SPELD NSW SLD: VISUAL & AUDITORY PERCEPTION Tamworth 2011

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1 Specific Learning Difficulties Dyslexia: Auditory &Visual Perceptual Difficulties

This is a summary of some of the more significant findings of research into dyslexia and assisting people with auditory and visual perceptual difficulties associated with reading difficulties.

2 SLD Definition (1) – *National Joint Committee on Learning Disabilities, (1994.)*

"Learning disabilities is a generic term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities.

"These disorders are **intrinsic to the individual,** presumed to be due to central nervous system dysfunction, and may occur across the lifespan. . ."

3 SLD Definition (2)

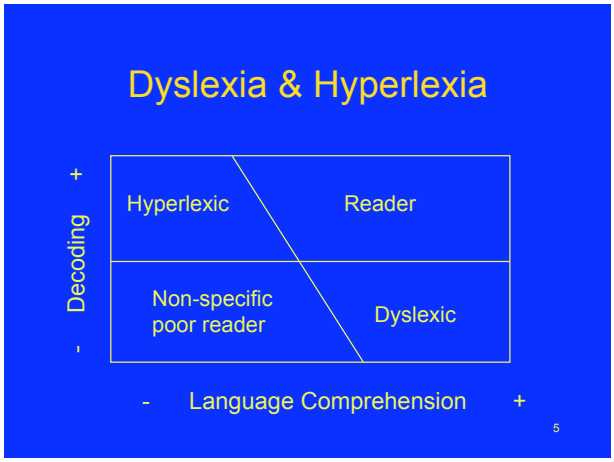
NOT attributable to: NESB, Emotional Problems, Family difficulties, Sensory deficits, Social factors, Intelligence, Inappropriate instruction, Insufficient instruction

4 The "Simple" view of reading (Gough, P.B. & Tunmer, W.E., 1986)

	Word Identification	
Reading =	**+**	
	Language Comprehension	

There are different views about the components of successful reading. However, research has validated Philip Gough's 1986 assertion that reading is made up of 2 essential components: ability to decode the written form of words to sounds, plus ability to comprehend spoken language. Spoken language is primary. If decoding is working automatically (that is, unconsciously), then comprehension of reading becomes the same as comprehension of spoken language.

5 Dyslexia & Hyperlexia



This helpful diagram follows P.G.Aaron in illustrating the four kinds of readers. The Hyperlexic has excellent decoding skills - can read complicated material aloud with fluency at an early age, but has poor understanding of what he is reading - or of spoken language for that matter. The non-specific poor reader is slow at decoding and also at understanding language. He may have an intellectual disability for example. The dyslexic is poor at decoding but understands language well. So if the story is read aloud to him with eyes closed, he will be able to recall it well.

6 Two Distinct Forms of Rdg Disorder

Dyslexia vs Poor Comprehender

So here are the two different kinds of poor reader. The dyslexic is poor at working out words he does not already know. The poor comprehender finds that quite easy. The reverse is true for comprehension.

7 Rose Review (UK): Sir Jim Rose (UK) – *Identifying and Teaching Children and Young People with Dyslexia and Literacy Difficulties (2009)*

In 2009 Sir Jim Rose produced a report on reading success in UK. This Review drew on the expertise of a large number of eminent scholars and teachers. It contains a parsimonious account of dyslexia and specific learning difficulties, with a helpful summary of important strategies for parents and teachers to use in making the processing of dyslexic children more effective. The "definition of dyslexia" that the report offers is really a description, including that dyslexia is a learning difficulty that primarily affects the

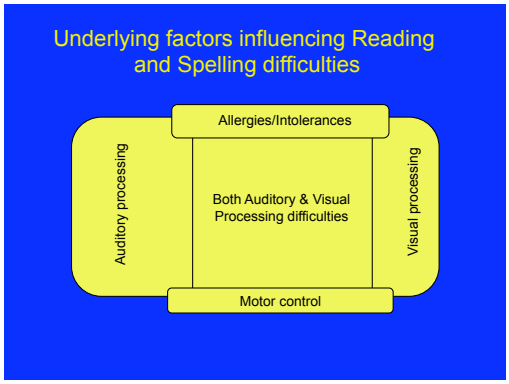
skills involved in accurate and fluent word reading and spelling.
Characteristic features of dyslexia are difficulties in phonological awareness, verbal memory and verbal processing speed. (2 of 6 points in the report's description). It ends with the following rather unhelpful but true statement: *"A good indication of the severity and persistence of dyslexic difficulties can be gained by examining how the individual responds or has responded to well founded intervention." This response to intervention definition has been widely criticised however.*

