

**Developmental dyslexia: Could there be a visual attention deficit.
presented by Judy Buchholz (April 2002)**

What is Dyslexia?

Dyslexia is a disorder that is characterised by a difficulty in reading that cannot be explained by any other factor. A safe measure to use is a child who is reading 2 or more years behind their chronological age, who has no other obvious difficulties such as neurological disturbances, and has a normal IQ, teaching instruction, and relatively normal socio-cultural background.

Dyslexia (also sometimes known as “specific reading difficulty”) may be manifested in a number of ways:

- *Phonological Dyslexia* - difficulties in phonological recoding – sounding words out
- *Surface Dyslexia* - difficulties with directly accessing a visual representation of a word, i.e. words that can’t be sounded e.g. yacht
- *Mixed Dyslexia* - difficulties in both the above

Other general difficulties may be seen:

- jumping to a “best guess” strategy from the sound of the first letter
- substituting words for contextually appropriate words
- transposing letters
- omitting, mispronouncing, adding or refusing to read words in text

These reading problems are usually accompanied by poor spelling with the same sort of errors, and poor handwriting. A separate disorder of spelling does exist, but it is unusual for a child to have a reading difficulty without a spelling difficulty.

Associated disorders

❖ Visual Discomfort (VD)

- characterised by a sensitivity to lines of high contrast that are placed close together (bright lights, computer screens). There is no underlying cognitive impairment.
- may be susceptible to headaches
- can cause the same errors as dyslexia (letter reversals) and is often misdiagnosed as such.
- given the right visual conditions (low lighting, low contrast text, widely spaced words/moving window) these children should be able to learn to read.

❖ Specific Language Impairment (SLI)

- difficulties expressing and/or understanding language.
- 35 – 50% of dyslexic children also have a language disorder.

❖ ADD/ADHD (Attention Deficit Hyperactivity Disorder)

