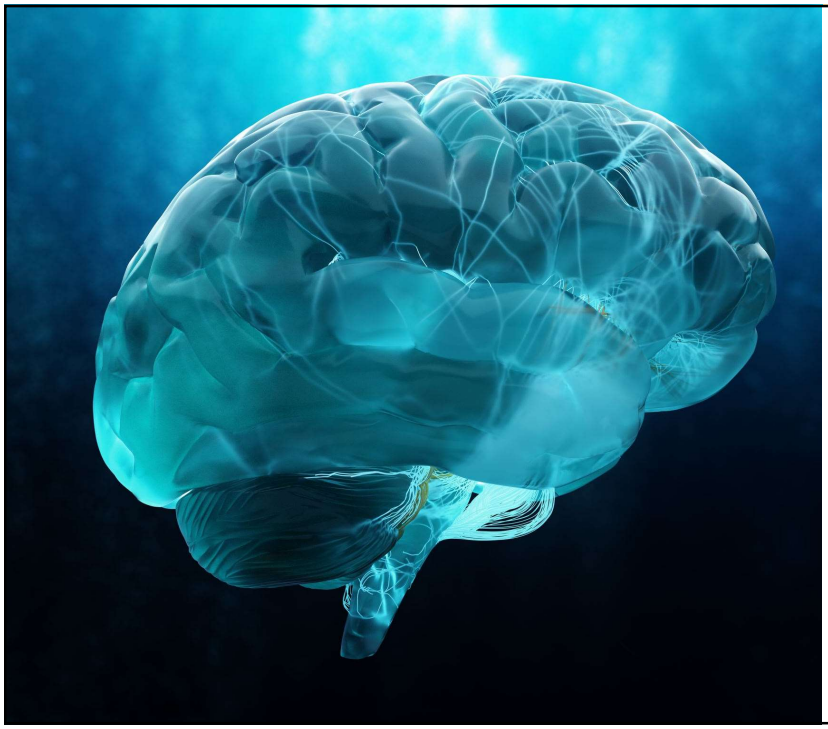


CORTICAL/ CEREBRAL VISUAL IMPAIRMENT

KEY CONSIDERATIONS & CASE STUDIES

ECEP Office Hours- Continuing Education Series for NM FIT Providers

March 12, 2025

Andrea Montaño & Luanne Stordahl

NMSBVI

SESSION OBJECTIVES

- Participants will be able to describe, at a basic level, how vision is processed in the brain
- Participants will learn about Cortical/Cerebral Visual Impairment and how it can manifest in children
- Participants will gain practical understanding by examining relevant case scenarios

THE CONUNDRUM OF EARLY IDENTIFICATION OF CVI:

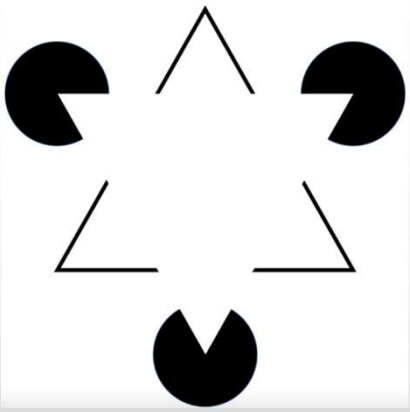
- If you don't know what you don't know, how can you know?

FACT:

- "Our perception of reality has less to do with what's happening 'out there' and more to do with what's happening [in our brains]."