8 Kinds of difficulty (Felton, R.H. (2001) *JSE 35,3,122-124)*

- **Decoding (critical)**
  - **Phonemic awareness**
- **Automatic word recognition**
- **Fluency (rapid naming of visually presented items)**

Ruth Felton's research identified three fundamental difficulties that people may have with reading. Decoding (usually dependent upon phonemic awareness) is the critical one. A second is automaticity (a product of successful mastery of decoding). The third is fluency. The latter may be influenced by difficulty with "rapid naming"- the ability to name familiar objects quickly - without hesitation.

9 Underlying Factors: Visual and Auditory (not eyesight and hearing)



10 Underlying factors diagram.

11 Auditory and Visual Processing Deficits (Brain)

Franck Ramus, Developmental dyslexia: specific phonological deficit or general sensorimotor dysfunction? *Current Opinion in Neurobiology, 13*(2), 212-218. "Dyslexia research is now facing an intriguing paradox: it is becoming increasingly clear that a significant proportion of dyslexics present sensory and motor deficits; however, as this "sensorimotor syndrome" is being studied in greater detail, it is also becoming increasingly clear that sensory and motor deficits will play only a limited role in a general causal explanation of specific reading disability."

Across 10 recent studies, 39% dyslexics displayed an auditory deficit related to temporal processing (rapid processing). But this is not typical of the majority of dyslexics, nor is each individual the same. It seems that the most auditorily impaired dyslexics also have severely impaired phonology and reading, although the reverse is not necessarily true.

"It is plausible that subtle visual deficits might have an impact on reading. Perhaps the clearest example is visual stress a condition that provokes visual distortions and sometimes leads to impaired reading fluency, which can be improved by using coloured overlays or glasses. In recent studies, about 30% dyslexics seemed to have a magnocellular deficit, but no demonstration has been provided that magnocellular dysfunction, when present, engenders visual problems that are more proximal to reading, like visual instability, crowding or stress. In fact, in the case of visual stress, there is evidence that the symptoms are unrelated to magnocellular dysfunction.

"At least visual stress seems to be dissociated from the phonological deficit, and is therefore a possible independent cause of reading disability. However, the underlying biological cause of these visual disorders and their precise impact on reading still need to be elucidated. The hypothesis of a magnocellular origin does not seem to be well supported."

12 Symptoms of Auditory Processing Difficulties (1)

- Asks for repetition or "What?" a lot
- Watches people's lips when they talk
- Finds it harder to hear with background noise
- Confuses spoken words that sound similar - May answer questions "off target" (as if they heard the question differently).
- Own speech may be poorly articulated
- Difficulty repeating instructions
- Difficulty in rote learning

13 Symptoms of Auditory Processing Difficulties (2)

- Doesn't keep up with the group in poems or songs
- Difficulty listening and taking notes
- Difficulty expressing oneself concisely
- Difficulty identifying the sounds that make up words
- Difficulty identifying or making rhyming words

14 Phonological processing task (brain).

Results: Dyslexic boys showed a greater area of brain lactate (a salt of lactic acid) elevation (2.33+SE 0.843 voxels) compared to the control group (0.57+SE 0.30 voxels) during a phonological task in the left anterior quadrant (ANOVA, p=.05). No significance differences were observed in non-language tasks.

