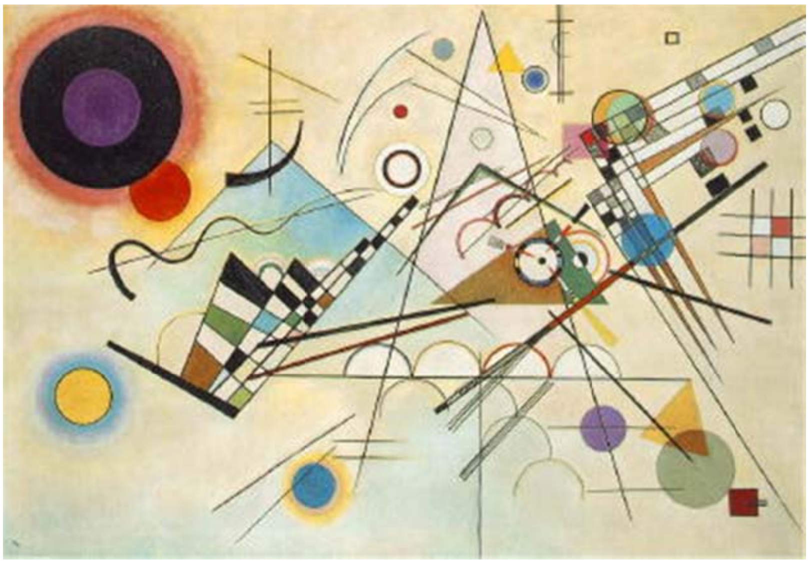
Visual Perception Disorder in Children

A Literature Review



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What is Visual Perception?

A General Definition

Visual perception refers to the process of interpreting and organizing visual information. Visual perception includes understanding what you see, identifying it, judging its importance and linking it to previously stored information. Visual perception relates to visual memory, too. This means, for example, recognizing words that you have seen previously, and using the eyes and brain to form a mental picture of the words you see.

A person needs to interpret sensory phenomena, and this can only be done on the basis of past experience of the same, similar or related phenomena. Perceptual ability, therefore, heavily depends upon the amount of perceptual practice and experience that the subject has already enjoyed. This implies that perception is a skill that can be improved through judicious practice and experience.

Or, more succinctly:

A person with problems in visual perception receives a version of reality (top-down perspective) or creates a reality (constructionist perspective) that differs from that of most other people.

These are very tidy, compact definitions that fail to address the fact that perceptions formed through visual input may be influenced significantly by emotional and other factors pertaining at the time.

For example, it is well known that a group of people who happen to watch a crime taking place will report to police afterwards that there were two criminals, or six, or four; that the shooter wore a green shirt, a blue boiler suit, a white jumper; that they were all Asian, black, white or Hispanic; that only one had a gun, three had guns, they all had guns; the getaway car was green, red, silver, and so on.

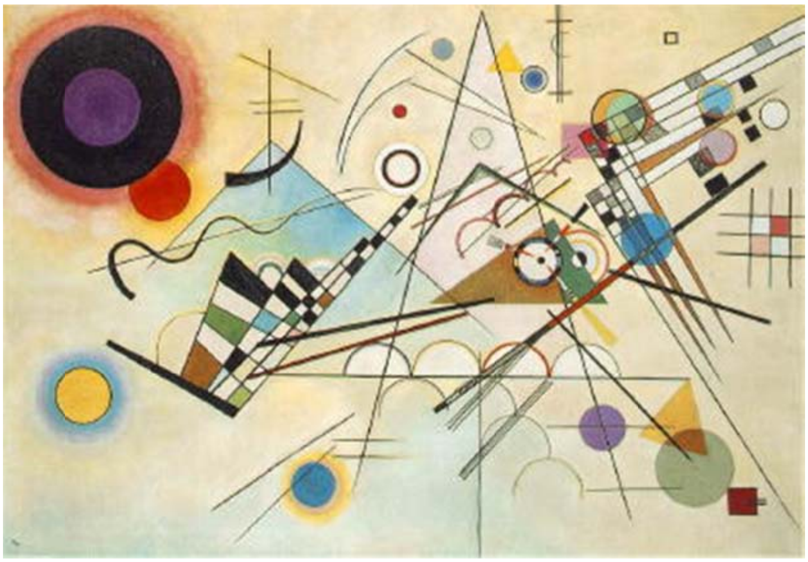
Experiments conducted by police involving a group watching a mock crime and knowing that they will be questioned afterwards still return wildly divergent observations.

While this example is extreme, there is no doubt that many children with learning difficulties are working under high stress levels in the classroom.

In short, previous experiences, emotional state, prejudice and vested interest may have a big impact on perceptions at any particular time and event.

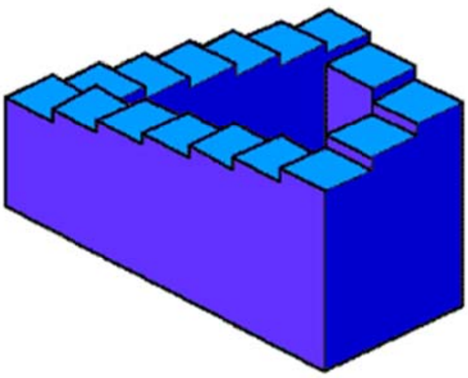
Faulty, or different, visual perception can depend on much more than a “visual perception disorder”.

Visual Perception skills vary with maturity and experience

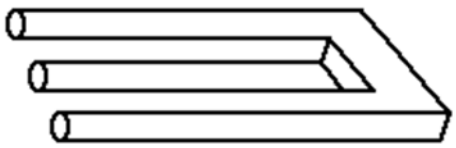


V. Kandinsky, Composition viii (1923)
www.psy.jhu.edu/.../ syllabi/118syl%20frame2.htm

Baffled by the message contained in this image? While pleasingly aesthetic, few people would understand the underlying concept behind this artist's work without an explanation. This does not mean that most people have a visual perception disorder; just that we lack the experience needed to acquire meaning on our own.



Young children would perceive nothing wrong with this picture of ever-upwards stairs, or that of the fork below. They are not yet mature enough to recognise visual absurdities.



Written Language Deficits

When discussing visual perception disorders, it is assumed that ***the visual pathways are intact and functioning normally.***

Visual perception disorders are defined as a function of ***the way in which the brain processes the information received.***

Despite all the time, effort and heart-ache that has gone into analyzing the reading process, and the process of learning to read, we are no better off than we were 30 or 40 years ago in terms of reading achievement in beginning readers. There is still a small proportion of really confident and fluent readers, a middle group of mediocre readers, and a significant and worrying tail (25% to 40%, depending on who is asked) who never learn to read with any confidence. This was so in the 1960's and is so today. Nothing, it seems, including Reading Recovery, has been able to change this sort of distribution in achievement.

One of the most compelling findings from recent reading research is that children who get off to a poor start in reading rarely catch up. As several studies have now documented, the poor first-year reader almost invariably continues to be a poor reader.

The Structure of Relationships between Language-Related Factors, Achievement-Related Beliefs, Gender and Beginning Reading Achievement: Final Report. New Zealand Ministry of Education Task Force. 2003
http://www.minedu.govt.nz/index.cfm?layout=document&documentid=9029&data=l#P1126_72618

Statistically, of course, half of all youngsters will be "below average" in reading ability, but there is no satisfactory reason why the proportion of failing readers should be so high.

Failing readers are usually failing writers.

Other explanations for a child's failure in beginning reading and writing proficiency also may include:

Genetics
The child was born with a lower general cognitive ability.

Early Childhood Experiences
The child starts school with low-level oral language facility, poor concept development and/or little experience with print.

Environmental Factors
The exponential increase of toxic chemicals in our environment and poor diet, especially when *in utero*, can be expected to impact on child development say some researchers.

Impaired Speech
The child is unable to make proper or clear sounds of speech.

Impaired Hearing
The child cannot hear speech sounds clearly enough to reproduce them.

Inadequate Teaching
Research has demonstrated many times over that failed or poor readers invariably lack knowledge and skills of phonemic awareness. There is still quite a strong tendency in New Zealand to teach a "method" of reading instruction, usually the whole-language approach, rather than teaching to a child's specific needs. This is beginning to change in light of the overwhelming evidence for the need for phonemic awareness training.

Visual Perception Disorder and Written Language

Visual perception disorders frequently become obvious when the child begins to learn to read and write.

These children have difficulty recognizing, organizing, interpreting and/or remembering visual images, including print symbols.

As a result, they have trouble understanding the whole spectrum of written and pictorial symbols-- not only letters and words, but also numbers and math symbols, diagrams, maps, charts and graphs.

