain injury, or otherwise.

Board Certification in Vision Development.
So, in conclusion, What is vision?

Vision is
the Deriving of Meaning and
the Directing of Action
as triggered by light

Deriving meaning = sensory input
Directing of action = motor output
The visual system writes the equations for the motor system to solve.
How can we *improve* the motor (body’s) ability to react to the visual system?

**Vision Therapy & Neuro-Optometric Rehabilitation**

enables the individual to effectively use

- their visual system *to input information* and then *to process that information*.
- the two eyes together as a team, in order to *bring in information* and then *to make sense* of that information.
- *take in* a large amount of *information* with the *least amount of energy* to quickly solve issues of daily life.
What is Vision Therapy & Neuro-Optometric Rehabilitation

It is a clinical approach for correcting

1. eye movement disorders,
2. focusing disorders,
3. Strabismus (eye turn)
4. Amblyopia (lazy eye)
5. Visual Perceptual (information processing) disorders.

6. Individuals that never developed the visual skills
7. Individuals that had the skills but lost them due to brain injury (concussion, traumatic, acquired)
More Information

- EyeDrRoth@aol.com
- www.NJBeyond2020.com (one word)

- College of Optometrists in Vision Development
  - www.covd.org 1-888-COVD770 (1-888-268-3770)

- Neuro-Optometric Rehabilitation Association
  - www.NORA.cc

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