Conclusion: Dylexic and control children differ in brain lactate metabolism when performing language tasks, but do not differ in nonlanguage auditory tasks. Todd Richards et al 1999. University of Washington.
It also appears that the dyslexic brain can be "retrained" in the auditory areas to function more like the normal brain. Dr Elise Temple's (Cornell & Dartmouth College) pioneering study on developmental dyslexia shows changes in brain function after behavioral training in 8-12-year-old children with developmental dyslexia. This study was the first to use fMRI—functional magnetic resonance imaging—which allows researchers to see the ways in which the brain functions. The training consisted of a research-based intervention, *Fast ForWord Language*, which is a computer-based program that focuses on oral language and auditory processing. After training, the children with dyslexia improved in both their reading skills and language ability with the dyslexic children showing changes in both left- and right-brain function.

15 Auditory Processing Enhancement

a.Instruction:

multisensory, systematic, (structured, sequential, cumulative)phonologically- based. – *But . . .*
Ever since neurologist Samuel Orton began to investigate learning disabilities (reading and spelling) in 1925, we have known that multisensory, systematic,(structured, sequential, cumulative) phonologically-based instruction improves dyslexic reading. BUT, Research and experience show that some dyslexics respond slowly even to such good teaching. Torgeson characterised these dyslexics as "treatment resistors". (Torgesen, J.K. (2000) Individual differences in response to early interventions in reading: The lingering problem of treatment resisters. *Learning Disabilities Research and Practice, 15,* 55-64.) Studies reported this year demonstrate that brain connections in dyslexics can be modified by such teaching if it is carefully structured and represents the processes necessary for good readers. This restructuring lasts for some time, and may be permanent. (Todd Richards, Virginia Berninger, University of Washington, 2008, *Journal of Neurolinguistics,21*,4,294-304.)

16 Auditory Processing: Effective Instructional Approaches:

- Dyslexia Institute Literacy Program
- Hickey Multisensory Language Course
- Dyslexia Therapy and Alphabetic Phonics (Scottish Rite Hospital - Sally Childs)
- Alpha to Omega (Beve Hornsby)
- The Writing Road to Reading (R. Spalding)
- Auditory Discrimination in Depth (Lindamood)
- Letterland (Lyn Wendon)

17 Auditory Processing

b. Cognitive Training

E.g. Fast ForWord (Merzenich & Tallal, 1997-2000)
(Positive for phonemics/alphabetics, mixed for comprehension)
Cellfield (Caplygin, 1999)

Cognitive training retrains the brain. All systematic, intensive practice tends to do that (cf. physiotherapy, speech therapy for stroke victims). FastForWord deals with a problem in auditory reception that begins at the brain stem where the message is significantly scrambled so that the cortex is unable to interpret it. The training program, *Fast Forward* bypasses the neuronal pathways that are affected. It does not work with everyone. It emphasizes sequence, and the hard sounds (consonants) omitting the vowels, so that there is a degree of guessing still to be done. It involves listening to artificially slowed speech sounds gradually increasing in speed in order to help improve auditory rapid temporal processing and phonological skills.

Cellfield aims to train both auditory and visual processing and their interaction at the same time. This is potentially useful;, as both systems operate interactively during reading and spelling. Cellfield clinical studies have demonstrated significant improvements in decoding, oral reading.

18 Visual Symptoms of Dyslexics (1)

a. Jordan, 1972

- **Reverses letters/ words**
- **Substitutes similar letters**
- **Loses place**
- **Words spread apart**
- **Letters seem to move**
- **Parts of words come & go**

Dale Jordan published "Dyslexia in the Classroom" in 1972. Olive Meares was a remedial teacher in a clinic in New Zealand at the same time. She did not publish until 1980. Her list of symptoms was gleaned from asking the children at her clinic what reading was like for them. Note how similar these descriptions are to Irlen syndrome, not described until 11 years later.

b. Olive Meares, 1972

- **Interference from print**
- **Print is blurry**
- **Shadows**
- **White more prominent**
- **Rivers**
- **White moves**
- **Letters thin / disappear**

19 Visual Symptoms of Dyslexics (2)

a. Jordan, 1972 continued

- **Needs to rest eyes**
- **Difficulty catching a ball**
- **Perceives symbols upside down**
- **Perceives symbols backward**

b. Meares, 1972 continued

- **Black letters hard to see**

c. Stein & Fowler (1985)

Stein and Fowler reported these phenomena in a letter to the editor of the Lancet, Britain's leading medical journal. Stein is still a leading researcher into visual processing.