Symptoms related to written language may include:

Writing

- Dislikes and avoids writing
- Delays in learning to write
- Papers are messy and incomplete; many cross outs and erasures
- Difficulty remembering shapes of letters and numbers
- Frequent letter and number reversals
- Uneven spacing between letters and words
- Omits letters from words and words from sentences
- Inaccurate copying
- Poor spelling (spells phonetically)
- Cannot spot errors in own work
- Difficulty preparing outlines and organizing written work

Reading

- Confuses similar-looking letters ("b" and "d," "p" and "q")
- Difficulty recognizing and remembering "sight" words (but can sound out words phonetically)
- Frequently loses place when reading
- Confuses similar-looking words ("bread" and "beard")
- Reverses words (reads "was" for "saw")
- Has trouble finding letters in words or words in sentences
- Poor memory for printed words (also number sequences, diagrams, illustrations and so on)
- Poor comprehension of main ideas and themes
- Difficulty with higher-level math concepts

Characteristics of Visual Perception Disorder in Children

- sensitive to bright lights; will squint, cover eyes, cry and/or get headaches from the light
- has difficulty keeping eyes focused on task/activity he/she is working on for an appropriate amount of time
- easily distracted by other visual stimuli in the room; i.e., movement, decorations, toys, windows, doorways etc.
- has difficulty in bright colourful rooms or a dimly lit room
- rubs the eyes, has watery eyes or gets headaches after reading or watching TV
- avoids eye contact
- enjoys playing in the dark
- has difficulty telling the difference between similar printed letters or figures; i.e., p & q, b & d, + and x, or square and rectangle
- has a hard time seeing the "big picture"; i.e., focuses on the details or patterns within the picture
- has difficulty locating items among other items; i.e., papers on a desk, clothes in a drawer, items on a shelf, or toys in a bin/toy box
- often loses place when copying from a book or the whiteboard
- difficulty controlling eye movement to track and follow moving objects
- has difficulty telling the difference between different colours, shapes, and sizes
- often loses his/her place while reading or doing math problems
- makes reversals in words or letters when copying, or reads words backwards; i.e., "was" for "saw" and "no" for "on" after first year
- complains about "seeing double"
- difficulty finding differences in pictures, words, symbols, or objects
- difficulty with consistent spacing and size of letters during writing and/or lining up numbers in math problems
- difficulty with jigsaw puzzles, copying shapes, and/or cutting/tracing along a line
- tends to write at a slant (up or down hill) on a page
- confuses left and right
- fatigues easily with schoolwork
- difficulty judging spatial relationships in the environment; i.e., bumps into objects/people or missteps on curbs and stairs

Visual perception may not be the only modality affected.

Explanations for Visual Perception Disorder in Children

Dyslexia

Dyslexia is a specific learning disability that is neurological in origin. It is characterized by difficulties with accurate and / or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge.
(Dyslexia Association)

Dyslexia refers to a broad family of impairments. Generally speaking, dyslexia is a term used to define a severe learning problem that is unrelated to intellectual ability, emotional disturbance, gross sensory or physical handicaps, socio-cultural status, or insufficient schooling. The most common type of dyslexia, specific reading disability (SRD) involves difficulties in learning to read and write. At present we lack clear agreement about the nature of dyslexia, including its causes and symptomology.

Most researchers agree that dyslexia probably results from abnormal neurodevelopment. Psychophysical studies suggest problems that are neural in origin as do anatomical studies of brain structure and physiological studies of neural activity.

Theories of developmental dyslexia
Adapted from: *http://en.wikipedia.org/wiki/Dyslexia*

The following theories should not be viewed as competing, but viewed as theories trying to explain the underlying causes of a similar set of symptoms from a variety of research perspectives and backgrounds.

The phonological hypothesis
The phonological hypothesis postulates that dyslexics have a specific impairment in the representation, storage and/or retrieval of speech sounds. It explains dyslexics' reading impairment on the basis that learning to read an alphabetic system requires learning the grapheme/phoneme correspondence, i.e. the correspondence between letters and constituent sounds of speech. If these sounds are poorly represented, stored or retrieved, the learning of grapheme/phoneme correspondences, the foundation of reading for alphabetic systems, will be affected accordingly.

The rapid auditory processing theory
The rapid auditory processing theory is an alternative to the phonological deficit theory, which specifies that the primary deficit lies in the perception of short or rapidly varying sounds. Support for this theory arises from evidence that dyslexics show poor performance on a number of auditory tasks, including frequency discrimination and temporal order judgement. Abnormal neurophysiological responses to various auditory stimuli have also been demonstrated. The failure to correctly represent short sounds and fast transitions

would cause further difficulties in particular when such acoustic events are the cues to phonemic contrasts, as in /ba/ versus /da/. There is also evidence that dyslexics may have poorer categorical perception of certain contrasts

The visual theory

The visual theory (Lovegrove et al., 1980; Livingstone et al., 1991; Stein and Walsh, 1997) reflects another longstanding tradition in the study of dyslexia, that of considering it as a visual impairment giving rise to difficulties with the processing of letters and words on a page of text. This may take the form of unstable binocular fixations, poor vergence, or increased visual crowding. The visual theory does not exclude a phonological deficit, but emphasizes a visual contribution to reading problems, at least in some dyslexic individuals. At the biological level, the proposed aetiology of the visual dysfunction is based on the division of the visual system into two distinct pathways that have different roles and properties: the magnocellular and parvocellular pathways. The theory postulates that the magnocellular pathway is selectively disrupted in certain dyslexic individuals, leading to deficiencies in visual processing, and, via the posterior parietal cortex, to abnormal binocular control and visiospatial attention. Evidence for magnocellular dysfunction comes from anatomical studies showing abnormalities of the magnocellular layers of the lateral geniculate nucleus (Livingstone et al., 1991), psychophysical studies showing decreased sensitivity in the magnocellular range, i.e. low spatial frequencies and high temporal frequencies in dyslexics, and brain imaging studies.

The cerebellar theory

Yet another view is represented by the automaticity/ cerebellar theory of dyslexia. Here the biological claim is that the dyslexic's cerebellum is mildly dysfunctional and that a number of cognitive difficulties ensue. First, the cerebellum plays a role in motor control and therefore in speech articulation. It is postulated that retarded or dysfunctional articulation would lead to deficient phonological representations. Secondly, the cerebellum plays a role in the automatization of overlearned tasks, such as driving, typing and reading. A weak capacity to automatize would affect, among other things, the learning of grapheme±phoneme correspondences. Support for the cerebellar theory comes from evidence of poor performance of dyslexics in a large number of motor tasks, in dual tasks demonstrating impaired automatization of balance, and in time estimation, a non-motor cerebellar task. Brain imaging studies have also shown anatomical, metabolic and activation differences in the cerebellum of dyslexics.

The magnocellular theory

There is a unifying theory that attempts to integrate all the findings mentioned above. A generalization of the visual theory, the magnocellular theory postulates that the magnocellular dysfunction is not restricted to the visual pathways but is generalized to all modalities (visual and auditory as well as tactile). Furthermore, as the cerebellum receives massive input from various magnocellular systems in the brain, it is also predicted to be affected by the general magnocellular defect (Stein et al., 2001). Through a single biological cause, this theory therefore manages to account for all known manifestations of dyslexia: visual, auditory, tactile, motor and, consequently, phonological. Beyond the evidence pertaining to each of the theories described previously, evidence specifically relevant to the magnocellular theory includes magnocellular abnormalities in the medial as well as the lateral geniculate nucleus of dyslexics' brains, poor performance of dyslexics in the tactile domain, and the co-occurrence of visual and auditory problems in certain dyslexics.

Perceptual noise exclusion hypothesis

The concept of a perceptual noise exclusion deficit is an emerging hypothesis, supported by research showing that dyslexic subjects experience difficulty in performing visual tasks such as motion detection in the presence of perceptual distractions, but do not show the same impairment when the distracting factors are removed in an experimental setting. The researchers have analogized their findings concerning visual discrimination tasks to findings in other research related to auditory discrimination tasks. They assert that dyslexic symptoms arise because of an impaired ability to filter out both visual and auditory distractions, and to categorize information so as to distinguish the important sensory data from the irrelevant.

Research also suggests

Genetic factors

Developmental dyslexia also appears to have a genetic component, such that it can tend to occur in multiple members of the same family. Reading difficulties in dyslexia can vary in their severity. The condition is not restricted to childhood, and can persist through adulthood. In addition, while early reports suggested dyslexia is more prevalent in boys, more recent studies have indicated it is not sex-linked, and occurs both in boys and girls with equal frequency.

Studies have linked several forms of dyslexia to genetic markers. One major genetic study identified a region on chromosome 6, DCDC2, as possibly linked to dyslexia. As of 2007, genetic research in families with dyslexia have identified nine chromosome regions that may be associated with susceptibility to dyslexia. However, several of the major studies have not been replicated.

