Dyslexia: What Pediatric Ophthalmologists and Parents Need to Know

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The AAAPOS Learning Disabilities Task Force

Reading and Dyslexia

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Language Development Sequence

- Understanding
- Speaking
- Reading
- Writing

Reading and Dyslexia

Growth

The Effects of Weaknesses in Oral Language on Reading Growth

What is Reading?
Reading is the complex process of extracting meaning from written symbolic characters

Oral Language & Reading

- Oral language is the foundation for reading
- Oral language is pre-programmed into human brain development
- Reading is not pre-programmed into human brain development
- Reading must be learned

Financial Disclosure

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* The more you read, the more things you will know.
The more that you know, the more places you will go.
(Or Seuss)
Reading

- Requires
  - Adequate vision
  - Good memory
  - Ability to sustain attention
  - Ability to name objects rapidly

Reading is comprised of
- Orthographic Perception
- Decoding
- Fluency
- Comprehension

This is the same dog turned in different directions
"Object Constancy" & "Mirror Invariance"

Orthographic Perception
- Recognizing the features of letters and words
  - b
  - d
  - p
  - q
  - g
  - s
  - e
  - These are just lines and circles - devoid of linguistic meaning unless the child can use the phonetic code
  - A letter's orientation matters! Developmentally, this takes time to understand and remember!!

Decoding - Phonemes
- Oral Language is broken up into phonemes
- Phonemes are the smallest units of sound in words that signal differences in meaning
  - "Bat" vs "Cat" are distinguished by the sounds of their initial consonants
  - kuh
  - aah
  - cat
  - tuh

Decoding - Phonemes
- Dyslexia is present in all languages
- English is an orthographically deep language
  - 44 phonemes (sounds) in different combinations produce every word in the English language
  - 44 Phonemes can be spelled in 74 ways
  - 23 of those letter combinations can make more than 1 sound

Decoding - Phonics
- English uses
  - Alphabetic system - written symbols represent an abstract building block of our language's phonemes

Decoding - Phonemes & Phonics
- Reading is more difficult than speaking
- Children must first understand the sounds within spoken language and
- Then utilize the corresponding alphabetic code to acquire the sound/symbol connection
Decoding - Difficulties

For some children the process of decoding is so laborious and time consuming that they are unable to comprehend what they are reading.

Decoding & Working Memory Difficulties

Decoding puts heavy demands on working memory, when not automatic.

How We Read - Language

Fluency

- Ability to read connected text with expression rapidly and automatically with little conscious attention to the mechanics of reading such as decoding.

Fluency - Difficulties

- It isn't as difficult to identify words or understand a word, but the spaces between words make you pause, which means your reading is less fluent.

Comprehension - other factors

- Attention
- Memory
- Background knowledge
- Cultural influences
Comprehension - Difficulties

"Jabberwocky" - by Lewis Carroll
'Twas brillig, and the slithy toves
Did gyre and gimble in the wabe:
All mimsy were the borogoves,
And the mome raths outgrabe

The importance of vocabulary -
Sometimes you can read words without being able to construct much meaning from them

Prevention of Reading Difficulties

The National Reading Panel - 2000
- Promotion of evidence-based programs
- To read a child must be taught:
  - Phonemic awareness
  - Phonics - systematic & explicit
  - Fluency - guided oral reading
  - Vocabulary
  - Reading comprehension

According to a leading reading researcher, Dr. Louisa Moats:
- "Teaching reading IS rocket science"

Learning Disabilities

- Are common problems
- 5 - 20% of the U.S. population has a learning disability (depending on the definition chosen)
- > 2 million children aged 6 - 11 years old in the U.S. are affected

Learning Disabilities

- Arise from neurological differences in brain structure and function
- Affect the brain’s ability to store, process or communicate information
- Do not arise from malfunctions in the visual system

Specific Learning Disabilities

- Dyslexia
  - Reading disability
- Dysgraphia
  - Writing disability
  - Often found in addition to dyslexia
- Dyscalculia
  - Mathematics disability

Difficulties in Early Reading

- Initial difficulty in learning to read occurs in nearly 40% of students in the U.S.
- It may have a number of different causes:
  - Deficits in oral language
  - Lack of background knowledge
  - Inadequate instruction
  - Insufficient reading practice
  - Reading disability = Dyslexia

Dyslexia-A Language-Based Learning Disorder

- International Dyslexia Association
- Dyslexia is a specific learning disability that is neurological in origin

These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities
Dyslexia - Phonologic Deficit

The phonological deficit causes weak decoding skills leading to labored reading and secondary difficulties with spelling and writing.

Dyslexia is a Language-Based Problem

- A problem understanding written words
- Separating the sounds within words
- Single word decoding
- Sight-word recognition
- Rapid Naming (processing speed)
- Reading fluency
- Reading comprehension
- Spelling
- Verbal short-term memory

Dyslexia

- Dyslexia is the most common learning disability
- 80% of all learning disabilities
- 20% of children in the U.S. have some degree of dyslexia
- But only 5% of children have been diagnosed

Dyslexia runs in families

- 40% affected sibling
- 40% affected parent
- Multiple genes are suspected

Dyslexia - Shaywitz

- Dyslexia occurs in boys and girls nearly equally
- But boys are diagnosed significantly more often - perhaps because boys tend to "act-out" more often

Dyslexia - Shaywitz

- Dyslexia can vary from mild to severe
- Reading disability represents the lower tail of a normal distribution of reading ability

Dyslexia - Shaywitz

- Dyslexia does not represent a transient developmental lag
- Dyslexia is a life-long condition
- A child doesn’t just “grow out of it”

Dyslexia - Shaywitz

- Dyslexia is not related to intelligence
- Dyslexia occurs at all levels of intelligence
- Children with dyslexia are not “dumb” or “lazy” their brains just process information differently
- They are often very bright, analytic, creative and gifted in other areas

The Assets of the Dyslexic Brain

- Dyslexic brains process information differently
- This often leads to “out-of-the-box thinking
- And innovative problem-solving abilities
- 35% of American entrepreneurs are dyslexic
Cerebral Diversity

The assets of the dyslexic brain may account for success in the fields of Science, Technology, Engineering and Math (STEM).

