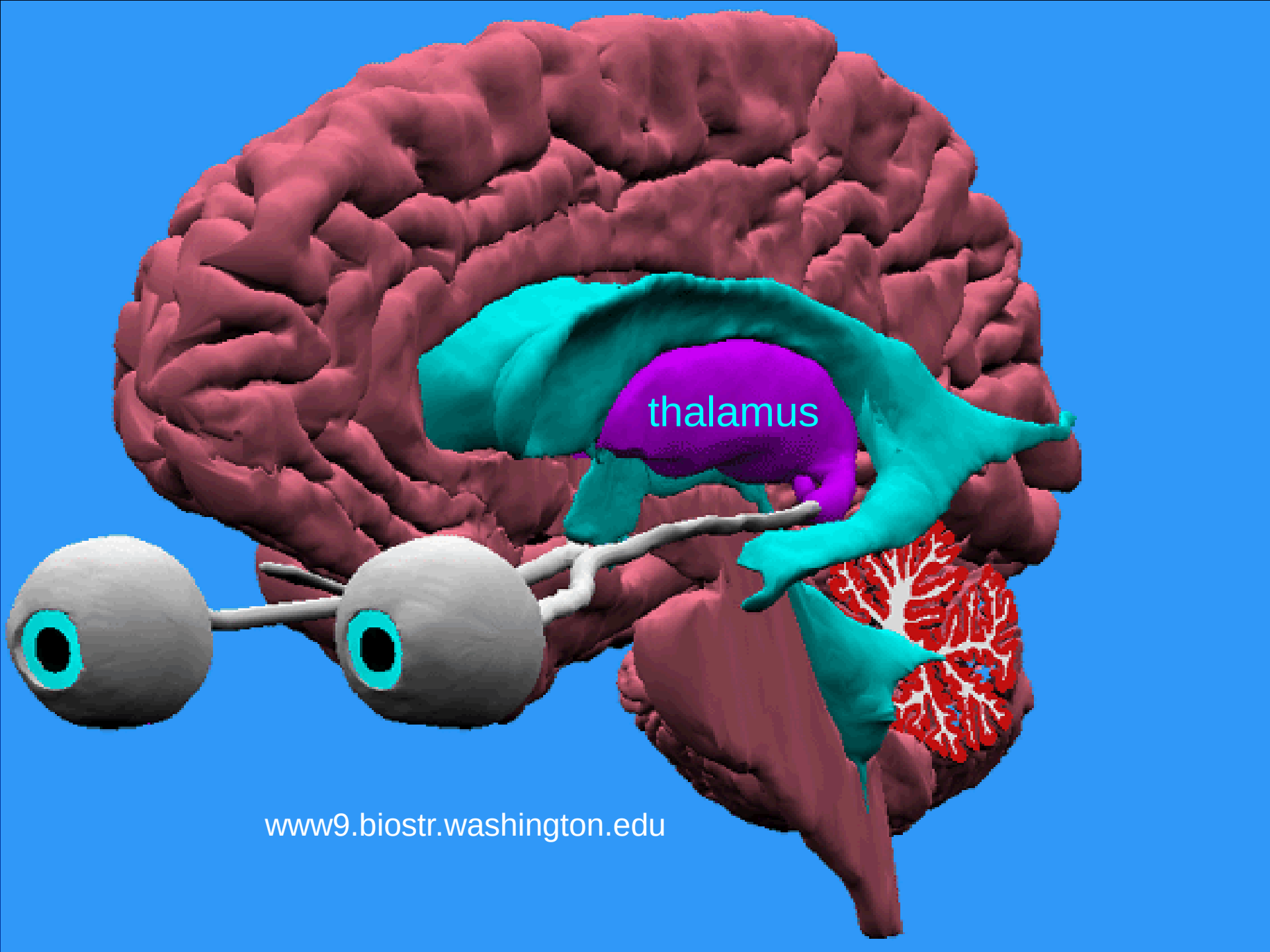
From perception principles

toward the complex practice of

people with visual function loss

Drs. Marjolein Dik
GZpsychologist/neuropsychologist
Royal Visio
Amsterdam


thalamus
www9.biostr.washington.edu

The discussion ocular versus cerebral/cortical

Amblyopia

- Stewart C. (2009). Spatial and neural deficits of human amblyopia. www.cvrsoc.org
- **Deficits** of spatial localization in children with strabismic amblyopia
  M Fronius, R Sireteanu, A Zubcov - Graefe's Archive for Clinical and …, 2004 - Springer

Sensitive period

- Sugiyama S, Di Nardo AA, Aizawa S, Matsuo I, Volovitch M, Prochiantz A, **Hensch TK.** (2008) Experience-dependent transfer of Otx2 homeoprotein into the visual cortex activates postnatal plasticity. *Cell* 134:508-520.

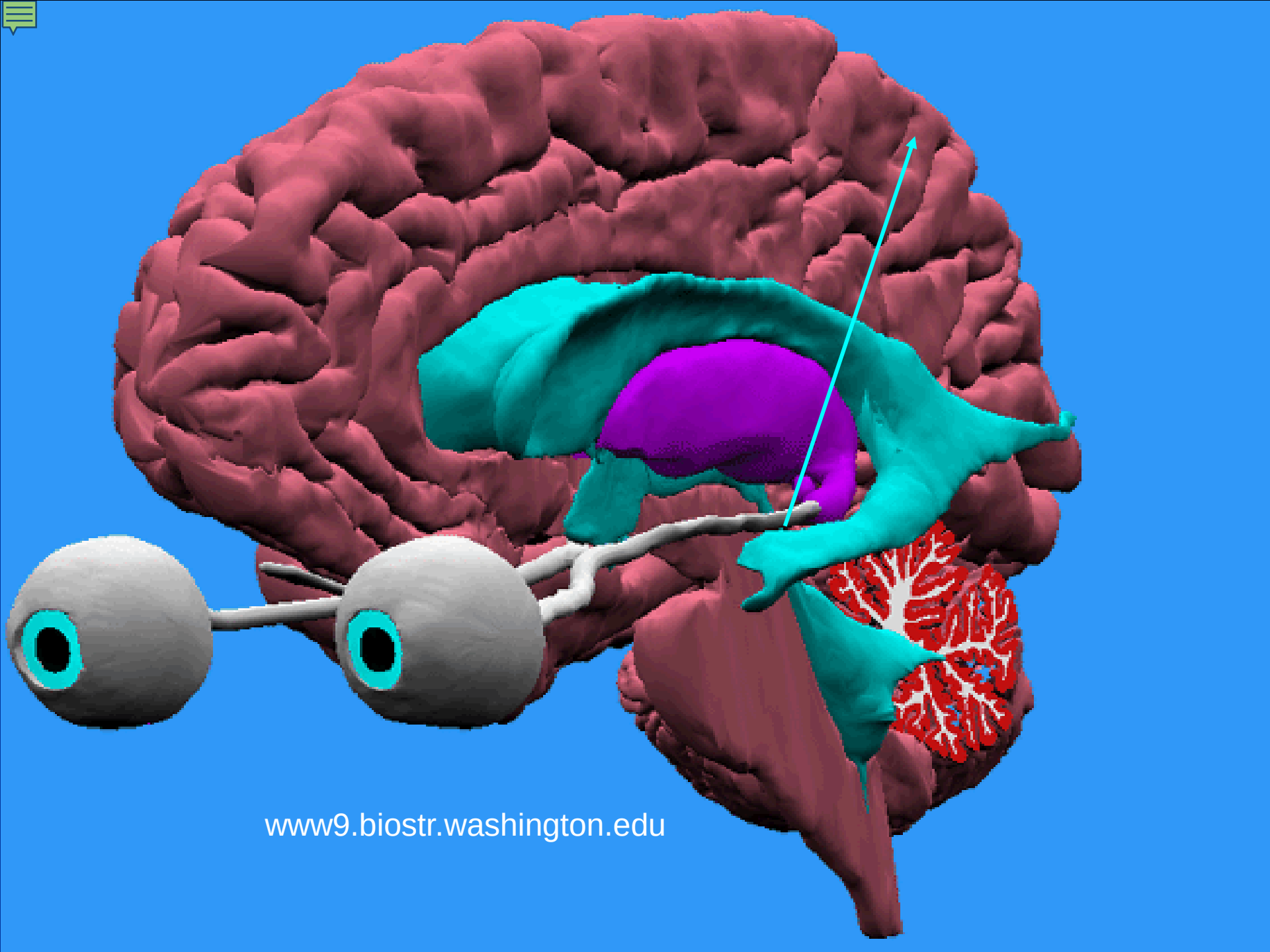
- Morishita H, **Hensch TK**. (2008) Critical period revisited: impact on vision. *Curr Opin Neurobiol.* 18: 101-107.