  -David Eagleman, Neuroscientist

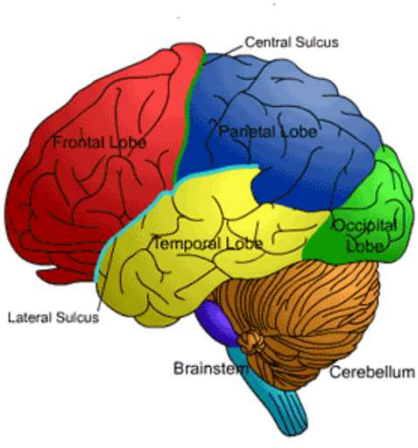
MY REALITY IS DIFFERENT FROM YOURS



- The world comes into existence in our brains

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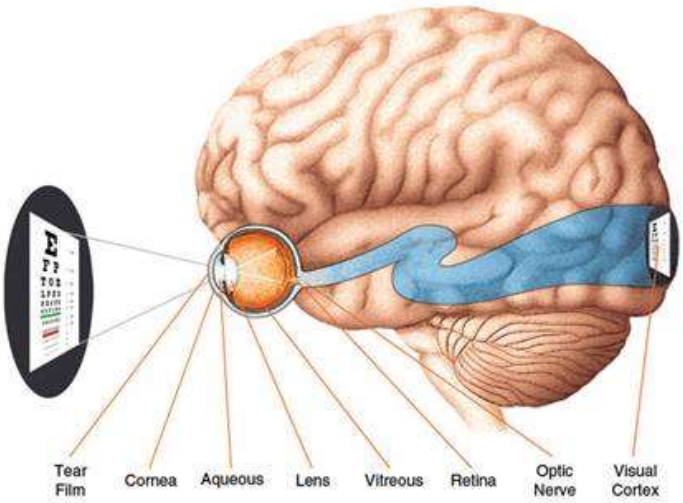
AT A BASIC LEVEL:



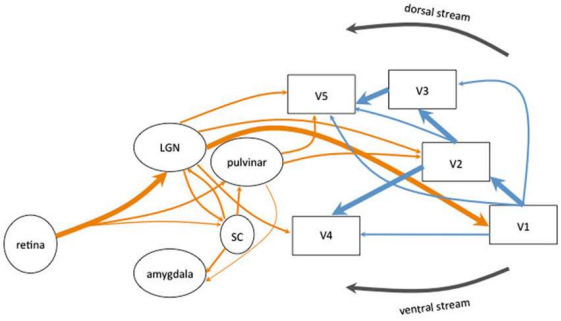
- The front of the brain thinks
- The middle moves and feels the body, and hears and interprets language
- And the back sees
- All three parts, or two parts, or only the back (more rarely) may be affected in any combination

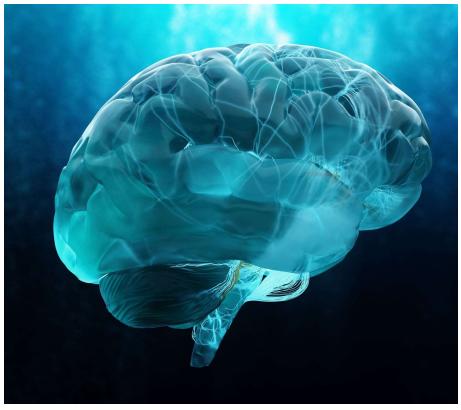
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THE VISUAL SYSTEM

