Hemianopia, the Hidden Impairment following PCA Stroke: Functional limitations, Assessment and Intervention

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Learning Objectives

- Describe the functional limitations that persons with hemianopia experience.
- Identify the key behaviors that indicate that your client may have a hemianopia.
- Identify screening assessments to describe the field deficit and its effect on functional performance.
- Identify key intervention strategies that enable the client to compensate for the hemianopia in reading, writing, mobility and activities of daily living.

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First-a few words about Vision Impairment from ABI

- Common types of vision impairment from ABI
  - Hemianopia/other VFD, poor high contrast/low contrast acuity, oculomotor impairment, neglect
- Limitations associated with vision impairment
  - Difficulty completing **vision-dependent** activities
  - Slow processing **speed**
  - **Errors** in decision making
  - **Fatigue**
  - **Dropping out** of occupations especially I-ADLS

Mennem et al., 2012; Berthold-Lindstedt et al., 2019; Hazelton et al., 2019; Warren, 2009   3

In general…

- Experience greatest difficulty with activities completed in **dynamic** environments with **lots of pattern**
  - Community activities
    - Driving, shopping, working, sports
- Person avoids **participating** in activities in these environments
  - Prolongs adjustment to disability
  - Impacts wellness

de Haan et al., 2015; Hazelton et al., 2019; Warren, 2009   4

Challenges Addressing Vision Impairment in Post Stroke

- Older client may show combination of
  - **Neuro-related** impairment
    - Occurring from the stroke
    - Or from a neuro-degenerative disease
      - Parkinson's disease
      - Alzheimer dementia
      - Multiple sclerosis
  - **Age-related** impairment
    - Normal changes in vision due to aging
    - Prevalent age-related eye diseases (ARED)
      - Age related macular degeneration (AMD)
      - Open angle glaucoma (OAG)
      - Diabetic retinopathy (DR)

Kunse et al., 2017; Ekker et al., 2017; Costello, 2016; Voleti & Hubschman, 2013   5

Vision Loss is a Hidden Impairment

- Generally observe only the **consequences** of vision impairment
  - Mimics deficits in the performance skills it supports
    - Motor
    - Cognitive processing
    - Social communication
- Client often presents an ambiguous picture
  - Difficult to tease out the visual impairment
    - May not be apparent until other skills improve
- Critical to collaborate with other professionals
  - Must have good communication with the eye doctors: ophthalmologist (MD) and optometrist (OD)
  - All members of rehab team must communicate/work together (including orthoptist)

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Visual Field Deficits

- The visual field
  - Area of visual world that can be seen when looking straight ahead
  - Divided into
    - Right/left halves
    - Superior/inferior halves
  - Provides brain with a **complete picture** of resources and threats
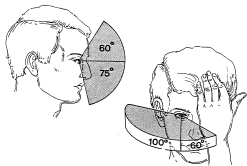
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Visual Field Deficit

- Occurs from damage along the visual pathway and within occipital lobe
- **Common** ABI visual impairment
  - In adults AND kids
  - Can be hemianopia, quadrantanopia, tunnel vision…
- In stroke-damage mostly occurs behind the chiasm
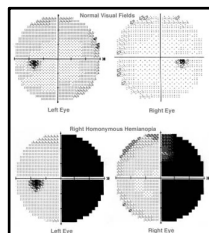 - Person experiences field deficit in both eyes
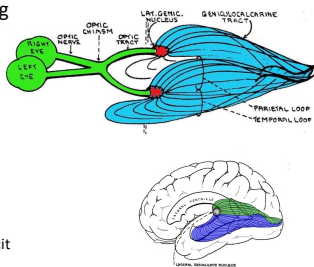
Gilbert, 2013; Kedar et al., 2006

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Homonymous Hemianopia

- Causes loss in **½ of visual field** in each eye
- **Most common** form of VFD following PCA stroke
  - And most studied in terms of recovery, affect on occupation and intervention
- Can occur with **macular sparring**

Rowe et al., 2013; Wolberg & Kapoor, 2021

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Recovery

- **Some improvement** possible in the first 1-3 months after onset
  - 40-60% experience some recovery of field
    - More likely to occur in lower visual field
- **Recovery slows down** with time
  - Generally little recovery beyond 4-6 months
- Considered a **permanent deficit**
  - Medicare considers it a **low vision** condition

