

# Vision and dyslexia

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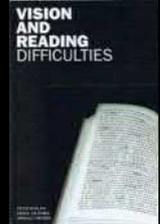
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  - Lecture content always my own
- i.O.O. Sales Ltd
  - Markets IFS orthoptic exercises, which the speaker designed, and for which he receives a small royalty
  - Community optometric practice in Brentwood, Essex



[www.aop.org.uk/ot/vision-and-reading-difficulties-book](http://www.aop.org.uk/ot/vision-and-reading-difficulties-book)

THE INSTITUTE OF OPTOMETRY

## PLAN

INTRODUCTION  
 CONVENTIONAL OPTOMETRIC CORRELATES  
 MAGNO (TRANSIENT) VISUAL DEFICIT  
 BEHAVIORAL OPTOMETRY  
 MEARES-IRLEN SYNDROME & VISUAL STRESS  
 CONCLUSIONS

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## 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

optoms do not treat dyslexia

## 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
  - Vision: R 6/15, L6/24
  - Refraction: R=L=-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



**Don't forget the basics**

But no justification for low Rx's helping atypically in dyslexia

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## Optometric correlates of reading difficulties: binocular instability

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



Evans et al. (1994) *Ophthalm. Physiol. Opt.* 14, 5-19.

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



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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 phoria relieved by monocular occlusion

**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



Evans et al. (1994) *Ophthalm. Physiol. Opt.* 14, 5-19.

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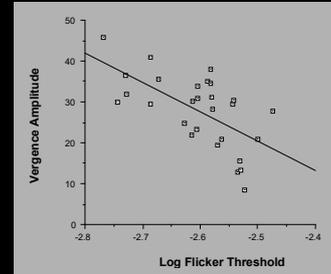
## Magno & parvo sub-systems (Transient and sustained)

magno system is predominantly	parvo system is predominantly
rapid	slow
low acuity	high acuity
low contrast	high contrast
colour insensitive	colour sensitive

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)



## 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., 2006
- Conlon et al., 2009



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## Behavioral optometry

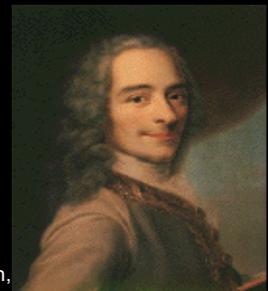
- Detailed symptomatology recommended
- Holistic approach
- Good orthoptic assessment & treatment
- Eye movement assessment & treatment
- Perceptual-motor and gross co-ordination exercises
- "learning lenses"
- Photo-syntonics Weak evidence

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)
- Doubt is not a pleasant condition, but certainty is an absurd one (Voltaire)



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."

## "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" Snowling & Hulme (2003)



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 (MISVIS)  
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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  
 up 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

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  
 up 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

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  
 up 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

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  
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 cat not dog come and look to for my  
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 up 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

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 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

OR

Placebo + Treatment effect

Evans & Drasdo (1991)    Evans (1994)    Wilkins & team

### The Intuitive Colorimeter

hue

saturation

- large gamut
- colour change continuous
- hue, saturation, luminance varied independently
- eyes remain colour-adapted
- no coloured surfaces visible

Wilkins et al. (1992)    Figures courtesy of Prof. Arnold Wilkins

### Precision Tinted Lenses (PTL)

7 dyes: 2<sup>5</sup> levels of deposition

Wilkins et al. (1992)    Figures courtesy of Prof. Arnold Wilkins

### Intuitive Overlays

NOTE: OVERLAY COLOUR DIFFERS FROM LENS COLOUR

Wilkins (1993)    Figures courtesy of Prof. Arnold Wilkins

### 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 up 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

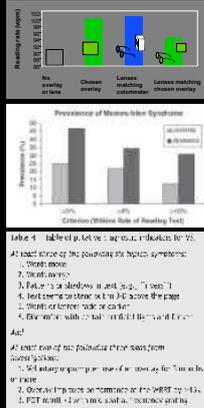
Wilkins et al. (1996) *Ophthalm. Physiol. Opt.* 16, 491-497

### Key research with the "Intuitive" system

- PTL may alleviate symptoms when reading  
Wilkins, Evans, Busby 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. (1994); 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, Busby et al. (1995); 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 [c. 20% of dyslexics]  
*Kriss & Evans (2005); Evans & Allen (2016)*
- Delphi study proposed diagnostic criteria  
*Evans, Allen, Wilkins (2017)*



## Pitfalls in researching MISVIS

- Research the target condition
  - Menacker et al (1993) & Henderson et al (2012) researched dyslexics
  - 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, allowing for a degree of precision
  - Menacker et al (1993) & Ritchie et al (2011) used limited range of colours
  - Debate ongoing concerning precision (e.g., Suttle et al., 2017)
  - Clinically, precision varies but is required by some patients
- Use appropriate outcome measures
  - Ritchie et al (2011) used enlarged WRRT 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**

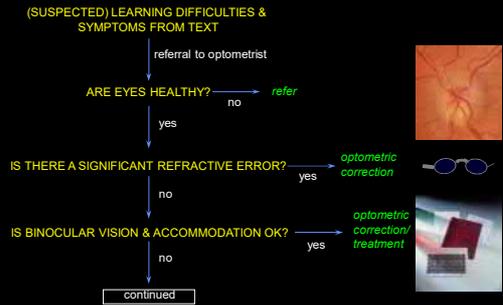


## Conservative clinical practice

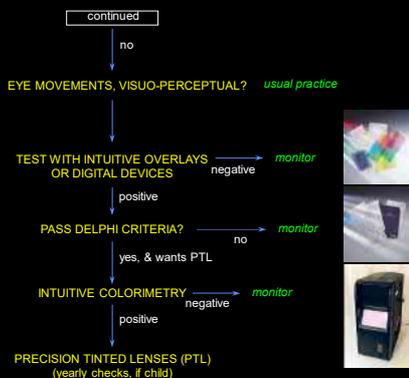
- Listen to symptoms but don't over-treat
  - This applies to VS & conventional optometric anomalies
- Beware favourite colour & gender effects
- Solution for many is digital devices



## SEQUENTIAL MANAGEMENT PLAN: optometrist with overlays



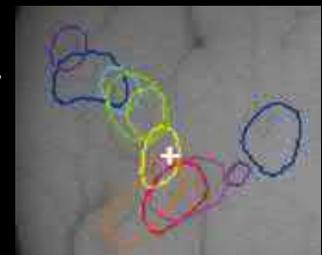
Evans (1994); Lightstone & Evans (1995); Evans et al. (1999); Allen, Evans, Wilkins (2010)



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

## 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



Xiao et al., 2003, Nature

