'Dorsal stream dysfunction' and 'dorsal stream dysfunction plus': a potential classification for perceptual visual impairment in the context of cerebral visual impairment?

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A large proportion of the brain is devoted to vision, so it is not surprising that visual processing is commonly affected when the brain is damaged. The classical model of understanding is that image data from the retina are transferred via the optic nerves and lateral geniculate bodies to the occipital cortex where the picture is 'seen'; and damage to this system leads to loss of visual field and reduced visual acuities. However, impairment of higher visual processing is also common and may easily go unrecognized or may be misdiagnosed, but there are typical behavioural features, easily elicited by structured history taking and validated by observation of behaviour and testing, which lead to the diagnosis.¹ Strategies can then be designed to meet the needs of each child.²

Two principal higher visual pathways have recently been described, namely the dorsal stream and the ventral stream.³ The dorsal stream passes between the occipital lobes and the posterior parietal lobes. This brain unit serves the functions of appraising the whole visual scene, and (along with the frontal lobes) attending to elements within the scene. It facilitates immediate visual guidance of movement through the scene, by interacting with area V5 (or the middle temporal lobes MT), the area of the brain responsible for processing perception of motion. The dorsal stream system is automatic and unconscious. It is 'on-line' and is not memory based. Damage in this brain territory is associated with a range of visual behaviours described in Table I.

The ventral stream passes between the occipital lobes and the temporal lobes where the 'image libraries' are stored. The recognition of faces, shapes, objects, and routes is attained by matching what is seen, with what is stored in the 'library'. A match leads to recognition. Table I outlines the visual problems resulting from damage to this territory. In children, dorsal stream damage is seen more frequently than ventral stream damage.

The symptom complex of dorsal stream dysfunction, which is associated with a range of pathologies affecting the posterior parietal area, ranges in character and severity. It may be associated with slightly or significantly impaired visual acuities and visual fields, and may also be associated with varying degrees of cerebral palsy. It has recently been shown to be common in children with periventicular white matter injury,⁴ those born very preterm,⁵ and in those with Williams syndrome.⁶ Ventral stream dysfunction is seen less frequently and there is usually concomitant dorsal stream dysfunction.

A specific symptom complex of dorsal stream dysfunction is emerging, which comprises difficulty handling the complexity of a visual scene (of varying degree) and which may include impaired visual guidance of the limbs (optic ataxia), possibly associated with reduced visual acuities, homonymous visual field impairment (particularly inferiorly), and occasionally additional impaired recognition (which could be considered as 'dorsal stream dysfunction plus'). The paper by Ortibus et al. in this number of the journal adds further objective evidence to support the existence of this emerging symptom complex of perceptual visual impairment which is specific to children and results from a wide range of brain pathologies.

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DOI: 10.1111/j.1469-8749.2008.03257.x **1**

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Table I: Typical behavioural features of perceptual visual impairment in children due to dorsal and ventral stream dysfunction, and an outline of possible strategies to help. Modified from Dutton et al.⁷

Features

Strategies

Dorsal stream dysfunction

Difficulty handling the complexity of the visual scene causes problems: Finding a toy on a patterned background Finding a toy in a toy-box Finding clothes in a drawer or in a pile Seeing a distant object (as there is more to see)

Finding someone in a group

Getting lost in crowded places Distress in crowded locations

Reading

Difficulty with visual guidance of movement causes problems: With inaccurate reach and grasp

Difficulty walking over uneven ground and steps despite viewing directly and good motor function

Difficulty 'dual tasking' causes problems: Bumping into obstacles when talking while walking Marked frustration when distracted from task Ventral stream dysfunction Difficulty with recognition causes problems:

Recognizing people and knowing who is unknown Understanding the language of facial expression Recognizing shapes and objects and their alignment *Difficulties with orientation cause problems:* Navigating inside the house