Retina

April 2007 Scientific American Magazine The Movies in Our Eyes

The retina processes information much more than anyone has ever imagined, sending a dozen different movies to the brain

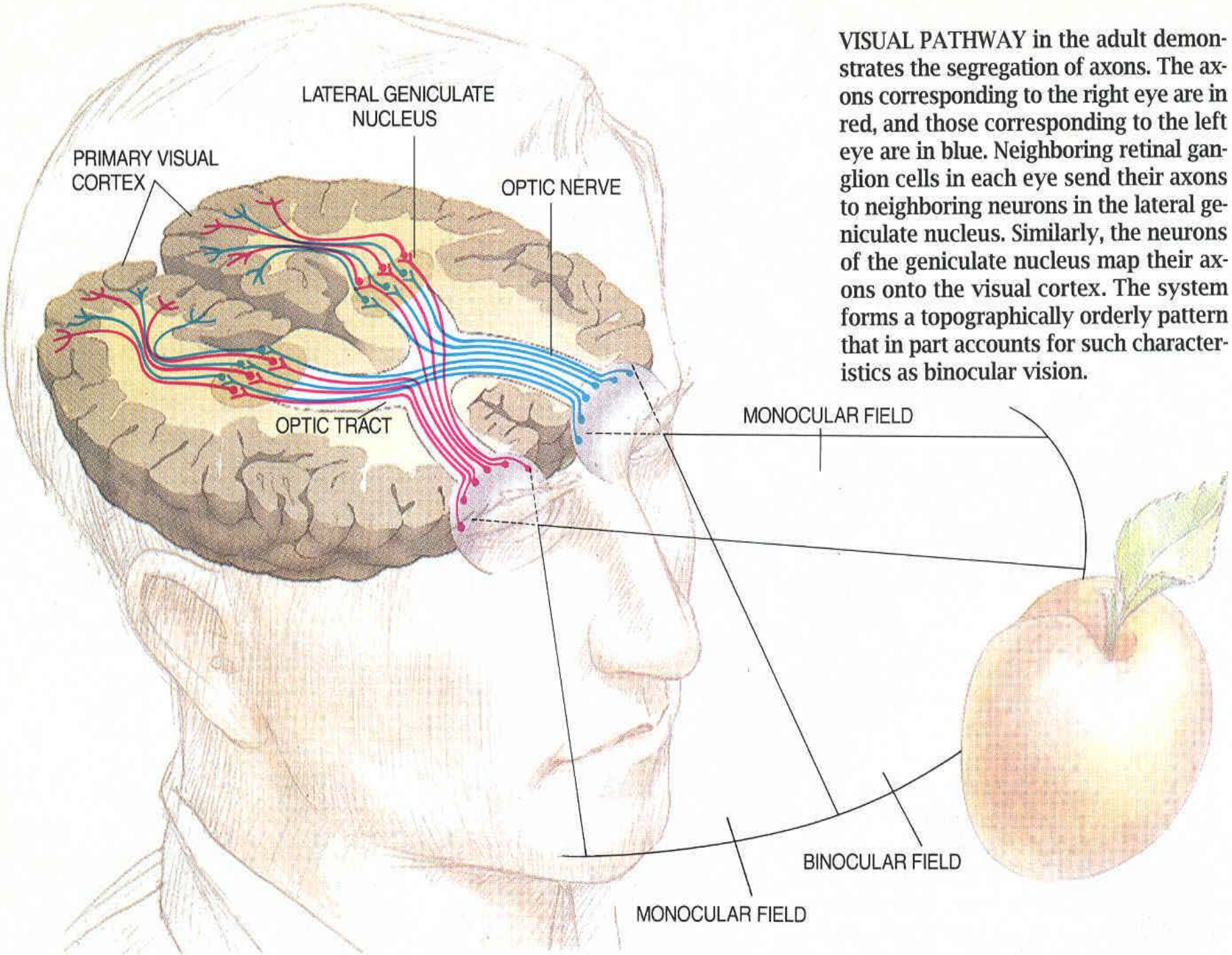
By Frank Werblin and Botond Roska


www9.biostr.washington.edu

Tellercards

Over/under registration, sensoric information processing

- Oversensitive for too many visual stimuli at once, for too much light
- “Looking away” behavior in certain situations



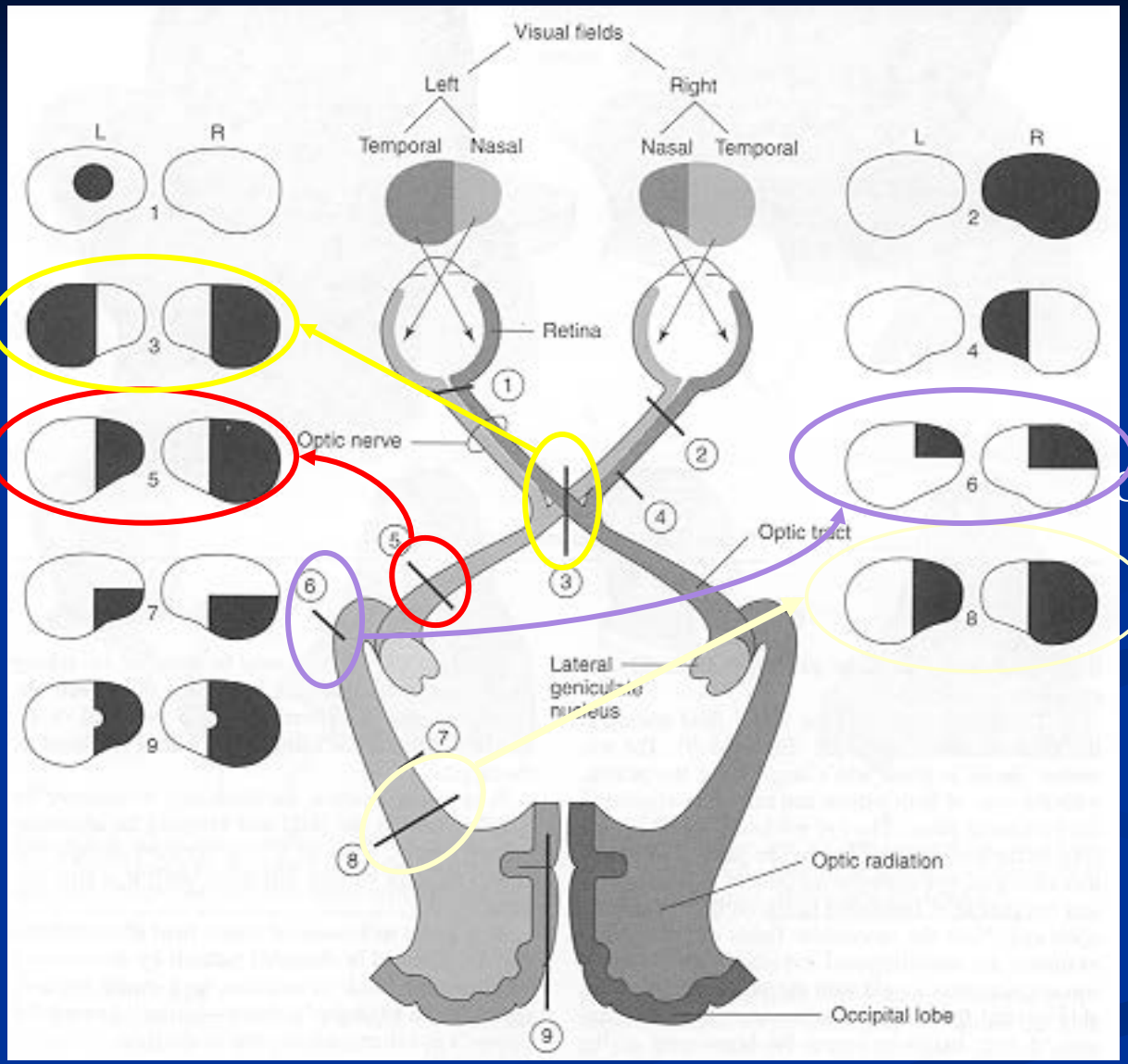
VISUAL PATHWAY in the adult demonstrates the segregation of axons. The axons corresponding to the right eye are in red, and those corresponding to the left eye are in blue. Neighboring retinal ganglion cells in each eye send their axons to neighboring neurons in the lateral geniculate nucleus. Similarly, the neurons of the geniculate nucleus map their axons onto the visual cortex. The system forms a topographically orderly pattern that in part accounts for such characteristics as binocular vision.

