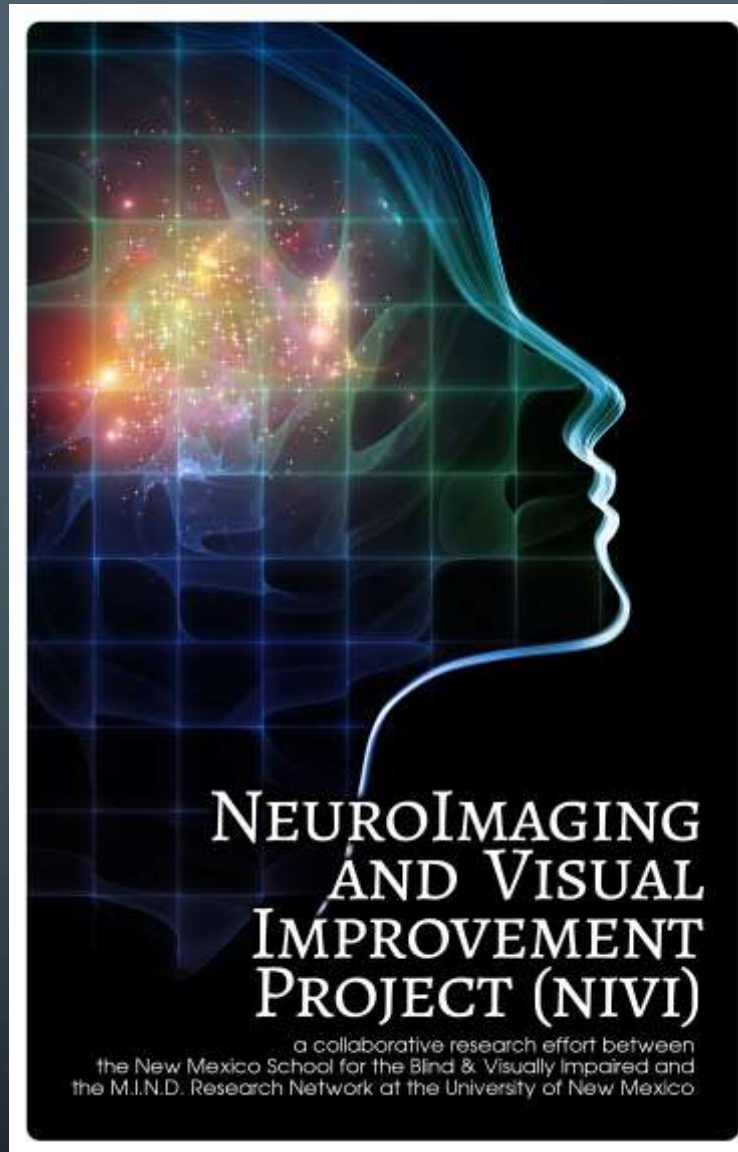


AER International
Conference

July 27, 2018

Reno, NV



Melody Zagami Furze
M.ed., CTVI
Doctoral Learner:
University of Northern
Colorado

OUR MISSION

- NMSBVI, an innovative leader and unifying entity in the field of educating students birth-high school who are blind or visually impaired, will identify and ensure quality education through collaborative relationships with students, families, and local/ state/national partners to provide outstanding advocacy, training, resources, and support services, thus ensuring that all students who are blind or visually impaired will become independent, productive members of their communities.

THE MIND RESEARCH NETWORK

- Founded in 1998
- State-of-the-art MRI and MEG neuroimaging systems
- Dedicated to the discovery and advancement of clinical solutions for the prevention, diagnosis, and treatment of mental illness and other brain disorders
- Current studies in addition, autism, forensics, neurodevelopment and traumatic brain injury

DOCTORS

John Philips M.D.



- Functional neuroimaging
- Pediatric neurorehabilitation
- Cerebral Palsy
- Spasticity management and care of children with special needs in Eastern European Orphanages

Arvind Caprinhan Ph.d.