Zhang et al., 2006; Celebisoy et al., 2011; Agarwal & Kedar, 2015

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Functional Limitations

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PRIMARY Challenge: person **does not** perceive the loss of visual field

- Person perceives an **unaltered** and **complete** visual field
  - No black curtain-no gaps in the field
- Occurs due to **perceptual completion**
  - Cognitive process that uses **memory** and **prediction** to **create** the **visual scene**
  - FL predicts what will be seen based on **experience, instructions and expectation**
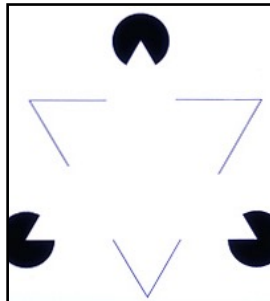
Dowling, 2018; Gilbert, 2013

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Perceptual completion influences **safe navigation**
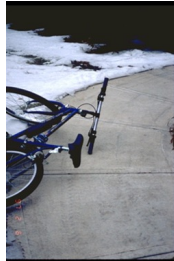
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Perceptual completion **alters visual search**

- Client has difficulty knowing **where** border of **blind field begins or ends**
  - **No marker indicating transition** between seeing and non seeing field
- To compensate client
  - May adopt a **narrow search** pattern often confined to **midline** and **sound side**
  - **Slows search** of blind field
    - Employs **stair-step saccades** to locate target

Machner et al., 2009; Zihl, 2011; Tant et al., 2002

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Perceptual completion **reduces** self-efficacy and autonomy

- Person instinctively trusts their **newly altered** perception and as result **experiences mistakes, collisions**
  - Thinks the aisle is clear in a grocery store and collides with another shopper or a pallet, box etc.
  - Thinks they have read to the end of a line of text-and realizes the text is not making sense
- This disconnect between perception and reality causes **confusion, uncertainty, anxiety, fear**
  - Person loses self-confidence, self-efficacy
    - Becomes **more passive/reliant** on others for decision making and completing activities
    - **Drops out** occupations

Hazelton et al., 2019; Warren, 2009

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Hemianopia Causes Challenges with

- Navigation
  - Changes in mobility and orientation
- Reading
- Writing and other activities requiring eye/hand coordination
- Completion of **vision-dependent** ADLS
- Narrowing of occupational engagement

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Mobility

- Person appears hesitant, uncomfortable, anxious navigating environments
  - Stiff, uncertain gait
  - Comes very close to obstacles
  - Uncertainty walking on surfaces with subtle features
  - **Shoe gazing**
  - **Trailing**
  - **Stopping to search**
  - **Following**
- 90% report experiencing a **collision** (Warren, 2009)
- 44% report **fear of falling** (de Haan, 2015)

Zhil, 2011; Krishnan et al., 2017; de Haan et al., 2015; Hazelton et al., 2019; Warren, 2009

Orientation

- **Doesn't obtain enough visual input** to build a complete/accurate map of surrounding space
  - **Focus on staying upright** limits awareness of surroundings
  - Plus **perceptual completion slows search**
    - Unable to scan **fast enough** to build the scene
- Experiences a **tendency to get lost**
  - **Very uncomfortable** navigating alone
  - **Avoids** independent travel
    - **Relies** on others to lead them
    - Difficult for client **and family**

Zihl, 2011; de Haan et al., 2015; Hazelton et al., 2019; Warren, 2009

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Reading

- Fluent reading depends on a **normal** perceptual span to view text
  - Approximately 15-19 characters wide
  - Asymmetrical
    - Extends farther to right (up to 15 characters)
    - Than left (3-4 characters)
  - **Foveal area** (light blue) used to **decode words**
  - **Para-foveal area** (darker blue) **guides eyes** across page

Living without children can be a blessing

Rayner, 1998   19

Reading

- **Alternately fixate/saccade** to move PS window across text
  - From middle of one word to middle of next word
- **Right side** of perceptual span
  - Partially **decodes** the next word(s)
  - **Plans** the next saccade to land in the middle of next work
- **Left side** of perceptual span
  - Assists with **word recognition**
  - **Navigating leftward** to start the next line of text

Living without children can be a blessing
Living without children can be a blessing