❖ Mood Disorders

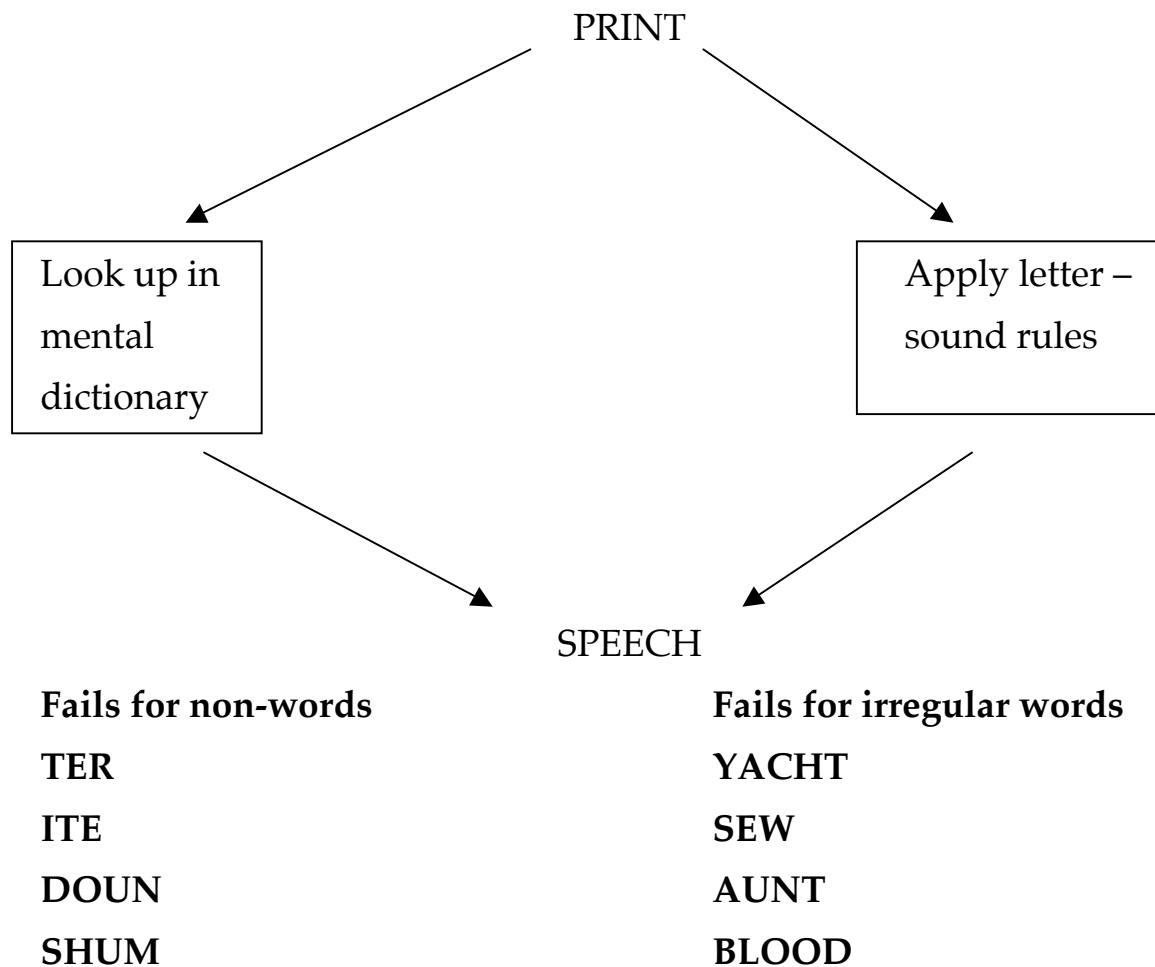
TESTS USED IN DIAGNOSIS

- NARA (Neale Analyses of Reading Ability) 3rd Edition
 - Supplementary Diagnostic Test 3 – Graded spelling
- CELF (Clinical Evaluation of Language Fundamentals) 3rd Edition
- Coltheart and Leahy reading norms
- Ravens Progressive matrices
- WISC (Wechsler Intelligence Scale for Children)
- Self-reported difficulties

What causes Dyslexia? (ultimately don't know; genetics, injury, disease?)

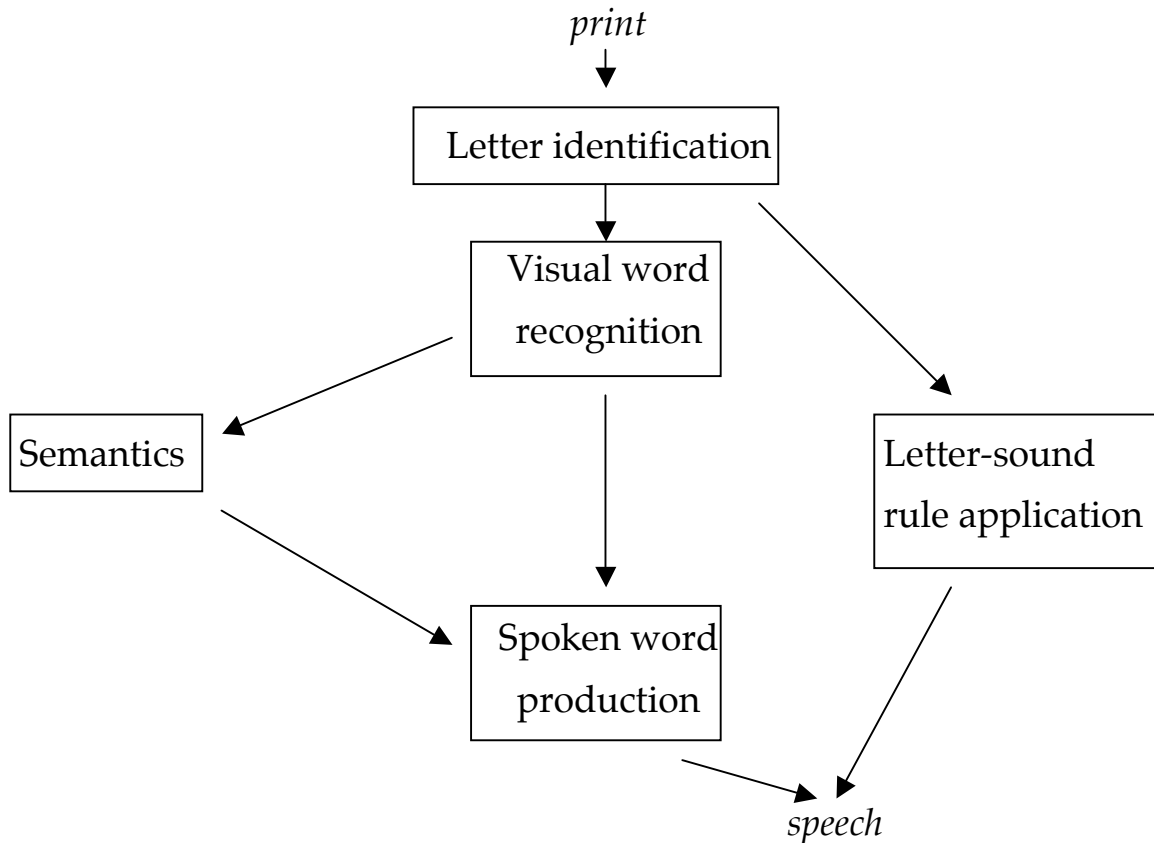
- memory difficulties (ST verbal) xxx
- language difficulties
- phonological difficulties
- brain "bits" (cerebellum = motor) xxx
- visual processing