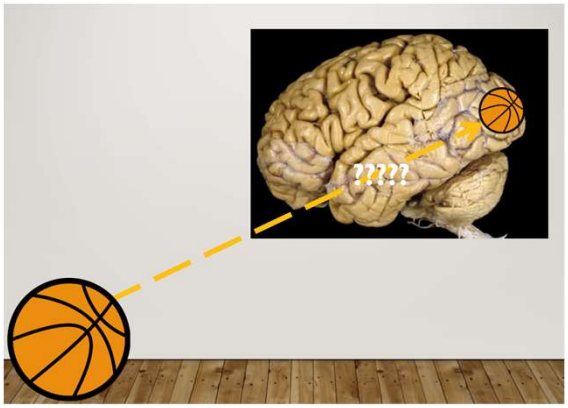


VISUAL FUNCTION VS FUNCTIONAL VISION



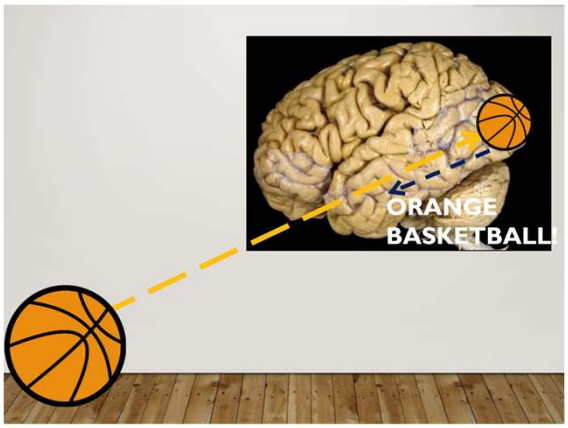


OCCIPITAL LOBES

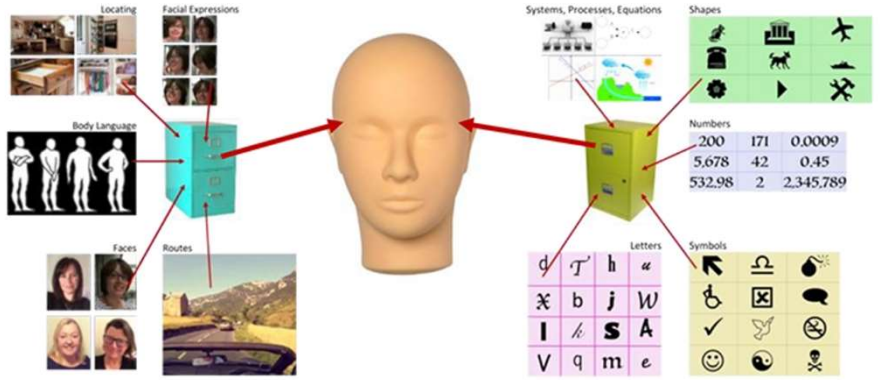


- Acuity
- Color contrast sensitivity
- Visual fields

TEMPORAL LOBES

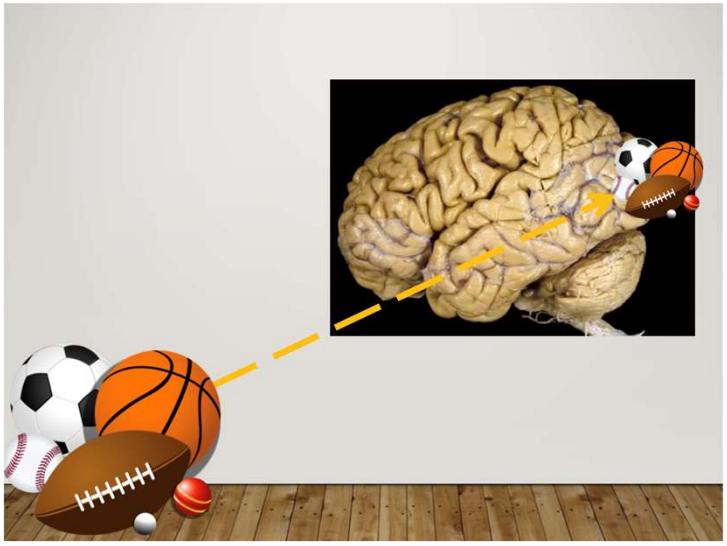


- Recognition
- Orientation

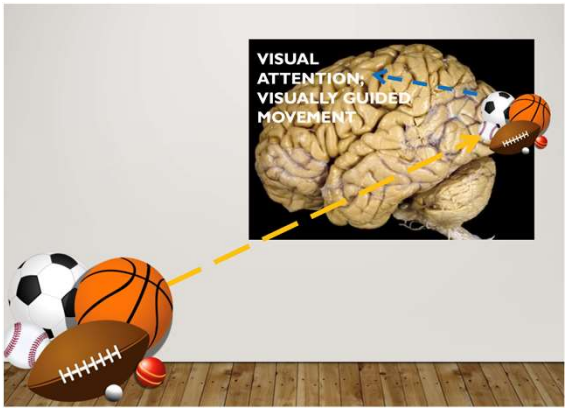


Right Filing Cabinet *(right temporal lobe)*. Memories created from organic, free flowing multi-layered experiences.

Left Filing Cabinet *(left temporal lobe)*. Memories created from systematic, learning experiences.



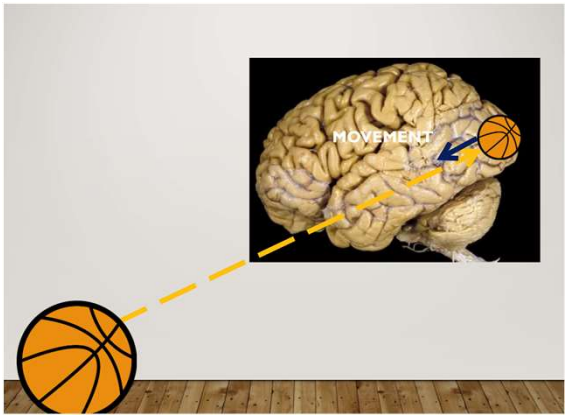
POSTERIOR PARIETAL LOBES



- Visual search and attention
- Visually-guided movement



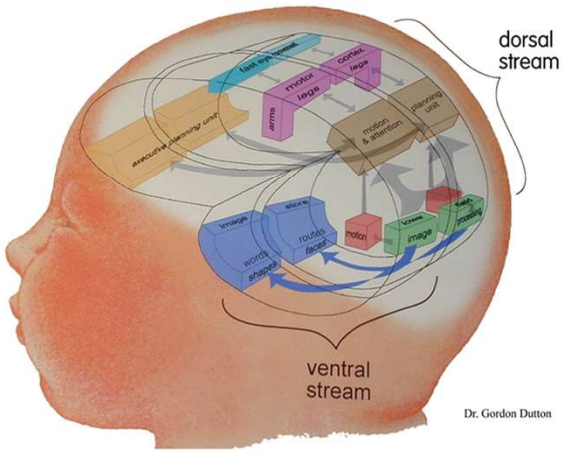
MIDDLE TEMPORAL LOBES



- Movement



Visual Processing Centers in the Brain





CORTICAL/CEREBRAL VISUAL IMPAIRMENT



CVI is a brain-based visual impairment caused by damage or interruption to visual cortex or visual pathways



CVI is the leading cause of visual impairment in children in developed countries.