Rayner, 1998   20

Reading

- HH shortens width of span on HH side
  - Cuts off letters at **beginning** or **endings** of words
    - **Snow** becomes **now**
    - **Hanger** becomes **hang**
- Smaller window disrupts the saccade pattern
  - Right HH-uses a **hit** and **miss saccade** pattern to locate next word/move through text
    - **Skips** or **doesn't see** all of the word
  - Left HH-**undershoots saccade** to locate beginning of next line
    - **Omit words** on left side of page
    - **Skips lines** of text

Zilh, 2011; Schuett, 2009; Blaylock et al., 2016   21

Reading

- Client forced to make **regressions** to accurately read text
- Reduces reading speed and accuracy
  - Slows reading speed way down
    - 50% of normal reading speed
- Person must put more effort into reading
  - Reduces pleasure and confidence
  - Feels that can no longer read

Blaylock et al., 2016; Warren, 2009

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Eye/Hand, Eye/Foot Coordination

- Difficulty visually monitoring the hand/foot
  - **Occurs only** when HH is on **same side as dominant hand/foot**
- **Reduces** handwriting legibility
  - Drift up/down on line
  - Write on top of other words
  - Position incorrectly
- Difficulty completing activities that **require precision** and **visual guidance** of the **hand**
  - Pouring, cutting, keyboarding
- Difficulty completing activities that **require precision** and **visual guidance** of the **foot**
  - Sports activities
  - Walking on cluttered, uneven terrain
  - Climbing a ladder

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Activities of Daily Living

- Difficulty completing **vision-dependent** ADLS
  - **Reading dependent** activities
    - Financial management, meal prep, communication (smartphones, computers)
  - Activities that require a **wide visual field**
    - Meal prep, cleaning, yardwork, viewing sports, movies
  - Activities that occur in **dynamic environments**
    - Driving, shopping, dining out, recreation

Warren, 2009; Costela et al., 2018; Bowers, 2016; Hazelton et al., 2019; de Haan et al., 2015

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Evaluation

- Why its important to screen for VFD
  - Commonly occurs following PCA stroke
  - Presence can reduce ability to achieve other goals
    - Reduces likelihood of independence in ambulation/ADLS
      - by 20% (Zihl, 1995)
- Difficult to accurately assess visual field early in recovery
  - All perimetry tests require
    - **Sustained fixation** on a central target
    - Presentation of a **second target** of a specified size/brightness in a designated area of the field
    - **Acknowledging** 2nd target **without breaking fixation** on central target

Diagnostic Evaluation

- Completed by ophthalmologist or optometrist
  - Must be referred out
- For clients with **multiple impairments** from ABI
  - **5 months** is the median time required to get a formal diagnosis
  - Persons with PCA stroke can often be tested earlier
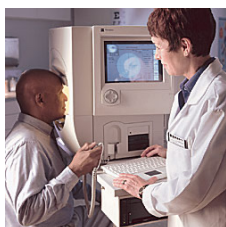
Humphrey Visual Field Analyzer

Bruce et al., 2006

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Clinical Observations

- Observing for behaviors that suggest **HH-best approach** in early stages of recovery
  - Client **can't provide an accurate description** of vision loss due to perceptual completion
  - But team should see **consistencies in behaviors**
- **Key** behaviors
  - Misses objects/features located on blind side
    - Especially small or patterned objects that lack contrast
    - **But attends and searches that side** when cued
  - Comes close to/collides with/knocks over objects **on 1 side**
  - Has difficulty reading-**aware of mistakes**
  - Anxious/stressed in **crowded dynamic environments**

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Screening Assessments

- Confrontation Test
  - Examiner confronts the field by holding up 2 targets
  - Estimate how much field is missing by comparing to examiner's field
  - May greatly **underestimate** presence of visual field deficit

Trobe et al., 1981; Celebisoy et al., 2011

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Alternative: 2 Person Kinetic Test

- Second examiner reduces cheating
- Bright penlight target reduces false positives in testing periphery

biVABA-Brain injury Visual Assessment Battery for Adults

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ScanCourse (biVABA)

- Dual task assessment
  - Assesses ability to integrate visual search with ambulation
- Validated on clients w ABI
  - Good inter-rater/re-test reliability
- Inexpensive, flexible
  - Can be set up anywhere

Good compensatory strategy: Head up, locates targets without pausing during ambulation
Poor compensatory strategy: Fixates on floor or stares straight ahead; stops to locate targets

Lund et al., 2020; Chau et al., 2021

Light Boards

- Primarily intervention tools
- Capture data for documentation
- Provide opportunity to observe
  - Slow scanning and processing on blind side
- Compare performance between the fields