Hemianopia and other visual fielddefects

Bitemporal

Homonymous Hemianopia

Macular sparing



Quadrantanopia

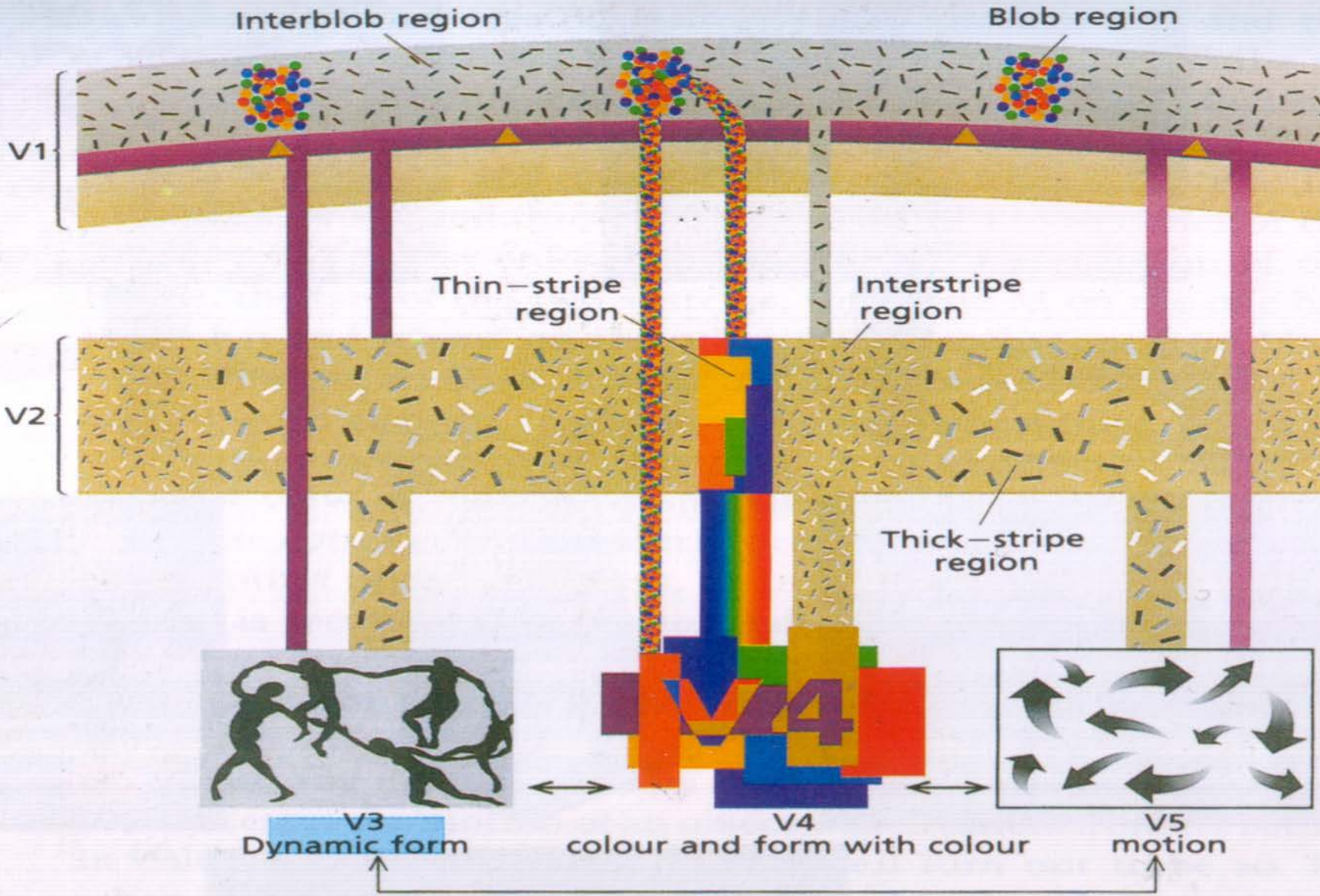
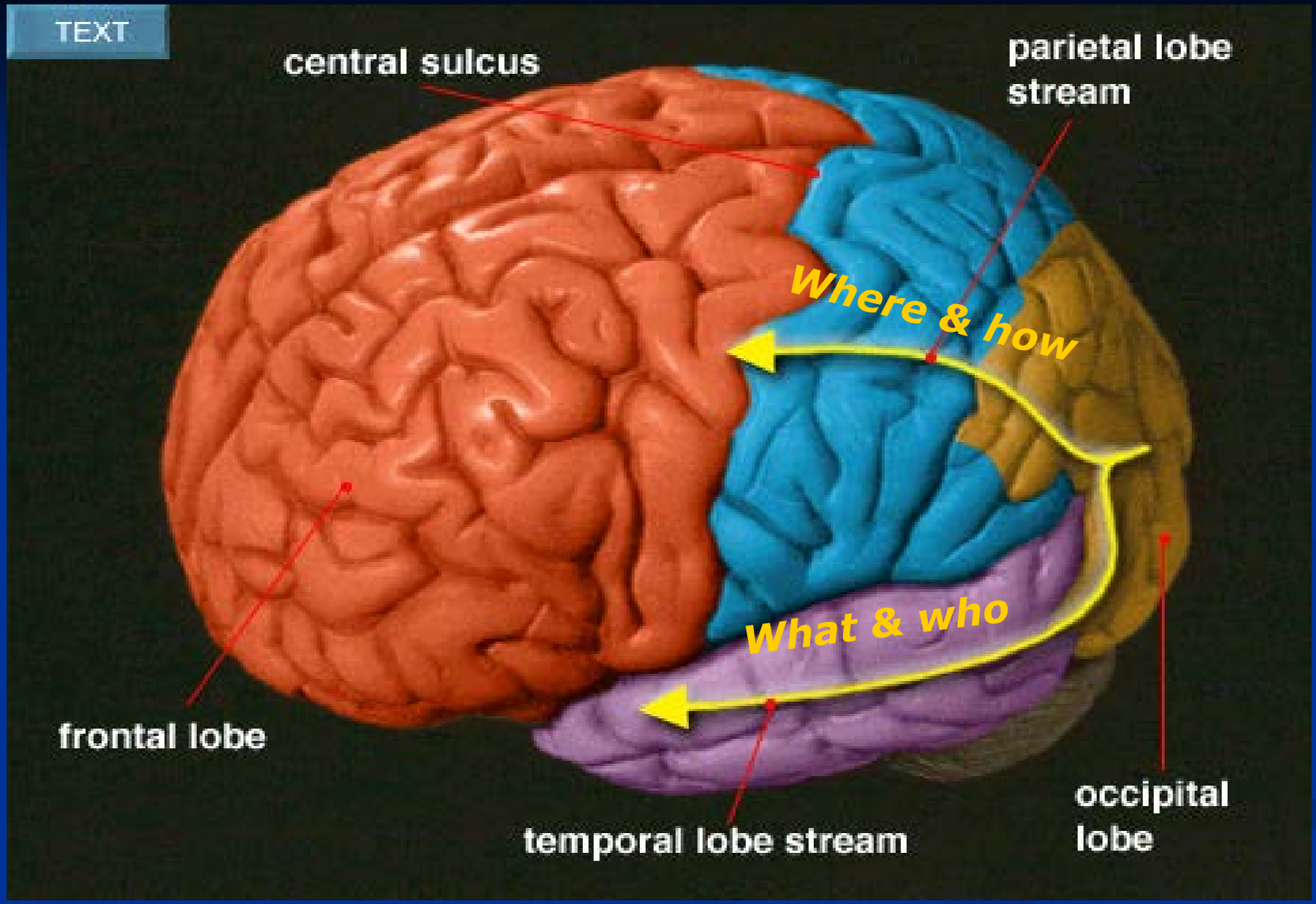


Plate 6 Summary diagram of the four perceptual visual pathways and their anat connections, from V1 to the specialized visual areas of the prestriate cortex. (Reproduced by permission from *The Visual Image in Mind and Brain* by S. Z Copyright © 1992 by Scientific American, Inc. All rights reserved.)