Physiology

Using functional Magnetic Resonance Imaging (fMRI), it has been found that people with dyslexia have a deficit in parts of the left hemisphere of the brain involved in reading, which includes the inferior frontal gyrus, inferior parietal lobule, and middle and ventral temporal cortex.

In 1979 , anatomical differences in the brain of a young dyslexic were documented. Albert Galaburda of Harvard Medical School noticed that the language centre in a dyslexic brain showed microscopic differences known as ectopias and microgyria. Both affect the typical six-layer structure of the cortex. An ectopia is a collection of neurons that have pushed up from the lower layers of the cortex into the outermost one. A microgyrus is an area of cortex that includes only four layers instead of six. These differences affect connectivity and functionality of the cortex in critical areas related to auditory processing and visual processing, which seems consistent with the hypothesis that dyslexia stems from a phonological awareness deficit. Others have reported from CAT scan studies that the brains of dyslexic children were symmetrical unlike the asymmetrical brains of non-dyslexic readers who had larger left hemispheres.

It is anecdotally claimed that some dyslexics have trained themselves to cope with their processing difficulties by developing uncannily efficient visual memories which aid in reading and comprehending large quantities of information much faster than is typical. Some dyslexics may show a natural dislike of reading and, as a consequence, compensate by developing unique verbal communication skills, interpersonal expertise, visual-spatial abilities, and leadership skills.

Effect of language orthography

Some studies have concluded that speakers of languages whose orthography has a strong correspondence between letter and sound (e.g. Croatian, Korean, Italian and Spanish) suffer less from effects of dyslexia than speakers of languages where the letter is less closely linked to the sound (e.g. English and French).

In one of these studies, reported in Seymour et al., the word-reading accuracy of first-grade children of different European languages was measured. English children had an accuracy of just 40%, whereas among children of most other European languages accuracy was about 95%, with French and Danish children somewhere in the middle at about 75%; Danish and French are known to have an irregular pronunciation.

However, this does not mean that dyslexia is caused by orthography: instead, Ziegler et al. claim that the dyslexia suffered by German or Italian dyslectics is of the same kind as the one suffered by the English ones, supporting the theory that the origin of dyslexia is biological. However, dyslexia has more pronounced effects on orthographically difficult languages.

It is very tempting to interpolate this last finding by suggesting that the Italian and Spanish experience demonstrates that the ***real*** *rate of "true" dyslexia in children is quite low. The American and English reports of much higher rates of dyslexia appear so because they include many youngsters who are simply having problems involving phonological awareness, caused in part by the irregularity of the relationship between English orthography and its pronunciation.*

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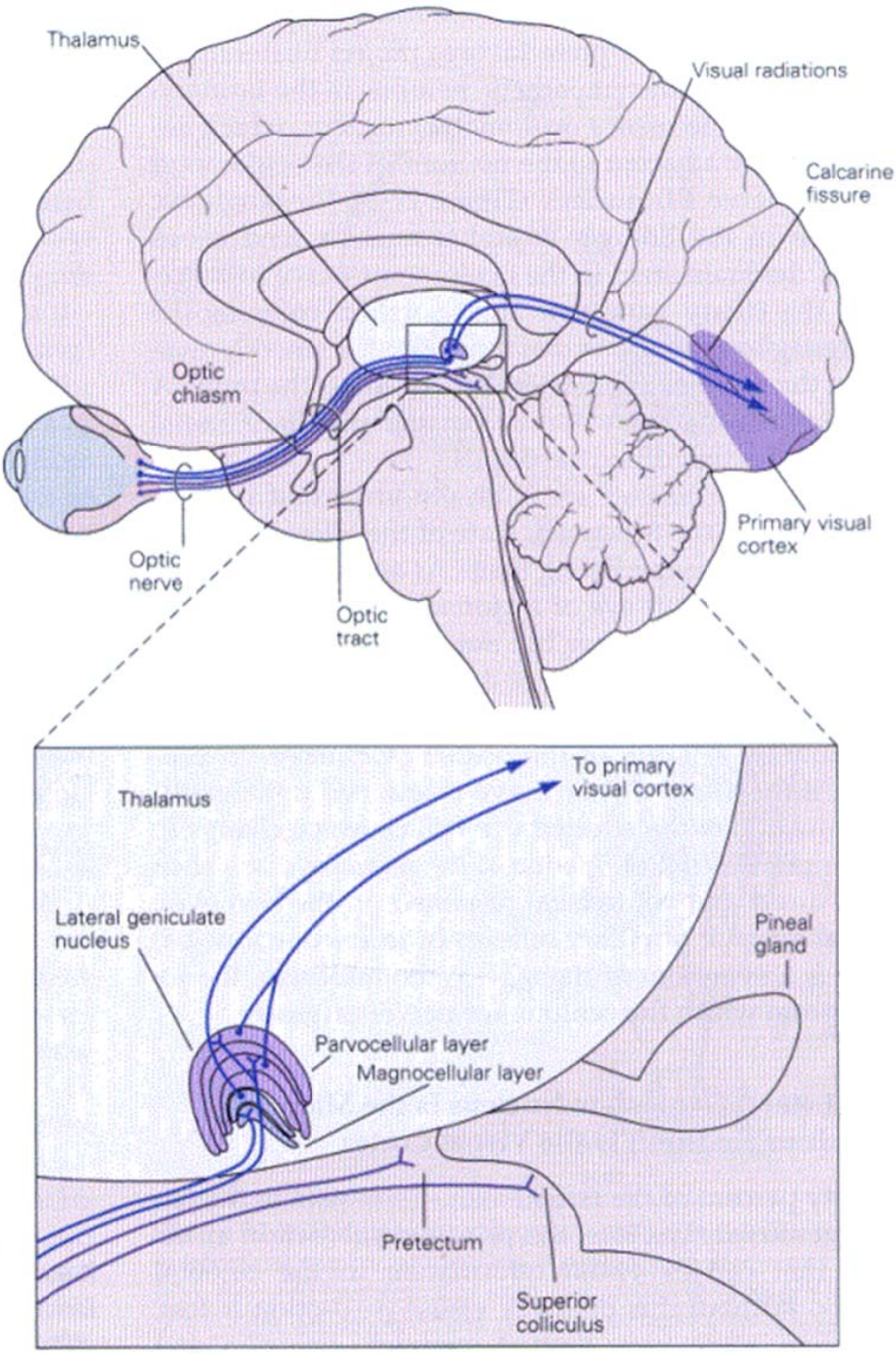
Diagram showing location of magnocellular layers



Irlen Syndrome

http://www.irlen.com

Over 20 years ago, research directed by Helen Irlen under a federal research grant studied methods of helping children and adults with reading and learning disabilities. One important discovery was that a subgroup of individuals showed a marked improvement in their reading ability when reading material was covered by coloured acetate sheets.

Irlen Syndrome is not an optical problem. It is a problem with the brain's ability to process visual information. This problem tends to run in families and is not currently identified by other standardized educational or medical tests.

This technology can improve **reading fluency**, **comfort, comprehension**, **attention, and concentration** while reducing **light sensitivity**. This is not a method of reading instruction. It is a colour-based technology that filters out offensive light waves, so the brain can accurately process visual information.

It helps children and adults suffering from

- Reading and learning problems
- Dyslexia
- ADD/HD, Autism and Asperger Syndrome
- Behavioural and emotional problems
- Headaches, migraines, fatigue and other physical symptoms
- Light Sensitivity/Photophobia
- Traumatic brain injury (TBI), whip lash, and concussions
- Certain medical and visual conditions.

ADHD

From a developmental/behavioural standpoint, the Diagnostic and Statistical Manual of Mental Disorders-IV-TR states that ADHD is a developmental disorder that presents during childhood, in most cases before the age of seven, and is characterized by developmentally inappropriate levels of inattention and/or hyperactive-impulsive behaviour. The DSM-IV also stipulates that in order to be diagnosed, the condition must also result in significant impairment of one or more major life activities, including interpersonal relations, educational or occupational goals, as well as cognitive or adaptive functioning.

N

Symptoms

The symptoms of ADHD fall into the following two broad categories:

Inattention:

- Failing to pay close attention to details or making careless mistakes when doing schoolwork or other activities
- Trouble keeping attention focused during play or tasks
- Appearing not to listen when spoken to
- Failing to follow instructions or finish tasks
- Avoiding tasks that require a high amount of mental effort and organization, such as school projects
- Frequently losing items required to facilitate tasks or activities, such as school supplies
- Excessive distractibility
- Forgetfulness

Hyperactivity-impulsive behaviour

- Fidgeting with hands or feet or squirming in seat
- Leaving seat often, even when inappropriate
- Running or climbing at inappropriate times
- Difficulty in quiet play
- Frequently feeling restless
- Excessive speech
- Answering a question before the speaker has finished
- Failing to await one's turn
- Interrupting the activities of others at inappropriate times

Symptoms must appear consistently in varied environments (e.g., not only at home or only at school) and interfere with function. One of the difficulties in diagnosis is the incidence of co-morbid conditions, especially the presence of Bipolar Disorder which is being reported at earlier ages than previously described.

