It IS All in Their Head: An Introduction to Neuro-Opticianry

Cira Collins, MPH, ABOM, NCLEC, LDO

1

My Failures

Academic Setbacks

- I left a fully-funded PhD program in Medical Sociology.
- I got a master's degree I do not use – and am still paying for.

Career Challenges

- I left a career in International Public Health after only a year and half.
- I made a necessary staffing changes and botched how I delivered it, losing two of my best employees.
- I have botched job interviews for jobs for which I was very qualified.

Personal Struggles

- I have gained, lost and regained the same 60 lbs.

2

Why?

Neuro-opticianry is an emerging opticianry sub-specialty

Fascinating!

Science is understanding the brain/eye connection better

New tools are emerging

20/20 Acuity is no longer sufficient

Wellness

3

Course Overview

Do a deeper dive into the neural pathways of vision

Distinguish between therapeutic, antagonistic, and yoked prisms and describe when each might be used

Identify conditions seen in Neuro-optometric practices by their symptoms and patient reports

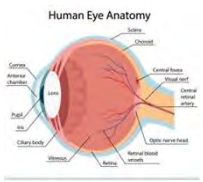
Describe tools used by opticians to help solve neuro-optometric issues

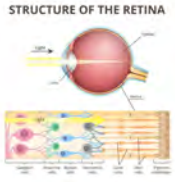
Identify at least three other subjects that would be needed to feel competent as a neuro-optician

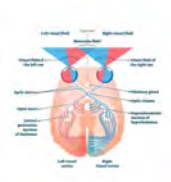
4

The Neural Pathway:

Review of neural pathway from light impulse to occipital lobe







5

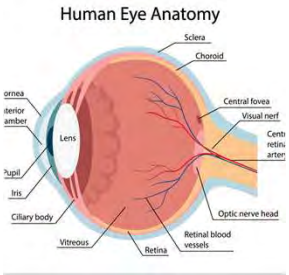
The Neural Pathway

Review of neural pathway from light impulse to occipital lobe

Visual Pathway: Eye

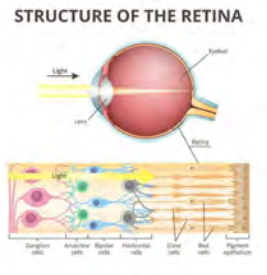
In the eye

- Tear Film Layer
- Cornea (43D)
- Pupil (Cilliary Muscles)
- Lens (12-15D)
- Vitreous



6

Visual Pathway: Retina



Retina – (Fovea)

- Ganglion – Carry visual information to the brain and ipRGC
- Amacrine – Make contact with ganglion, horizontal and bipolar cells

o Refine visual signal by being able to modify the signals of other cells

- Bipolar- Pass on signals about perceived light to ganglion cells
- Horizontal – Have horizontal dendrites that spread horizontally and contact multiple photoreceptors

o Enhance contrast and adapt to changes in lighting

- Photoreceptor – Cone or Rod

7

The Visual Pathway: The Optic Nerve

Optic Disc

A bundle of Ganglion cells

Visual Pathway, Cranial Nerve II

The Optic Nerve

8

The Neural Pathway: The Optic Chiasm

Optic Chiasm

60% cross over, 40% stay on the side that they originate from

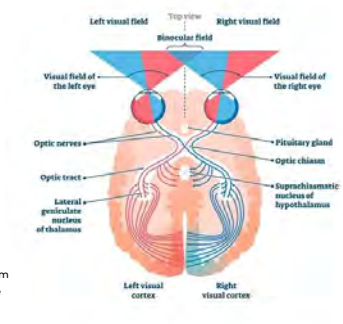
Central Carotid Artery

RIGHT next to the Optic Chiasm

Pituitary Gland

JUST under the Optic Chiasm

Pressure from a dilated Internal Carotid Artery or from a growth of the pituitary will disrupt the axons of the Optic Tract



