# Reading Recovery in Acquired Brain Injury

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## Acquired Brain Injury

- Traumatic Brain Injury
- Cerebral Vascular Accident
- Anoxia
- Other Neurological Disorders - MS, Guillain-Barre, Parkinsons, etc.
- **KEY** – Different types and locations of lesions affect different aspects of reading and the visual process

## Incidence of RD After Stroke – Rowe, et al.

- Most studies on alexia and homonymous hemianopsia
- 915 patients recruited
- Reading difficulty in 177 (19%) patients
- Some had language issues (without visual)
  - 15 expressive or receptive aphasia, 8 had alexia
- Most all had visual diagnoses (87 with multiple)
  - 109 Visual field loss (R50, L 55, both 4)-61%
  - 85 Eye movement disorder, ocular alignment-48%
  - 27 Low vision-15%
  - 39 Visual perceptual impairment-22%
- How about visual skills – efficiency?

## Incidence of RD in other ABI?

- Traumatic vs. mild Traumatic Brain Injury
- mTBI is underreported in the literature (concussion)
- Reading difficulty vs. efficiency of reading (visual)
- Ciuffreda study on Reading and ABI/mTBI
  - Saccadic dysmetria (>65% EOM abnormalities)
  - Unstable Vergence
  - Accommodation

## Literature Reading, Oculomotor, and ABI


## Reading – What Is It?

- Define Reading
- Learning to Read vs. Reading to Learn
- What is Reading for?
- How is reading affected in ABI?
  - Loss of ability to read
  - Loss of efficiency in reading
- How does one recover and/or improve reading?
The Continuum (Models) of Reading

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<tr>
<th>TOP</th>
<th>Comprehension</th>
<th>UP</th>
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<td>Thoughts</td>
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<td>DOWN</td>
<td>Grapheme/Phoneme</td>
<td>BOTTOM</td>
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MA Tinker (part to whole)

Reading is acquired by stages:
1-the child acquires decoding skills in word recognition
2-the decoding vocabulary is increased
3-the knowledge of concept and comprehension of ideas emerge
4-older child increases the capacity to grasp meaning and appreciate the style of written passages
5-beyond 7th grade, a mature reader should be able to interpret, evaluate and reflect on the meaning of what is read.

Kenneth Goodman, PhD (whole to part)

“Reading is a psycholinguistic guessing game. It involves an interaction between thought and language. Efficient reading does not result from precise perception and identification of all elements, but from skill in selecting the fewest, most productive cues necessary to produce guesses which are right the first time. The ability to anticipate that which has not been scene, of course, is vital in reading, just as the ability to anticipate what has not yet been heard is vital in listening.”

Patterning of Behavior - Anticipation

- Human Brain, Human Learning by Leslie Hart
- Examples of patterning of behavior
  - Auditory example
  - Visual example – OM skills, accommodation and binocularity
- Patterning establishes neural networks, next we automatize or simplify the pathway, thus releasing attention and working memory for other tasks
- Patterning provides opportunity for ANTICIPATION
- ANTICIPATION allows for selective recognition so one can “approximate print” and read efficiently!

The Fallacy of Phonics

- 2000 ways to write 44 english sounds
- Berdiansky, et.al.- 6,092 most commonly used words of 6-9 year olds
  - 69 grapheme units related to 38 sounds a total of 211 ways
  - Thus 166 rules and 45 exceptions
  - The exceptions make up 600 of the most commonly used words ! (Smith)

“i” before “e”, except after c ...

Except when you run a feisty heist on a weird foreign neighbor wearing a beige shirt.
How about “your” – “4-9-7-1” sounds, thus you have 252 possible combinations

Sound these out

- ghoti
- shebug

Recognizing Words

- Word Shape (word superiority effect)
- Serial Letter Recognition
- Parallel Letter Recognition
- Dual Route models are now status quo
- Other considerations – isolated vs. text
  - Visual Word Form Area – VWFA
  - *Includes word recognition (visualization) and is meaning driven

Word Jumble – unknown category

- gitrua

Word Jumble – “Musical Instruments”

- dsurm
- pnoia
- sxoponhea
Researcher David Sousa

“That the brain learns to read at all attests to its remarkable ability to sift through seemingly confusing input and establish patterns and systems. For a few children, this process comes naturally; many have to be taught.”