Het schema van Zeki



Milner, D. A. & Goodale, M. A. (1995) *The Visual Brain in Action.* Oxford University Press

Sensitive periods

Strong early - experience expectant - development of brainareas

Occipital: peak at 6 mnth & 15 mnth

Parietal: peak 15 mnth (& 50 mnth)

Temporal: peak bij 15 mnth (en 50 mnth)

Frontal:peak 0-4 yr

Greenough, W. T.,Black , J.E., Wallace, C.S. Experience and braindevelopment. Part IV van *Brain development and Cognition* Johnson M.H. ed. (2002)

Multiple systems

1. Basal: o.a. selectiv attentior
2. Ventral: What & who
3. Dorsal: Where & how
4. Recurrent to occiptal

conciousness

(2004) *The visual neurosciences* **Subcortical processin**
Ch36 C.Casanova The visual functions of the pulvinar

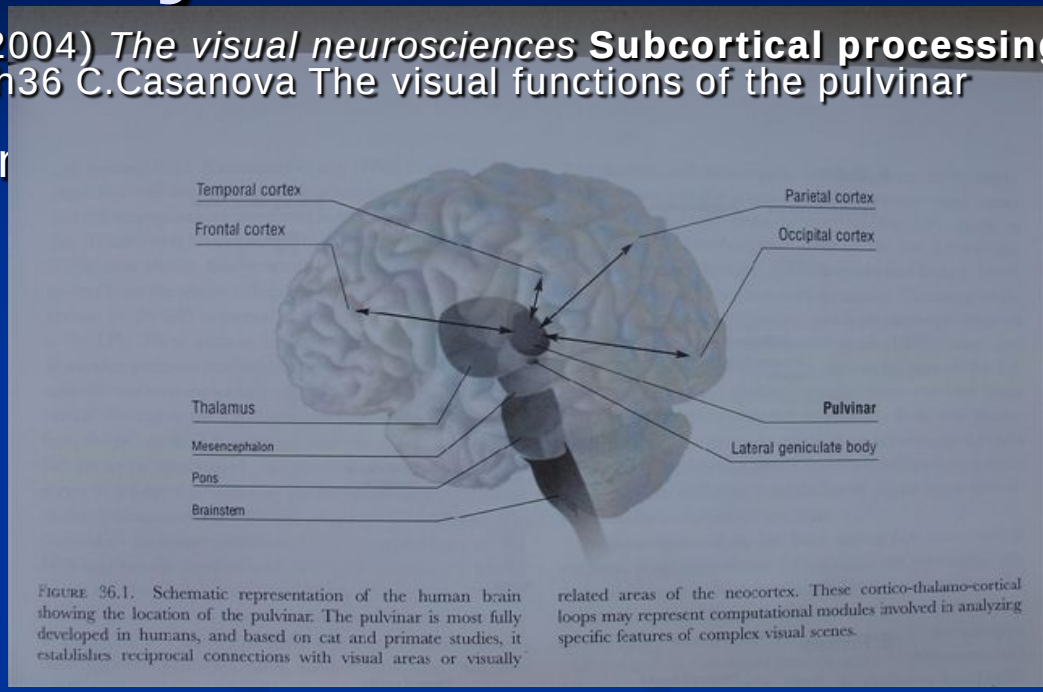


FIGURE 36.1. Schematic representation of the human brain showing the location of the pulvinar. The pulvinar is most fully developed in humans, and based on cat and primate studies, it establishes reciprocal connections with visual areas or visually related areas of the neocortex. These cortico-thalamo-cortical loops may represent computational modules involved in analyzing specific features of complex visual scenes.

- Only a limited number of items reach a privileged status (± 4)
- Feedforward to V1 (40 ms), further 60-80 ms
- Early recurrent processing (to V1) builds up perception (100-150 ms)
- Recurrent processing brings conciousness (200-300 ms)

Lamme, V.A.F. (2004). *Separate neural definitions of visual consciousness and visual attention; a case for phenomenal awareness.* www.sciencedirect.com

The databank

The more severe the visual limitation –
the more time it consumes to feed the databank with correct/proper “images”

Too far away resp. too big:
tree/building/ train/airplane/camel

Too “flying”/small: bird, butterfly, insect

Outside the personal world of experience:
city/country side, busstation/harbour

One can not take the natural completion by television and books for granted!

The databank

Much used solutions:

- gamble by pattern and colour: zebra/tiger, parrot/frog/crocodile, cow/goat/dog/cat
- guessing according to expectation for the setting

Only after the databank has been filled with sufficient information one can expect play development

Everybody is unique

Braindevelopment is different for everybody

Plasticity /braindamage has different effects and outcomes as well in children as in adults.

It means controlling all variables before coming to conclusions.

Elements of visual perception assesment

- ✓ Formperception
- ✓ Visual spatial action
- ✓ Attention
- ✓ Does it match with medical history and brainorganization?

Form perception
What & Whom do we see?

- Face perception
- Object perception
- Form constancy
- Movement & direction
- Giving meaning
- Letters
- “My” situations – basic situations in spatial orientation
- Long term memory

Only a few hours after birth babies already prefer a face-like stimulus over other stimuli - even with their limited acuity

Two days old babies prefer already a known face-like stimulus

From 6 weeks onward babies recognize faces by the external contours; the hairline.

From 3 month onward babies recognize faces by the face configuration itself (eyes, nose mouth)

Goren e.a. ’75, Bushnell ’82, Schonen & Mathivet ’89, de Haan ‘98

prosopagnosia

From birth

Skillful in recognizing people by hair, clothes, gate and objects like glasses, keys, etc.

Say very friendly “Hellow!”- hear the voice and know who it is

Training only at a very young age

(≠ Facial expressions training which is done much longer, especially at kindergarten age)

NB Probably 1-2% in normal population within families (without damage)

Martina Grüter (2004) **Genetik der kongenitalen Prosopagnosie**

Acquired

“meaningless part of body material”

An example of object constancy – many children only recognize the cat walking with the tail up in the air (the one way that has been teached).

Visual experience with movement and direction

Notice how disturbung reflections can be!. Print pictures mat, non-reflective and have some extra made. Do not plastify material or use a non-reflective kind.

Form recognition and brainactivity

Separate areas for reading and object recognition

Letter recognition: the left hemisfere is more active than the right one

Limitations in formperception and memory

The ongoing question “what is it that I see?

Teach by category: cognitive expectations per location matched with sound, touch and smell.

An animal, outside at the market , bigger than…., it stinks and has …. colour. So …

The lower the mental level, the more the parents/ professionals must choose what is essential

Roland Blokhuizen NRC 31-3-07

Methods

- Organize and instruct environment
- Improving Contrast
- Improving lighting
- Enlarging or schaling down
- Lightboxes or computeruse
- Use of aids
- Hand over/under hand method
- Talking about it

the where & how pathway for spatial action

When moving yourself in a moving world integration with visual data is needed to be able to perceive it all in the blink of an eye.

Databank elements (ventral/what & whom) are recognized instantly and integrated into one flowing move attuned to the- also moving - environment.