9

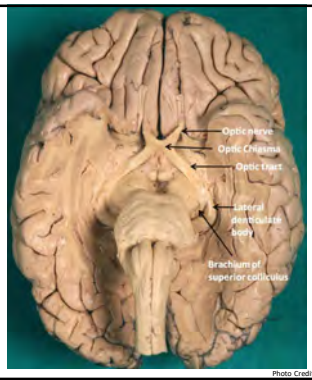


Photo Credit: Ophthalmic Signs in the Practice of Medicine; Feb 2024

10

The Neural Pathway: The Optic Tract

After Chiasm in the Thalmus

No longer called the Optic Nerve, now called the Optic Tract

Pretectum

Pupillary Light Reflex

Hypothalmus

Super Chiasmatic Nucleus – Circadian Rhythms

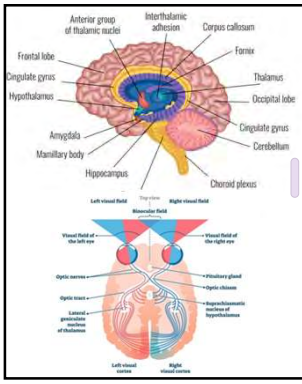
Superior Colliculus

Coordinate Head and Eye Movements

Lateral Geniculate Nucleus

Most fibers end here (one on each side)

11



The Neural Pathway: The LGN to V1

Optic Radiations

Bundles of Fibers called the Optic Radiations

Calcarine Sulcus

A Fissure or brain wrinkle

Primary Visual Cortex

The Primary Visual Cortex (V1)

12

Visual Processing in V1

V1 Organization

Part closest to skull for central/foveal vision, deeper for peripheral

Spatial Mapping

Upper vision, down low; lower vision, higher

Striate Cortex

White stripe processing orientation, movement, contrast, depth

Higher Processing

Communicates with V2-V8, each with specialized functions

These other areas recruit other parts of the brain to do higher level processing moving from basics like shape and contrast to object recognition

13

A word on the Trigeminal Nerve

5th Cranial Nerve

The Trigeminal Nerve is the largest of the 12 cranial nerves

Ophthalmic (V1)

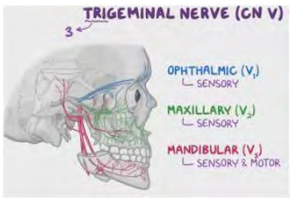
Extends into the cornea and the ciliary bodies

Maxillary (V2)

Middle branch of the trigeminal nerve

Mandibular (V3)

Responsible for sensations and movement



Thus, the trigeminal nerve is implicated in photosensitivities.

Image Credit: vrougue.co

14

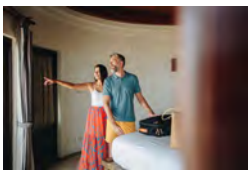
Two systems: The vergence and the accommodative

Vergence System

Extra-Ocular Muscles make the eyes work together (efferent system)

Accommodative System

Inter-Ocular muscles make images focus (afferent system)



To do this, we have to have both systems work with stamina, stability, smoothness and without fatigue.

15

The eyes fix their gaze on a subject of interest using:

Saccades

A quick eye movement where your eyes jump from one target to another

Pursuits

A smooth eye movement where we move our eyes at the same speed that the target is moving

Vergence

Extra-ocular muscles that line our eyes up to work together

Vestibulo-Ocular

Orientation of the eyes in the head and head in space

16

What is perfect binocularity?

- Focus
- Saccadic eye movements
- Smooth Pursuits not requiring head movement
- Perfect Vergence (Eye Teaming)
- Straight Head

Leading to one, fused, 3-D image, with depth perception and a wider field of view (200.), spatial awareness and visual coordination

17

What is imperfect binocularity?

When the muscles of the eyes or the perception system do NOT sustain two images that can fuse and fully capture the field straight ahead and equally on both sides or cannot do so without making compensatory effort.