Good spatial skills are a great advantage to work as engineers, architects and artists.

Dyslexia - Neurobiology

Brain Research - using functional MRIs

The brain of people with dyslexia are “wired” differently even before they start to read.

They use a different areas of the brain for processing written words, compared to typical readers.

The connections may be weak and slow to the word form area and also to the attention systems.

This leads to trouble retrieving the sounds in spoken words, making it difficult to read.

Dyslexia - Common Signs

Significance of the signs are age dependent

Difficulty learning the names of the letters

Difficulty learning the sounds of the letters

Reversing letters and words

Adding, dropping, changing words, skipping lines

Trouble spelling

Trouble with reading comprehension

Slow reading in adolescents & adults

Reading Systems in Brain

Dyslexia - Common Signs

Associated Problems

ADHD in 20 - 40% & vice versa

Spoken language difficulties

Dysgraphia (writing disabilities)

Spelling difficulties

Difficulties learning a foreign language

Math word-problem difficulties

Motor coordination difficulties

Dyslexia

Risk Factors

Family history of dyslexia

Fetal exposure to drugs or alcohol

Prematurity or birth problems

Infections of the central nervous system

Exposure to toxins (lead)

Severe head injuries

Other neurological problems

Possible Early Indications of Dyslexia

Family history

Speech delay

Trouble hearing sounds in words

Difficulty with rhymes

Confusing words that sound alike

Word retrieval difficulties

Delay in learning letters

Delay in learning phonics

Dyslexia is More Than a Reading Disability

Spelling Difficulties

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Dyslexia is More Than a Reading Disability

Spelling Difficulties
Dyslexia – Secondary Consequences

- Students who cannot read well tend to read less and this negatively impacts their:
  - Reading fluency
  - Vocabulary
  - Comprehension
  - Concept knowledge
  - Self-esteem

- Children may be teased or bullied by others
- May develop anxiety &/or depression

Dyslexia – Not a Vision-Based Disorder

- Some visual problems can interfere with learning
- But, children with dyslexia do not have more visual problems than children without dyslexia
- Visual problems may co-exist with dyslexia but are present with the same incidence as in the general population
- Rarely, a visual problem will “masquerade” as a learning problem

Dyslexia – Not a Vision Based Problem

- People with dyslexia do not see things backwards
- Difficulties in maintaining proper directionality have been demonstrated to be a symptom, not a cause, of reading disorders
- Word reversals and skipping words and lines are due to linguistic deficiencies and not visual or perceptual disorders

Dyslexia is a Language-Based Problem

Contrary to popular belief:
- The primary sign of dyslexia is not reversing letters
- Rather it is a difficulty interpreting the sound components of our language and difficulties sounding out words
- It is important to look for spelling problems not reversals

Dyslexia is NOT Caused by a “Tracking Problem”

- Children with dyslexia often skip words or lines when reading
- Some people call this word and line skipping a “tracking problem”
- Fluent reading is not based on “eye tracking”
- Fluent reading has to do with decoding abilities, fluency, comprehension, memory and attention!
- “Tracking problems” are over-diagnosed!

Educational Laws

- Federal Laws:
  - Individuals with Disabilities Education Act (IDEA) & (IDEIA)
  - Section 504 of the Rehabilitation Act of 1973 (504)
  - Americans with Disabilities Act (ADA)
  - 2008 ADA Amendments Act (ADAAA)
  - No Child Left Behind (NCLB)

Can’t Read Because of a “Tracking” Problem ???

Early Detection of Reading Difficulties

Yearly reading screening allows earlier identification of the struggling child
- K - Alphabet recognition, phonemic awareness & rapid naming
- 1st - Add word identification fluency
- 2nd - Add oral reading fluency
Early Intervention Programs

- **Response To Intervention (RTI) method**
  - Child is directly placed in an educational intervention program when difficulties arise
  - Tier 1 - Core Curriculum
  - Tier 2 - High Quality Group intervention
  - Tier 3 - Individualized intervention
  - Only children who do not show significant improvement after both tiers will undergo a full educational assessment

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- **Response To Intervention (RTI) method**
  - Not a lot of data
  - Not standardized
  - Now used by most states
  - Dr. Sally Shaywitz calls RTI: “Watch A Child Fail”

Initiating Evaluation

- A child’s teacher may contact the parents to initiate an evaluation or
- Parents can request (in writing) an educational evaluation at any time - (do not need to wait to complete RTI)
- Parents can request an evaluation at their local public school even if their child is in private school

Evaluation

- The diagnosis and treatment depends on the collaboration of a team
- Making the correct diagnosis in children with reading weaknesses is important before a therapeutic regimen can be prescribed
- Evaluation for attention and other problems is very important

I.E.P.s

- The IEP Team determines eligibility for special education
- The IEP Team does not identify or diagnose a child they classify a child into 1 of 13 disability areas (including specific learning disability)
- AND because of the severity of the disability need special education
- If a child’s disability is severe enough s/he will be eligible & an IEP plan will be written

I.E.P.s

- An IEP Plan will include:
  - Student’s educational needs
  - Specific learning goals
  - Different instructional methods
  - Treatments (ST, OT, PT etc)
  - Accommodations and modifications
  - IEPs are funded - services are provided at no cost to the family