CVI impacts the person's ability to visually attend, recognize, understand, and thus react.

A HIDDEN EPIDEMIC

- Diagnosed or likely CVI in the US, aged 0-22:
  - 180,449
    - 24,269 diagnosed
    - 155,980 likely

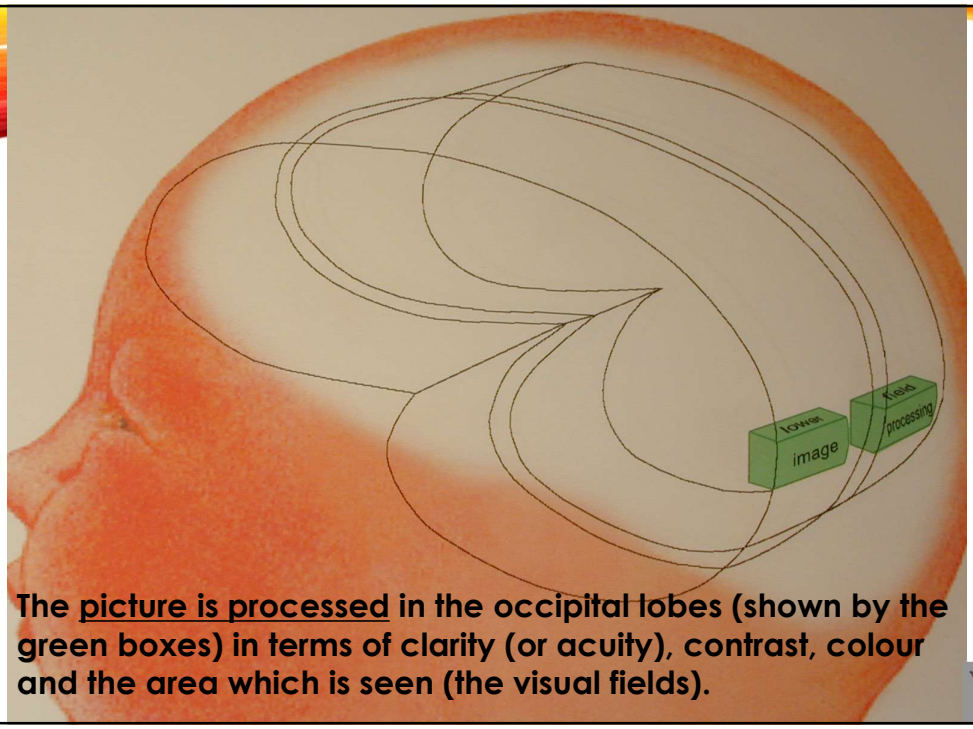
Perkins School for the Blind. *The Current State of CVI: A hidden epidemic*. Perkins.org. 2023

COMMON CAUSES OF CVI

- **Hypoxic ischemic encephalopathy (HIE) (in the term born infant)**
- **Periventricular leukomalacia (PVL) in the preterm infant)**
- **Traumatic brain injury**
- **Neonatal hypoglycemia**
- **Infections (e.g. meningitis)**
- **Epilepsy / seizure disorders**
- **Metabolic disorders**
- **Abnormal brain conditions**
- **Certain genetic disorders or variants**
- **Stroke**
- **Neurological disorders**
- **Maternal addiction to drugs and alcohol**
- **Cytomegalovirus**

CONDITIONS ASSOCIATED WITH CVI

- Premature birth
- Developmental Delays
- Cerebral Palsy
- Epilepsy
- Hydrocephalus
- Williams Syndrome
- Autism Spectrum Disorder
- Down Syndrome
- CDKL5 Deficiency Disorder
- Rett Syndrome
- Other genetic syndromes and variants



The picture is processed in the occipital lobes (shown by the green boxes) in terms of clarity (or acuity), contrast, colour and the area which is seen (the visual fields).