It is rather surprising that most people are able to find their way so easingly in our (nowadays) very complex surroundings! It is much easier to understand that some have trouble doing it

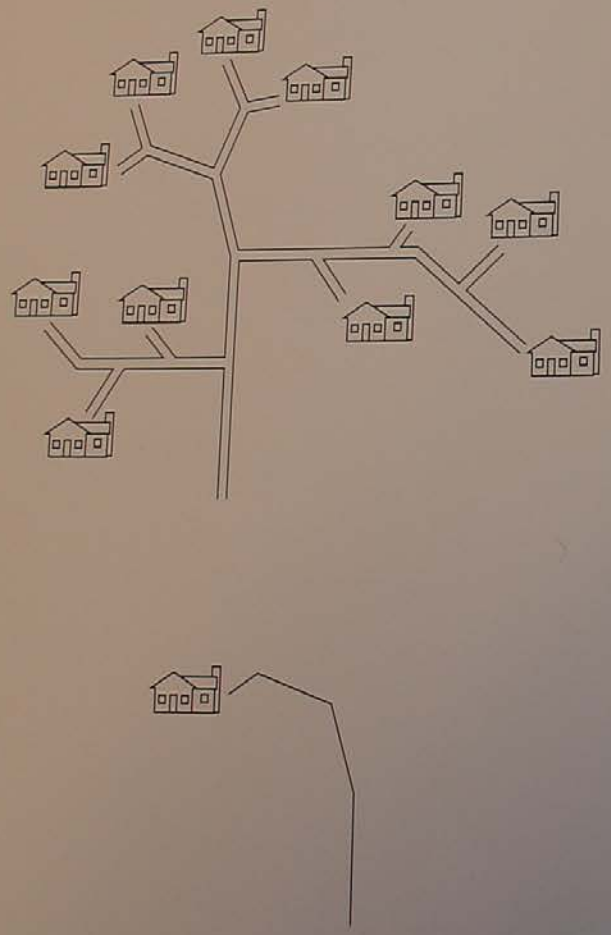
Visual Spatial Action

- ✓ Closure/incomplete figures
- ✓ Figure background perception/visual complexity
- ✓ Focused attention (at the surroundings but also ones own body)
- ✓ Visual-motor integration

Games to learn to perceive incomplete shapes

I see, I see,....

what you do not see and it .....!



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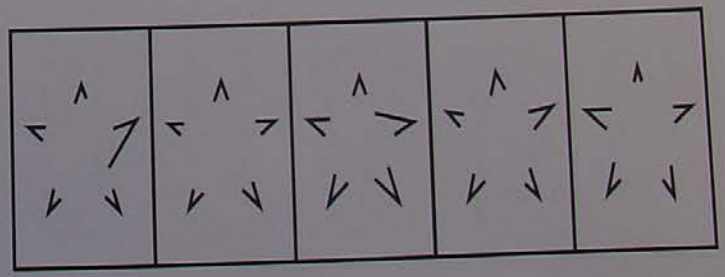
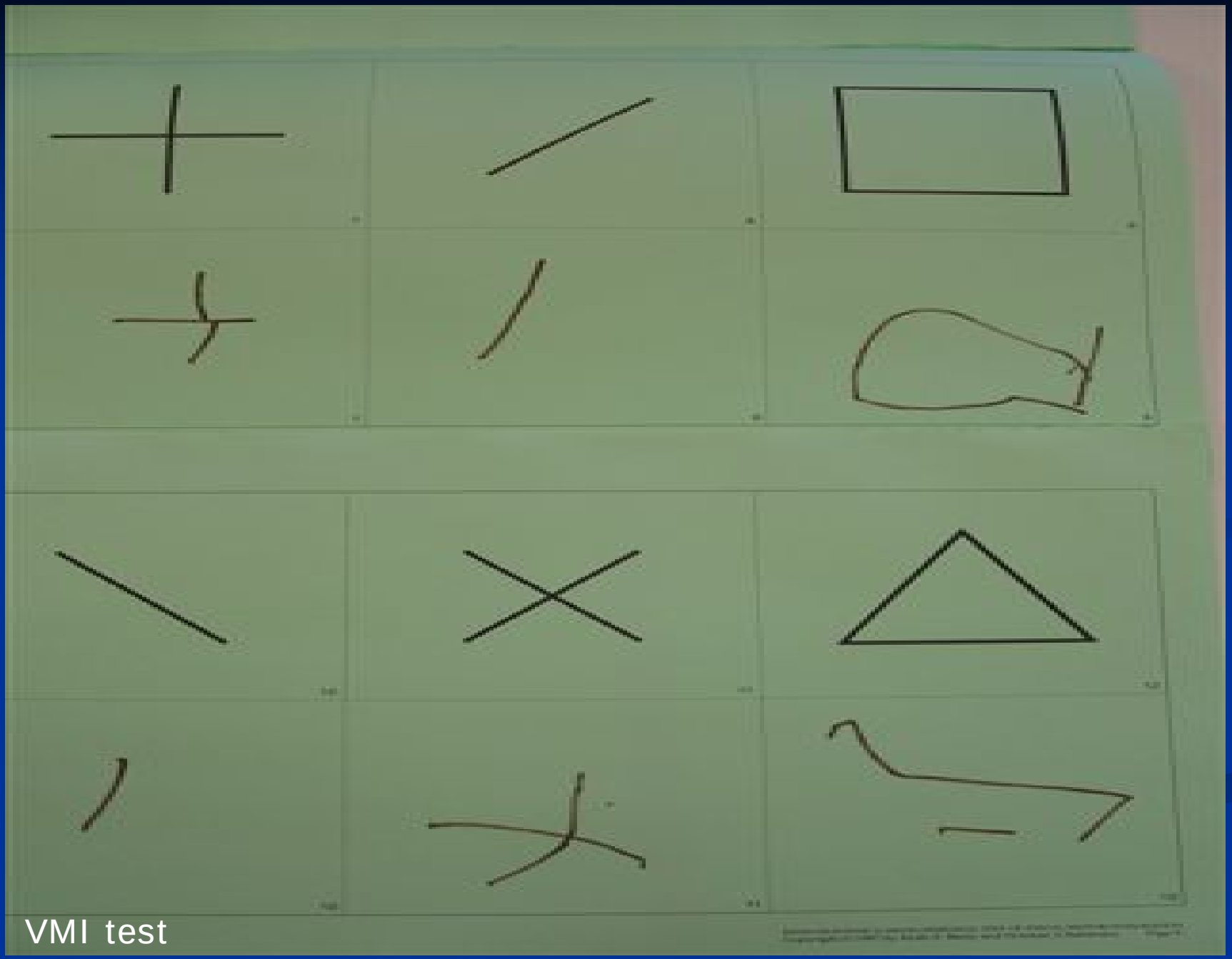