- Diffusion measurement
- Analysis of imaging relation to brain structure



ALIGNMENT WITH OUR STRATEGIC PLAN 2015/2016

1.1 Identify and collaborate with leaders in the field of visual impairment in order to offer cutting edge training, camps, and educational opportunities for students, staff, and others.

- **Research Classroom at ECP**

4.2 Develop and/or identify assessment tools leading to appropriate goals, curriculum, and programming.

- **Gather VI assessment data from research class**

Definition of CVI: A working definition for educational services CVI is defined as impaired vision that is due to bilateral dysfunction of the optic radiations or visual cortex or both. It can coexist with ocular and ocular motor disorders and can be the result of perinatal brain dysfunction or be caused by trauma. Approximately 30%-40% of children with visual impairments have CVI.

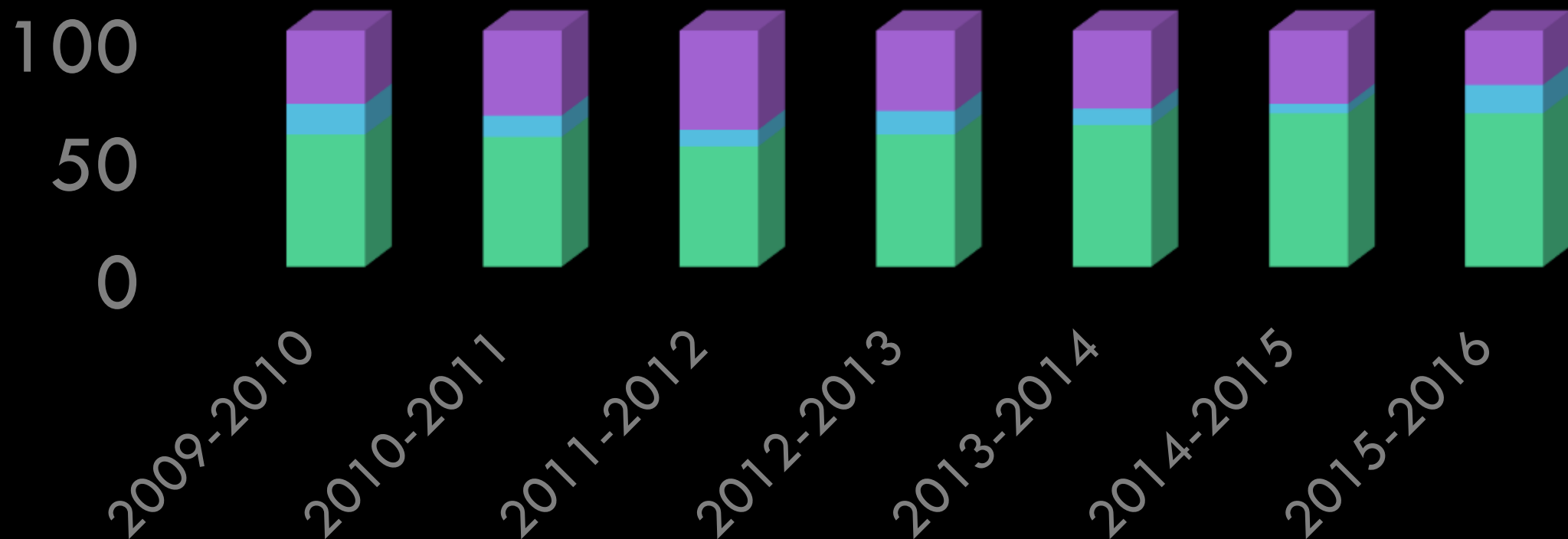
American Printing House for the Blind: Statement on CVI

Tech.aph.org/cvi/wp-content/uploads/2015/01/Statement-on-Cortical-Visual-Impairment.pdf

DEMOGRAPHICS: THE SPECTRUM OF CVI

- Severe: Children with CVI who have profound visual impairment due to CVI
- Moderate: Children with CVI who have functionally useful vision and cognitive/behavioral/functional challenges
- Mild: Children with CVI who have functionally useful vision and who are on, or near, the same cognitive/functional/behavioral level as their peers.

