VISUAL PROBLEMS IN DYSLEXIA

Kristen Pammer
The Research School of Psychology
The Australian National University
Beneath The Surface

I have blond hair, blue eyes and an infectious smile. People tell Mum how gorgeous I am and that she should have me. But under the surface I live in a turmoil, words look like squiggles and writing stories is a disaster area because of spellings. There were no play times at my old school until work was finished with meat no play times at all. The teachers said I was clever but just didn't try. Shouting was the only way the teachers ever communicated with me. Other boys made fun of me and so I broke lonely and miserable. It was like being on a desert island, lost and alone. Life was life and school was school.

Alexander (age 9)
OVERVIEW

• The visual system
• Vision and reading
• Eye movements in reading
• Magnocellular deficit
• How might a magno deficit result in reading problems?
• Can we do anything about it?
• Other visual disorders that impair reading
  • Visual discomfort
• Questions
Developmental Dyslexia was originally considered to be a difficulty in visual processing. However this belief was abandoned when dyslexic readers were consistently shown to have normal vision.

There was then a shift to investigating more cognitive aspects to dyslexia.
• Most dyslexic readers have problems in tasks that require phonological decoding e.g.,
  • In pre-readers, phonological awareness predicts later reading ability
  • Problems in blending, segmenting, odd-one-out tasks
  • Spoonerisms
  • Rhyme
  • Reading non-words
  • Phonological intervention strategies seem to be the most successful
  • Difficulties discriminating between similar phonemes

I wish you were at Gold Coast School
However, we now know that dyslexic readers also differ from normal readers in the way they process visual information

- The mechanics of visual processing – such as the way their eyes move across the page
- Neurophysiology of visual processing
There are advantages and disadvantages of both electronic and hardcopy journals. Hardcopy journals are more easily browsed, more portable and, of course people are very much used to their format. Electronic journals save on paper and their format has improved considerably over the past few years, but there are still problems over managing copyright restrictions and persuading people to use electronic instead of hardcopy journals. There is also the problem of portability. More and more journals are now being published in electronic format, although some publishers will only let you subscribe to an electronic journal provided you also subscribe to the hardcopy (more money for the same thing). Some electronic journals cost over 100% more than their equivalent hardcopy. With all these factors in mind I have been discussing individual and shared-subscriptions with the Biochemistry Department, the RSL and Blackwell's. Whilst I feel that a move from hardcopy to electronic journals will be a very slow process in the ULP Library, electronic publishing is being carefully monitored and I would hope to introduce a few electronic texts into the Library alongside the journals which are already available for free over the Internet.
THE PROCESS OF READING IN DYSLEXIA

- Eye fixation pattern differ in a characteristic way from those of normal readers.
  - Dyslexic readers fixate longer on words and demonstrate more regressive eye movements
  - Fixations are less stable in dyslexic readers
  - Poor binocular convergence

As society has become progressively more complex, psychology has

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Eye movement patterns from a normal reader
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Some researchers have argued that these differences in reading characteristics may be causal in dyslexia

- Poor visual stability -> difficulties in generating and maintaining the link between orthography and phonology.

But reading is an extraordinarily complex task, and there are other aspects of vision and reading that could be problematic.
The brain has not evolved to read, so many different parts of the brain need to learn to talk to each other in order to develop reading skills.
...and in most cases it does an amazingly good job.
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Initial visual processing

Later visual processing
A bit of anatomy and physiology:

Dorsal Stream
- Colour insensitive
- global form
- movement
- spatial processing
- lower contrast
- fast

Ventral Stream
- Colour sensitive
- detail
- movement insensitive
- higher contrast
- slow
The distinction between the two pathways has been known for some time first from animal single cell recording, and then from human studies.

Researchers moved away from simply measuring visual acuity.

It then became apparent that dyslexic readers have difficulties in processing information that needed to be transmitted by the dorsal stream.
• Dyslexic children respond differently/are less sensitive to tasks that require dorsal or magnocellular functioning
  • Coherent motion
  • Visual frequency doubling
  • Apparent motion
  • Visual search
  • Contrast sensitivity

• But the same children respond normally on similar tasks that do not require dorsal/magnocellular functioning
  - coherent form
  - non-frequency doubled
  - popout search
  - acuity
How might a magno deficit result in a reading deficit?

The dorsal stream isolates important regions of space, and feeds this info to the ventral system. The ventral system then uses this info to spotlight text and construct words.

The dorsal stream helps guide the eye across the page in terms of the fixations (the ‘stops’) and saccades (the ‘jumps’).
MAGNO DEFICIT AND READING

• How might a magno deficit result in a reading deficit?

Constructing letters and words?

Spatial navigation?
CAN WE DO ANYTHING ABOUT A MAGNO DEFICIT?

• There is very preliminary evidence to suggest that tasks that training the dorsal/magnocellular pathway may be beneficial to reading (Franceschini et al. 2012)
WHAT DYSLEXIA IS NOT: VISUAL DISCOMFORT

• Visual Discomfort (also known as scotopic sensitivity syndrome, or Meares-Irlen Syndrome) is a disorder of visual processing, that makes it very difficult to read.

• People who have visual discomfort, describe sensations such as:
  • Words “moving”, “shimmering” and “shaking”
  • Words “floating on the page”, or “carved into the page”
  • Text looking like “rivers”
  • May suffer migraine, and/or severe motion sickness
  • Hyper-sensitivity to light
• Visual discomfort comes about because text looks like the type of visual stimuli that upsets the visual system i.e., high contrast black and white lines
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This text is written to look like the pattern on the left. Because it looks like the black and white lines on the left, it makes it more difficult to read, particularly if you have visual discomfort.

It is this visual sensitivity that makes reading difficult for a person with visual discomfort.
People with VDS often find it much easier to read if you change the visual environment:

- Low lights
- Not fluorescent lights
- Low contrast, larger text
- Coloured text, glasses and/or overlays

This is NOT the case for people with dyslexia.

Readers with VDS tend not to have phonological decoding problems.

However, children with VDS can often be reading far below average, because they avoid reading as much as possible.

Of course, people with VDS (as with any other concomitant disorder) can also have dyslexia.
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SUMMARY

- Dyslexia is primarily a difficulty in phonics
- However there are also subtle visual deficits that can make it difficult to read
  - Poor visual stability (eye movements)
  - Deficits in the dorsal/magno pathway (constructing letters and words, navigating eye across page)
  - Visual Discomfort
THANK YOU FOR LISTENING

QUESTIONS?

Kristen.pammer@anu.edu.au