H 53.30

Diagnosis Code

Unspecified Disorder of Binocular Vision

18

The Neuro-optometric umbrella

Neuro-optometry

The overlying umbrella – affected by disease, trauma

Sports Vision

Focuses on enhancing sports performance combining acuity and cognitive ability

Binocular Vision

Addresses refraction, accommodation and vergence systems, particularly related to learning and information processing

19

What symptoms indicate a neuro-optometric patient?

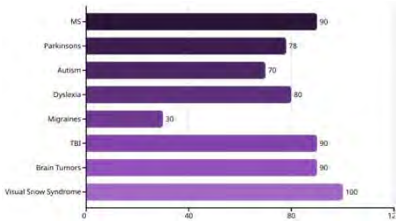
20

Symptoms not specifically Visual

- Car Sickness
- Driving Anxiety
- Dizziness
- Headaches
- Rereading or skipping lines of text
- Persistent head tilt

21

Systemic Conditions



- Sensory Processing Disorders: ?
- Cancer, Especially with Brain Tumors: Varies by cancer and location – Up to 90% of Brain Tumors

22

PRISM

Definition

A prism is just a translucent wedge of material that shifts images toward the apex and light toward the base.

Properties

It has dioptric power, but not refractive power.

23

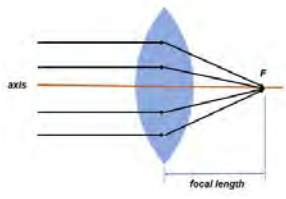
Diopters

What is a diopter of spherical/refractive power?

The amount of power required to focus light at one meter. The dioptric power is the inverse of the focal length. (D)

F= 1/D

D = 1/F



24

Diopters

Prism Diopter Definition

The amount of power required to shift an image

Measurement: 1 degree shift

Shifts image by 1 degree

Measurement: 1 cm at 1 meter

Shifts image 1 cm at 1 meter from the optical surface (PD)

25

What is a Phoria? Tropia?

Phoria

A phoria is a tendency for the eyes to deviate from working together.

Tropia

A tropia is a steady state of the eyes not aligning.

Directional Terms

- Exo- Out
- Eso- In
- Hyper – Up
- Hypo - Down

26

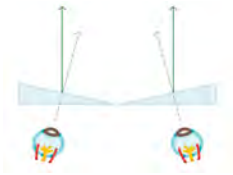
Base In and Base Out Prism Functions

Base In Prism

Base In Prism is a RELIEVING prism for Exotropic/Exophoric Eyes and a TRAINING prism for Esotropic/phoric eyes.

Base Out Prism

Base Out Prism is RELIEVNG prism for Esophoric/tropic eyes and a TRAINING prism for Esophoric/tropic eyes.



27

Prism Types and Optical Effects

Prism Terminology

We call RELIEVING prism Therapeutic Prism

We call TRAINING prism Adverse Prism

Base-In Effects

Base-In prism in a lens with refractive power creates a bit of magnification and Pincushion Distortion

Base-Out Effects

Base-Out prism in a lens with refractive power creates a bit of minification and a bit of Barrel Distortion

28

What is yoked prism?

Yoked Prisms are prisms of similar quantities in the direction that they move the image together.

Examples of Yoked Prisms

Example 1	2.0 BU OU
Example 2	4.0 BI OD 4.0 BO OS

29

Why do we use yoked prism?

Homonymous Hemianopsia

Shifts or deficits of visual field, usually caused by stroke or TBI

Midline Shift

Unilateral spatial inattention

Nystagmus with a null point

30

What does yoked prism do?

- Initiate spatial shifts
  - Shifts in a person's center of gravity
- Create postural change
  - Triggers a shift and/or rotation in the pelvis
- Alter behavior and attention
  - Most often Vertical, frequently in autism
- Maintain straighter head position
  - Alleviating future spinal issues

31

Optical Tools:

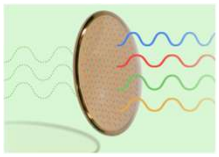
Color: Solving for Reliability and Validity

32

Avulux Lenses

Notch Filter

Avulux lenses are a notch filter blocking wavelengths of light in the short (480nm) and long (620nm) wavelengths specifically thought to be antagonizing of migraines.