Curious Coincidence:

On-line support groups for various conditions claim famous people suffer or suffered the same condition, as an encouragement to current sufferers not to simply give up. Among those identified are the following, claimed by all three support groups, and additionally by associations for people with Bi-Polar disorder:

Dyslexia	**ADHD**	**Autism**
Winston Churchill	Winston Churchill	Winston Churchill
Benjamin Franklin	Benjamin Franklin	Benjamin Franklin
John F. Kennedy	John F. Kennedy	John F. Kennedy
Leonardo daVinci	Leonardo daVinci	Leonardo daVinci
Ludwig van Beethoven	Ludwig van Beethoven	Ludwig van Beethoven
W A Mozart	W A Mozart	W A Mozart
Albert Einstein	Albert Einstein	Albert Einstein
Thomas Edison	Thomas Edison	Thomas Edison
Alexander Graham Bell	Alexander Graham Bell	Alexander Graham Bell
The Wright Brothers	The Wright Brothers	The Wright Brothers
Louis Pasteur	Louis Pasteur	Louis Pasteur
Hans Anderson	Hans Anderson	Hans Anderson

Current thinking suggests that true geniuses are more likely to be people who simply don't care what others think of them. They are not inhibited by the more normal desire to be like everyone else. They are not constrained by the conventional wisdoms of experts, and are thus free to soar in their thinking and creativity.

Acquired Brain Injury

When there is little physical injury to the head, perhaps just a bruise or a lump which quickly responds to treatment, it is usually assumed that there is no internal injury either. This assumption is unfortunate and frequently wrong.

A mild head injury may well result in a non-trivial brain injury, however rapidly the physical injury to the head may recover.

A mild head injury does not equal a trivial brain injury.

Often visual problems resulting from even mild brain injury are overlooked during initial treatment of the injury. Frequently these problems are hidden and neglected, lengthening and impairing rehabilitation. Vision is the most important source of sensory information. Consisting of a sophisticated complex of subsystems, the visual process involves the flow and processing of information to the brain. Because there is a close relationship between vision and the brain, Acquired Brain Injury can disrupt the visual process, interfering with the flow and processing of information. The result is a vision problem. Symptoms indicating a vision problem include:

- Blurred vision
- Sensitivity to light
- Reading difficulties; words appear to move
- Poor fine motor skills, eye-hand coordination
- Comprehension difficulty
- Attention and concentration difficulty
- Memory difficulty
- Double vision
- Aching eyes
- Headaches with visual tasks
- Loss of visual field

The number of children with visual perception disorders due to acquired brain injury is unknown.

Discussion

General

Visual perception disorder, dyslexia and Irlen syndrome are assumed to reflect a neurological condition, abnormal neurodevelopment or mild brain injury, as is ADHD.

Behaviours and child-reported symptom clusters associated with mild brain injury, visual perception disorders, dyslexia and Irlen syndrome are very similar, especially with regard to access to print.

Despite the various theoretical approaches, to dyslexia in particular, there is strong evidence of convergence of research and resulting thought in recent time.

Even with reference to the *Current Theories of Developmental Dyslexia* (page 8), there is a common thread emerging: that the magnocellular system has a significant part to play in the symptoms of dyslexia, and likely in Irlen Theory as a subset of dyslexics.

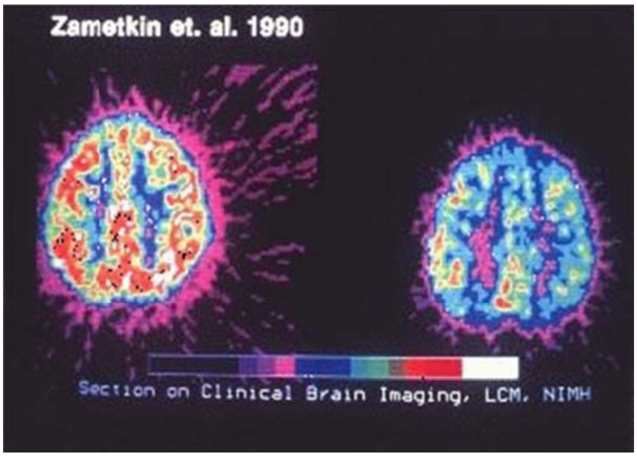
It is now well established that poor readers universally lack phonological skills, whether because of inadequate teaching, poor oral language or a neurological condition. That is to say, having poor phonological skills without other symptoms does NOT mean that a child is dyslexic.

The interesting study comparing word decoding skills across different languages points out the comparative difficulty English-speaking children may have relating sounds to an irregular orthography.

Current research (e.g. Dr Franklin R Manis at USC Dept of Paediatric Neuropsychology) suggests that a problem in forming perceptual categories in a noisy environment might underlie both the visual and auditory perception problems (in dyslexics). In an ongoing study, he is investigating whether dyslexic children show deficits in noise exclusion with both auditory and visual stimuli, and whether the noise perception problems are associated with poor phonological decoding and word recognition. Put simply, high levels of aural and visual distraction will make learning to read more difficult in many classrooms.

Whatever the underlying cause, there is a significant number of children in our schools whose problems with visual perception interfere with their learning.

Caution with Brain Scans



Some researchers describe brain activity differences acquired by MRI scans to show how one condition differs from another, for example between dyslexic and normal readers, or between ADHD and non-ADHD readers.

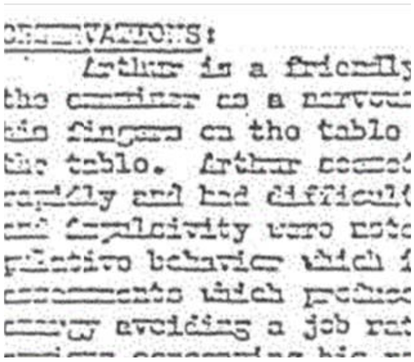
The image on the left illustrates areas of activity in the brain of a person without ADHD while doing an assigned task. The image on the right illustrates the areas of activity of the brain of someone with ADHD when given that same task.

Cautionary arguments include the suggestion that children with ADHD will not be attending to the task as the normal readers will be, and hence the scans are bound to show a difference in brain activity. Secondly, if a child is a non-reader for whatever reason, including inadequate teaching, the brain will be bound to function differently regardless of any underlying condition. Anxiety and stress is likely to be much higher in the non-reading subject. If brain imaging is done while one person moves their arm and another doesn't there will also be a demonstrable difference.

Behaviour can cause changes the structure of the brain. For example, learning Braille causes enlargement of the part of the motor cortex that controls finger movements. After they have passed their licensing exam, London taxi drivers have been found to have a significantly enlarged hippocampus compared to non-taxi drivers. Patients abused during their childhood with post traumatic stress disorder will have a flattened out hippocampus. Professional musicians have brains that are different from non-musicians. Monks who meditate show measurable differences in their prefrontal lobes. So diminished concerted effort when confronted with tasks thought to be drudgery (homework, paying attention to teachers, and the like) even if not caused by differences in the brain, can have brain changing effects.

Irlen Syndrome: Scotopic Sensitivity Syndrome

The notion of Irlen syndrome is based on theory and practice. Noticing that some children were assisted in their visual difficulties, especially in their access to print, by coloured overlays, Irlen developed the Scotopic Sensitivity Theory to explain how or why this was so. Scotopic Sensitivity is a term no longer used by Irlen, who now prefers the term Irlen Treatment or Irlen Method.



Despite the scientifically unorthodox derivation of the theory, there is a large number of both children and adults world-wide who claim that tinted lenses or coloured overlays help enormously with their access to print by preventing the apparent movements and distortions of print that they previously experienced.

While the treatment is not very well accepted by ophthalmology specialists, it nevertheless appears to help a large number of people where other strategies have failed.

Dyslexia

The Dyslexia Association reports:

The exact causes of dyslexia are still not completely clear, but anatomical and brain imagery studies show differences in the way the brain of a dyslexic person develops and functions. Moreover, people with dyslexia have been found to have problems with discriminating sounds within a word, a key factor in their reading difficulties. Dyslexia is not due to either lack of intelligence or a desire to learn; with appropriate teaching methods dyslexics can learn successfully.

The comments referring to brain differences could be subject to the same comments applied to scans of brain differences in ADHD (*above*).