Dynavision D2
Blackwell et al., 2020
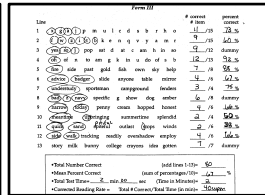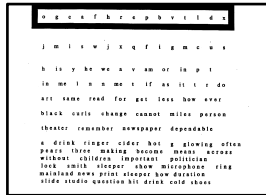
Vision Coach
Brooks et al., 2017

Bioness Integrated Therapy System, Stephenson et al., 2019

NVT Vision Rehabilitation System
Hayes et al., 2012

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Pepper Visual Skills for Reading Test

- Evaluates
  - Scotoma influence, reading accuracy, reading speed
- Validated on persons with HH

Blaylock et al., 2016; Lott et al., 2001

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The Telephone Number Copy Test (biVABA)

- Numbers have similar configurations
  - 3,6,8,5,9
- No/delayed feedback when mistakes occur
  - Is the Visa bill $688.00 or $633.00?
  - Is the expiration dat-3/6/2021 or 9/5/2021?
- Common errors
  - Incorrectly identifying the number
    - Especially numbers in a series

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Activities of Daily Living

- Self-Report Assessment of Functional Visual Performance (SRAFVP)
- 38 item assessment of **vision-dependent** ADLS
- Validated on persons with HH
- Free-download toolkit from:
  - https://www.uab.edu/shp/ot/low-vision-rehabilitation/free-resources

Mennem et al., 2012

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Distinguishing Hemianopia from Neglect

- Neglect is more common following MCA right hemisphere stroke but does occur with PCA stroke
- Hemianopia
  - **Primary sensory deficit** (blindness)
  - **Limits** amount of incoming visual information BUT **doesn't alter** ability to attend
- Neglect
  - **Cognitive deficit**
  - **Alters** ability to **attend** to visual information reducing **ability to acquire sufficient** information to complete occupations

Sperber et al., 2020; Karnath et al., 2011; Gammeri et al., 2020; Nurmi et al., 2018; Vallar & Calzolari, 2018

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Cancellation Tests
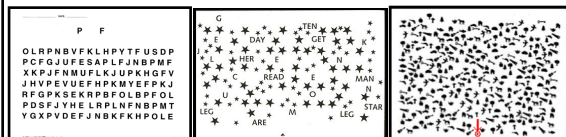
Single Letter Search biVABA   Star Cancellation BIT   Bells Test

Search patterns of adults without brain injury
- Left-to-right, top-to-bottom linear strategies
- Symmetrical, consistent, accurate

Diller & Weinberg, 1972; Warren et al., 2008

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| Hemianopia	Neglect
• Abbreviated search pattern with omissions on blind side • Pattern usually slow, tedious but **ORGANIZED** • Ability to sustain attention (measured by time) is appropriate for the task • Improves with cuing and practice	• Abbreviated search pattern towards left with omissions • Pattern is **asymmetrical, random, disorganized** • Short completion times little or no re-scanning to check accuracy • Unable to incorporate cue, less improvement with practice

Intervention

- HH creates permanent deficit-client must learn to use remaining vision to **compensate** for vision loss
  - **Key interventions**
    - **Compensatory Visual Scanning Training (C-VST)** to improve ability to use remaining vision to efficiently search environment and read
    - **Assistive technology** and adaptive devices
- Environment strongly influences client's performance
  - Environments/tasks often contain **visual stressors** that increase effort, reduce success, and fatigue the client
    - Client experiencing visual stress completing an activity will be less motivated to participate and will ultimately drop or avoid the activity
  - **Key Intervention**
    - Create a visible, structured environment/task to optimize **person-environment fit** to facilitate visual search and reduce visual stress

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Before starting intervention **Maximize** client's ability to use current vision

- Make sure client has and wears (clean) eyeglasses
  - Lotery et al., 2000
    - 25% did NOT have their glasses with them
    - 27% with glasses-spectacles were dirty, scratched or broken
  - Keep glass cleaner in your pocket, use it daily with your clients-educate other rehab team members
- Refer client to eye doctors
  - 50% of the participants with glasses in the Lotery study **benefited from updated refraction**

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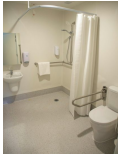
Visual Stressors