504 Plans

- If a child does not qualify for an IEP but if dyslexia “substantially limits” learning and he/she still needs targeted reading instruction or other assistance
- A 504 plan will describe a child’s area of difficulty along with the accommodations and modifications that will be provided in the regular classroom
- 504 plans are not funded - so schools are not obligated to pay for 504 accommodations
Importance of Early Remediation

- Dyslexic children who receive effective phonological & phonemic training in K & 1st grade:
  - 10 - 25% will continue to show problems in learning to read
- Vs. children not identified until 3rd grade:
  - 74% will continue to show problems through high school

Remediation of Dyslexia

- Intensive treatment
  - 90 minutes in the regular classroom
  - 60 minutes extra instruction
- Sufficient duration
- Explicit instruction
- Multi-sensory (visual, auditory, tactile) reading and language program by a high quality instructor
- Systematic

Principles of Dyslexia Treatment

- Fluency Training
  - Practice, practice, practice!!
  - Children should re-read previously decoded and memorized words - (reading level below grade-level)
  - ≥ 20 minutes of oral (not silent) reading daily
- Comprehension Training
  - Vocabulary Training - Morphology

Principles of Dyslexia Treatment

- Dyslexia is a life-long condition
- People with dyslexia read slowly
- Dyslexia robs a person of time
- The accommodation of extra time
  - Levels the playing field
  - Does not “produce” success
  - Allows the student to show what he/she knows
  - Decreases stress and anxiety

Accommodations

- Accommodations can include:
  - Extra time
  - Separate quiet room
  - Testing alternatives - oral instead of written tests
  - Preferential seating
  - Lecture notes
  - Assistive technology
  - Computers & computer programs
  - Spell checkers
  - Recorded books

Treatment of Dyslexia - Summary

- Individualized explicit multisensory teaching of the 5 reading skills:
  - Phonemic Awareness
  - Phonics
  - Vocabulary development
  - Reading Fluency
  - Reading comprehension
  - PLUS
  - Spelling & Writing
  - PLUS
  - Accommodations

Other Recommendations for Children with Dyslexia

- Evaluation for attention and other problems is very important
- Medications or counseling can improve attention or other problems such as anxiety or depression
- Enhanced attention may contribute to improvement in reading and overall school performance

Dyslexia

- Barriers to success:
  - Lack of teacher training
  - Schools fail to provide evidence-based instruction
  - Schools don’t “believe” in dyslexia
  - Schools allow a child to fail
  - Mild to moderate dyslexics deserve identification and intervention
Teacher training is weak and inadequate. Only 29% of colleges of education taught ≥ 2 hours on the science of reading and evidence-based methods of reading instruction (phonemic awareness, phonics, fluency, vocabulary and comprehension).

Most elementary education teachers …
- Have not been exposed to the latest research
- Believe that dyslexia is a vision-based problem
- Have received a minimal training in reading instruction
- Have not been prepared to prevent reading problems
- Not aware of the signs of dyslexia - leading to delays in assessments and interventions.

The importance of well-trained teachers:
- Some colleges of elementary education teacher training are now beginning to teach:
  - Language structure
  - Reading theory
  - Reading development
  - Reading problems
  - The early signs of possible dyslexia
  - Reading assessment
- States with trained teachers in science-based reading intervention programs are seeing improving reading scores.

International Dyslexia Association
- Unlocking Dyslexia Campaign - 2013
  - E-mailed the toolkit “Dyslexia in the Classroom: What Every Teacher Needs to Know” to every public elementary school in the U.S.
  - Has not yet sent toolkit to private schools
- What you can do
  - You can get a copy at www.interdys.org
  - You can send it to the private schools in your area
  - Join the IDA

International Dyslexia Association
- Knowledge and Practice Standards for Teachers of Reading - 2010
  - To serve as a guide to prepare and certify the professional development of those who teach reading.

What you can do to help:
- House Resolution on Dyslexia - # 456 Bill Cassidy (R-LA)
  - Defines and explains dyslexia and resolves:
    - The House of Representatives calls on schools and State and local educational agencies to recognize that dyslexia has significant educational that must be addressed
  - Go to www.dyslexia.yale.edu
  - Write to your local congressman in support

Eye functions necessary to read:
- Michael Spedick, M.D. FACS, FAAO, FAAP Toms River, N.J.
- Visual perception
- Visual acuity
- Accommodation
- Convergence
- Saccades
- Fixations
**Visual Pathway**

- Visual perception requires an intact visual pathway
- Nerve impulses travel from retinal ganglion cells to V1

**Visual Acuity Testing**

- Near Visual Acuity
  - Each eye separately
  - Test @ 13-15 inches/33-40cm
  - Testing Cards:
    - Near Snellen Acuity Card
    - Jaeger Acuity Card
    - Rosenbaum Pocket Card
    - Wormington Near Card
- Distance Visual Acuity
  - Test at 20 feet/6 meters

**Clinically Significant Refractive Errors**

- Bilateral refractive errors - glasses recommended if:
  - Hyperopia
    - ≥ +3.00 D and near symptoms
  - ≥ +4.50 D
  - Astigmatism
    - ≥ +1.50 D
  - Myopia
    - ≥ -1.00 D
  - Anisometropia
    - ≥ 1.50 D

**Child with visual perception difficulties**

- Children’s visual perception can be affected by:
  - Astigmatism
  - Near vision problems

**Accommodative amplitude in phoropter**

- Manifest refraction then
  - Add (-) until blurry = Positive Relative Accommodation
  - ≥ 1.50 D
- Add (+) until blurry = Positive Relative Accommodation
  - Abnormal ≤ -1.50 D

**Accommodative facility in phoropter**

- Manifest refraction then
  - Add -1.50 and +1.50 alternately (use 3 diopter jumps)
Accommodation Testing