Ongoing studies – various theories

A study reported in 2005 provided a surprising new twist to the theory that dyslexia involves a problem in actually seeing words. Researchers led by Anne J. Sperling at the Georgetown University Medical Center reported that the real problem may be an inability to discriminate visual cues from background signals called "noise." (Sperling AJ, Lu ZL, Manis FR, and Seidenberg MS. Deficits in perceptual noise exclusion in developmental dyslexia. *Nature Neuroscience* 2005 8(7):862–863.)

The researchers asked children to look at a series of patterns, both flickering and static, on a computer screen and to say whether the patterns appeared on the left or right side. When the patterns alone appeared on the screen, children with dyslexia could identify them as often as other children. But when the researchers partly obscured the patterns by adding visual "noise" in the form of television-like "snow," the children with dyslexia were less able than their peers to

identify the patterns. The authors propose that the underlying problem in dyslexia may therefore involve an inability to screen out background "noise" and focus on important signals.

and,

Coloured filters improve exclusion of perceptual noise in visually symptomatic Dyslexics *Nature Precedings* : hdl:10101/npre.2008.1729.1 : Posted 27 Mar 2008 (Nadia Northway, Velitchko Manahilov (Department of Vision Sciences, Glasgow Caledonian University, Cowcaddens, Glasgow) and William A. Simpson (School of Psychology, University of Plymouth, Drake Circus, Plymouth)

This study showed that visually symptomatic dyslexics had noise-exclusion deficits when discriminating symbols without filters and with neutral density filters but not with colored filters. The ability to exclude noise (distractors) depends on the tuning characteristics of the perceptual templates. At the neuronal level, the tuning characteristics of visual neurons are modulated by cortical suppression, for example GABA mediated suppression. Therefore, the non-optimal visual processing in dyslexics might be due to reduced cortical suppression. This impairment of cortical suppressive mechanisms might result in hyperexcitability which has been regarded as a possible neural mechanism underlying the perception of visual distortions in individuals with visual stress syndrome. How could colored filters modify the noise-exclusion mechanisms of dyslexics? . . .. The reduction of visual distortions and discomfort might be based on "emotional attention" driven by color. Specific colors can elicit specific emotional responses in humans which may have impact on mood and performance. Warm colors (red, yellow) have been associated with excitement and stimulation and they improve performance in tasks involving short term memory and problem solving. Cool colors (blue and green) have been related to comfort, security and calm. It should be noted that some dyslexics reported that the colors selected were similar to the colors of their home environment. Anecdotally, facial tension is seen to reduce in subjects when their preferred color is in use, along with subjective reports of increased relaxation. We speculate that the observed effects of colored filters on noise exclusion might reflect some improvement of suppressive cortical mechanisms of dyslexics due to top-down influences of "emotional attention". Whatever the mechanisms underlying the effects of colored filters are, such filters may improve the ability of dyslexics with visual stress syndrome to extract important sensory information from irrelevant distracters.

20 Arnold Wilkins: Multifocal Cortical Hyperexcitability

- **Certain patterns of stripes induce seizures**
- **Similar patterns cause illusions, distortions**
- **Such patterns aversive to migraineurs**
- **Text can have spatial characteristics of aversive patterns**
- **Colour helps migraineurs**
- **Children who benefit from colour in reading are twice as likely to have migraine in their family**

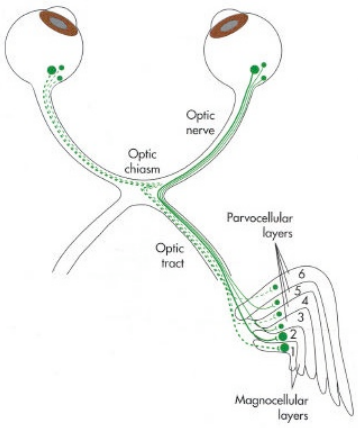
Professor Arnold Wilkins was studying features of epilepsy and migraine with a grant from the British Medical Research Council. He noted for example that women working in a clothing factory using black-and-white striped materials had to be given regular rest breaks because of the strain on their eyes.