But...how about recovery from ABI?

Doidge—"The Brain that Changes Itself"

- Neurons that fire together, wire together.
- Neurons that fire apart, wire apart.
- Visually letters are essentially the same, but sounding out letters is quite inconsistent!
- Words vs. Non-Sense Words
- How do we get them firing together when one area is damaged? KEY is Context...

Paragraph reading

Aaccrdng to rscheearh at an Elingsh univrsy, th eordr of ltteers n a wrod dosen’t mtaer, th olney iprmoetnt thng is tht th frsit nd lst ltteers aer in th rghit plce. th rset cn be a tnt mses nd yu cn stll rada t wwithit a porbelm. Th ths bscause w do not rada evry ltter by it slef, nt instaed w usuqlly rcsrginiz wrods s w wlohe.

Neurometabolism Match with Anagram and Word Reading

Automaticity (automatic patterning)

- Developing an automated response requiring less neural processing and energy or blood flow
- Example – initially learning to drive vs. driving while simultaneously eating, on cell phone, etc.
- Benefit is freeing up attention for more challenging demands and increasing processing speed
- Concern is that you may spread your attention too thinly with more tasks, the result is decreased performance such as reduced visual fields while talking on a cell phone, or the loss of reading ability from an ABI

Where Is Reading Located?

- Single area of the brain?
- Single neural network?
- KEY - Multiple neural networks working in unison to provide the outcome
  - What happens when one area disrupted?
  - Can other areas make up for the loss, or fill in?
  - Do you lose a specific aspect reading?
    - Oculomotor skills, Localization and/or Spatial Skills
    - Expressive vs. Receptive Language
    - Can read, but not name letters?
Neural Networks - Basics

- Reciprocal interweaving of all pathways
- TBI or stroke affecting the ACA, MCA or PCA
  - Right / Left Hemisphere Processing
  - Anterior / Posterior Processing
  - Subcortical to Cortical pathways
- Coup – Contrecoupe Injuries / Shearing Injury
- "Because around half of the circuits in the brain are involved in vision, many aspects of the visual system are vulnerable to moderate, severe or mild TBI."
- Ocular Motor Control – example of CN6

Researcher Stephen Covey

"To begin with the end in mind means to start with a clear understanding of your destination. It means to know where you're going so that you better understand where you are now so that the steps you take are always in the right direction."

This holds true for evaluation and treatment of vision, reading and acquired brain injuries.

What is the Problem in Reading?

- Visual skills?
- Loss of ability to read? VWFA? Language?
- Span of recognition?
- Speed of processing?
- The answer is YES, but “it depends” from individual to individual, all unique
- We need to address the big picture!

The Recovering (Emergent) Reader

- Basic Processing Skills
- Visual, Auditory, Speech-Motor, etc.
- Processes/Strategies – Sustained Attention?
- How do you load memory? Learn patterns?
- Ignition – intrinsic motivation
- Patient needs – realistic hope that it can improve
- Curriculum
- Part-Whole, Whole-Part, Combination – see examples
Basic Skills - Visual Testing for ABI

- Routine Visual Examination – Visual Skills
  - Accommodation, Binocularity
  - Ocular Motor Control – Basic, DEM, Readalyzer
- Visual Field Loss and/or Visual Neglect (USI)
  - Threshold vs. Motion vs. Dual Extinction
- Motion Hypersensitivity - OKN
- Vestibular Probes – Dynamic Visual Acuity
- Observations of Motor and Postural Control
  - Overall tone, posture during reading, arousal level

Visual Treatment Considerations

- Visual hygiene and guidance – missing link?
  - Blinking rate reduced, short working distance, breaks
- Lenses – loss of resilience and speed
- Prisms – binocularity, postural, visual field
- Selective occlusion – decrease diplopia or noise
- Visual Rehabilitation/Vision Therapy
- Reading Recommendations
- Others

