Vision and dyslexia

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Disclosure
- Funding for lectures, KOL/product feedback, research:
- Lecture content always my own
- i.O.O. Sales Ltd
  - Markets IFS orthoptic exercises, which the speaker designed, and for which he receives a small royalty

Background
- Polarised views on vision & dyslexia
  - Zealots: middle view
  - Deniers

- Visual factors cause dyslexia
  - Vision irrelevant to dyslexia
  - maybe visual problems can co-occur with dyslexia

- Visual stress major cause of RD
  - Visual stress does not exist
  - maybe visual stress can co-occur with dyslexia

- Evans et al. (1994)
  - Dyslexic children are significantly more likely to report transient blurring (26% of 9%) & doubling (23% of 7%)
  - N.B., most dyslexics don’t have visual symptoms
  - Study concluded that visual factors are “not a major cause of the dyslexia”

- Eliminating any visual symptoms is likely to be helpful

Role of visual factors in dyslexia
- Dyslexia is a learning difficulty that primarily affects the skills involved in accurate and fluent word reading and spelling (Rose, 2009)
- Characteristic features of dyslexia are difficulties in phonological awareness, verbal memory & verbal processing speed (Rose, 2009)
- Visual problems are not “the cause” of dyslexia
  - The term “visual dyslexia” is a misnomer
  - Visual problems may contribute to reading difficulties
    - In these cases visual treatments may help
Case study G5781

- 08-02: 29 yr old female adult student, referred by EP
  - Words blur & jump when tired, skips words, sore eyes with VDU
  - Ocular motor balance, pupils, ophthalmoscopy, fields all OK
  - Refraction: R = -0.25/-3.25x180 = 6/9
  - Glasses to correct astigmatism prescribed
- 04-03: “much better since specs”
  - No symptoms, can read for longer, education much easier

Findings similar to above

But no justification for low Rx helping atypically in dyslexia

Optometric correlates of reading difficulties: binocular instability

**SYMPTOMS:** blur, double vision, visual perceptual distortions, eye strain & headaches

**SIGNS:** low fusional reserves, unstable phoria

**PREVALENCE:** circa 15% in dyslexia; c.f., 5% good readers (so, not found in 85% of dyslexics)

**TREATMENT:** fusional reserve exercises, refractive correction

**EVIDENCE:** moderate for correlate; weak for cause


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Optometric correlates of reading difficulties: binocular instability

**SYMPTOMS:** blur, double vision, visual perceptual distortions, eye strain & headaches

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PLAN

INTRODUCTION

CONVENTIONAL OPTOMETRIC CORRELATES

MAGNO (TRANSIENT) VISUAL DEFICIT

BEHAVIORAL OPTOMETRY

MEARES-IRLEN SYNDROME & VISUAL STRESS

CONCLUSIONS
**Magno & parvo sub-systems**

*(Transient and sustained)*

<table>
<thead>
<tr>
<th>magno system is</th>
<th>parvo system is</th>
</tr>
</thead>
<tbody>
<tr>
<td>predominately rapid</td>
<td>slow</td>
</tr>
<tr>
<td>low acuity high acuity</td>
<td>high contrast</td>
</tr>
<tr>
<td>low contrast high contrast</td>
<td>colour sensitive</td>
</tr>
</tbody>
</table>

Dyslexia is correlated with a deficit of the magno-cellular visual sub-system.

**Dyslexia: linking the visual deficits (a)**

- Magno visual deficit is correlated with binocular instability (Evans et al., 1996)

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**Dyslexia: linking the visual deficits (b)**

- BUT, magno system is not colour-specific
- Magno deficit is not directly related to the benefit from coloured filters
  - Evans et al., 1994
  - Evans et al., 1995
  - Simmers et al., 2001
  - White et al., 2005
  - Conlon et al., 2009

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CONCLUSIONS

Handout from www.bruce-evans.co.uk for regular tweets on optometric research

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**Behavioral optometry**

- Detailed symptomatology **recommended**
- Holistic approach
- Good orthoptic assessment & treatment
- Eye movement assessment & treatment
- Perceptual-motor and gross co-ordination exercises
- "learning lenses"
- Photo-syntometrics

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**Behavioral optometry**

- As many therapies as there are practitioners
- "no randomised controlled trials" (Jennings, 2000)
- "a large majority of behavioral management therapies are not evidence-based" (Barrett, 2008)
- Doubt is not a pleasant condition, but certainty is an absurd one (Voltaire)

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Voltaire: "Practical therapeutics is the art of keeping the patient entertained until nature effects a cure."