Melanopsin

Melanopsin found in ipRGCs is thought to also play a role in migraine,

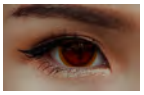
Image Credit: Avulux

33

Color: Altius Contact Lenses

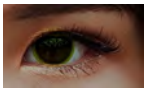
Sports Vision Contact Lenses

Green and Amber in a daily wear format



Amber Effect

Thought to be exciting to the nervous system



Green Effect

Calming to the nervous system

Therapeutic Use

The therapeutic use case is emerging

Image Credits: Altius

34

Color: FL-41 Filters

41

Fluorescent Light

Meaning Fluorescent Light 41 – Built to reduce irritations of this kind of lighting

480-520

Target Range (nm)

Targets 480-520nm where there are a lot of sensory sensitivities.

80%

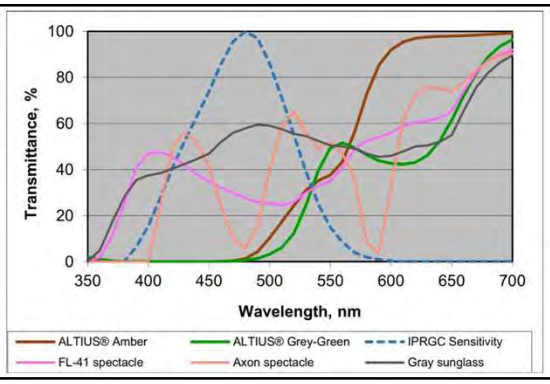
Blue Light Blocked

Up to 80% of blue light is blocked.

Three intensities

At least two colors – a bright orange and a purple/lavender

35



36

Syntonics: Colored Light Therapy

What is Syntonics?

Syntonics is an optometric phototherapy dealing with the application of selected light frequencies through the eyes. It has been used clinically for over 70 years in the field of optometry with continued success in the treatment of visual dysfunctions.

Effective for:

- Focusing issues, strabismus, amblyopia, convergence problems
- Learning disorders, effects of stress and trauma, brain injuries
- Emotional disorders, jet lag, PMS, sleep disorders
- Mood and behavior disorders

37

Notch Filters: Precision Light Control

What are Notch Filters?

- A notch filter is one with specific light-blocking properties.
- This is difficult to achieve in dip tinted lenses with reliability.
- Notch filters block specific wavelengths (with precision up to 2 nm) and allow light wavelengths above and below to pass through the lens.
- They do create distortion of color perception if too specific

Optical Tools:

38

Microprism Technology:

Beyond Surfaced Prism

Microprism technology offers precision beyond traditional surfaced prisms

Theralens

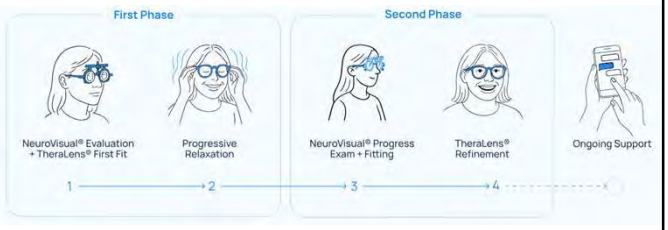
Theralens is the lens soon to be released by Neuro Visual Medicine and is a series of lenses with microprisms to correct BVD, especially vertical heterophoria.

ANSI Tolerance Solution

Theralens resolves the issues of small prisms being within ANSI tolerance.

