

# Overview of visual factors relating to reading difficulties

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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)

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THE INSTITUTE OF OPTOMETRY

## PLAN

INTRODUCTION

CONVENTIONAL OPTOMETRIC CORRELATES

MAGNO (TRANSIENT) VISUAL DEFICIT

BEHAVIORAL OPTOMETRY

SENSORY VISUAL STRESS (SVS)

CONCLUSIONS

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## 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

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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 sensory visual stress can co-occur with dyslexia

- Evans et al. (1994)
  - Dyslexic children are significantly more likely to report text transient blurring (26% cf 9%) & doubling (23% cf 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

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## 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

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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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## Optometric correlates of reading difficulties: binocular instability

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

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



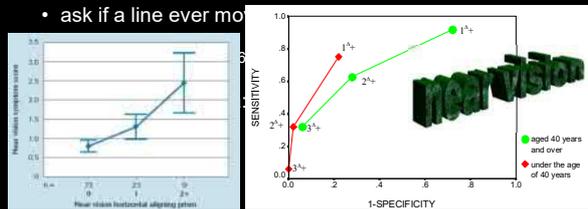
Evans et al. (1994) *Ophthalm. Physiol. Opt.* 14, 5-19.



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## ALIGNING PRISM: Mallett Unit

- aligning prisms/spheres to eliminate F
- good foveal and peripheral fusion lock
- question set is important
- ask if a line ever mo



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## FUSIONAL RESERVES

Can be measured with:

loose prisms

Prism bar



Rotary prisms



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## SUMMARY: DIAGNOSIS

Sign or symptom	score
one or more of the symptoms of decompensated heterophoria	+3
cover test: heterophoria detected	+1
cover test: absence of rapid and smooth recovery (+1 if quality of recovery 'border-line')	+2
aligning prism (Mallett): 1Δ+ for under 40 years or 2Δ+ for over 40 years	+2
aligning prism (Mallett): <1Δ but unstable	+1
foveal suppression (Mallett): >3', or diplopia during foveal suppression test	+2
<i>if score: &lt;4 diagnose normal, &gt;5 treat, 4-5 continue down table adding to score so far</i>	
Sheard's criterion: failed	+2
Percival's criterion: failed	+1
dissociated heterophoria unstable so that result is over a range 3Δ (i.e., phoria ±2Δ)	+1
fusional amplitude (divergent break point + convergent break point) <20Δ	+1
<i>if total score: &lt;6 diagnose normal, otherwise treat</i>	

Evans, B.J.W. (2007) *Pickwell's Binocular Vision Anomalies*, Elsevier.



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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:** does not always require treatment fusional reserve exercises refractive correction

**EVIDENCE:** moderate for correlate; weak for cause, but improved academic behaviour with VT (Borsting et al., 2012)

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

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### Do eye exercises improve fusional reserves?

1a. Systematic review of homogenous RCTs  
 1b. Individual RCT with good CI  
 2a. Systematic review of homogenous cohort studies  
 2b. Individual cohort study  
 3a. Systematic review of case control studies  
 3b. Individual case control study  
 4. Case series  
 5. Expert opinion

Scheiman & Gwiazda (2011), Cochrane review (only 1 modest RCT)

EBP is "the integration of best research evidence with clinical expertise and patient values." (Sackett, 2000)

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### Do base in prisms work? – depends on test used

1a. Systematic review of homogenous RCTs  
 1b. Individual RCT with good CI  
 2a. Systematic review of homogenous cohort studies  
 2b. Individual cohort study  
 3a. Systematic review of case control studies  
 3b. Individual case control study  
 4. Case series  
 5. Expert opinion

Evans (2007): **yes**  
 Scheiman & Gwiazda (2011): **no**  
**Conc: controversial**

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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

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

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

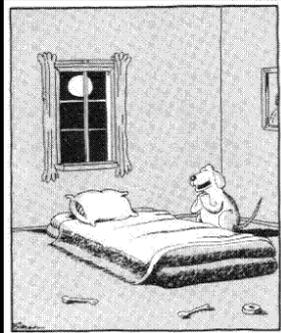
Vergence Amplitude vs Log Flicker Threshold

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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., 2006
- Conlon et al., 2009



"... And please let Mom, Dad, Rex, Ginger, Tucker, me, and all the rest of the family see color."