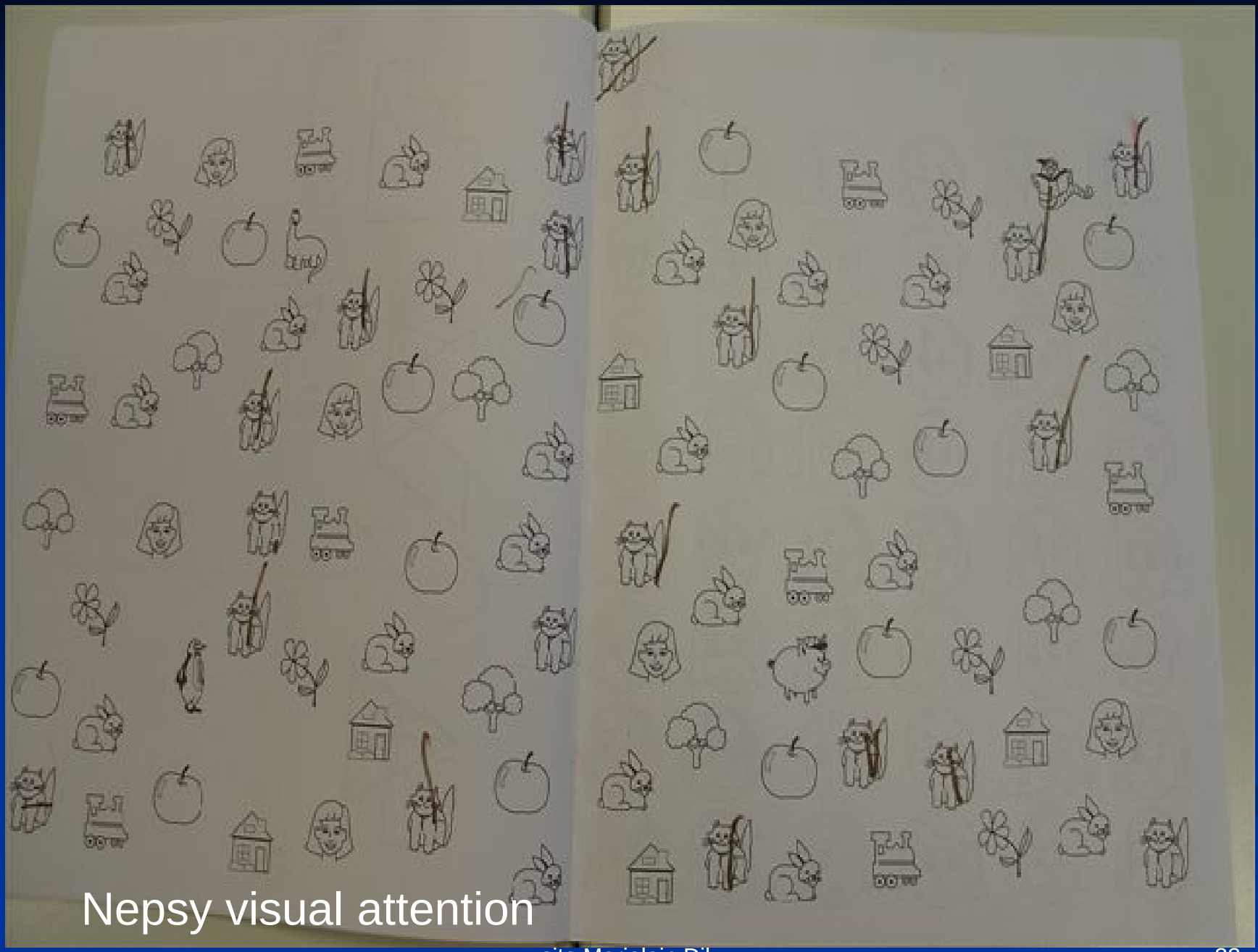
Subtest 6: Visual Closure 35

Nepsy: route finding

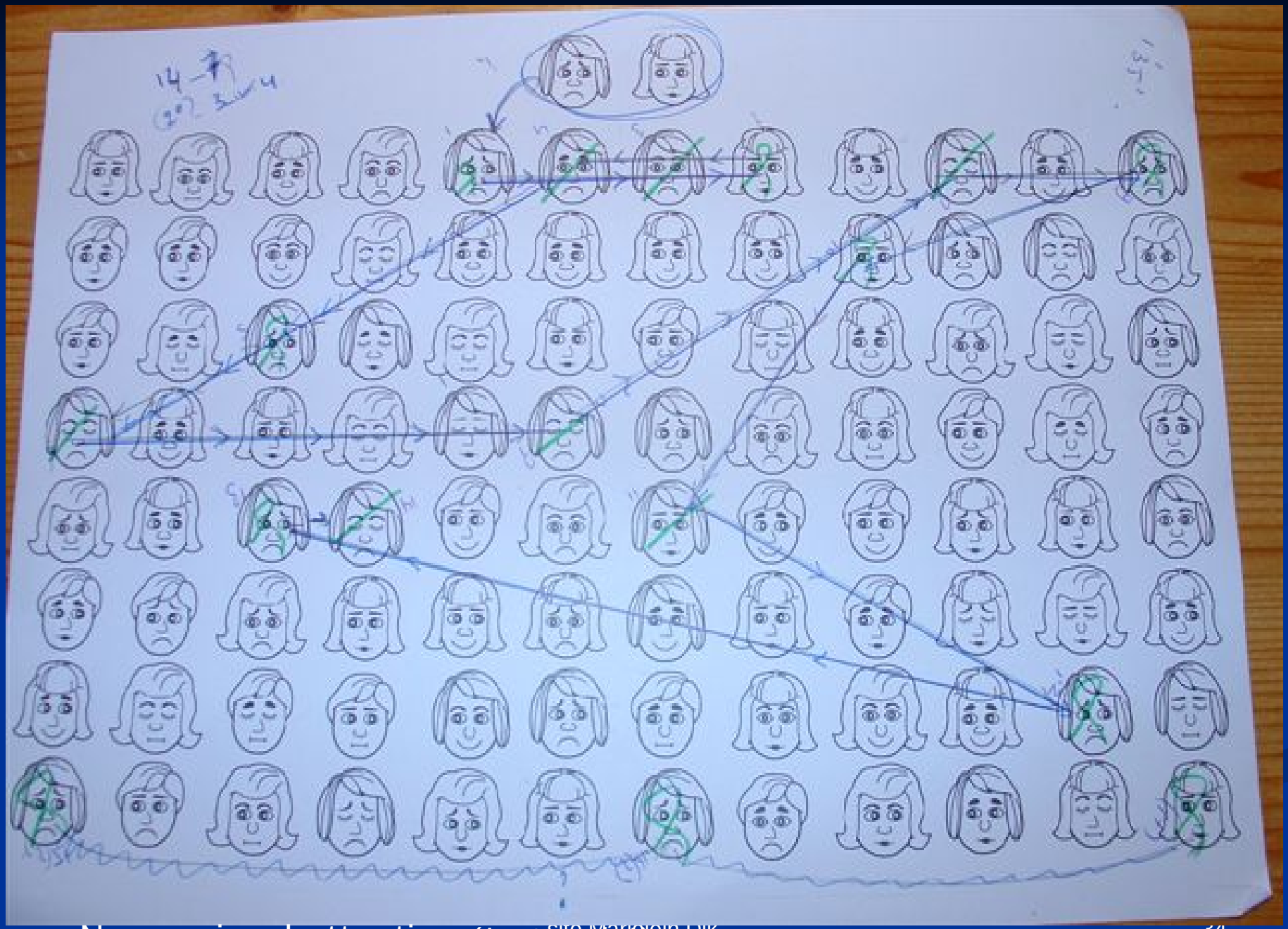
DTVP-2: closure



VMI test



Nepsy visual attention



Nepsy visual attention (Instructie!)

Attention and brainactivity

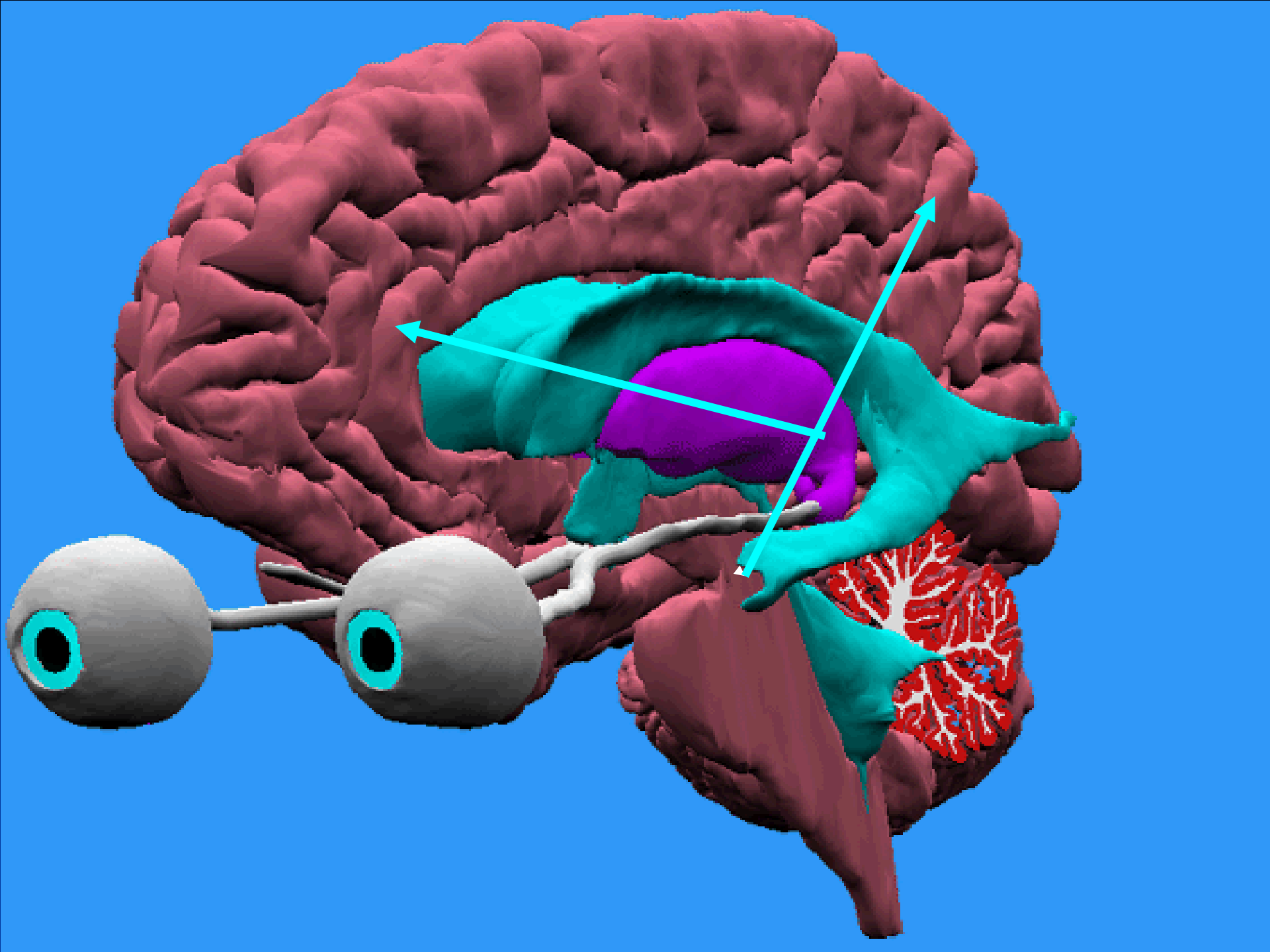
Different kinds of attention are organized by different brain areas.