Navigating outside

Use plain bed spreads and carpets Store toys separately (with linear storage) Store clothes separately in compartments Get close. Reduce clutter around blackboard Share screen of a digital/video camera Wear bright clothes, wave, and speak Adopt buddy or similar strategy for playground Training in seeking and recalling landmarks Arrive at parties early Go shopping when quiet Enlarge and space out text. Mask surrounding text Wear full spectacle correction for hypermetropia to gain magnification. Use magnifiers

Use tactile guidance with other hand as part of occupational therapy Reach beyond and gather up

Provide tactile guidance to the height of the ground ahead, such as using a toy pram or allow to hold on to clothes of an accompanying person (while pulling down)

Limit conversation when walking Limit background clutter and activity

Family and friends introduce themselves and wear identifiers Language is used to explain emotions Include training in tactile recognition using blind methods

Use colour coding for doors Put footprints on the floor to follow Create songs and poems for routes

USING E-ANNOTATION TOOLS FOR ELECTRONIC PROOF CORRECTION

Required Software

Adobe Acrobat Professional or Acrobat Reader (version 7.0 or above) is required to e-annotate PDFs. Acrobat 8 Reader is a free download: <u>http://www.adobe.com/products/acrobat/readstep2.html</u>

Once you have Acrobat Reader 8 on your PC and open the proof, you will see the Commenting Toolbar (if it does not appear automatically go to Tools>Commenting>Commenting Toolbar). The Commenting Toolbar looks like this:

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Note Tool — For making notes at specific points in the text

Marks a point on the paper where a note or question needs to be addressed.



How to use it:

- 1. Right click into area of either inserted text or relevance to note
- 2. Select Add Note and a yellow speech bubble symbol and text box will appear
- 3. Type comment into the text box
- 4. Click the X in the top right hand corner of the note box to close.

Replacement text tool — For deleting one word/section of text and replacing it

Strikes red line through text and opens up a replacement text box.



How to use it:

- 1. Select cursor from toolbar
- 2. Highlight word or sentence
- 3. Right click
- 4. Select Replace Text (Comment) option
- 5. Type replacement text in blue box
- 6. Click outside of the blue box to close

Cross out text tool — For deleting text when there is nothing to replace selection Strikes through text in a red line.

substitute part of one or more word(s) Change to italies Change to capitals Change to small capitals

How to use it:

- 1. Select cursor from toolbar
- 2. Highlight word or sentence
- 3. Right click
- 4. Select Cross Out Text

Approved tool — For approving a proof and that no corrections at all are required.



How to use it:

- 1. Click on the Stamp Tool in the toolbar
- 2. Select the Approved rubber stamp from the 'standard business' selection
- 3. Click on the text where you want to rubber stamp to appear (usually first page)

Highlight tool — For highlighting selection that should be changed to bold or italic.

Highlights text in yellow and opens up a text box.

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How to use it:

- 1. Select Highlighter Tool from the commenting toolbar
- 2. Highlight the desired text
- 3. Add a note detailing the required change

Attach File Tool — For inserting large amounts of text or replacement figures as a files. Inserts symbol and speech bubble where a file has been inserted.



How to use it:

- 1. Click on paperclip icon in the commenting toolbar
- 2. Click where you want to insert the attachment
- 3. Select the saved file from your PC/network
- 4. Select appearance of icon (paperclip, graph, attachment or tag) and close

Pencil tool — For circling parts of figures or making freeform marks

Creates freeform shapes with a pencil tool. Particularly with graphics within the proof it may be useful to use the Drawing Markups toolbar. These tools allow you to draw circles, lines and comment on these marks.



How to use it:

- 1. Select Tools > Drawing Markups > Pencil Tool
- 2. Draw with the cursor
- 3. Multiple pieces of pencil annotation can be grouped together
- 4. Once finished, move the cursor over the shape until an arrowhead appears and right click
- 5. Select Open Pop-Up Note and type in a details of required change
- 6. Click the X in the top right hand corner of the note box to close.

Help

For further information on how to annotate proofs click on the Help button to activate a list of instructions:

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