Overview of LD & SpLD

- Profound learning disabilities (PLD): usually low IQ & disabilities in several academic areas
  - e.g., Down syndrome, cerebral palsy
  - a.k.a., Intellectual impairment (Shute, 1991)

- Specific learning difficulties (SpLD): specific difficulties with certain activities. IQ may be normal
  - e.g., dyslexia, dyspraxia

- Problems with classification
  - e.g., autism
  - In USA, LD=SpLD

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 text 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.

ECPs do not treat dyslexia.

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Optometric correlates of reading difficulties: binocular instability

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

**Signs:** low fusional reserves, unstable heterophoria

**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

Optometric correlates of reading difficulties: accommodative anomalies

**Symptoms:** blur, eye strain & headaches

**Signs:** low amplitude of accommodation, high accommodative lag, poor accommodative facility

**Treatment:** accommodative exercises (if appropriate), refractive correction

**Evidence:** weak for correlate; very weak for cause
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**Magno & parvo sub-systems**
(Transient and sustained)

<table>
<thead>
<tr>
<th>magno system vs</th>
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</thead>
<tbody>
<tr>
<td>predominance</td>
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<tr>
<td>parvo system</td>
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<tr>
<td>predominance</td>
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</table>

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

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**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
  - Whelan, 2005
  - Condon et al., 2009

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**Behavioral optometry**

- Detailed symptomatology
- Holistic approach
- Good orthoptic assessment & treatment
- Eye movement assessment & treatment
- Perceptual-motor and gross co-ordination exercises
- “Learning lenses”
- Photo-syntonics

Weak evidence

- Jennings (2000)
- Barrett (2008)
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)

"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"
  - ADD 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 (Medland et al., 2010)
- Treatments based on training saccadic or pursuit eye movements are controversial
- The DDAT has not been validated by masked controlled trials (PubMed search 15-Oct-06)
  - "Reynolds et al. (2003) provides no evidence that DDAT is an effective form of treatment"

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Visual Stress = symptoms + benefit from colour

a.k.a. Scotopic Sensitivity syndrome, Irlen syndrome

Meares-Irlen Syndrome / Visual Stress (MISVIS)
come see the play look up is cat not my and dog for you to the cat up dog and is play come you see for not to look my you for the and not see my play come is look dog cat to up dog to you and play cat up is my not come for the look see play come see cat not look dog is my up the for to and you to not cat for look is my and up come play you see the dog my play see to for you is the look up cat not dog come and look to for my come play the dog see you not cat and is up come look for the not dog cat you to see is and my play is you dog for not cat my look come and up to play see the my and dog

Why might the tints help?

**Successful treatment**

- Placebo only
- Placebo
- OR
- Treatment effect


The Intuitive Colorimeter

Precision Tinted Lenses (PTL)

Intuitive Overlays

Assessing optometric interventions

**Wilkins Rate of Reading Test**

come see the play look up is cat not my and dog for you to the cat up dog and is play come you see for not to look my you for the and not see my play come is look dog cat to up dog to you and play cat up is my not come for the look see play come see cat not look dog is my up the for to and you to not cat for look is my and up come play you see the dog my play see to for you is the look up cat not dog come and look to for my come play the dog see you not cat and is up come look for the not dog cat you to see is and my play is you dog for not cat my look come and up to play see the my and dog
Key research with the “Intuitive” system

- PTL may alleviate symptoms when reading
  Wilkins, Evans, Busby et al. (1994)
- Overlays can improve speed of reading
  Wilkins et al. (1996); Bouldoukian, Wilkins, Evans (2002)
- Overlays may improve visual performance
  Evans et al. (1994); Singleton & Henderson (2007); Allen et al. (2008)
- Binocular & accommodative anomalies need to be detected
  Scheiman et al., 1990
- The benefit from PTL is linked to pattern glare
  Evans et al. (1994, 1996); Singleton & Henderson (2007); Allen et al. (2008)

>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
  [c. 20% of dyslexics]
  Kriss & Evans (2005); Evans & Allen (2016)

Primary clinical practice

- Research the target condition
  Mitchell et al (2008) did not study people with MISViS
  Bouldoukian et al (2002) studied participants who ‘reported relief from overlays’
  Ritchie et al (2011) used an Irlen diagnostic process which found MISViS in 77% of poor readers
- Prescribe colour individually with a degree of precision
- Debate ongoing concerning precision (e.g., Suttle, 2017)
  Clinically, precision varies but is required by some patients
  Use appropriate outcome measures
  Ritchie et al (2011) used enlarged WRTT text
- 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

- Pitfalls in researching MISViS
  Research the target condition
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  BUT, in part owing to these issues, MISViS is still controversial
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

New et al., 2003, Nature

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

Do not view this if you have epilepsy or migraine

Wilkins, 1993

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Visual stress

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

Conclusions

- A minority of patients with reading difficulties report visual symptoms
  - Does text start clear & then move or blur?
- If symptoms, suspect:
  - Visual stress, binocular instability, accommodation insufficiency
  - Treatment may help symptoms but will not cure dyslexia
- People with reading difficulties & symptoms can be referred to interested ECPs via www.s4clp.org
- Candour about controversial treatments
  - May include (for SpLD): coloured filters, low plus, bifocals, prisms, vision therapy