Visual Diagnosis Frequency



■ Other Conditions

■ Non-Accidental Trauma

■ Neurological Vision Impairment

CURRENT BARRIERS

- Diagnosis
- Tailoring therapy to underlying etiologies
- Variations in pathophysiology > improvement in some populations and not others... PVL versus cortex damage
- Lack of research-based therapeutic interventions
- Lack of services

NEUROIMAGING AND VISUAL IMPROVEMENT

UNM

- Conduct three functional MRIs (fMRI) over the course of the school year
- Establish baseline and repeated brain scans
- Analyze scans for changes over time
- Work with staff to understand what an fMRI can tell us about our student's brains and functioning

NMSBVI

- Choose participants based on diagnosis, placement and other factors
- Assess students
- Develop focused goals
- Track data on goals
- Addition focused learning in CVI

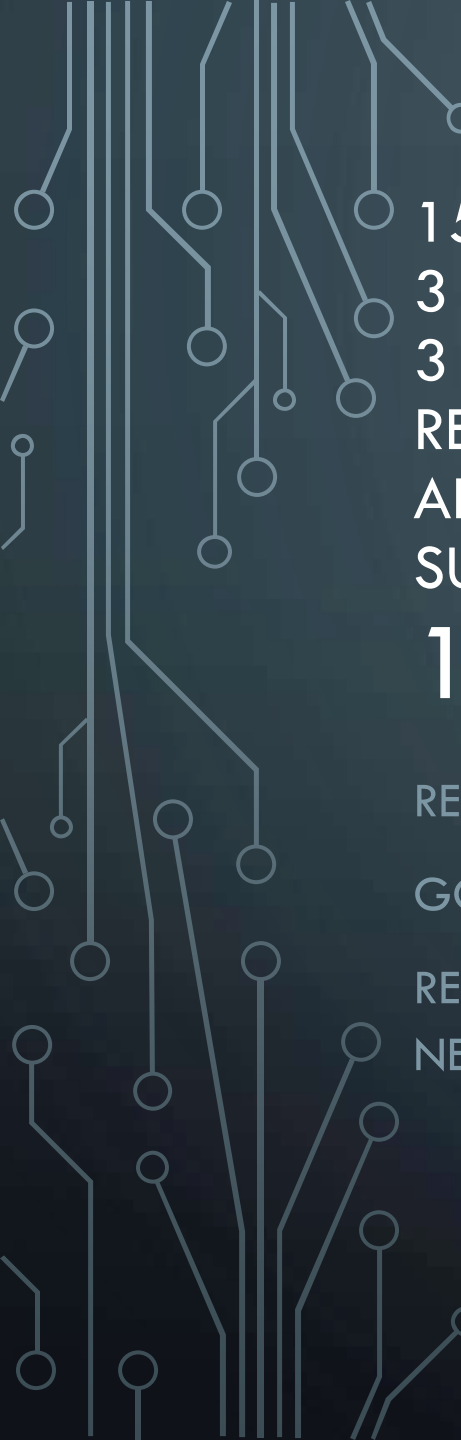
WHAT'S THE POINT?

Why do this work?

- To gain insight into neuroplasticity after damage and show improvement in our student's visual abilities over time.

What questions are we asking?

- Can fMRI (functional MRI) and DTI (diffusion tensor imaging) paired with educational assessment show changes in both function and neural networks?



15 PARTICIPANTS (9 COMPLETERS)

3 CLASSROOMS

3 TEACHERS

RESEARCH COORDINATOR

ADMINISTRATION

SUPPORT FROM BOARD OF REGENTS

1 ACADEMIC YEAR

REVIEW OF CVI LITERATURE

GORDON DUTTON COURSE

REVIEW OF BRAIN IMAGING TECHNOLOGY AND INFORMATION WITH PEDIATRIC
NEUROLOGISTS

CRITERIA FOR INCLUSION

- CVI diagnosis
- Parental consent
- Ability to lie in MRI Scanner with no contraindications
- Predicted consistent attendance
- classroom

WHAT DO WE WANT TO KNOW?