Low contrast

Deceptive pattern,
too much light,
low contrast

Low contrast; varying light level

Glare, low contrast, pattern

Too little light, too much
clutter/pattern, too little structure

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Modify Environment/Task

- Reduce visual stressors and create a visible task and environment
- Three step intervention
  - Add sufficient and **well-tolerated lighting**
    - Brighter lighting increases visibility of small/low contrast features
  - Increase contrast of **key features in** the environment/task
    - Makes these features stand out and more easily identifiable
  - **Reduce pattern** in environments/tasks
    - Pattern camouflages features/objects, hiding them from the client
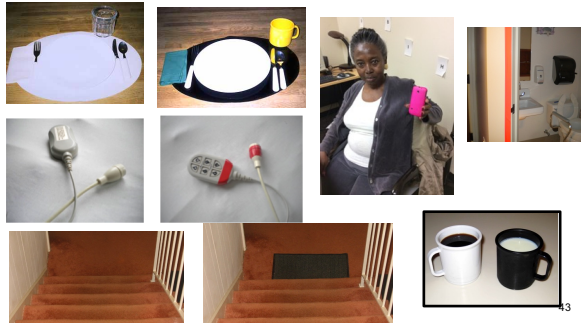   - Can be inlaid or overlaid pattern, or clutter

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Add Optimal Lighting

- Desired qualities
  - **Even** illumination
    - No shadows
  - **Maximum** illumination
  - **Minimum** glare
    - **Halogen** and **LED** provide strongest illumination with least amount of glare
  - **Flexible** placement
    - Light source should be **as close to task as possible**
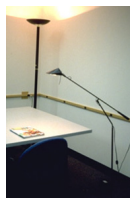
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Add Contrast to Key Features/Items

Reduce Pattern/Clutter

C-VST

- Training focuses on
  - Increasing the **width, speed,** and **efficiency** of search towards the **blind field**
  - Client is taught to employ a **conscious search strategy** that is **over practiced** to make it more automatic
- Various training activities
  - Light boards
  - Dual task training strategies

C-VST

- As an intervention for **hemianopia**
  - Has most evidence for effectiveness compared to other interventions based on recent Cochrane Review
    - Pollock et al., 2019
  - Several good RTCs
    - Aimola et al., 2014
    - de Haan et al., 2016
    - Rowe et al., 2016
  - RTCs suggest training effect is specific to the task
    - E.g. tasks that emphasize locating objects in environment won't improve reading and vice versa

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C-VST Interventions

- Light boards
  - Employ gaming principles* to increase motivation/practice Increase **width, efficiency, accuracy** of head turn
  - Increase **visual anticipation/attention** towards blind side
  - Employ search strategies **automatically** without explicitly thinking about them
    - Search strategies become second nature
- Dual task activities with ambulation
  - Breaks habit of shoe gazing/staring straight ahead
  - Increases client confidence navigating alone in environments
  - Examples
    - Scan courses
    - Treasure hunts
    - Narrated walking

*Olgiati et al., 2016; Anderson et al., 2011; Kim et al., 2011; Brooks et al., 2017; Stephenson et al., 2019

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Reading

Motivated to Resume Reading	**Needs Text Information**

- Pre-reading exercises to adapt perceptual span
  - Practice executing saccades to accurately move new PS
- Practice reading text
  - Familiar content in large print
- Evidence based reading programs
  - Read Right Program
  - **D**urham **R**eading and **EX**ploration training (DREX)
	- **THE** goal for all clientS
	- **With reading**: strategies to improve text navigation
	  - Marking/outlining text
	  - E-readers
	  - Accessibility features on devices
	- **Without reading**: assistive technology
	  - Text to speech and vice versa- using software/apps
	  - Internet connected virtual assistants (e.g. Siri, Alexa)
	  - Talking devices

Ong et al., 2010

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Return to Driving

- Depends on many factors
  - Government regulations
  - Co-impairments: dangerous combinations include
    - HH and inattention or cognitive impairment
    - HH and hemi**plegia**
    - R-HH and aphasia
  - Person's driving history
    - Years of experience, number of accidents/citations/per year
  - Driving environment
    - Rural vs. city, hilly vs. flat terrain
  - Extent of the VFD
    - Better outcomes for
      - Quadrantanopia
      - Hemianopia with macular sparring
      - Relative field loss

Bowers, 2016

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End of Lecture

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