Subcortical- the basal attentional system to focus attention selectively at something and to let go again

Parietal- the posterior attentionsystem to redirect attention (orienting)

Frontal – the anterior attentionsystem for planning, divided attention

Anterior+posterior= sustaining



Cerebral Palsy
Congenital disorders

Referred at 8 mnth of age

No eye contact with parents

No Tellercard measurement possible

No fixation, but now and then …

Treatment by supporting the selective visual attentional system externaly – lighting up high contrast patterns, faces and objects in a (somewhat) darker environment

tboxes facilitate visual attention. Older children computeruse - not too much lighted
oundings and without reflections in the screen!

Frequently occuring visual attentional problems

Late and slow start of looking because of a limitation in the visual selective attentional system

Even if the start is allright within the sensitive period, in later periods crowding problems and/or directing or maintaining visual attention may occur – looking away

The visual field in use turns smaller according to the complexity of the task that has to be performed. This can be understood as a sensory information processing problem, a capacity problem.

Crowding

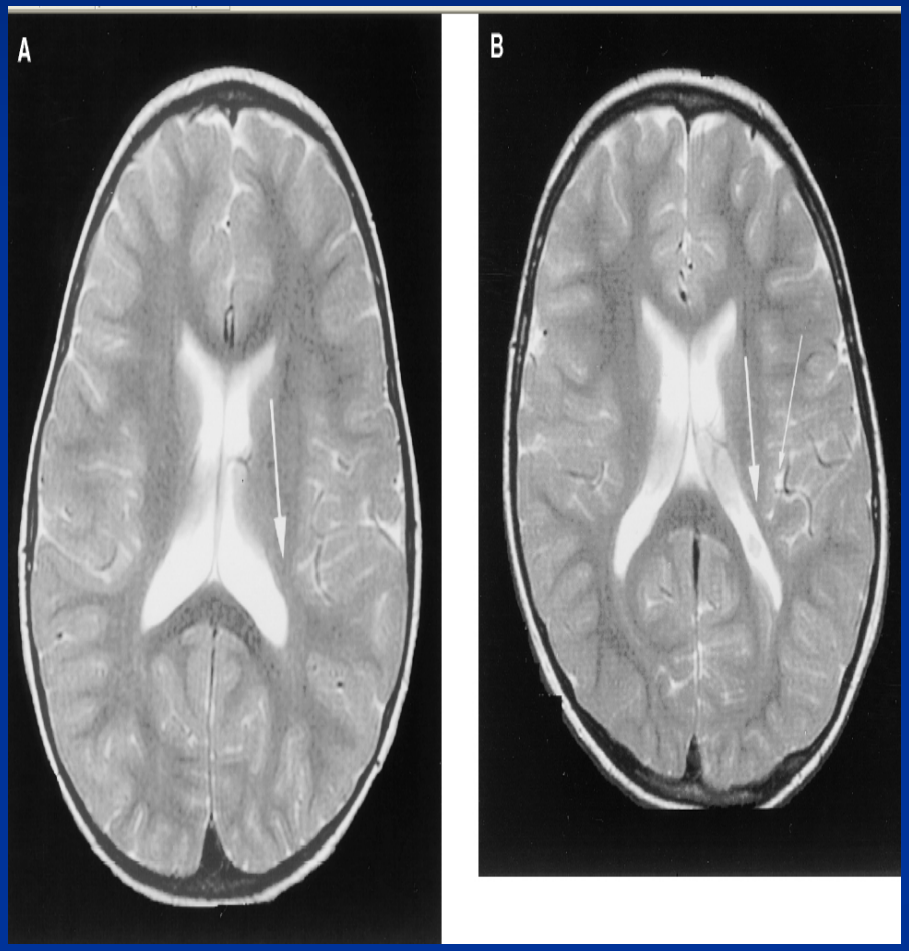
- Ophthalmologist: often finds a difference in between angular/linear acuity measurement
- Limitation in the selective attentional system. Visual elements may not be too small/too close to each other in order to be perceived /discriminated.
- Children: do not like a table full of things, tiny things or pictures with lots of little elements, bending forward more than expected by acuity.

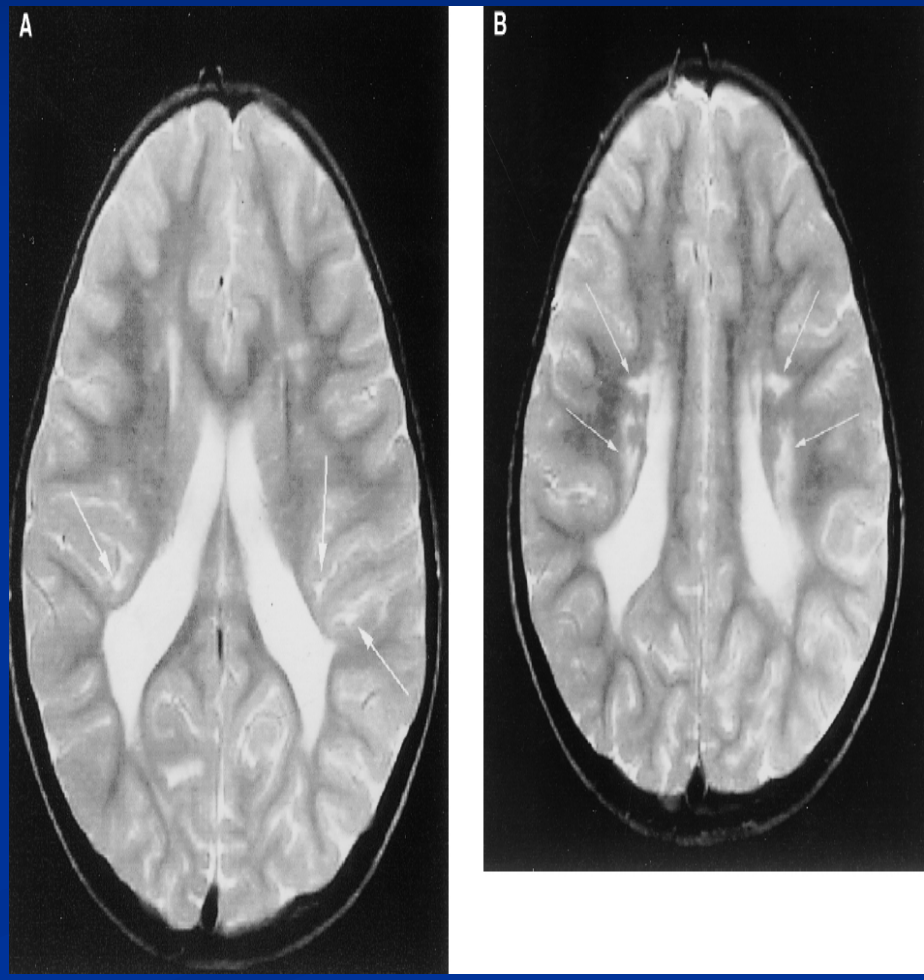
Adults: the lines of a hypodermic syringe, - of a schale, - the washing machine, - the coffee percolator, finding screws etc in a box