VISION

- Our goal is always to understand as much as we can about the way a child functions visually and sensorially throughout daily routines and different environments
- Can we increase our knowledge about vision by understanding brain function?

BRAIN

- can we use our knowledge of the ventral and dorsal paired with scans to better serve our students and improve visual capabilities?
- Can we use our knowledge of compensatory sensory strategies paired with scans to increase connections between environment and child?

FUNCTIONAL MRIS

- 3 scans
- Baseline, 2nd scan (Fall 2015)
- 3rd Scan (Spring/Summer 2016)
- Standard research MR sequences – high resolution structural imaging (MPRAGE), diffusion tensor imaging (DTI), resting state MRI, fMRI.

WHAT DO WE WANT TO KNOW?

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BRAIN

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GOAL DEVELOPMENT

Present levels include student's placement on the CVI Range, information from Vision Maps, Functional Vision Evaluation and Vision and Vision Processing Assessment, Insite and Oregon

“environments” can refer to the various demands of activities across daily routines and potential transition settings

Goal Development



- Present levels of visual functioning
- adaptations required
- sensory needs
- needs across environments

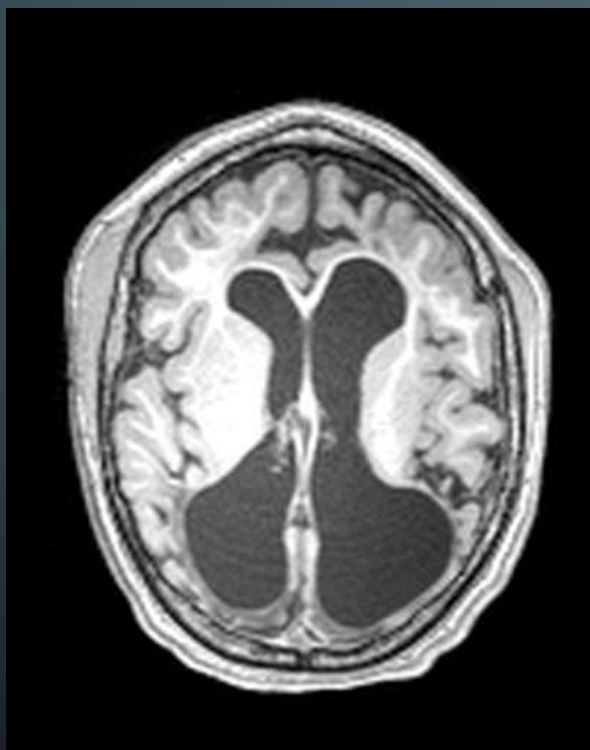
PROTOCOLS

- Ongoing assessment
- Daily visual adaptations related to goals
- Data collection on a weekly/biweekly basis
- Adaptations recorded on iPads
- Collaborative Assessment
- Strength-based goals, not deficit based
- Transition, Transition, Transition
- Teacher Education