- Dynamic retinoscopy
  - Retinoscope while reading distance chart
  - Then continue retinoscope while switching to a near target
- Accommodative lag
  - The amount of plus needed to neutralize the reflex
  - The (normal) expected lag = plano to +.75 for children

Dynamic Retinoscopy

Accommodative Insufficiency (AI)

- Treatment can include:
  - Treat underlying condition
  - Glasses for latent hyperopia
  - Reading glasses / bifocals
  - +1.00 or +2.00
  - Home exercises to improve accommodation
    - Computer accommodative exercises
    - Near point exercises
    - Near-far rock
    - Flippers

Near Point of Convergence

- NPC with accommodative target
  - Sustain Convergence

Convergence Amplitudes

Convergence Insufficiency (CI)

- Diagnosis:
  - > 500 seconds of stereopsis
  - Exodeviation at near > distance
  - Decreased NPC
  - Difficulty maintaining convergence
  - Decreased convergence amplitude
  - Asthenopic symptoms

- .1 – 8%
  - Less common in young children
  - May be associated with A.I.
  - Frequently over-diagnosed!
  - Aggravated by lack of sleep, illness, or anxiety
  - May be more common in ADHD
  - Possibly secondary to medications
  - Is treatable

Convergence Insufficiency (CI)

Symptomatic Convergence Insufficiency

- Treatment can include:
  - Home-based convergence exercises
  - Push-up exercises involving accommodative targets
  - Push-up exercises with additional BO prism
  - Jump to near
  - Assumption from a target
  - Stereogram convergence exercises
  - Maintaining convergence for 30 – 40 seconds
  - Home computer convergence exercises
  - Office-based vision therapy
  - Base-in prism reading glasses
Symptomatic Convergence Insufficiency

- Does not cause dyslexia
- Is treatable with exercises or Vision Therapy
  - Treatment will make reading more comfortable & will allow reading for longer periods of time
  - But does not improve decoding or comprehension directly
  - Will not treat dyslexia

Eye Movements - Smooth Pursuit

- Smooth Pursuit or “Eye Tracking” is not involved in reading

Saccades

- Saccades are small jumping eye movements used in reading

How We Read - Saccades

- Reading uses:
  - Forward saccades - 85% of saccades
  - Average length of adult saccade is eight letters
  - Backwards saccades - 15% of saccades
  - Half the distance of forward saccades
  - Increase with difficulty of the text
  - Used for verification & comprehension
  - Used to jump to the next line

How We Read - Saccades & Fixation

- Reading is a sequence of:
  - Fixations
    - Average duration < 1/4 second
    - 90% of our reading time are fixations
    - Short words are read with 1 fixation
    - Longer words with 2 fixations
    - Information is acquired during fixation
  - Saccades
    - Move the eyes to the next point of fixation
    - Suppression during saccade

How We Read – Saccades & Fixation

- Children, early or dyslexic readers
  - Show similar saccadic eye movement and fixation patterns
  - Saccades - 1/2 length of adult
  - Fixates - twice as long and twice as often
  - More backwards saccades than adult

How We Read – Saccades & Fixation

- Dyslexic readers show normal saccadic function when not reading
  - The eye movement differences between dyslexic and typical readers are the result, not the cause, of their dyslexia

How We Read - Saccades & Fixation

- The saccadic pattern “improves” = progresses toward the adult pattern as:
  - Typical readers improve their reading
  - Dyslexic readers improve their reading
  - Training saccades does not improve reading
Who Should Have A Pediatric Eye Exam?

- Children who have suspected learning or reading difficulties should be evaluated for the possibility that vision problems are interfering with their learning.
- Some children may have a visual problem that masquerades as a learning problem.
- Some children may have a treatable visual problem along with their primary learning problem.
- If Office-Based Vision Therapy has been recommended:
  - It is recommended to get a 2nd opinion by a Pediatric Ophthalmologist.

How We Read - Visual Functions

- Children can be good readers even if they have:
  - Reduced vision
  - Convergence Insufficiency
  - Strabismus
  - Inability to make saccades
  - Nystagmus

Principles of Treatment

- Most eye and vision disorders can be treated with glasses and school performance will improve quickly.
- For the rare child with symptomatic convergence or insufficiency, eye exercises will generally improve comfort within a few weeks.

Controversial Theories and Therapies

Magnocellular Deficit Theory & Tinted Lenses

A. Melinda Rainey, M.D., FAAO, FAAP - Austin, TX
Section Chief, Dell Children’s Eye Center of Central Texas

Examining the Evidence

Pediatric Eye Exam For Dyslexia

- You should have the child read a paragraph or short page at their level.
- Look for difficulties sounding out words.
- Look for sight-word knowledge.
- Look for smoothness or fluency.
- Then you can discuss this with the parent.

Controversial Treatments

- A treatment is controversial if:
  - It is proposed to the public or commercially pushed prior to research or before preliminary research has been replicated.
  - The treatment proposed goes beyond what research data supports.

There are 2 parallel visual systems:

- **Magnocellular (large-celled) visual system**
  - Responds to high frequency & movement

- **Parvocellular (small-celled) visual system**
  - Responds to low frequency & fine spatial details

In reading:

- Parvocellular system is active during fixations
- Magnocellular system suppresses the parvocellular input during saccades (so when your eye moves your brain does not perceive the motion)

**Dyslexia—Magnocellular Deficit Theory**

- Deficits in the Magnocellular System creates a blurring effect during reading saccades causing dyslexia

**“Scotopic Sensitivity Syndrome”**

- Symptoms of SSS are called “visual stress”
- SSS supporters claim that symptoms of “visual stress” may be due to:
  - “Magnocellular Dysfunction”
  - “Hypersensitive Photoreceptors”
  - “Cortical Excitability”

“Visual stress”

- Visual perceptual distortions & sensitivities to particular wavelengths of light
- Moving or blurring print
- Sensitivity to color or illusions of color
- Pattern glare from striped lines of print
- Visual discomfort & eye strain
- Burning eyes & tearing
- Headaches & migraine headaches

**Irlen Lenses**
Tinted Lenses / Filters

- Helen Irlen proposed using colored lenses in certain types of dyslexics (1983)
- Irlen’s initial claims were based on observations, anecdotal accounts of adults and no formal experimentation
- Prior to any supporting research it was featured twice on the television program 60 Minutes
- This national exposure led to great interest in the treatment.