There is considerable evidence that children with SRD (Specific Reading Disorder) exhibit a set of visual perceptual problems that precede this stage, however, and researchers are working to characterize their relationship to SRD.

Lovegrove, Garzia, & Nicholson (1990) provide a good discussion of the early work in this area.

A large literature now documents impairments in motion perception (*Cornelissen, Richardson, Mason, Fowler, & Stein, 1995; Eden et al., 1996*) contrast sensitivity (Borsting et al., 1996; *Cornelissen et al., 1995; Evans, Drasdo, & Richards, 1994*), flicker sensitivity (*Evans et al., 1994*), as well as other tasks that preferentially involve the magnocellular pathway (*Edwards, Hogben, Clark, & Pratt, 1996*).

Further support for visual perceptual correlates of SRD comes from a recent study revealing a correlation between motion detection thresholds and word reading performance in children without SRD (*Cornelissen, Hansen, Hutton, Evangelinou, & Stein, 1998*).

Anatomical and physiological abnormalities in the brain are associated with these behavioural abnormalities. In individuals with dyslexia the magnocellular layers of the LGN have been reported to be disordered and the cells themselves much smaller than normal (*Livingston, Rosen, Drislane, & Galaburda, 1991). Eden et al. (1996*) used fMRI to reveal abnormal neural activity during visual motion processing in adults with dyslexia.

In an attempt to explain the range of perceptual and anatomical impairments that are associated with SRD, investigators have recently suggested that dyslexia may be linked to a general sensory temporal processing impairment (*Farmer & Klein, 1995; Stein & Walsh, 1997*). That is, individuals with SRD have ***difficulty in processing sensory information that is brief or that changes rapidly over time*** *(Editor's emphasis)*, an essential skill component of efficient reading. Studies of visual perceptual abilities of children with SRD would be consistent with this explanation, as well as studies that show that children with SRD have difficulties with some non-verbal auditory perceptual tasks as well as verbal ones (*Tallal, 1980*).

Research Study

Translating these finding into practice is a study by John Stein, University Laboratory of Physiology, Oxford, UK in Huddersfield, England, in 1997.

A few years back we were able to test the vision, hearing and reading of an entire class of 10 year olds. We wanted to find out how important the quality of their seeing and hearing was in helping them to learn to read.

We found that their sensitivity to moving visual stimuli correlated strongly with their skill at identifying the visual order of letters and the visual form of words – their 'orthography'. This is because visual motion is sensed by a special set of visual nerve cells, the magnocellular system, that plays the main part in controlling visual attention and eye movements following the letters when reading. If the visual magnocellular system is weak then eye control during reading will be poor, and the letters may appear to move around and take the wrong order.

Likewise these children's sensitivity to changes in sound frequency correlated with their ability to translate letters into their sounds (phonology). The differences that you hear between letter sounds are because they change in frequency and loudness, and these changes are detected by the auditory magnocellular system. Hence if the auditory magnocellular system is weak, children will tend to confuse letter sounds, hence also their order in words.

In fact in this primary school class the children's visual and auditory magnocellular sensitivity accounted for over half their differences in reading ability. Since we have discovered treatments that can help children to improve their visual and auditory processing capabilities, this is very encouraging for the future treatment of dyslexic problems.

But we wanted to make sure that these findings apply to all children in all types of school, not just in this one school where conditions were ideal for testing. So we have just finished a study of over 350 children aged from 7 to 12 years, randomly selected from many of Oxford's primary and middle schools.

This larger study has confirmed what we found in Meltham, that basic visual and auditory magnocellular processing abilities do indeed play a dominant role in determining how well children develop the visual/orthographic and auditory/phonological skills that are required for reading.

We are now trying to improve the sensitivity of these tests, and to make them fun for 5 & 6 year olds. This should help us to identify children's visual and auditory weaknesses when they first start in school, before they begin to fail at reading. We hope to protect them from the shame, misery and loss of self–confidence that reading failure so often brings in its train.

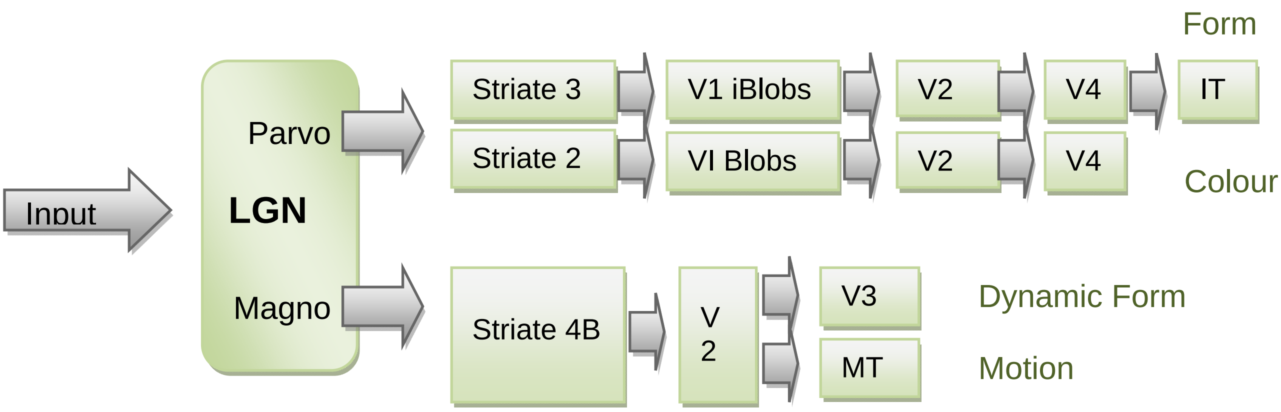


Figure adapted from: University of Calgary. http://www.psych.ucalgary.ca/PACE/VA-LAB/Brian/neuralbases.htm

The slow-conducting parvocellular pathway mediates our perception of colour and acuity; the fast-conducting magnocellular pathway is responsible for our perception of stimulus change (including motion) and is largely colour-blind. It is the latter process that appears to be at fault in children with dyslexia.

DYSLEXIA and BRAILLE READERS

Paper by John Greaney, Rea Reason. University of Manchester, UK. 2003

Abstract

The relationship between phonological abilities and reading progress in blind children was investigated in two interdependent studies. The first examined the performance of a sample of 22 Braille readers aged 7:10-12:1 years. The second compared the phonological skills of two 'matched' Braille readers, one a struggling learner and the other making good progress. An adapted form of the Phonological Assessment Battery was used in the research. Results for the first study showed that, while reading scores on a standardized test were lower than for sighted children, the scores achieved by this sample for each test of phonological awareness/memory were higher than those expected from the norms of the sighted standardization sample. Results of the second study demonstrated marked differences between the two learners, not only in their phonological skills but also in their approaches to learning. The role that phonological competencies play in Braille learning is discussed in relation to the complexity of the symbol system and the tactile processing involved. The results have implications for the identification of phonological dyslexia in Braille readers and for the teaching of Braille.

Children using Braille are subject to the same phonological awareness deficits as normally sighted children.

ADHD

While ADHD does not appear to sit very well with a discussion of visual perception disorders, there are studies to suggest that at least some children labelled as ADHD may in fact be children with visual perception disorders. The associated frustrations and lack of understanding by others may have led, directly or indirectly, to the inattentive tendencies and consequently, even, some of the behavioural symptoms.

The American College of Paediatric Psychology comments:

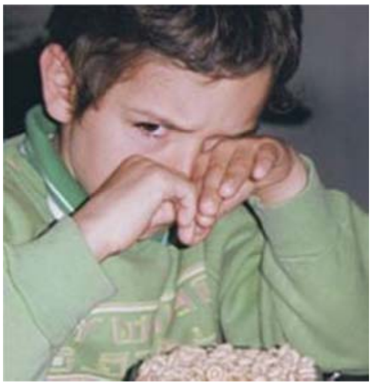
ADD and ADHD are syndromes, associations of symptoms. There is no well established cause for the condition.

Confusion may also arise from the fact that ADD/ADHD symptoms vary with each individual, and some mimic those of other causes. A known fact is that, as the body (and brain) matures and grows, the symptoms and adaptability of the individual also change. Many individuals diagnosed with ADD/ADHD successfully develop coping skills, while others may never do so.

The American College of Paediatric Psychology also proposes a "chicken or the egg" quandary regarding observed brain patterns in ADHD:

There are numerous, often contradictory, claims that the brain is physically different in children with ADHD. However, even if this eventually is confirmed, by no means does it establish that the condition is biological. Behaviour can cause changes the structure of the brain (*see page 18*).

Priscilla Anderson, Professor of Childhood Studies, University of London, takes a social construct view of the recent enormous increase in reported ADHD:



Rapidly rising rates of the fairly new disorder ADHD could have more to do with social changes than illness. Some deeply disturbed children do need medical help, but millions of others are being diagnosed with ADHD, who would not have been seen as sick a few years ago.