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DAMAGE TO OR INVOLVEMENT OF OCCIPITAL LOBES

- Reduced Acuity:
- Reduced Contrast Sensitivity:
- Color Blindness / Color Anomia
  - Rare
- Hemianopia





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CLARITY OF VISION

Reduced Contrast Sensitivity
cviscotland.org



View of City of Edinburgh

Reduced Visual Acuity
cviscotland.org



View of City of Edinburgh

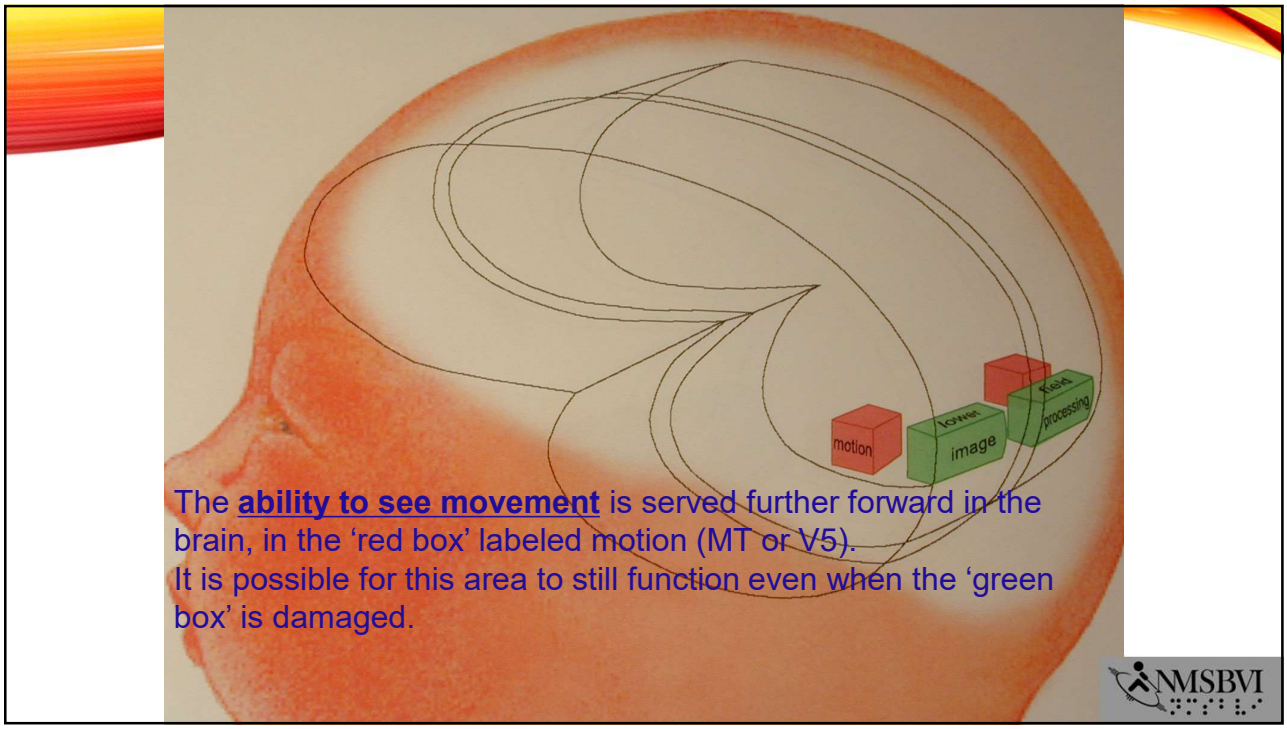
VISUAL FIELD IMPAIRMENTS
CVISCOTLAND.ORG