Tinted Lenses / Filters

- Tinted lenses are also being used to treat "visual stress" from:
  - Headaches & migraine headaches
  - Trauma
  - Autoimmune disease
  - Fibromyalgia
  - Depression and others

Tinted Lenses / Filters

- Tinted lenses are said to improve reading skills
- In 1983 Irlen used the term “scotopic sensitivity syndrome”

Tinted Lenses / Filters

- Color selection methods vary in the different studies - some studies use:
  - Yellow filters
  - Blue filters
  - Irlen Method - patient selection
  - Wilkins Precision Tint Method - using the “Intuitive Colorimeter”
  - “ChromaGen Method”

Tinted Lenses / Filters

- Patient Color Selection Issues:
  - Woerz’s study - poor test-retest reliability on color selection
  - Stone’s study - 25% needed their color changed within a year
  - Henderson’s study – 38% chose a different color 2 weeks later

Tinted Lenses / Filters

- Menacker 1993: A cohort study showed no improvement or preferred tint among disabled readers
- Robinson 1993: Review of multiple studies all showed methodologic flaws

Tinted Lenses / Filters

  - Reviewed 17 Studies on Tinted Lenses & Filters from 1988-2003
  - Conclusion: Failed to demonstrate the efficacy of the tinted lenses

Tinted Lenses / Filters

- Ritchie, Della Sala & McIntosh - 2011 Irlen colored overlays do not alleviate reading difficulties
  - Placebo controlled study
  - Irlen diagnostician diagnosed Irlen Syndrome in 47 of 61 below-average readers
  - Irlen colored overlays showed no immediate effect on reading in children with reading difficulties - even among those diagnosed with Irlen Syndrome
Tinted Lenses / Filters

- **JM Fletcher & D Currie 2011 - Review**

  Many studies found:
  
  - Minimal evidence for small increases in reading rate - but these increases were clinically insignificant.
  - Minimal evidence of improvement in accuracy or comprehension.

  *Perspectives on Language and Literacy - International Dyslexia Association* 2011;37:21-26

Tinted Lenses / Filters

- **Handler & Fierson - 2011**

  
  - Serious flaws invalidate many published studies.
  - Many of the studies cited as proof actually have been found to be inconclusive.
  - Colored filters and lenses may be ineffective except that they act as a placebo.
  - The evidence does not support the use of tinted lenses & filters in patients with dyslexia.

  *Pediatrics* 2011;127(3):e818-856

Tinted Lenses / Filters

- **LM Henderson, N Tsogka, MJ Snowling - 2013**

  - Reading connected text & comprehension were not improved by colored overlays.
  - Symptoms of "visual stress" can be attributed to visual problems or dyslexia itself.

  *Questioning the benefit that colored overlays can have for reading in students with and without dyslexia* 2013;13:57-65

Tinted Lenses / Filters

- **Arnold Wilkins' Lenses**

  - Developed the "Intuitive Colorimeter".
  - The instrument independently changes the parameters of color, hue, saturation and brightness.

  *Wilkins - Double-blind placebo controlled study* 2001

  - SSS symptoms decreased in both the placebo & tint groups (greater in tint group).
  - Reading rate, accuracy & comprehension were not affected in either placebo or tint group.

Tinted Lenses / Filters

- **Harris' ChromaGen Haploscopic filters**

  - Arnold Wilkins' Lenses
  
  - Developed the "Intuitive Colorimeter - Holden's".
  - The instrument independently changes the parameters of color, hue, saturation and brightness.

  *Wilkins - Double-blind placebo controlled study* 2001

  - SSS symptoms decreased in both the placebo & tint groups (greater in tint group).
  - Reading rate, accuracy & comprehension were not affected in either placebo or tint group.

Tinted Lenses / Filters

- **Harris' ChromaGen Lenses**

  - Harris & Mac-Row Hill - 1998

  - Pilot study with 9 subjects compared: "Intuitive Colorimeter" selected = "Wilkins Lenses".
  
  - Subjects improved 8.8 Words Per Minute (WPM) - Deemed "not a significant increase".
  
  - ChromaGen Lenses - Subjects improved 12.1 WPM - Deemed a "highly significant increase".

  *Optometry* 2013;13:57-65
Tinted Lenses / Filters

- Harris’ ChromaGen Lenses

- Harris & MacRow-Hill - 1999

- 47 subjects - responded to media interest
  - Biased selection

- 9/47 (19%) were color deficient
  - Compared to normal prevalence of <1% in females & 8% in males

- Study claimed to be a double-masked placebo controlled study but the clear placebo lenses could not be “masked” from the tinted lenses

- Harris’ ChromaGen Lenses

- Harris & MacRow-Hill - 1999

- Baseline average reading rate 83.7 WPM

- No Treatment Group
  - Reading rate - no change - 83.5 WPM

- Control Lenses
  - Reading rate increased by 6.5 to 90.2 WPM

- ChromaGen Lenses
  - Reading rate increased by 12.2 to 95.9 WPM

Tinted Lenses / Filters Summary

- Deficits in the Magnocellular System do not appear to be a significant cause of dyslexia
- There is no evidence that Irlen, Wilkins or Chromagen lenses or filters improve a magnocellular deficit
- There is no evidence that tinted lenses or filters are helpful in dyslexia
- Tinted lenses and filters do change the way that colors are visualized and may make some children more comfortable with some print