There have been great changes over the past 20 years that restrict children's activity. Schools have a more rigid curriculum and regular tests. Even five year olds have daily maths and literacy hours, homework and incessant testing that in other countries would not begin until they are six or seven; many are locked into early failure.

The government's solution to childhood poverty is that parents do more paid work. This leaves parents with less time and energy to enjoy life with their children. Fear of traffic, crime, stranger-danger, other people's children, media scandal and being sued seems to terrify the nation into keeping children contained inside schools, homes, cars or expensive childcare settings.

Undirected developmental play with peers has disappeared from youngsters' lives. Every free moment is filled, often by proxy parents in organised activities.

Ordinary activity and frustration can then seem hyperactive and impetuous; boredom and loneliness can look like inattention.

This is not to say that children's behaviour is wholly driven by adverse social pressures - or by their brain structure, hormones or genes - but it can be harder for them to do well.

Instead of trying to turn social problems into medical ones, and to project them on to children and young people, let's listen to their warnings. Let's work with them more actively to tackle the growing social problems that undermine mental health.

Although this article was written in London, the contents will resonate with New Zealand educators, The New Zealand primary school curriculum sometimes appears to have been written to meet political and social imperatives rather than to meet the varied learning needs of young children.

More children now visit the doctor with mental health problems than for injury or illness (New Zealand National Radio report, 17 May 2007).

Assessment of Visual Perception Disorders

1. Elimination of Optical Errors

- Ophthalmological examination is clear
- Regular Functional Visual Assessment is clear

2. Elimination of Other Physical Conditions

- Hearing check is clear
- Speech is normal
- Oral language is normal or advanced for age
- No CP or other contributory condition

3. Elimination of Psycho-Social factors

- Child appears to be of normal or better intelligence and capability in most areas
- There are no significant family issues such as abuse or recent divorce
- There are no psychological conditions such as autism or depression

Having eliminated other possibilities or conditions, the Checklist on Page 7 provides a useful basis for an initial assessment of Visual Perception Disorder.

Finally, it is important to have the child assessed by a paediatric or developmental optometrist, who has access to assessment tools designed to measure factors such as convergence and accommodation at different distances, tracking faults, flicker detection and all the other relevant factors that Resource Teachers are not qualified or equipped to measure.

The optometrist may suggest vision therapy or exercises designed to help with some faults in convergence, accommodation and so on. Coloured overlays may assist some children cope with glare and contrast problems.

There is no cure, however, for the underlying neurological condition.

There is no purpose in visiting an ophthalmologist again, as optical examination has already proved clear.

Activity Suggestions to Improve Visual Perception Skills *by Annetta Miller*

Visual perception – the ability to process visual information and make sense of it. Visual perception has several sub-components:

Visual discrimination	Ability to look at objects or pictures and recognise whether they are alike or different. This is important for matching and categorising.
Visual memory	Ability to remember, even for a short period, something you have seen
Visual closure	Ability to mentally visualise what something looks like, even if it is only partially visible, e.g. child can visualise what the whole pencil looks like even if it is half covered by the pencil case
Visual figure ground	Ability to distinguish an object/figure from its background, e.g. finding a particular toy in the toy box, finding your spot on the page or on the blackboard
Form constancy	Ability to recognise forms and objects as the same, regardless of size, colour or orientation, e.g. child can recognise a triangle regardless of which way it is turned, how big it is or what colour it is
Position in space	Ability to recognise the spatial relationship between yourself and objects in the environment, as well as relationship between objects. This is important for directional language concepts such as up and down; in front of and behind; between, left and right
Depth perception	Ability to judge how far away something is from yourself or another object, e.g. judging the depth of stairs when walking up or down

Visual Perception Activities

- Matching, sorting and labelling activities based on colour, shape, size, texture, function, etc.
- Sorting and labelling pictures.
- Picture matching games, e.g. Lotto, Snap, Dominoes. A wide variety is available commercially, or you could design your own.
- Matching object to outlines drawn.
- Pattern making using pegboard or threading beads
- Visual Closure cards. Show dotted outline or half a picture.
- Pictures requiring the child to find "What's Wrong".
- "Spot the Difference" between two pictures. Start with simple pictures.
- Picture sequencing using simple sequences of daily life.

- Memory games using a small selection of picture cards, and finding pairs
- Memory games where beads, pegs or cards are placed in a colour pattern and then covered. The child tries to remember and copy the pattern (start with 4 items).
- "Traffic Lights": 3 large cards; red = sit, green = run, amber = stand. Use the same idea for movement with shape card such as a circle = hop, a square = jump, a triangle = crouch, etc.
- "What's missing" - present 2, 3, 4 or 5 objects, cover and take one or more away.
- "What's Been Added" - as above but add new object(s).
- "What Did You See" - show 2, 3, 4 or 5 objects for ten seconds, cover and the child recalls what has been seen.
- "Blanket Game" - using a small group of children (5), cover one child with a blanket while the children close their eyes. One child guesses who is missing.
- "I Touch My _______ and _______ ". The children watch actions first and copy the teacher.
- Memory Lotto - played as for normal lotto except cards are placed face down and children must recall where their cards are.
- "Which One Is It" - show a picture card for several seconds. Uncover a group of objects and the child finds the object to match the card that was shown.
- “Find it” games, where a segment of a small picture must be found within a large scene

CLASSROOM ACCOMMODATIONS FOR STUDENTS WITH DYSLEXIA / VISUAL PERCEPTION DISORDER

Adapted from: Susan M. Barton: *Learning Disabilities Journal. January 2003•Volume 13•No.1*

The dyslexic child needs two things:

1. One-on-one tutoring by a professional trained in the use of an Orton-Gillingham-based reading and spelling system, and
2. Classroom accommodations until his/her reading, writing, and spelling skills reach grade level.

WHAT IS AN ACCOMMODATION?

Accommodation does not mean changing the curriculum. It means changing:

- the way a teacher presents information
- the way a student practices new skills, or
- the way a teacher tests students to ensure they have mastered the material

An accommodation is something the teacher does differently to ensure that a student does not fail due to an inherited condition over which the student has no control.

WHAT DYSLEXIC STUDENTS NEED

Dyslexic students need a teacher who understands the frustration of being smart, yet unable to do what other students do so easily: read, write, spell, and memorize. They need a teacher who:

- understands that these difficulties are due to a brain difference—not laziness, lack of intelligence, or lack of motivation.
- will not give up on them—a teacher who is willing to learn how to teach around their weaknesses.
- knows that they suffer from extreme anxiety. More than anything else, these students fear that their teacher will make them look stupid in front of their peers.

FEAR & ANXIETY

Why do children with dyslexia complain of headaches and stomach aches right before school, and beg their parents not to send them to school? Why do students with dyslexia tend to sit in the back of the room? Why do they rarely make eye contact with the teacher? It's because they dread school. They rarely participate because they don't want to appear stupid in front of their friends. Whenever a teacher shows the rest of the class what a dyslexic student cannot do, directly or indirectly, on purpose or accidentally, our student feels humiliated. If this happens often enough, our student may develop an anxiety disorder.

A student who is in a constant state of fear and anxiety cannot learn. So before you can teach our student, you must reduce his anxiety. You can do that by privately promising him that you will:

- NEVER force him to participate in a spelling bee. Instead, you'll let him be the scorekeeper or do some other administrative task.
- NEVER force him to read out loud in class, without getting his permission in advance, and without also showing him, in advance, the passage that he'll have to read, so he can practice ahead of time.
- NEVER force him to write on the board where other students can see his spelling mistakes and his terrible handwriting.
- NEVER collect or distribute tests or homework by passing papers down the row, where other students can see his handwriting, spelling, and mistakes.
- NEVER allow other students to correct his assignments or grade his tests.

READING

Students with dyslexia usually read very slowly, and they misread lots of words—which can lead to comprehension problems. Their reading skills are often way below grade level. So although they may be able to learn by listening, by watching demonstrations or videos, by participating in discussions, and through hands-on activities, they can't learn very much by reading.

It takes special training, and the use of an Orton-Gillingham-based system, to improve the reading skills of a student with dyslexia.

If a teacher provides time to read books during class (often called "silent sustained reading"), I recommend that she have five or six copies of the book on audiotape, (along with inexpensive tape players with headphones that cost less than $10 at most large discount stores). She can allow all students to either just read OR to listen and read. Good readers will discover that listening while reading slows them down. So, generally, only poor readers will take advantage of the listen and read option.

By the way, it's better to have a dyslexic student listen to a book written at his grade level—so it will challenge him intellectually, improve his vocabulary, and allow him to participate in classroom discussions about the book—than read a book written for much younger students. (Forcing a sixth grader to read a third-grade book in view of his friends will not only increase his anxiety, but it will teach him to hate and resist reading.)