Refractive Status

- Loss of resilience to overcome minor refractive concerns and early presbyopia
- Lens has ‘stimulus’ effects upon
  - Clarity (refractive status) and accommodation
  - VOR and stable motion (dizziness)
- Spatial localization (how is everything related – x,y,z)
  - Absolute and Relative disparity
- Volume/Size of Attentional Fields – C/P and Z axis
- Monovision – concerns of refractive surgery and implant choices for cataract surgery (include bifocals)

Accommodation

- Amplitude
- Flexibility
- Sustainability
- Loss of resilience in pre-presbyopia
- Effects upon Neuropsychology evaluation and Speech evaluation

Binocularity

- Can they fuse?, C/P relationships?, Proprioception?
- Flexibility – vergence with tilted page
- Sustainability
- Evaluate phoria and/or tropia (horizontal, vertical and cyclo), vergence ranges
- Stereopsis-speed?, Fixation disparity?
- Effects upon localization, dysequilibrium, central/peripheral and motion processing

Ocular Motor Control

- Basic EOM control
  - Range of movement – monocular and binocular
  - Fixation, Pursuits, Saccades, VOR, OKN
- DEM, KD testing
- Readalyzer or Visagraph
- Guidance – bookmark, EZC reader, slant board
- Tracking and processing speed
Compensatory Strategies

- Bookmark
- Fingers
  - 1 finger across page
  - 2 finger, complicated
  - 1 anchor finger
- EZC Reader
- Open window reader

Red Permanent Marker-Overlay

The attractions of the American prairies as well as of the alluvial deposits of Egypt have been overcome by the azure skies of Italy and the antiquities of Roman architecture. My delight in the antique and my fondness for architectural and archaeological studies verges onto a fanaticism.

Single Finger Across Page

Single Finger Anchor Technique
EZC Reader from ReallyGoodStuff.com

Open Window Reader – not a fan!

Kindle – concerns with touchscreen

Eraser or Red Pointer (Best!)

Colored Filters
- Harold Solan, OD from SUNY – effects of Blue
- Irlen Filters – “Reading by the Color”
- ChromaGen – R/L differences
- Intuitive Colorimeter – precision tints
- Short vs. long term, spectacles vs. overlays
- Spatial distribution of letters, VOR gain, etc.
- Blue = plus = magnification, spatial aspects?
- Red/Yellow = minus = minification, minus projector?

Visual Field Testing
- Differentiate VF loss vs. Visual Neglect (USI)
- Location – Occipital = VF loss, Others = USI
- Is USI more of a concern?
  - R/L Hemisphere (processing) vs. loss of field (input)
- Confrontation Fields
  - Motion
  - Form
  - Dual Extinction
- Draw a Clock, Line Bisection, Star Cancellation
Draw a Clock – CW vs. CCW

Sequential and Simultaneous Concerns

Visual Fields and Reading
- What would you rather have a R or L hemianopsia?
  - Right field concern
    - Span of recognition, macular sparing
  - Left field concern
    - Return saccade into blind field
- Treatment considerations
- Rotation of print
  - 90 degrees vs. slight tilt

Can You Read With a Hemianopsia?

L Hemianopsia – Saccade Back

The part of farming enjoyed boy is the making of maple sugar better than blackberrying and good as fishing. One reason why this work is that someone else does it. It is a sort of work in which appear to be very industrious as little.

R Hemianopsia - Span of Recognition
- Digit span is 7-8 letters
- Span of recognition in reading is 14-15 letters
- Tilt material, may pick up 5-7 letters vs. 2-4
- Inter-hemispheric processing – for loading memory
  - Sequential vs. Simultaneous processing
  - WASHINGTON – 10 letters, three chunks or 1 word?
- Word Recognition vs. Anticipation/Comprehension
- Tachistoscopic projection may be helpful
- Other considerations
R Hemianopsia – Slight Tilt

The part of farming enjoyed most
3-7 letters

The part of farming enjoyed most by
5-7 letters

Motion Sensitivity and Vestibular

- Text around fixation may cause difficulty, appears to move or jump
- Effects of
  - Low plus – spatial distribution, VOR gain
  - Binasals – Ciuffreda article on VEP’s
  - Low BI prism – Padula study combined binasal/BI
- Bookmark or EZC Reader – removes text below reading, color effects upon size and contrast, possibly parvo/magno?