Behavioral/Developmental Optometry

- Skeffington’s (1890 - 1976)
  - Theories were the basis for much of behavioral optometry
  - Theories were derived from clinical experience & never independently refereed or formally debated by non-behavioral optometrists
  - Director of Optometric Extension Program (OEP)
  - Recommended a standard 21 point examination
  - 21 point examination compares to OEP “expected” values
  - OEP “expects” 6 P.D. exophoria @ near
  - Average value is 1 P.D. exophoria
  - “Relative exophoria” is diagnosed
  - Presumed secondary to nearpoint stress
  - Treated with low-plus “Training/Developmental Lenses” which help the visual system develop and mature normally
  - Treated with behavioral vision therapy

Optometric Eye Movement Testing

- Subjective Evaluation of Saccades & Pursuits
  - Maples & Picklin 1988
  - No consistent procedures for oculomotor testing
  - Various methods have not been thoroughly evaluated for reliability
  - Low inter-observer agreement when evaluating the accuracy of saccades

- Developmental Eye Movement Test (DEM)
  - Coulter, Shallo-Hoffman - 2000
  - Accuracy on the DEM is related to attention
  - Should not be referred to as an eye movement test
  - Does not correlate with saccadic eye movement assessment tool
  - Is related to reading performance
Optometric Eye Movement Testing

- Visagraph baseline analysis & procedural guide
  Ciuffreda, Ciuffreda & Santos - 2003
- Some optometrists use the Visagraph II as an objective way of measuring and documenting reading eye movements but...
- Guidelines for the determination of a baseline for comparative purposes have not been established.

Some optometrists use the Visagraph II as an objective way of measuring and documenting reading eye movements but... Guidelines for the determination of a baseline for comparative purposes have not been established.

Conclusions:
- Subjective eye movement testing methods have no validity as used
- There is no valid theory behind grading saccades in dyslexia
- The "Developmental Eye Movement Test" does not assess eye movements.

Visual Information Processing

- Tests for deficits in visual spatial orientation
  - Bilateral Integration
    - Chalkboard Circles
  - Directional Concepts
    - Gardner Reversals Test
    - Piaget Left – Right Test

Directional Concepts

- Gardner Reversals Test
- Piaget Left – Right Test

Visual Information Processing

Tests for deficits in visual analysis
- Visual Discrimination / Visual Form Perception
- Visual Figure Ground
- Visual Closure
- Gardner Test of Visual-Perceptual Skills (TVPS-R)
- Visual Memory / Visual Intake
- TVPS (visual memory subtest and visual sequential memory subtest)
- Getman Memory Test

Visual Closure

- Accuracy of testing for Visual Closure
  Groffman - 1970
  - Younger children
    - Low reliability of scores
  - Older children and adults
    - Test did not discriminate well

Behavioral Optometric Testing

In summary: many tests are not validated.
Skeffington’s Nearpoint Stress Model
- Suggested that the reading demands of our culture are not consistent with the evolutionary development of the visual system
- Proposed that near tasks provoked a biological stress response
- Children read closer as a compensation

Developmental optometrists believe that low-power training glasses are surprisingly effective in permitting more efficient reading
- Developmental optometrists believe their methods foster optimal development and minimize stress on the visual system

Studies
- Greenspan - improvement in pencil & paper visual tasks & posture
- Keller & Amos - reviewed Greenspan’s data No significant effect
- Barry & Cochran - plano vs +.50 No significant difference in visual performance
- Wildsart & Foo - plano vs +.50 to +1.00 No significant difference in reading comprehension

Vision Therapy (Vision Training = VT)
- Is a term used by optometrists
- Optometrists define VT as:
  - An attempt to develop or improve visual skills and abilities
  - Improve visual comfort, ease, and efficiency
  - Change visual processing

Orthoptic techniques are used to change specific visual functions
- Convergence
- Accommodation
- Ocular motility
- Binocular fusion capability
- Behavioral vision therapy is used to improve visual perception

An optometric VT program consists of:
- An individualized progressive program of vision procedures
- Performed in-office under supervision
- Supplemented with procedures performed at home between office visits
- Therapy is generally conducted once or twice weekly in-office for 30 – 60 minutes over a period of weeks to years
- Exercises, lenses (“training glasses”), prisms, filters, patches, electronic targets, specialized instruments, or balance boards may be used

Some valid treatments are included in VT
- Orthoptic techniques - Eye Exercises
  - Convergence
- Amblyopia treatments
  - Patching
  - Penalization with eye drops
  - Blurring filters
- Pediatric Optometrists and Orthoptists use the methods that have been validated:
  - ...but we just don’t call those techniques “Vision Therapy.”
Training Techniques - Ocular Motility

- Improve monocular saccades first
  - Corner saccades
  - Hart chart saccades

Training Techniques - Eye Movement

- Space Fixator and Rotating Pegboard
- Marsden Ball

CI Treatment

- Computerized Vergence System
- Brock String and Vectograms

Binocular Integration / Vergence Training

- Pencil Push-ups
- Brock String Training
- VektoGraphic and Tranaglyphic Targets
- Aperture-Rule Trainer

Accommodation Treatments

- Near-Far Rock
- Mental Minus
- Lens flipper Rock
- Aperture Rule

Training Techniques - Bilateral Integration

- Jumping Jacks + metronome
- Windshield wipers
- Angels in the snow
- Balance board
- Chalkboard circles
- Snap-tap
- Bean bag toss

Visual Motor Integration Treatments

- Geoboard

Vision Therapy in Learning Disabilities

- American Academy of Optometry
- American Optometric Association
- Policy Statement 1997

- "Vision therapy does not directly treat learning disabilities or dyslexia"
- "Vision therapy is a treatment to improve visual efficiency and visual processing, thereby allowing the person to be more responsive to educational instruction."