typical vision



left hemianopia





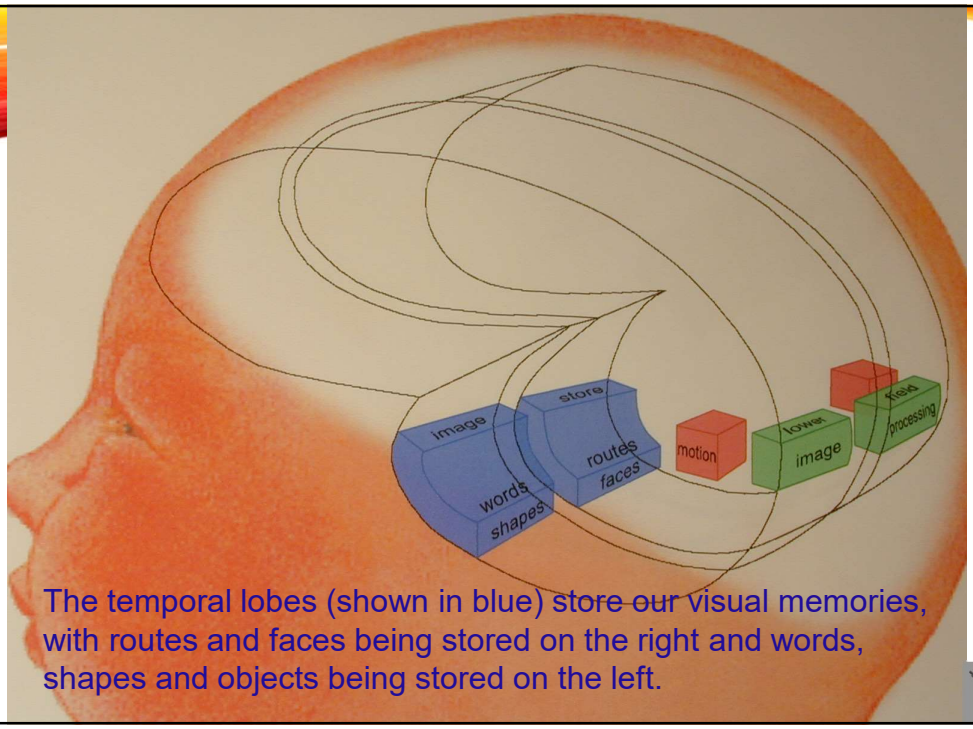
The **ability to see movement** is served further forward in the brain, in the 'red box' labeled motion (MT or V5).
It is possible for this area to still function even when the 'green box' is damaged.

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- Dyskinetopsia: a defect in motion perception
  - Moving objects may be perceived as leaving behind after-images in their trail
  - Some people may not be able to see traffic or other fast-moving things at all

DAMAGE TO OR INVOLVEMENT OF MIDDLE TEMPORAL LOBES

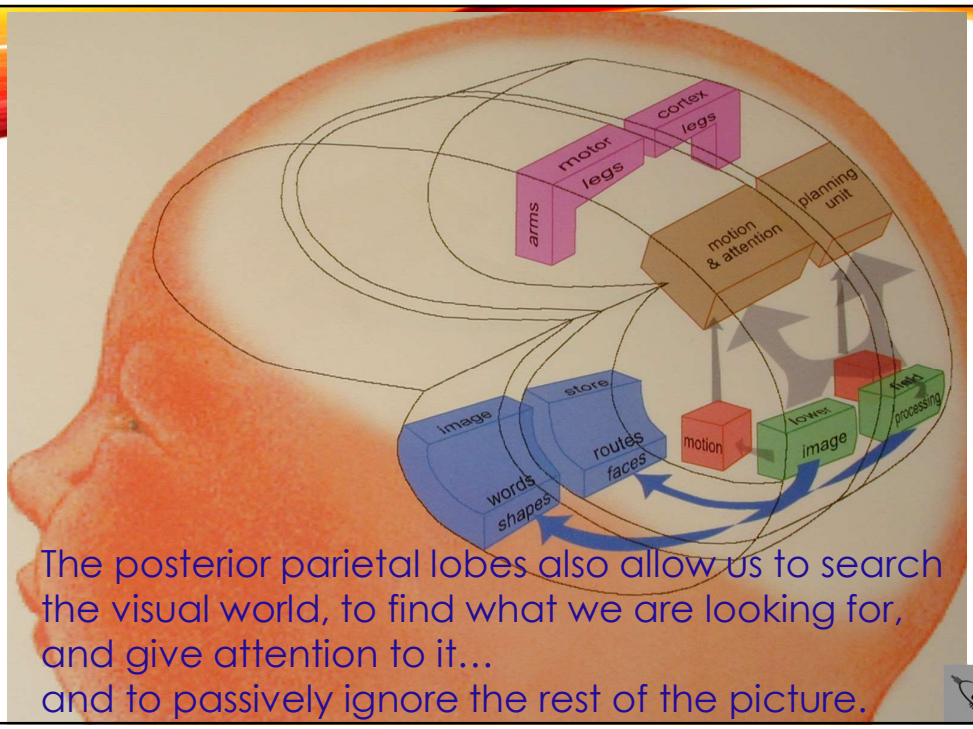
NMSBVI



The temporal lobes (shown in blue) store our visual memories, with routes and faces being stored on the right and words, shapes and objects being stored on the left.

DAMAGE TO TEMPORAL LOBES / VENTRAL STREAM

- Impaired recognition
  - Difficulty recognizing people/person in photographs
  - Difficulty interpreting facial expressions
  - Difficulty recognizing animals, shapes, objects, etc.
- Impaired orientation
  - Getting lost in known and unknown locations/new environments
  - Difficulty/inability to create or hold route in memory



The posterior parietal lobes also allow us to search the visual world, to find what we are looking for, and give attention to it…
and to passively ignore the rest of the picture.