Binasal Occlusion and mTBI

Ciuffreda KJ, Yadav NK and Ludlam DP
Effect of binasal occlusion (BNO) on the visual-evoked potential (VEP) in mild traumatic brain injury (mTBI).
*It is speculated that mTBI attempt to suppress visual information to reduce their abnormal motion sensitivity. BNO negates the suppressive effect, thus an increase in VEP and decrease in symptoms

How Might a Binasal Help?

Global Brain Processing

- Head/Neck Postural Control, Vestibular Input
- Arousal to task – observe head movement
- Selective Attention – multitask, RL processing
- Postural control – extensor tone
- Processing speed – often improves
- Treatment considerations – vestibular input is helpful if they can handle head movement
  - Turn and clap, Turn and catch
  - Bean bag toss

Bean Bag Catch – Vestibular Input

- Goal is to look at vestibular input, spatial abilities, bilateral skills, raise and lower the demands as needed
- 20X Head Tracking/Catching
- 20X Eye Tracking/Catching
- Always observe for overloading of vestibular
- Document pre and post testing findings…DEM, KD, Visagraph/Readalyzer, OM skills
Initial Recovery – pre post bean bag

Test C Pre Bean Bag Activities
107, 103 seconds

Test C Post Bean Bag Activities
42 seconds

Effects of Bean Bag Activities
- Combined visual and vestibular therapy
- Increased arousal
- Increased bilateral processing (R/L hemisphere)
- Comprehension and Language/VWFA?
- Increase extensor tone (better postural control)
- Integration of multiple neural networks
- Attention, executive functioning, motor, vestibular, visual
- Just cortical benefits or are there also effects upon cerebellar function and timing?
**Curriculum - Reading Models**

- Phonics – bottom up reading – part to whole
- Sight Word – somewhere in the middle!
- Whole Language – top down reading – whole to part
- Benefits and Limitations of these
- Reading has to be multidimensional
- Read Right Program is one such type

**Read Right! – Dee Tadlock, PhD**

- Interactive Constructivist Theory
- Initial stages of acquisition
- Then primarily general comprehension strategies and
- Rapid word recognition
- Read Right Program

**Spelling and Reading Recovery**

- Why work on Spelling/Visualization?
  - Working memory
  - Sustained visual attention
  - Reintegrate sequential/simultaneous processing
  - Strategies for recall – verbal vs. visual, ignition?
- Why work on Reading Recovery?
  - Visual skills
  - R/L hemisphere processing
  - Speed of processing
  - Opportunity to regain reading abilities

**Traditional Spelling Approaches**

- Verbal rehearsal
- Flash cards
- Look, cover remember, write
- Write each 5X, 2X in sentence
- Benefit to neural networks of reading?

**Non-Traditional Spelling Approaches**

- Ball spelling
- Word array
- Word Search and Crossword Puzzles
  
- Short to long term recall – 60-90 minute rule by
  John Medina, “Brain Rules”
Ball Spelling Activity

- Which words? – Pretest/Reading/etc.
- Say word-spell it-say word
- Look at word (observe trust in vision)
- Hide word (visualization)
- Spell backwards (look for chunking)
- 60-90 minute rule – see Brain Rules, Medina
- Modifications

Word Array - Ingersoll

- Write 3-5 words across page
- Correct them as you go
- Cover and ask to rewrite all from memory
  - If incorrect, ask them to recheck
  - Rewrite all of them till 100%
- Phonetically correct vs. incorrect
- 60-90 minute rule – write over again

Word Array - Watch Handwriting

- Washington
- Believe
- Oregon
- Washington
- Believe
- Oregon

Miscellaneous Others

- Clay as a medium (Davis Dyslexia)
- Concentration games
- R/G letters and words (Headline)
- R/G Phonetic Focus (Cobb)
- Word Search-from word lists

*Do these all use “sustained” attention?
*Stimulate sequential/simultaneous processing?