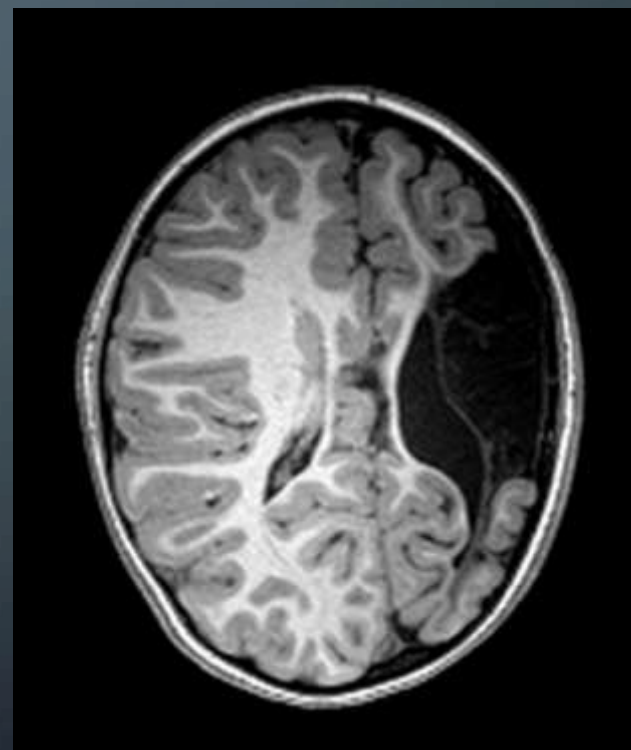
Cohort/Demographic Information

URSI	NAME	DOB	MEDICAL DX	VISION DX	GENDER	INJURY ONSET	RACE
M87130483			HYPOXIC	ONA/LP?	M	18 MOS.	H
M87102299			WLLMS SYNDROME		F		H
M87188129			NA TBI	OM	F	4 MOS.	W
M87155021			NA TBI	OM	F	19 MOS.	
M87104464			Severe glycemic	ONA	M		H
M87153591			Genetic	ONA	F		W
			GLOBAL REF	ON LP	F		W
M87147726			Tuberous Scl		F		H
M87189562			CP		F		
			HYDROCEPHALY	ONA	M		H
			NA TBI	RTN HEM	M		H

X



A



A PICTURE OF A'S VISION

right hemi, CP,
difficulty with visual
attention, congenital
stroke

20/80, 20/50

left field best, but has
learned to
compensate, lower
fields a concern (fall
2015).

range: Phase III

consistently use
neglected fields,
visual adaptations to
cross midline

VISION/ACADEMIC SPECIFIC RESULTS

URSI #	Name	Visual Challenges	Targeted Visual Behaviors	Oregon Project	CVI Range 1-10	Skills Gained	Adaptations	Frequency
M87189562		Right side neglect, potential lower visual field impacted as well. Does not cross midline when presented with a picture or words that spread across two pages. Latency, slower visual response when fatigued. Unable to draw lines across a page (various shapes) unless given adaptations for vision. Cannot draw diagonal lines independently.	Specific visual field testing by staff observed vision on the far right of A's visual field, neglect in the middle and then response toward midline. We worked on specific adaptations for crossing midline when drawing, copying, etc. Also letter formation to be able to write her name correctly.	Feb 15 Cog 4-5: 68% 5-6: 3% Vision 3-4: 50% 4-5: 39% 5-6: 15% Mar 16 Cog 4-5: 95% 5-6: 52% Vision 4-5: 83% 5-6: 62%	9.75 Spring and fall	Greater use of visual function on right side? -writing -letter formation - writing on a line using left to right orientation. Drawing diagonal lines using reference points	Scanning left to right Use of slant board Bolding of print Reduction of clutter Dots as reference points for drawing lines 1:1 teaching vision specific skill	Daily Practiced independently and generalized across settings.

AUBREE OTHER RESULTS AND ADAPTATION TRACKING

NIVI GOAL

- NIVI Goal: will write name without adaptations and will recognize and copy lower case letters in her name.

STRATEGIES & ADAPTATIONS

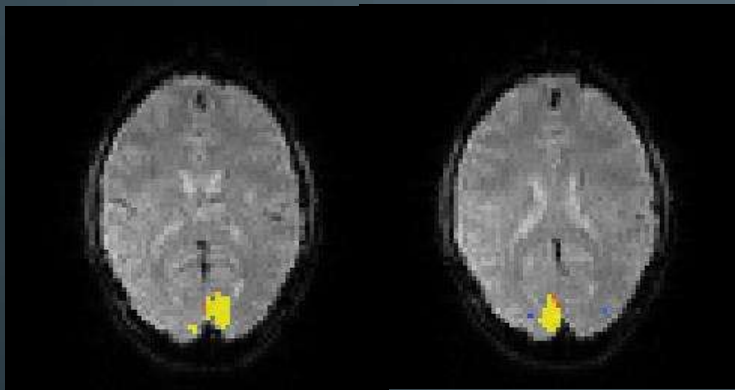
- Scanning left to right
- Slantboard/reading stand
- Bolding of print/model for copying
- Reduce clutter
- 1:1 teaching vision specific skills