21 Coloured Overlays - Wilkins

- **50% normal children choose overlays**
- **20% use them long-term**
- **– Particularly if they are poor readers**
- **Colour choice is individual but reliable**
- **Reading is faster with overlays (5% go + 25%)**
- **No speed/accuracy trade-off**
- **Not related to orthoptic abnormalities**
- **Not a placebo effect**

Wilkins went on to experiment with coloured overlays for reading. Note particularly that while there is a novelty effect, the ultimate results are not placebo. Wilkins rate of reading test is a good one, because it uses real words in random order, so that predicting cannot be used to guess at words.

22 Visual Pathways in the Brain (1): Parvocellular & Magnocellular



23 Visual Pathways in the Brain (2)

• Magnocellular (large cells) Pathway

– Low contrast

– Course-patterned, general material

– Motion

– Depth perception

– Locating objects in space

The Transient system is also known as the Magnocellular pathway, and in 1991, Livinstone, Galaburda and others demonstrated problems in the operation and construction of this pathway in the brains of dyslexics. This pathway is supposed to work in conjunction with the Parvocellular pathway, but they appear not to work properly together. (see next slide).

Visual magnocellular sensitivity helps to determine orthographic ability because it mediates the precision with which visual attention and eye fixation can be directed on letters in order to identify their correct order. Boosting the magnocellular function of poor readers and treating their eye movement deficits can greatly improve their reading. (Stein, J. (2003). Visual motion sensitivity and reading. *Neuropsychologia,* 41, 1785-1793.)

24 Visual Pathways in the Brain (3)

• Parvocellular (small cells) Pathway

– high contrast

– Detailed (High spatial frequency) material

– Colour

– Stationary images

The Parvocellular pathway take signals ultimately from the cones on the retina, which are supposed to be in the central focus (fovea), but some of which are actually in the rod (peripheral) area. Signals from these "migratory" cones would arrive at the cortex as "rod" messages and cause confusion, (response to colour for instance being received as response to movement.) There is a large area of research now into the operation of these two pathways.

25 **Visually–based dyslexia** can occur when there is a timing imbalance.

The sustained and transient systems theory has recently been further revised and incorporated in the conceptual framework of parvocellular and magnocellular processing in the primate visual system (Breitmeyer, 1989; Livingstone & Hubel, 1987). The implication is that dyslexics have an abnormality in the magnocellular subsystem, which normally should act to inhibit the parvocellular system after each saccade, thereby erasing the image of the previous system (Lovegrove, Garzia, & Nicholson, 1990). Livingstone, Rosen, Drislane, and Galaburda (1991) found that reading disabled subjects had diminished evoked potentials for rapid low-contrast stimuli, but normal responses to slow or high-contrast stimuli. Such abnormalities were consistent with a defect in the magnocellular pathway. This possibility was further corroborated in the study by comparing in autopsy brains of five dyslexic and five control persons. Abnormalities were found in the magnocellular but not the parvocellular layers for the dyslexic individuals. Lehmkuhle, Garzia, Turner, Hash and Baro (1993) also reported visual evoked potentials were larger for eight reading disabled children than 13 normally achieving controls, which was claimed to suggest that the magnocellular visual pathway is slowed for reading disabled children.

AND (*Neuropsychologia*. 2003;41(13):1785-93. Visual motion sensitivity and reading. Stein J. (University Laboratory of Physiology, Oxford) Many poor readers have particular problems with the rapid visual processing required for these tasks because they have a mild impairment of the visual magnocellular system. This deficit has been demonstrated using neuropathological, evoked potential, functional magnetic resonance

imaging and psychophysical techniques. The sensitivity of the M-system in both good and bad readers correlates with their orthographic abilities, suggesting that the M-system plays an important part in their development. This role is probably to mediate steady direction of visual attention and eye fixations on words. Thus many children with reading difficulties have unsteady eye control and this causes the letters they are trying to read to appear to move around, so that they cannot tell what order they are meant to be in. Therefore, boosting M-performance using yellow filters, or training eye fixation, can improve reading performance very significantly. Several genetic linkage studies have associated reading difficulties with the MHC control region on the short arm of chromosome 6. This system has recently been shown to help regulate the differentiation of M-cells. This association could also explain the high incidence of autoimmune conditions in poor readers. Other chromosomal sites are associated with the metabolism of polyunsaturated fatty acids (PUFAs) as found in fish oils, and this could explain why PUFA supplements can improve reading.