"I do not agree with what you have to say, but I'll defend to the death your right to say it."
**Plan**

**Introduction**

Conventional Optometric Correlates

**Magneto (transient) Visual Deficit**

Behavioral Optometry

**Meares-Irlen Syndrome/Visual Stress (MISVIS)**

Conclusions

Handout from www.bruce-evans.co.uk

**Visual Stress = symptoms + benefit from colour**

aka. Scotopic Sensitivity syndrome, Irlen syndrome

Meares-Irlen Syndrome / Visual Stress (MISVIS)

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"Tracking" & Dyslexia

- Saccades are not unique to reading
- Most studies have not found a saccadic eye movement deficit in dyslexia
- Dyslexia influences saccades: "search for meaning"
- ADHD influences saccades
- The DEM test does not measure eye movements (Ayton et al., 2009; Webber et al., 2011)
- Poor DEM scores do not mean that reading difficulties result from poor eye movements (Webber et al., 2011)
- Treatments based on training saccadic or pursuit eye movements are controversial
- The DDAT has not been validated by masked controlled studies from poor eye movements (Ayton et al., 2009; Reynolds et al., 2003) provides no evidence that DDAT is an effective form of treatment"
Why might the tints help?

Successful treatment = Placebo Treatment effect + Placebo only


The Intuitive Colorimeter

Precision Tinted Lenses (PTL)

Intuitive Overlays

Assessing optometric interventions

Wilkins Rate of Reading Test

Key research with the “Intuitive” system

- PTL may alleviate symptoms when reading
  (Wilkins, Evans, Budy et al. (1994))
- Overlays associated with improved speed of reading
  (Wilkins et al., 1996; Bouldoukian, Wilkins, Evans (2002))
- Overlays may improve visual performance
  (Evans et al. (1984); Singleton & Henderson (2007); Allen et al. (2008))
- Binocular & accommodative anomalies need to be detected (Scheiman et al., 1990) but MISVIS is an independent sensory dysfunction
  (Evans, Wilkins, Budy et al. (1992); Scott et al. (2002))
- The benefit from PTL is linked to pattern glare
  (Evans et al. (1994, 1996); Singleton & Henderson (2007); Allen et al. (2008))
**Key research with the “Intuitive” system (cont)**

- >80% of people prescribed PTL report still using after one year.
  - Evans, Patel, Wilkins et al. (1999)
- Lens colour is different to overlay colour: Lightstone, Lightstone, Wilkins (1999)
- MISVIS appears to be about 2-3x more common in dyslexic children than non-dyslexic. [Knee & Evans, 2002; Evans & Allen (2016)]
- Delphi study proposed diagnostic criteria: [Evans, Allen, Wilkins (2017)]

**Pitfalls in researching MISVis**

- Research the target condition:
  - Mitchell et al. (2006) did not study people with MISVIS
  - Boulodoussian et al (2002) studied participants who “reported relief from overlays”
  - Ritchie et al (2011) used an Ilmen diagnostic process which found MISVIS in 77% of poor readers
- Prescribe colour individually, allowing for a degree of precision:
  - Debate ongoing concerning precision (e.g., Siddall et al., 2017)
  - Clinically, precision varies but is required by some patients
- Use appropriate outcome measures:
  - Ritchie et al. (2011) used external ARFF test
  - Systematic reviews with inappropriate selection criteria will reach negative conclusions (e.g., Griffiths et al., 2016)
  - BUT, in part owing to these issues, MISVIS is still controversial

**Conservative clinical practice**

- Listen to symptoms but don’t over-treat
  - This applies to VS & conventional optometric anomalies
- Beware favourite colour & gender effects
- Solution for many is digital devices

**Sequential management plan: optometrist with overlays**

- **Suspected Learning Difficulties & Symptoms from Text**
- **Are Eyes Healthy?**
  - Yes: Refer to optometrist
  - No: Referral
- **Is There a Significant Refractive Error?**
  - Yes: Optical correction
  - No: Refer
- **Is Binocular Vision & Accommodation OK?**
  - Yes: Optical correction
  - No: Refer

**Representation of colour in macaque area V2**

- Used optical recording & confirmed with electrode recording
- Identified “colour-preferring” modules
- Did not overlap with “orientation-preferring modules”
- Each contour illustrates the cortical region giving the maximal response to each tested colour
  - But different colours produce different response magnitudes

**Evans et al., 2018, Nature**

**Evans (1994); Lightstone & Evans (1995); Evans et al. (1999); Allen, Evans, Wilkins (2010)**
Pattern glare

DO NOT VIEW THIS IF YOU HAVE EPILEPSY OR MIGRAINE

Visual stress

PREVALENCE: c. 20% of people with dyslexia

SYMPTOMS: eyestrain, headaches, visual perceptual distortions (text moves & blurs)

SIGNS: diagnosis of last resort – rule out other causes of symptoms. Coloured overlays alleviate symptoms

TREATMENT: coloured filters or coloured background

EVIDENCE: debated & controversial. Evidence is weaker than would be required for a new drug or for surgery

Conclusions

- A minority of patients with reading difficulties report visual symptoms. Does text appear to move, blur, or cause headaches?
- If symptoms, suspect: Visual stress, binocular instability. Treatment may help symptoms but will not cure dyslexia.
- People with reading difficulties & symptoms can be referred to interested eyecare practitioners via www.s4clp.org

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- You will receive a report describing solutions.
- We will tell you whether you are eligible for a clinical trial in the year of new glasses for computer eyestrain. If suitable, you would receive these free of charge.

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