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## The magno deficit in dyslexia: the take-home message for clinicians

- The magno deficit is unlikely to be a major cause of dyslexia and may even be a consequence of dyslexia
- Optometrists do not routinely test magno function (except maybe FDT test)
- No validated treatments for the magno deficit
- Magno deficit not directly linked to visual stress

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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-syntonic Weak evidence
- Jennings (2000)  
Barrett (2008)

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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)



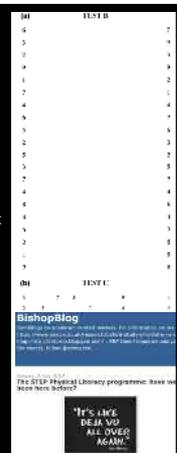
Voltaire: "Practical therapeutics is the art of keeping the patient entertained until nature effects a cure"

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

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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"
  - 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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## Is vision therapy for saccades effective?

1a. Systematic review of homogenous RCTs  
1b. Individual RCT with good CI  
2a. Systematic review of homogenous cohort studies  
2b. Individual cohort study  
3a. Systematic review of case control studies  
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4. Case series  
5. Expert opinion

Fischer et al. (2000)  
**CONTROVERSIAL**  
(speaker is sceptical)

EBP is "the integration of best research evidence with clinical expertise and patient values."  
(Sackett, 2000)

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Visual Stress = symptoms + benefit from colour

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

Meares-Irlen Syndrome / Sensory Visual Stress (SVS)



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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

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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

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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

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## Key research on sensory visual stress (SVS) with the "Intuitive" system

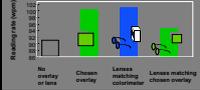
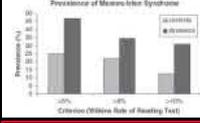
- PTL can alleviate symptoms when reading  
Wilkins, Evans, Busby et al. (1994)
- Overlays associated with improved speed of reading  
Wilkins et al., (1996); Bouldoukian, Wilkins, Evans (2002)
- Overlays may improve visual performance  
Evans et al. (1994); Singleton & Henderson (2007); Allen et al. (2008)
- Binocular & accommodative anomalies need to be detected (Scheiman et al., 1990) but VS 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)




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## Key research of VS 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)
- VS 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)


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## Pitfalls in researching VS

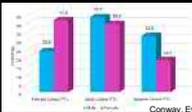
- Research the target condition
  - Menacker et al (1993) & Henderson et al (2012) researched dyslexics
  - Mitchell et al (2008) did not study people with VS
  - Bouldoukian et al (2002) studied participants who "reported relief from overlays"
  - Ritchie et al (2011) used an Irish diagnostic process which found VS 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, VS is still **controversial**

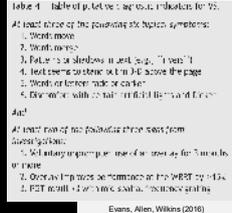


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## Conservative clinical practice

- Listen to symptoms but don't over-treat
  - This applies to SVS & conventional optometric anomalies
- Beware favourite colour & gender effects (Conway, Evans, Evans, Suttle, 2016)
- Solution for many is digital devices





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## Sensory visual stress



**PREVALENCE:** uncertain, ~20% of people with dyslexia

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

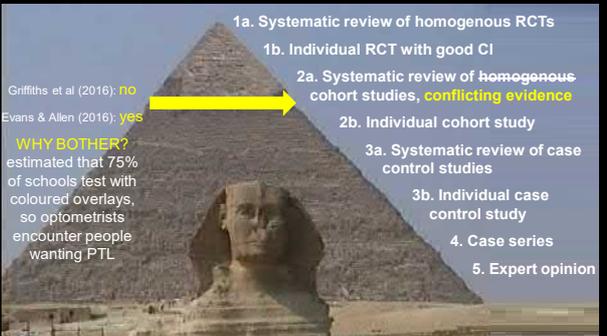
**SIGNS:** diagnosis of last resort – rule out other causes of symptoms  
coloured overlays alleviate symptoms

**TREATMENT:** coloured filters or coloured background

**EVIDENCE:** debated & controversial

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## Do individually prescribed filters help alleviate visual stress? – evidence too weak to be sure



- Systematic review of homogenous RCTs
  - Individual RCT with good CI
- Systematic review of **homogeneous cohort studies, conflicting evidence**
  - Individual cohort study
- Systematic review of case control studies
  - Individual case control study
- Case series
- Expert opinion

Griffiths et al (2016): **NO**  
Evans & Allen (2016): **YES**

**WHY BOTHER?** estimated that 75% of schools test with coloured overlays, so optometrists encounter people wanting PTL

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