Concentration Games

- Magnadoodle or Clay
It is purposeful
It is selective
It is anticipatory
It is based upon comprehension
*Compare vision therapy vs. training visual skills in isolation?

Can You Make Reading Hard?
- Include little relevancy (meaning)
- Emphasize reading each and every word perfectly
- Emphasize they must remember everything in the story
Neural Networks of Reading-Activities

- Reading Guidelines-KEY
  - 90% Independent Level
  - Two grade levels up – they point and you read
- Print size
  - Large print vs. span of recognition, working distance
  - Crowding effect
- Neurological Impress Method
- Sentence Cut Up
- Words on objects, Word families

Neurological Impress Method (NIM)

- From TBI population (war)
- 2 or 3 steps
- Facilitator reads, both read, patient reads
- High predictability guides anticipation
- Develop initial confidence, new strategies vs. sounding out
  IGNITION !!!

Pyramid Reading

The frogs went under a log.

Sentence Cut Up

John went to the store.

Word Families

-ark -ad -ate -aw
bark bat date caw
dark cut fate jaw
hark fat gate law
lark hat hate gnaw
mark mat Kate paw
park great late raw
Clark put mute saw
shark rat rate claw
spark sat create caw
stark tat grate draw

-ash -est -ate -aw
bash brat plate flaw
bash chat state saw
bash draft straw straw
### Advanced Reading Recommendations
- Books on CD or Tape, follow book?
- SQ3R or...SQR
  - Survey
  - Question
  - Read
  - Recite
  - Review
- Writing Stories – balloon/bubble method

### Brain Based Learning - Eric Jensen
- Myths-
  - Prereading is a waste of time
  - Prereading is too much work
  - Prereading is something new
- Watch out for-
  - Subvocalization
  - Regression
  - Prolonged fixation

### Case Presentations
- R hemianopsia, minor language issues (cannot name letters/words seem easier) – why?
- Parkinson's moderately advanced

### R Hemi/Language issues, Head Tilt
- NIM – ‘BARB’ was read as ‘TARM’

### Go back to letters, include naming
Therapeutic Thoughts - Letters
- Letter puzzles with pictures behind
- Reduce number of letters (complexity)
- Say “A as in Apple” to drive meaning
- Increase the number of letters over time
- Present letters in isolation
  - Initially reduce number, increase over time
  - Alphabetize, etc.
- Remember that Neurons that Fire Together…

Sentence Cut Up
- I had a poached egg on toast.

Parkinson’s - Evaluation
- Routine evaluation – refraction, ocular health good
- Observed reading with book and Kindle, added substitution activities
- Adult DEM – A-62, B-58, C-130, post BB C-102
- Blink rate – about 40 seconds, often > 1 minute
- Alternating 10PD Exotropia, No NPC, Fuses Worth 4 dot at near

Could do whole book after with NIM
- Parkinson’s – Referral from Speech
  - Slow response – light to dark, far to near
  - Dry eyes, blurry at times
  - Poor depth perception (binocularity or speed?)
  - Reading only 10 minutes, loses place
  - Kindle loses place, can’t keep up place of words when it reads aloud

Parkinson’s Treatment
- No change in glasses
- Use bookmark for reading, Kindle use red stick
- Bean Bag Activities
  - Sitting vs. standing
  - Couldn’t alternate hands, went to both hands
  - Challenging coordinating head vs. eye tracking
  - Read with greater fluency
- Increase blinking to 1X every 5 seconds
Parkinson’s Treatment

- Binocular therapy determination at next visit
  - With and without vestibular input (BB activities)
- Visual tracking therapy at next visit
  - With and without vestibular input
- Patient left feeling he had concerns addressed and was more comfortable with reading and processing speed

Summary

- Reading is one of the most complex tasks we learn, when we have difficulties from an ABI, there are many possible reasons and we need to evaluate and address them via therapy or referral
- Optometrists must first do what they do well, especially the judicious use of lenses, prism and selective occlusion
- Next investigate reading from a more global view. Looking for the patterning of behavior, which should lead to better anticipation and recovery of reading.