39

TheraLens®
POWERED BY NEUROVISUAL MEDICINE



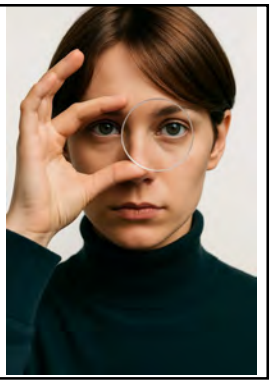
Prisms often require adjustment as the visual system adapts to them. This is a built-in process in the Theralens treatment protocol.

Image Credits: Theralens

40

Neurolens

- Neurolens uses contoured microprisms to correct eye misalignment
- Assessed by using the Neurolens device which detects small horizontal phorias
- It alleviates pressures on the trigeminal nerve.



41

Fresnel Prism Applications

What is a Fresnel Prism?

A film with many, small prisms, creating the desired prism effect, particularly at the straight ahead gaze.

High Prism Powers

Where the amount of prism is difficult or impossible to surface (Above 10 PD)

Changing Prism Needs

Especially useful where prism is changing frequently

42

Partial Prism Solutions

Understanding Partial Prisms

It is possible to get lenses where the prism is only in a part of a lens. These are incredibly difficult to source and very expensive. In practice, we assume that prism is applied to the entire lens.

Practical Options

If prism is only needed in one gaze or one area of the lens, our options are:

Solution Approaches

1. Two pairs of eyewear
2. Fresnel prism in the necessary portion of the lens

www.qldsamerica.com

Image credit: www.hemianopsia.net/the-Fresnel-prism

43

Patching and Fogging Techniques

Patching

Patching the eye blocks all light from entering the eye. This generally has the effect of strengthening the used eye in amblyopia.

Key Advantage

It can be done in only part of the lens where a patch cannot.

Fogging

The same effect is reached by fogging the eye, often done by sandblasting the surface of the lens, allowing all light through.

Trial Method

We trial fogging using scotch tape

44

Vision Therapy Approaches

What is Vision Therapy?

Treatment through training, often of extra and intra-ocular muscles

Neural Pathway Development

Creating new/reinforcing neural pathways

Treatment Methods

In-office observed treatments and at-home exercises

45

Case Study #1: Brain Tumor Patient

Patient Referral

Your OMD brings you a patient with a brain tumor.

Clinical Observation

Looking at the patient, you can see a visible, consistent turning of the left eye inward.

Doctor's Prescription

The doctor's Rx has 23 BO OS.

Clinical Challenge

How do you proceed?

46

Case Study #2: Computer Headaches and Driving Anxiety

- Your OD brings you a patient and does a lovely handoff suggesting that this patient is getting headaches at the computer and asks you to talk about options.
- You dispense computer multifocals with a blue-filter and AR and then the patient comes back, tells you that they are really thrilled with this pair.
- You also dispense a pair of PALs with AR in a very lightweight, but full-framed pair of eyewear, because while shopping, the patient tells you they are sensitive to any weight on their face and are a little photophobic. Their last pair of rimless had them constantly seeing flashes in the lens edge.
- The patient shares with you that they are experiencing a weird sensation when driving, especially on long narrow roads and that they seem to be getting anxious, especially when driving.
- What do you think, then what do you do about it?

47

Case Study #3: Your Challenge

Clinical Scenario

Whatcha got?

Your Approach

How would you handle this case?

Treatment Options

What solutions would you recommend?

48

Developing a Neuro-Opticianry Program

If we were going to develop a full program in Neuro-Opticianry, what would we need to know?

- Basic Neuro – Anatomy of the eyes and brain and how it applies to vision
- Understanding the Visual system in terms of refractive error, accommodation and the vergence system
- Exploration of Neuro-optometric Conditions
- Pediatric vs. Presbyopic Concerns
- Minimal Binocular Dysfunction
- Interaction of Vision, Auditory and Vestibular Systems
- Color for function with no adverse side effects
- Contrast Sensitivity and Visual Acuity as metrics for evaluating color efficacy

49

50

Reach out to me! cira@cira.me

51