Dual-Route Hypothesis of Reading



But

the reading system is more complex!



- A child having difficulty in acquiring any one of these subskills will have a reading difficulty.
- Various testing procedures will allow determination of specific deficits.
- Various effective ways of treating specific problems.

Role of Visual Processing

Parallel Pathways of vision

Segregation of visual information begins at the retina, continues through the Lateral Geniculate Nucleus (Thalamus) to the primary visual cortex (V1) and beyond.

Reading requires fine grained pattern vision, and object discrimination for which the parvocellular system would be expected to be specialised. It also requires fast and accurate processing of transient visual stimuli, for which the magnocellular pathway may be necessary. Thus one might expect to find deficits in either or both of these pathways in dyslexic individuals.

Much scientific evidence points to a difficulty in visual processing, such that 75% of dyslexic children appear to have difficulty in processing visual information that is carried by one particular visual pathway – magnocellular. This is subtle and only becomes obvious when complex visual integration tasks are required.

Physiological and anatomical abnormalities have also been demonstrated consistent with a deficit in only the magnocellular pathway of the visual system.

How could M deficits affect reading?

- Parvocellular suppression xxx
- Eye movement control xxx

- **Visuo-spatial attention**

Reading is a learned skill and such skills learning does not occur without prior focussing of attention and appropriate motivation. It involves not simply identifying and focussing on stimuli, but identifying *appropriate* stimuli on which to focus and, in addition sometimes integrating two or more stimuli. Controlled shifts of attention to different locations in space are necessary for the selective attention of a word or sentence.

Attention and the parietal cortex

Detection of complex stimuli (conjunction search)

- lesion studies
- TMS

Studies of visual search and Dyslexic children

- These studies have generally used RT measures of detection of target item amongst an array of distractors.

Problems with previous research has been:

- RT for dyslexics may contain components related to motor responses, decision time, voluntary attention
- need to use appropriate features in order to target specific parietal (magnocellular) attention function
- performance factors such a fatigue, boredom and eye movement control may have contributed to the results
- did not control for ADD/ADHD

So needed to develop a method which could remove as many of these confounds as possible

Results and Conclusion

Both adults and children demonstrated deficiencies in visual search consistent with a deficit in the attentional spotlight function of the parietal cortex, and thus the magnocellular visual pathway.

This function is a learned one requiring inputs from earlier stages of the pathway, so it would seem reasonable to expect that earlier processes would also show a deficit.

YES

- coherent motion (V5/MT)
 - both V5/MT and parietal cortex receive inputs from mLGN

- retinal ganglion function
 - to date only a single study on dyslexic children and one on adults has been carried out. While inconclusive both have shown deficits in dyslexics compared to age matched controls.
 - while inconclusive there appears to be a relationship between
 - i) degree of low level visual impairment and degree of high-level impairment.
 - ii) degree of visual deficit and degree of language impairment.

How might studying these phenomena help Dyslexics?

- Findings may provide guidelines for assessment and thereby remediation requirements suited to the individual.
- A realistic view of expected outcomes of remediation might be attained.
- Self-esteem may be improved when a child realises their difficulty is one of vision.
- Many adult dyslexics can function very well, but may require an objective measure of dyslexia to gain help in the workplace.