SCAN RESULTS

FMRI WITH ALTERNATING RIGHT – LEFT VISUAL STIMULUS

Right Stimulus

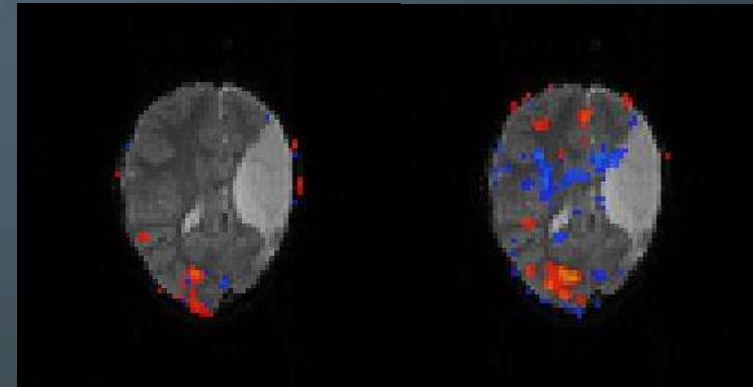
Left Stimulus



Healthy adult

Right Stimulus

Left Stimulus



M87189562

A PICTURE OF X'S VISION

bilateral occipital lobe
infarcts, left parietal
subdural hematoma
cortical atrophy (parietal
and occipital lobes)

attracted to gold, shiny,
movement

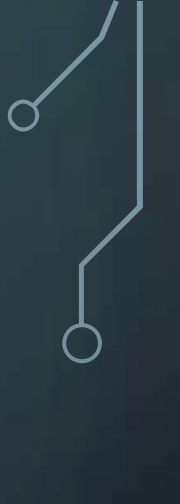
central best, responds
visually when lying down

minimal Phase I

consistently use vision in
supine position
reach and touch

URSI #	Name	Assessments	Goals toward sensory development	CVI Range Fall 15	CVI Range Spr 16	Gains in Responses	Adaptations	Frequency
M87104464	Xavier	Vision and Visual Functioning Blink response to touch, Limited light perception, responds to lights being turned on or off. Insite 4 months	Demonstrate purposeful, differentiated body movement in response to differing stimuli	Beginning phase 1 Extremely minimal visual response Blink reflex	Mid-phase 1 Blink reflex Reflective properties Starting to localize	beginning to alert to items with shiny or reflective properties from 4-6 inches Turns head toward social stimulus Quiets body in response to visual input Moving legs to activation	Optimal positioning, reduced noise, reduced overhead lighting	Exposure to stimulus within daily routines and with all adaptations bi-monthly



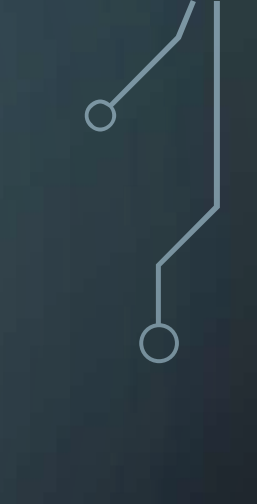
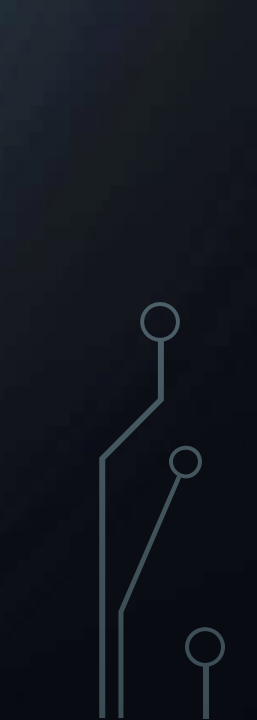


THIS STUDY HELPED US...