SPELLING

Unless a dyslexic student has had Orton-Gillingham tutoring, or has unusually good visual memory for words, his spelling will be far worse than his reading. Traditional methods of spelling instruction do not work for students with dyslexia.

The only way his spelling will improve is if he works with an Orton-Gillingham-based tutor who teaches a set of specific spelling rules that allow him to spell by sounding out—NOT by memorizing.

A dyslexic student must not be punished just because his teacher has not been trained to teach spelling in this special way. So I recommend three accommodations for spelling:

- Do not grade his spelling tests. Instead, let him know, privately, that you have not been trained to teach spelling in a way that will work for him. Tell him not to waste hours every night trying to memorize the weekly spelling list. Tell him he can take the test along with everyone else, but it will not count as part of his grade. (If there's a place for a spelling grade on his report card, just leave it blank.)
- Ignore spelling mistakes on written assignments. Grade on the content of his answers—NOT the spelling, grammar, vocabulary, or handwriting. Never hand back to a dyslexic student a written assignment that's bleeding with red correction marks.
- NEVER ask a dyslexic student to look up the spelling of a word in a dictionary. Dictionaries are nearly impossible for our students to use. Most are unable to memorize the alphabet in order. They also can't read most of the words on the page. Instead, allow our students to type their assignments into a PC running a word processor program with a spell checker. Or allow them to look up the spelling using a computerized version of the dictionary. Or allow them to use a handheld electronic spell checker, such as a Franklin Spelling Ace—provided by their parent.

And to make sure our student don't feel different from others, allow any student in the class to use these tools.

HANDWRITING

Many dyslexic students also have dysgraphia— extreme difficulty with handwriting. For them, the act of handwriting is slow and painful. It requires so much thought and concentration that they cannot learn while writing or copying. As a result, these students aren't able to learn by listening to a teacher, if at the same time, they must take notes or copy from the board. For a dysgraphic student to succeed in your class, you must reduce the need for handwriting to the bare minimum.

One way is to identify another student in the class who takes good notes, has legible handwriting, and is willing to help. Provide that student with Carbonless Notebook paper. This special two-part, pressure-sensitive paper creates an extra copy of anything written on it, yet avoids the mess of carbon paper. While the other student takes notes, our dyslexic student can focus all his energy on listening to the teacher. At the end of class, the other student can hand him the copy of his notes, including what was on the board.

If a reliable volunteer note-taker isn't available, the teacher should provide a photocopy of her lecture notes, along with a copy of what she wrote on the board.

For similar reasons, it's not a good idea to require a dyslexic student to copy a problem out of a textbook before answering it. Instead, either have someone else copy it for him, or allow him to photocopy (and enlarge, if he wishes) the page containing the questions, then have him write the answers on the photocopy.

By the way, if in-class or homework assignments require writing more than a few words, I recommend allowing our student to dictate his answers to a classroom aide, a volunteer, a parent; or into a tape recorder. He could even dictate into a PC running voice-recognition software, such as NaturallySpeaking by Dragon Systems.

Once a student with dysgraphia has learned to type (an absolutely essential skill), allow him to type all assignments, using a portable keyboard (such as an AlphaSmart Pro), a laptop computer, or a classroom PC.

WRITTEN EXPRESSION

If you've worked with dyslexic students for any length of time, you know that their reading skills are poor, and their spelling is worse. But the skill that is weakest of all is written expression. In addition to difficulty with handwriting, spelling, punctuation, capitalization, and grammar, they have extreme difficulty organizing their thoughts into main ideas and details.

That's why I strongly recommend that teachers provide alternatives to written reports. One way a teacher can accomplish this is to allow all students to choose between writing a paper, creating a video, or making a classroom presentation.

Another way is to make writing a report a team project. The entire team brainstorms the project, then assigns each part of it to a different member. The dyslexic student might be assigned the task of illustrating the report, or of participating in a panel discussion. If the teacher insists that a dyslexic student write a composition or report, allow that student to dictate the information—to a parent or classroom aide who will write it down, into a tape recorder, or into a computer using the NaturallySpeaking software program.

Orton-Gillingham-based reading and spelling system

http://www.dys-add.com/teach.html#ogmethod

The Orton-Gillingham Multisensory Method was developed in the early 1930's by Anna Gillingham and a group of master teachers. Dr. Samuel Orton assigned Anna's group the task of designing a whole new way of teaching the phonemic structure of our written language to people with dyslexia. The goal was to create a sequential system that builds on itself in an almost 3-dimensional way. It must show how sounds and letters are related and how they act in words; it must also show how to attack a word and break it into smaller pieces. And it must be a multi-sensory approach, as dyslexic people learn best by involving all of their senses: visual, auditory, tactile, and kinesthetic.

The Orton-Gillingham Multisensory Method is different from other reading methods in two ways: *what* is taught, and *how* it is taught.

What is taught:

- **Phonemic Awareness** is the first step. You must teach someone how to listen to a single word or syllable and break it into individual phonemes. They also have to be able to take individual sounds and blend them into a word, change sounds, delete sounds, and compare sounds -- all in their head. These skills are easiest to learn *before* someone brings in printed letters.

- **Phoneme/Grapheme Correspondence** is the next step. Here you teach which sounds are represented by which letter(s), and how to blend those letters into single-syllable words.

- **The Six Types of Syllables** that compose English words are taught next. If students know what type of syllable they're looking at, they'll know what sound the vowel will make. Conversely, when they hear a vowel sound, they'll know how the syllable must be spelled to make that sound.

- **Probabilities and Rules** are then taught. The English language provides several ways to spell the same sounds. For example, the sound /SHUN/ can be spelled either TION, SION, or CION. The sound of /J/ at the end of a word can be spelled GE or DGE. Dyslexic students need to be taught these rules and probabilities.

- **Roots and Affixes**, as well as Morphology are then taught to expand a student's vocabulary and ability to comprehend (and spell) unfamiliar words. For instance, once a student has been taught that the Latin root TRACT means pull, and a student knows the various Latin affixes, the student can figure out that retract means pull again, contract means pull together, subtract means pull away (or pull under), while tractor means a machine that pulls.

How it is taught

- **Simultaneous Multisensory Instruction**: research has shown that dyslexic people who use all of their senses when they learn (visual, auditory, tactile, and kinesthetic) are better able to store and retrieve the information. So a beginning dyslexic student might see the letter A, say its name and sound, and write it in the air -- all at the same time.

- **Intense Instruction with Ample Practice**: instruction for dyslexic students must be much more intense, and offer much more practice, than for regular readers.

- **Direct, Explicit Instruction**: dyslexic students do not intuit anything about written language. So, you must teach them, directly and explicitly, each and every rule that governs our written words. And you must teach one rule at a time, and practice it until it is stable in both reading and spelling, before introducing a new rule.

- **Systematic and Cumulative**: by the time most dyslexic students are identified, they are usually quite confused about our written language. So you must go back to the very beginning and create a solid foundation with no holes. You must teach the logic behind our language by presenting one rule at a time and practicing it until the student can automatically and fluently apply that rule both when reading and spelling. You must continue to weave previously learned rules into current lessons to keep them fresh and solid. The system must make logical sense to our students, from the first lesson through the last one.

- **Synthetic and Analytic**: dyslexic students must be taught both how to take the individual letters or sounds and put them together to form a word (synthetic), as well as how to look at a long word and break it into smaller pieces (analytic). Both synthetic and analytic phonics must be taught all the time.

- **Diagnostic Teaching**: the teacher must continuously assess their student's understanding of, and ability to apply, the rules. The teacher must ensure the student isn't simply recognizing a pattern and blindly applying it. And when confusion of a previously-taught rule is discovered, it must be re-taught.

Other variations of this method have been developed, but all methods have one factor in common: the emphasis on phonological awareness.

Addressing Visual Perception Disorder

Is Visual Perception Disorder a Form of CVI?

CVI spans a very long continuum from learners who appear totally without ability to see to those who have perhaps a minimal vision perception difficulty which only comes to light when they come to learning specific skills.

One definition, which is commonly held, is from the handbook for parents and professionals by Marieke Steendam, 0. T .of the Royal Blind Society of New South Wales. She states:

"CVI can be described as a condition in which the vision is more severely impaired than can be explained by the ophthalmological findings alone ".

The damage to the visual system is not to the eye itself, nor to the optic nerve, although this damage can co-exist, but to other systems in the brain which deal with the processing and the integration of visual information.

This definition presents BLENNZ and Resource Teachers of Vision with a quandary.