DAMAGE TO POSTERIOR PARIETAL LOBES/ DORSAL STREAM

- Impaired search and visual guidance of movement (optic ataxia)
  - Impaired ability to handle complex visual scenes
  - Impaired visually guided movement
  - Impaired visual attention ←because they can't visually attend or because they can only visually attend to one thing at a time?
- Simultanagnosia
  - The inability of the individual to visually perceive more than one object (or visual target) at a time.

SIMULTANAGNOSIA

CVISCOTLAND.ORG





MANIFESTATIONS/IMPLICATIONS OF CVI

Sensory Integration / Regulation

Visual Attention

- Clarity of Vision
- Following People or Objects Visually/Movement of the Eyes
- Locating People/Objects/Visual Search/Impact of Clutter/Crowding
- Area of Vision/Visual Field Abilities
- Tracking/Following People/Objects
- Response to Faces/Access to People
- Response to Movement/Impact of Motion

Visual Recognition

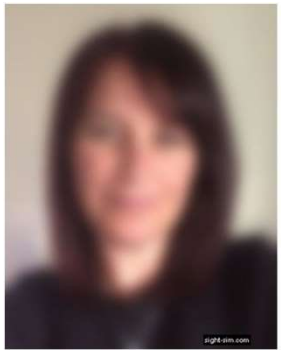
- Accuracy of Visual Motor Planning & Control/Visually guided reach: Arms/legs/Depth Perception
- Color/Impact of Color
- Illumination/Impact of Light
- Response to Sounds
- Response to Environment
- Visual Curiosity (incidental learning)
- Effects of Visual Novelty
- Response Time/Response Interval

Compensatory Skills

Access to Learning

IMPAIRED FACIAL RECOGNITION

CVISCOTLAND.ORG









VIDEO –THROUGH THE EYES OF SOMEONE WITH CVI



CASE SCENARIO 1 HALEY

- BACKGROUND:
  - Full term
  - "Dusky" at birth w/no cry
  - Hospital 2 days; normal MRI
  - Seizures @ 4 mos
  - Pediatrician referred to EI @ 6 mos
- REFERRED TO NMSBVI @ 7 mos
  - Diagnosed with CVI at 9 mos
- ONGOING EI SUPPORT
  - Global delay
  - Very sensitive; sensory concerns



FIRST VISIT/PARENT INTERVIEW

- No specific vision concerns
- Parents reported Haley was very "sensitive" to touch and sounds
- Colic
- "Doesn't like new people"
- Hard for her to make/keep eye contact
- Startled easily
- Very fussy at family gatherings
- Sleeps frequently--"cat naps" all day



IMPLICATIONS FOR SERVICES



- Fussy/crying/falling asleep
- Very sensitive during sessions
- Not tolerating positioning
- Feeding strategies difficult
- "Not making progress"

- Support for parents
- *Implications for school

STRATEGIES

- Touch and auditory cues
- Wait time (SLOW DOWN)
- Environmental impacts (multi-sensory, familiar/unfamiliar, lighting, who is implementing the strategy)
- Tactile exploration (no requirement to use vision)
- Fields
- FUN and MOTIVATING
- Educating parents***



"If a child is happy, then something is working, and if they are not happy, something needs to change."
--CVI Scotland

CASE SCENARIO 2 STEVEN

- Background
  - Full-term
  - Meconium aspiration
  - Respiratory distress
  - "Floppy"
  - Moderate encephalopathy
- Referred to NMSBVI at 2mo
  - "Not looking at faces"
- Ongoing EI support
  - Excellent overall progress
  - CVI diagnosed at 2years
- Zoo Visit, 33 months
  - How impactful is Steven's CVI?





STRESS RESPONSE / PERSONALITY CHANGE



WHY ARE WE HERE?





NO REALLY, WHY?











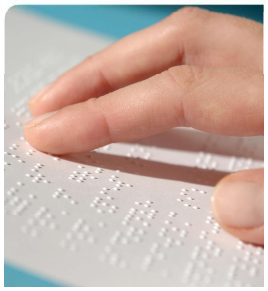



IMPORTANT CONSIDERATIONS AS STEVEN TRANSITIONS TO PRESCHOOL

- If a target blends in with the background, he struggles to see it unless it moves
- Steven is much more visually responsive if he is well-rested & unstressed
- Steven struggles to localize the source of a sound
- Steven "loves all textures" / "loves to get messy"
- Upon casual observation, Steven's vision is his strongest sense for obtaining information, but upon closer inspection, this is only true under certain circumstances
- Steven struggles to attend to and understand the "full picture", especially in new environments