- Apply strength-based approaches
 - Reconsider our roles as instructing in all sensory areas **MIGHT CHANGE**
- 
- 



LOOKING AHEAD

- Characterize brain-behavioral relationships in cvi
 - Improving diagnosis
 - Early diagnosis
 - Individualize therapy and services
 - Extend findings to the clinical population
 - Longitudinal Studies
- 
- 
- 

WHAT DO WE WANT TO KNOW FROM THE LITERATURE? HAVE STUDIES BEEN CONDUCTED BEFORE THAT ARE SIMILAR TO OURS?

- In the field of Blindness – i.e. studies that look at brain imaging to define and calculate neural reorganization.
- 2015 Hirsch Bauer & Merabet

Used Using Structural and Functional Brain Imaging to uncover how the brain adapts to blindness

“The brain is highly malleable throughout life and can adapt in response to experience, development, the environment and damage.”

- - Modern imaging enables us to see how the brain adapts (neuroplasticity)
- - Changes associated with profound VI
- - Structural changes occur within already intact sensory systems
- - Potential for research as it applies to CVI

GUIDING LITERATURE

- 2015 Hirsch Bauer & Merabet

Used Using Structural and Functional Brain Imaging to uncover how the brain adapts to blindness

“The brain is highly malleable throughout life and can adapt in response to experience, development, the environment and damage.

- **Characterizing Visual Field deficits in CVI using combined diffusion based imaging and functional retinotopic mapping: A case study** (Merabet et al)

- Subject: 17 year old with CVI, IVH, PVL and hydrocephalus, 20/50, 20/40
- Field loss identified at age 5.

Used multimodal brain mapping to confirm functional field loss.

- “By combining these imaging modalities, it is possible to provide further insight regarding the functional manifestations of early onset developmental damage to key visual pathways and their relation to specific impairments of visual function”(2).

NEUROPLASTICITY CONTINUED...

*The visual cortex is still active in congenitally blind children (Veraart 90)

*Areas of the occipital cortex is activated in braille reading

* Other studies conducted in areas of other non-visual tasks; tactile acuity, shape discrimination, sound localization, smell, & memory have shown cross-modal plasticity in the blind.

• WHAT ABOUT CVI?

CVI is the leading cause of blindness in children in the developed world. (Kong 2012).

Recent investigations show differences in neuroanatomical structure, reduction in the integrity of specific white matter fibers responsible for the processing of information from primary visual areas to higher cortical areas

CVI brain is not normal, but it is not blind

DATABASES AND PROCEDURES

University of Northern Colorado library database:

Various databases

Keywords:

Cerebral/cortical visual impairment, diffusion MRI, fMRI, visual fields, neuroplasticity, blindness, connectivity, white matter tractography, etc.

- Studies included are those with an emphasis on neuroimaging techniques to discern areas of the brain responsible for vision. Specifically neuroplasticity studies to show neural reorganization and studies with a focus on “recovered” or active areas in subjects with a bilateral or unilateral field deficit and confirmation from brain imaging.

OTHER STUDIES REVIEWED

- Clinical studies involving CVI and vision habilitation or outcomes
- Studies that state CVI is a real visual impairment, it has a proven origin within neural networks, its causes and potential further research
- Educational studies involving evidence-based practices for students with CVI and field neglect.

Assessments

Ongoing

Functional Vision Evaluation	Learning Media Assessment	CVI Range	Oregon Project for Preschoolers with Visual Impairment (when applicable)	Insight	Vison and Visual Functioning
Communication Matrix	O&M Checklist	Vision Maps	Tactile Maps	ABLS	History Taking