Review of Optometric Vision Therapy Studies

- UCLA Professor of Special Education
- Questioned:
  - "For whom is VT appropriate & effective?"
- Found little definitive evidence for its effectiveness - even when the results were aggregated across studies
- Found it paradoxical that VT was being recommended and used for a broad range of problems including preventative treatment
Review of Optometric Vision Therapy Studies

- The Complementary Therapy Assessment on Vision Therapy for Learning Disabilities - AAO - 2001
  - During a course of VT, children were simultaneously receiving continued and even enhanced instruction
  - No consistent scientific evidence supports vision therapy as an effective treatment for learning disabilities

- The Institute for Clinical Systems Improvement Technology Assessment Report on VT - 2003
  - 2 Ophthalmologists & 2 Optometrists - Review
  - Studies were predominantly poor quality case studies
  - Inadequate scientific evidence to enable a conclusion to be reached about the efficacy of VT for patients with learning disabilities

- Rawstron - 2005 – Review of VT Studies
  - Small controlled trials and many case reports supported the use of eye exercises in the treatment of Convergence Insufficiency
  - No clear scientific evidence supported the use of eye exercises in the remainder of the areas reviewed including learning disabilities and dyslexia
  - The use of VT remains controversial

Optometric Vision Therapy Studies

- A Randomized Clinical Trial of Treatments for Convergence Insufficiency in Children - M Scheiman - 2005
  - Vision therapy / orthoptics was more effective than pencil push-ups or placebo vision therapy in reducing symptoms and improving signs of convergence insufficiency in children 9 - 18 years old
  - 8/15 = 53% “cured” with office-based VT

Treatment of Symptomatic Convergence Insufficiency

- B Kushner - Editorial Reply - 2005
  - Orthoptic therapy
  - Taught in the office
  - Carried out by the patient at home
  - Reevaluated in the office on a monthly basis

- D Wallace - Editorial Reply - 2008
- D Granet - Letter to Editor - 2009
- HS Sethi - Letter to Editor - 2008

- Review of last 20 treated patients
  - 16 = 80% objective cure
  - 16 = 80% symptom free
  - Minimally intensive pencil push-ups is not representative of the standard of care & not the proper comparison
  - Both intensive office-based VT and home-based orthoptic treatments are effective

- Home therapy group was not designed properly as it did not include sustaining convergence

Vision Therapy for Convergence Insufficiency

- A Randomized Clinical Trial of Treatments for Symptomatic Convergence Insufficiency in Children - 2008
  - Vision Therapy techniques are effective in reducing symptoms and signs of Convergence Insufficiency
  - 35% Placebo VT rate
### Review of Optometric Vision Therapy Studies

#### UK College of Optometrists - AJ Jennings - 2000 - Review of VT Studies
- Questioned whether improvement on the VT task would transfer to routine activities.
- Conclusion - There was a lack of evidence to support behavioral VT.

#### Review of Optometric Vision Therapy Studies

- UK College of Optometrists - BT Barrett - 2009 - Review of VT Studies
  - Conclusions:
    - Continued paucity of controlled trials to support behavioral optometric approaches.
    - A large majority of Vision Therapy approaches are not evidence-based and cannot be advocated.

#### Review of Optometric Vision Therapy Studies

- Quackwatch.com - Eye-Related Quackery
- RS Worrall - Optometrist
  - Even though there is no scientific evidence that VT can improve academic performance, public relations activities have persuaded many teachers & counselors to refer children with dyslexia to a behavioral optometrist.
  - Parents often abandon common sense in their quest to help their struggling children and are easy prey for therapists promising a cure.

#### Joint Policy Statement 2009

- Joint Technical Report 2011
  - Learning Disabilities, Dyslexia, and Vision
    - American Academy of Pediatrics
    - American Academy of Ophthalmology
    - American Association for Pediatric Ophthalmology & Strabismus
    - American Association of Certified Orthoptists
  - Conclusions:
    - There is no evidence to support using VT or tinted lenses to directly treat dyslexia.
    - Vision therapy has not been shown to improve a child’s responsiveness to educational therapy.

#### Review of Optometric Vision Therapy

- Quackwatch.com - Eye-Related Quackery
- RS Worrall - Optometrist
  - The FDA defines health fraud as the promotion, for profit, of a medical remedy known to be false or unproven.
  - No scientific evidence supports behavioral VT in improving school & athletic performance, increasing IQ, overcoming learning or attention problems, or preventing juvenile delinquency.

- JM Fletcher (Neuropsychologist) & D Currie (Optometrist) - 2011 - Review
  - Conclusions:
    - Vision efficiency interventions may make a person more comfortable with reading.
    - But there was little evaluation of whether even the experience of more comfort carried over to the classroom.
Pediatric Ophthalmology
Sheryl Handler

Review of Optometric Vision Therapy Studies

L Kirkeby - 2012
Review of 567 VT studies cited
Only 41 of these studies were primary research on VT
Only 5 studies were on reading & attention!!
No study on reading & attention was classified as excellent or good
Only 2 studies were classified as moderate quality

Vision Therapy Studies Summary

Therapy overlaps different areas
- Educational Therapy
- Occupational Therapy
Not an evidence-based treatment
- Except Convergence Insufficiency
- Treatment of CI is not a treatment for dyslexia

Discussing Dyslexia With Parents

Gregory Ostrow, M.D. - La Jolla, CA
William Young, M.D. - Greensboro, N.C.