CASE SCENARIO 3
CVI, READING, & BRAILLE

- Child struggled with reading
- Parents explored every possible avenue
- CVI diagnosed when child was 11
- Braille introduced at age 12
- Fluency by age 13
- Lane-Karnas, K. (2023). A Case Study on Cerebral Visual Impairment, Reading, and Braille. Journal of Visual Impairment & Blindness. https://doi.org/10.1177/0145482X231218069







Practice Report

JVIB Journal of Visual Impairment & Blindness

A Case Study on Cerebral Visual Impairment, Reading, and Braille

Katie Lane-Karnas[1]

Keywords
CVI, cerebral visual impairment, agnosia, braille

QUESTIONS TO CONSIDER

- What is required for fluent literacy?
- What are the ways CVI might adversely affect fluent literacy?
- How did child try to compensate?
- What was the cost?
- How / why did Braille help?

MINIMAL REQUIREMENTS OF FLUENT PRINT READING

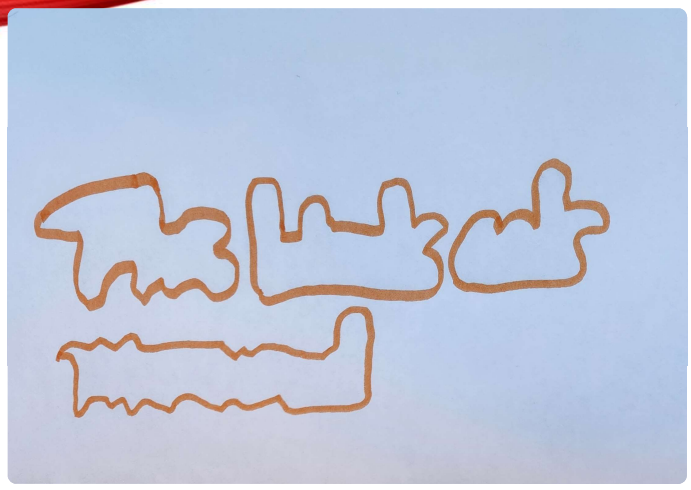
- Adequate functional acuity
- Letter recognition progressing to word recognition
- Orthographic mapping progressing to "lightning speed" orthographic mapping
- An inherent understanding of symbols
- Endurance / Stamina

THE WAYS CVI AFFECTED CHILD'S ACCESS TO LITERACY

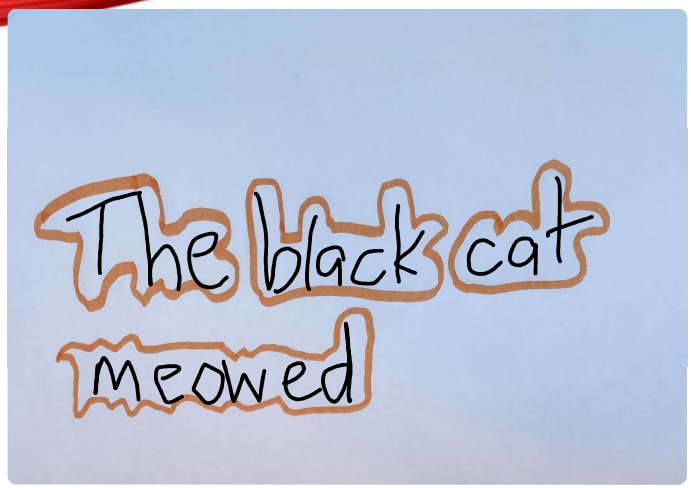
- Simultanagnosia
- Visual agnosias
- Simultanagnosia + Visual agnosia = ~~Orthographic Mapping~~
- Oscillopsia
- Convergence and accommodative insufficiency
- Visual Fatigue
- Adverse Effects

THE WAYS CHILD TRIED / TRIES TO COMPENSATE WHEN READING PRINT

- Prediction based on other contextual cues
- Aligns eyes / sits still
- Tinted typoscope
- Blue backlit screen
- Increased font size
- Reduced visual complexity
- Mentally perceive the tactile outline of the word



TACTILE OUTLINE OF THE WORDS



TACTILE OUTLINE OF THE WORDS

HOW AND WHY BRAILLE WORKED

- For some reason, child's brain was already primed for touch over vision
- It allowed for orthographic mapping
- It somehow created the circumstances that allowed for an inherent understanding of the purpose of symbols
- It prevented the fatigue and overload



QUOTE FROM AN ADULT WITH CVI

"If it's not understood, CVI will leave a hole in your life and your identity."

Questions?



Thank you!

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