Traditionally, vision education in New Zealand has divided vision impaired children into two broad groups:

1. Those children in mainstream education whose clinical and functional vision assessment reveals optical system errors that result in low vision or no vision at all. This group of children are generally expected to master the regular classroom curriculum. If children's ophthalmological and functional vision "checks out OK", there is no further involvement by Resource Teachers Vision.
2. Children with gross global developmental deficits, including vision, due to brain damage and labelled "children with complex interrelated needs". This group of children may be in the mainstream, but are commonly placed in special education facilities. They are not expected to master the regular classroom curriculum. They are described by the Vision Education sector as having CVI..

Situated between these two extremes, however, may exist a significant group of mostly mainstreamed children struggling with vision perceptual disorders, either developmental (congenital) or acquired ("mild" brain injury). They would be included in the accepted definition of CVI, but have been largely ignored by Vision Education.

Questions for BLENNZ and Resource Teachers of Vision could include:

Does BLENNZ have the desire and the resources to get involved in the assessment and teaching of children with visual perception disorders (that is, mild CVI)?

If not, how does BLENNZ justify ignoring the visual needs of these children?

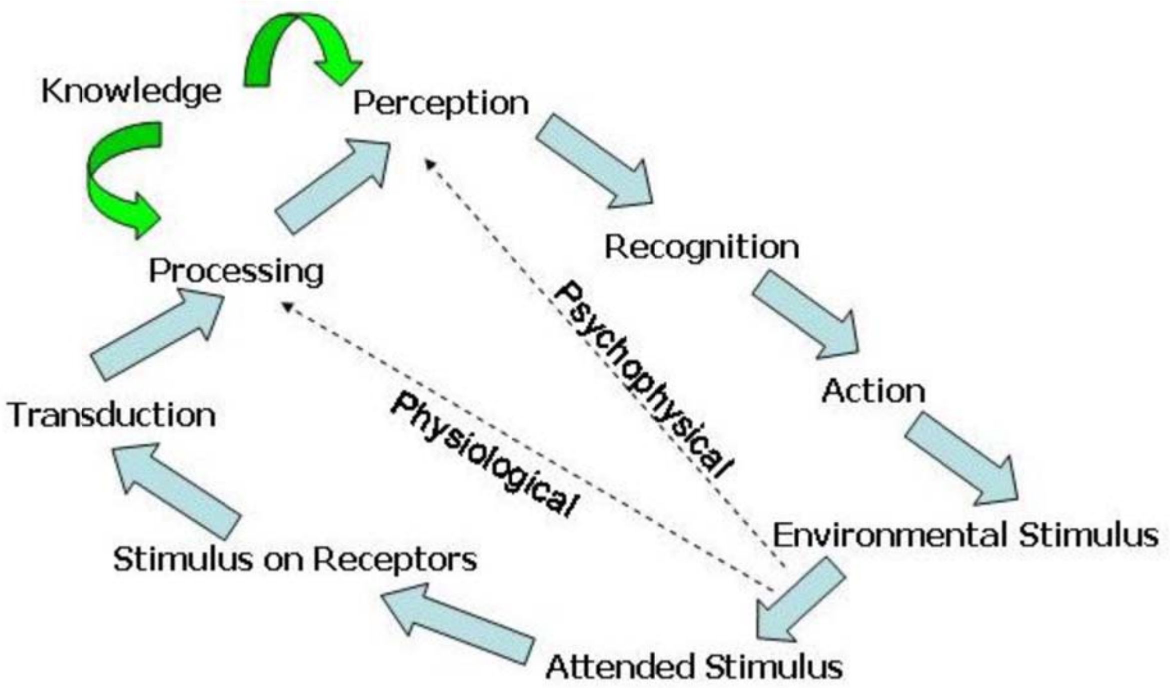
If not, where is the to be boundary drawn between CVI and not-CVI (i.e. between CVI and visual perception disorders)?

Visual Perception – an Introduction to the Process

http://viperlib.york.ac.uk

Most of us take for granted our ability to perceive the external world. However, this is no simple deed at all. Imagine being given a task of designing a machine that can perceive, locate, describe and identify all the objects in the environment and their relationship with each other. Such a machine is yet to be realized. However, humans and animals have solved this problem in an seemingly effortless manner. Because of this ease with which we perceive the environment around us, often we do not realize the complexity and the importance of the feat achieved.

Figure 1.1: The Perceptual Process



The Perceptual Process

First, let us introduce the perceptual process. This process is diagrammed in Figure 1.1 as a sequence of steps starting from the environment to the perception of a particular stimuli, recognition of the stimuli and action with regard to the stimuli. We will do this with an example. Let us take an example of Mary who has just arrived at the circus.

The ***environmental stimulus*** is defined as all the things in our environment that we can *potentially* perceive. In our example, as Mary takes her seat, she observes everything around her: an animal act going on in the centre stage, a few clowns in the side, the audience around her, the trapezes hanging from the ceilings and the music band on the right. These form the environmental stimulus.

Next, Mary focuses her attention to something that she finds particularly interesting, for example the animal act going on in the centre stage. This is called ***attended stimulus***.

When Mary focuses her attention on the animal by looking directly at it, a image of the animal is formed on the receptors of the retina of the eye. This defines the ***stimulus on the receptors*** stage.

Transduction is the process of transformation of one form of energy to another. For example, when you press any button on the bank teller machine, the pressure produced by your finger is transducted to electrical energy. Similarly, in the nervous system, when environmental energy is transformed to electrical energy, it is called transduction. In our example, this occurs when the stimulus on the receptors are transformed into electrical signals. These electrical signals generate new signals in the cells of nervous system called neurones. This process is called ***neural processing***.

Perception can be defined as a conscious sensory experience. When the electrical signals produced by the neurones are somehow processed by the brain and converted to the experience of seeing the animal, the stimulus is said to be perceived.

The next two processes, recognition and action are not exactly perception. They are perceptual behaviours that are important outcome of perceptual process. ***Recognition*** is our ability to place a object in a category. For example, Mary is at this point identify the animal to be a tiger. Though it may be tempting to believe that perception and recognition happen together, it has been shown that they are different. ***Action*** includes the motor activities such as moving the eyes or moving the body in response to the process of perception.

Almost always an action involves movement of the eye, which changes the attended stimulus and the whole cycle repeats.

Knowledge has a role to play in the ability of an individual to recognize different objects, events or situations. For example, using previously acquired and stored knowledge of different animals, Mary is able to identify the animal in the centre stage as a tiger. Thus, knowledge is involved during perception and triggers recognition.

The inclusion of knowledge in this cycle enables us to distinguish between two types of perceptual processing.

- When the process starts from the stimulus on receptors and goes towards perception, it is bottom up processing.
- The process that starts with the knowledge that a person brings to an environment is a top down processing.

Perception usually involves both of these working together.

Visual Perception

There are several sense which help us to perceive the world around us. These include seeing, hearing, touching, tasting and smelling. There are some creatures for whom non-visual senses play the dominant role. For example, bats use their audio perception for navigation. However, for humans and for most other species, vision plays the most important role. Vision has evolved in these animals to provided successful means of survival and reproduction. It is through vision that one can achieve desirable objects like nutritious food, warm shelter and strong mates. It also provides important cues against dangers like predators and falling objects.

The primary advantage of vision, which is probably the reason for its evolution as the preeminent vehicle of perception, is that it provides accurate information from a distance. The sense of hearing and smelling can provide information from a distance, but may not be very accurate. At the same, tasting and touching can provide accurate information, but only on contact. Thus, vision provides, what we call *veridical perception* (in Latin *veridicus* means *truthfully*) consistent and accurate with the actual state of the environment without being in contact with the environment. Though there are a small number of pathological cases when this is not true, but for amazingly large number of situations, by and large, *what we see is what we get*.

Visual perception is defined as the process of acquiring knowledge about our environmental objects and events by extracting information from the light they emit or reflect. Note that visual perception involves acquisition of knowledge. This means that it is a cognitive activity and is not merely an optical process. This is the different between human vision and cameras. Cameras can take pictures but do not *know* anything about the scenes/objects they capture. Cameras can merely capture *information*, but humans and animals can additionally *acquire knowledge* from this captured information.

Studying the Perceptual Process
There are primarily two different ways to study the perceptual process. In the first, we study how the person's perception is related to the stimulus. Here we do not consider the details of *how* this perception was really arrived at. This is called *psychophysical analysis* of the perceptual process.

The second way to study it is to consider how the person's perception is related to the physiological processes that are occurring within the person's sensors and/or brain. This is called *physiological analysis* of the perceptual process. Both of these are indicated in Figure 1.1. In both these, we will also be concerned with the role of knowledge (includes also memories, expectations etc) in perception. This is called *cognitive influences*. However, note that all these are intimately related and often we will take a more holistic approach of cross referencing these disciplines and forming a complete and consistent picture of the perceptual procedure.