How Struggling Readers Often Present To Our/Your Office

Known reading difficulty; parent or teacher suspects eyes are the cause, or
Non-organic blur, especially at near, or
Symptoms when reading (with normal exam), or
Reading difficulty reported on history form; not mentioned since unrelated to reason for visit
Our Patient
- Struggling with reading
- Phonics not so hot
- Math much easier (except word problems)
- Skips words and lines
- Losing confidence
- Teacher thinks it's the eyes, recommends exam
- A friend mentioned vision therapy
- Now what??

Here's How Mom Feels

What This Child's Parents Need From You
- An exam that rules out the real eye issues that might interfere with her child's reading
- Unequivocal assurance that the eyes are not the cause (assuming that's the case, and it almost always is)
- Clear information re: What dyslexia is (and what it is not) How dyslexia should be treated (and how it should not) Where to go locally for evaluation/remediation
- In short: Hope and a plan!

What You Need To Know:
- What to ask
- What to check
- What to tell the parents
  (all without ruining your schedule for the day!)

Rule #1
- Be your patient's advocate!

What To Ask:
Begins with the history form the parent fills out
- On your standard history form, ask:
  "Any difficulties with reading/learning/schoolwork?"

What To Ask: — continued
- Nothing — if...
  - The exam is for reasons unrelated to school difficulties, and
  - There are no non-organic complaints, and
  - No school problems were reported on history form

Otherwise, I ask:
- How's the schoolwork going?
- Which is easier for her, reading or math?
- Has she had trouble "sounding out" words?
- How does she do with reading out loud?
- Has anyone in the family found reading difficult?
Also Check The History Form For:
- History of reading glasses/tinted overlays/vision therapy
- History of speech delay
- Central auditory processing disorder
- Home schooled

What Can You Do To Help?
Keep in mind that a certain percentage of these children have already spent a significant amount of time with a vision therapist and/or on chat rooms/forums etc. and will not be receptive to your exam or science.

Our job with these kids is to rule out any true eye disease and treat if there is any.

After that, I try to direct them towards research proven reading therapy so that at least they are getting some true treatment.

What To Tell The Parent Of A Struggling Reader
I'm concerned that she may have dyslexia or another learning problem.

It's not my place to say whether it is dyslexia.

What it's not is her eyes.

Continued…

What To Tell The Parent — continued
Here are some key features of dyslexia:
Please read the information in the packet.
Friends may recommend tinted overlays/VT.
Please pursue educational evaluation/remediation instead.

Continued…

What To Tell The Parent — continued
Here are some key features of dyslexia:
Please read the information in the packet.
Friends may recommend tinted overlays/VT.
Please pursue educational evaluation/remediation instead.

Continued…

How My Exam Differs
If Reading Difficulty Is Suspected
- Near acuity
  If abnormal, check with +0.12 “readers”
- Accommodation
- NPA
- Near acuity still J1+ with -4.00 over OU?
- Dynamic retinoscopy
- Convergence
- NPC
- Convergent fusional amplitudes
- Remainder of exam as usual

Why Should The Exam Be Different If Reading Difficulty Is Suspected?
To rule out legitimate eye issues that might interfere with reading comfort/stamina.
So the vision therapist won't find something (AI, CI) we really should have checked but didn't.

What To Tell The Parent
I'm happy to talk with her teachers if they have questions.
Please call me if you have problems during this process: I want to be your advocate.

Take Our Terms Back From The Vision Therapists!
When I'm done with the exam I let them know that the “tracking and teaming are fine.” These are things we test (motility, ductions, versions) but not terms we use.
I often tell them that I suspect this may be a “reading disorder” — “dyslexia” — or another learning problem, and that the only people who can truly diagnose this are educational psychologists or neuropsychologists.
I warn them to be wary of anyone who both diagnoses the problem and offers the therapy for the problem.

Parents Need To Be A Wise Consumer
Using ineffective, controversial methods of treatment may give parents and teachers a false sense of security that a child’s reading difficulties are being addressed.
They also waste family and/or school time and resources, and may delay proper instruction or remediation.
Key Features Of Dyslexia In 15 Seconds
Difficulty with phonics ("sounding out" words)
Poor fluency ("choppy" reading)
Difficulty spelling
Difficulty reading aloud

Emphasize The Positive
This does not mean she isn’t smart - she is special and her brain works differently (but no worse) than other kids
Many famous/accomplished people have dyslexia (give names)
There are effective treatments and we want to help you get them
The sooner you get started with appropriate remediation, the better

Give A “Dyslexia Packet”
Information about dyslexia: articles, books, websites
Specific local resources for evaluation and remediation, with contact information

My Current Dyslexia Packet
"Outsmarting dyslexia" Parents 12/11
Brief, accurate, in plain English, to the point
AAP/AAD/AAPSO Joint Policy Statement
List of 5 local resources for evaluation and remediation, with description and contact info
I believe less is more

The AAPOS Learning Disabilities Package
Learning Disabilities Brochure
A Parents Guide to Dyslexia Booklet
Resource List for Parents
Resource List for Pediatric Ophthalmologists
Template of Pediatric Ophthalmology Report for Schools - find in Members Section of the AAPOS Website under Resources

And For Your Waiting Room...
AAPOS Learning Disabilities rack card
AAPOS Dyslexia for Kids rack card

Many more resources listed in your handout
Choose a few
Give the parent hard copies, not just a list
We will all do this differently...

But Whatever We Do, Let’s Make Sure We Give The Parent What He/She Needs:
- An exam that rules out legitimate eye problems
- Accurate information re: reading disorders
- Clear guidance on how to proceed

The Bottom Line
- Saying “It’s not the eyes” is not enough.
- We must give parents hope and a plan.
- If we don’t, the vision therapist will!

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