Components of the Functional Vision Evaluation

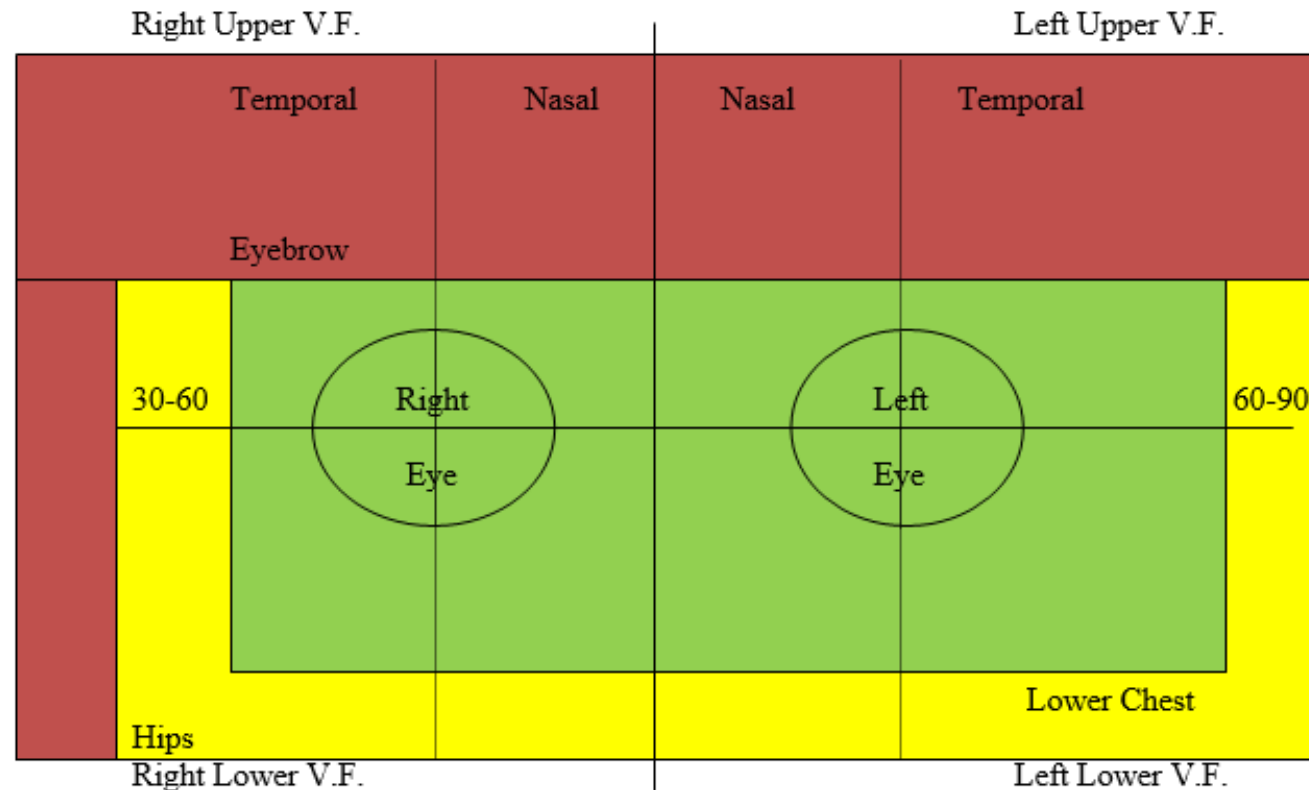
FVE

- Vision Diagnosis
- Assessment Tools
- Evaluation Setting
- Purpose for evaluation
- Medical Background
- General information/observations during routine activities
- Ocular Functions
- Visual Skills
- Functional Acuity, Contrast and Color Perception:
- CVI Range Results
- Learning Media Assessment
- Recommendations
- Eligibility Statement

Perception:

Light: ☐

Object: X

Green: Field of best vision**Yellow:** Field of decreased vision**Red:** Field of minimal to no vision**Other things you should know about how I see best:****Preferences:****Viewing Distance – Near:** 36 font or 3/16 of an inch from 12 inches away, if smaller she uses 4-6

VISION AND VISUAL FUNCTIONING ASSESSMENT

- Looks at child's response to the environment as a result of vision and visual processing
 - Accounts for adaptive behaviors
 - Examines Dorsal and Ventral Stream functions
 - Visual search - identification of people, facial expressions,
 - Visual guidance of movement objects shapes pictures and words
 - Intersensory attention - orientation in surrounding environment
 - Auditory processing
 - Field neglects
- Also considers profound visual impairment
- Preferred stimuli/auditory processing/blindsight