26 Prevalence

7-10% of the population have SLD
More than 12% of the population and as many as 20% may have Irlen Syndrome
50% - 60% of all people with SLD or reading difficulties have Irlen Syndrome
60% of these people will respond to the lenses and not need further treatment
40% will need lenses and remediation programs
50% - 70% of jail inmates have Irlen
Tim Miles, Some problems in determining the prevalence of dyslexia. University of Bangor.Electronic Journal of research in Educational Psychology, 2(2),5-12.- 3% severe; +6% mild. Whichard, J.A., Feller, R.W., & Kastner, R. (2000). The Incidence of Scotopic Sensitivity Syndrome in Colorado Inmates. Journal of Correctional Education, 51(3), 294-299. You hear various estimates of the prevalence of illiteracy among prison inmates - 29% in Ireland (A Survey of the Level of Learning Disability among the Prison Population in Ireland, Michael Murphy, Dr. Mark Harrold, Dr. Seán Carey, Mark Mulrooney Final Report, 2000) 3-40% USA (Murphy & Mason, 1999), 60-80% anecdotally but these are really illiteracy rates. In Uk it seems to be 20% SLD + 35% illiteracy. (The Dyslexia Institute, Incidence of hidden disabilities in the prison population. March 2005.)

27 Intelligence

(clinically) usually have average to well above average intelligence.
Good verbal skills
Good lateral thinking skills
May be very creative
Good at drama
Good in technology areas

28 Dyslexic brains work 4.6x as hard as normal readers

29 What it feels like

- Student feels dumb, stupid
- Lack of success
- Loss of confidence
- Loss of self esteem
- Inappropriate behaviour
- Substance misuse
- Reduced employment options
- Crime

30 Coping mechanisms

- Try to cover up
  - Truancy
  - Excuses to get out of class
  - Forget books etc
  - Class clown
- Girls – Adaptive behaviours
- Boys – Maladaptive behaviours

31 Boys

- "I'd rather appear naughty than stupid"
- Aggressive
- Withdrawn

32 Girls

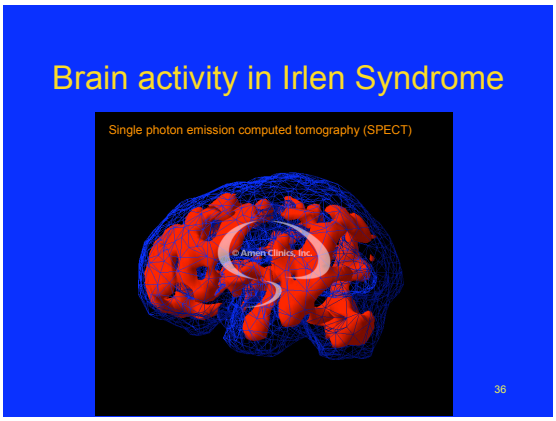
Use social skills and verbal skills
Negotiate help with friends
Do helpful things for the teacher
Extra projects
Withdrawn

33 Is it real or psychological?

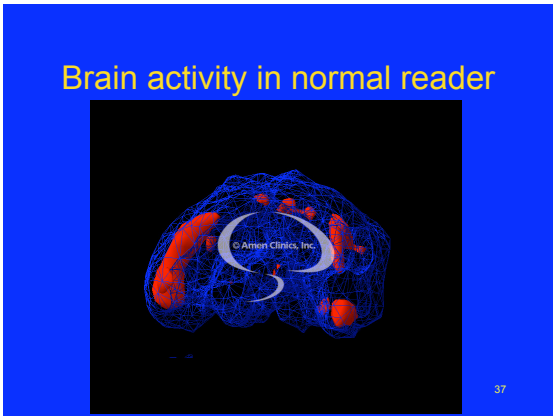
34 Different activation in dyslexics Guinevere Eden, neuroscientist, Georgetown University

One brain study investigating activation of the area of the cortex concerned with movement. Dyslexic brain do not seem to activate this area, but do activate other areas not used by normal readers. There is clear evidence now of different brain operation in dyslexics. Considerable re-training is needed (as we know!).

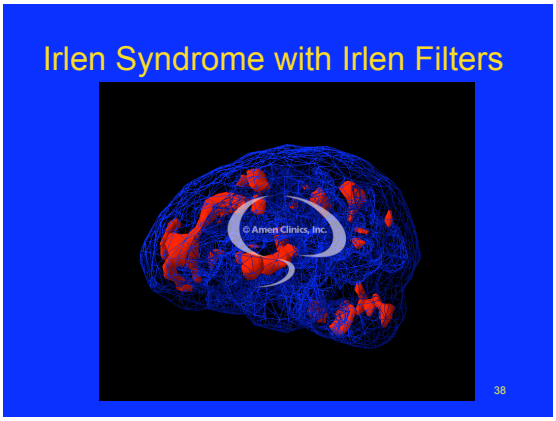
35 Brain activity in Irlen Syndrome



36 Brain activity: Normal reader



37 Irlen Syndrome with Irlen filters



38 Without & with Irlen Filters

39 2004 3rd Gde Study – immediate

This study is helpful because it eliminated any children who could not yet read at first-grade level. Irlen filters do not teach people to read! The effect on reading was then able to be observed (not the effect on non-reading.) One group were given lenses immediately and their progress observed over 3 months. The other group were given lenses after three months. Both groups had the same instruction, so acted as controls. (Jeanne Noble; Michelle Orton; Sandra Irlen; Greg Robinson Australian Journal of Learning Difficulties, 1940-4166, Volume 9, Issue 2, 2004, Pages 14 – 22)

40 2004 3rd Gde Study – delayed

This group made no progress at all in three months, but when given filters, progressed rapidly. The first group plateaued after 3 months, because they had reached grade level in reading, and could now be expected to make normal progress.

41 Lenses that match overlays are no good (Wilkins, A. - Colorimeter)

An important study because it demonstrates that you cannot just find a suitable overlay, put the colour into lenses, and expect it to work.

42 Symptoms

Rapid fatigue when reading
Slow down after few lines
Loss of place
Skipping words
Skipping lines
Re-reading the same line
Print distortions
Narrow visual span
Reversal of letters and words

43 Symptoms continued

- Confusion of little words eg. was/saw, on/no for/from etc.
- Headaches / nausea (Reading/Computer screens/ Outside glare
- Poor depth perception (Judgement/Clumsiness
- Poor Ball Skills

44 Signs

Spelling: Careless errors
Maths
Misaligned numbers in columns
Looking away/day dreaming
Head on the side
Eyes
Puffy eyes
Frequent rubbing
Blinking
Fidgety and restless
Poor organisational skills

45 Writing

Slow to copy
Difficulty copying
Untidy
Uneven slope of letters
Unequal spacing
Printing easier than cursive

46 Basic Investigations

Some of the above symptoms are also symptoms of optometric abnormalities.
Optometric visual assessment is required prior to diagnosis.
Behavioural / orthoptic exercises may be required as well as or instead of Irlen filters.

47 How to help - Glare

Find darkest part of the room
Avoid fluorescent lighting
Shade eyes
Shade work
Shift the angle of the book

48 Increasing Glare

Fluorescent lighting
White pages
Shiny pages
White classrooms
Large windows
White boards

49 How to Help - General

Note the students exhibiting 3 or more of the signs and symptoms
Assessment - visual/auditory
Speak slowly and clearly
Allow time for answers
Look for 'white board' alternative
Use a coloured overlay on overhead projector to modify white board
Allow students to work on coloured paper
Supply handouts on coloured paper

50 How to Help (cont'd)

Allow caps/visors
Encourage water bottle
Utilise latest computer software
Acknowledge small successes
Look for strengths to improve self image
Allow extra time for reading and writing
Do not ask students to read aloud
Provide alternative activities

51 Alternative Activities

Allow work to be presented on audio tape or power point
Use videos and audio tapes where possible
Allow mind mapping for presenting information
Provide copy of blackboard work
Provide alternative for silent reading time