- Often letters/signs are too close together to be able to read

It is an non concious system - so do not train! –
Solution: use enlargement
(sometimes even with normal acuity)

Prematurely born





Pictures of Jacobson & Dutton

Types of Peri-Ventriculaire-Leucomalacie

- **Brain injury in premature infants: a complex amalgam of destructive and developmental disturbances**
  Joseph J Volpe ***Lancet Neurol*** **2009; 8: 110–24**

site Marjolein Dik

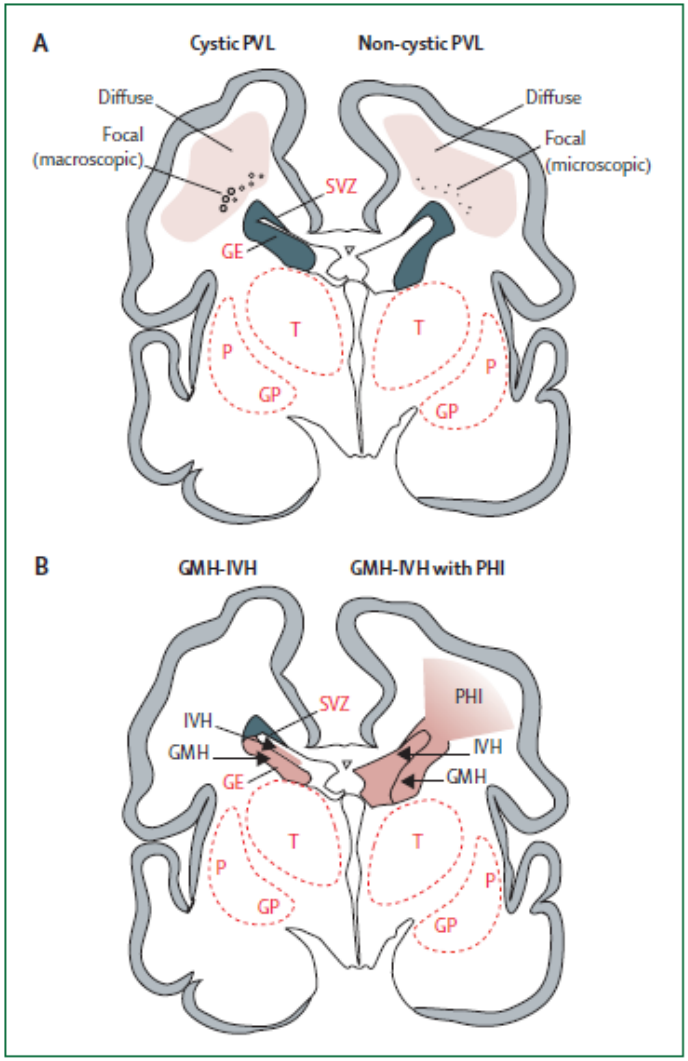
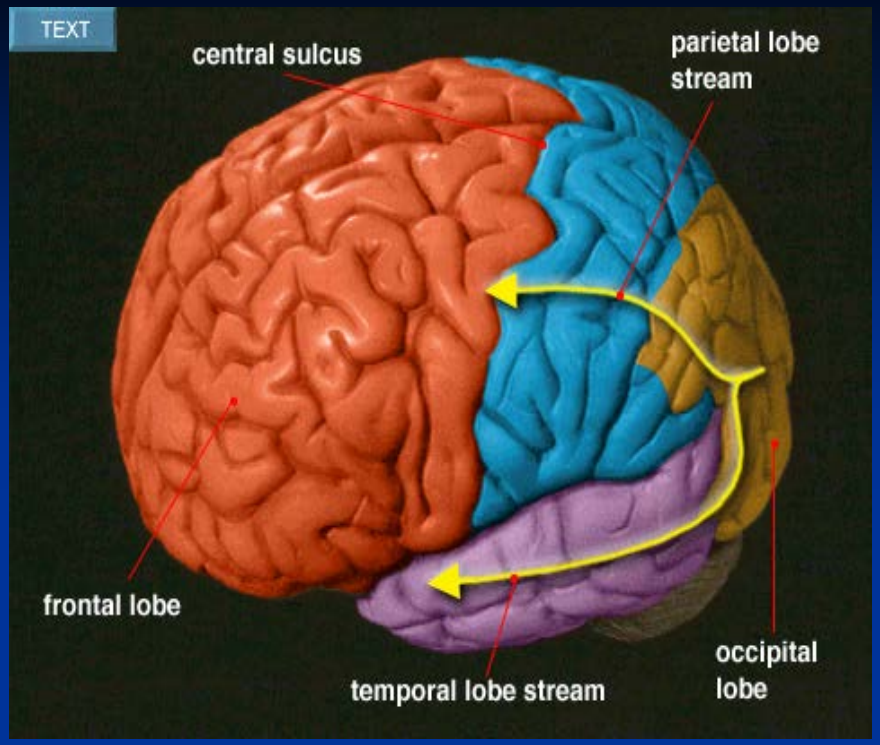
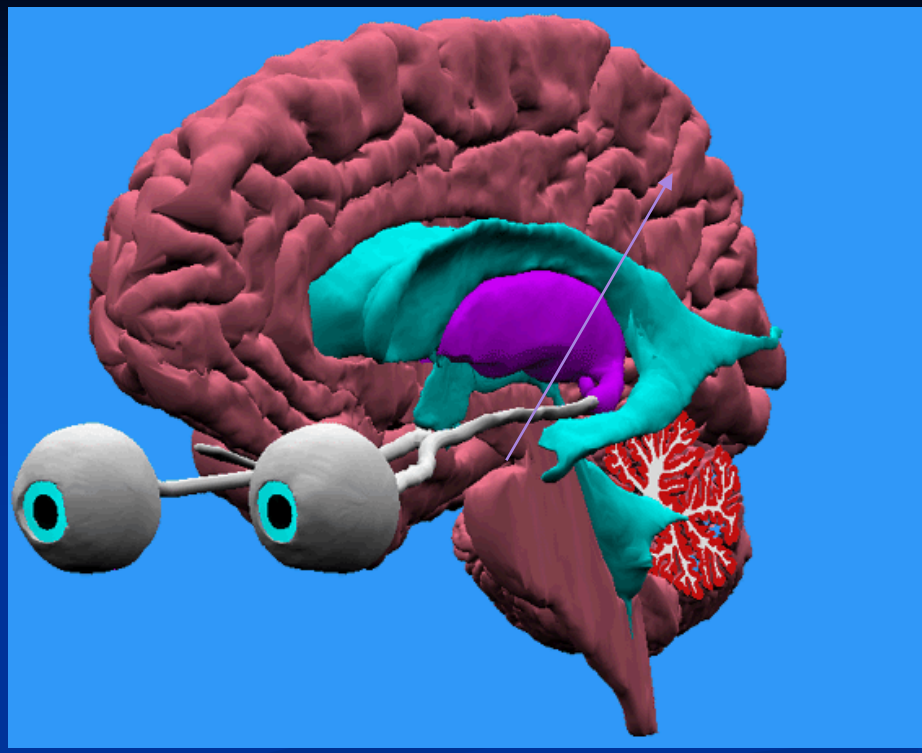


Figure 1: **Cystic and non-cystic periventricular leukomalacia (PVL) and germinal matrix haemorrhage–intraventricular haemorrhage (GMH-IVH) and GMH-IVH with periventricular haemorrhagic infarction (PHI)**
Coronal sections from the brain of a 28-week-old premature infant. The dorsal cerebral subventricular zone (SVZ), the ventral germinative epithelium of the ganglionic eminence (GE), thalamus (T), and putamen (P)/globus pallidus (GP) are shown. (A) The focal necrotic lesions in cystic PVL (small circles) are macroscopic in size and evolve to cysts. The focal necrotic lesions in non-cystic PVL (black dots) are microscopic in size and evolve to glial scars. The diffuse component of both cystic and non-cystic PVL (pink) is characterised by the cellular changes, as described in the text. (B) Haemorrhage (red) into the GE results in GMH, which could burst through the ependyma to cause an IVH (left). When the GHM-IVH is large, PHI might result (right).





Attention development in infants and preschool children born preterm: A review

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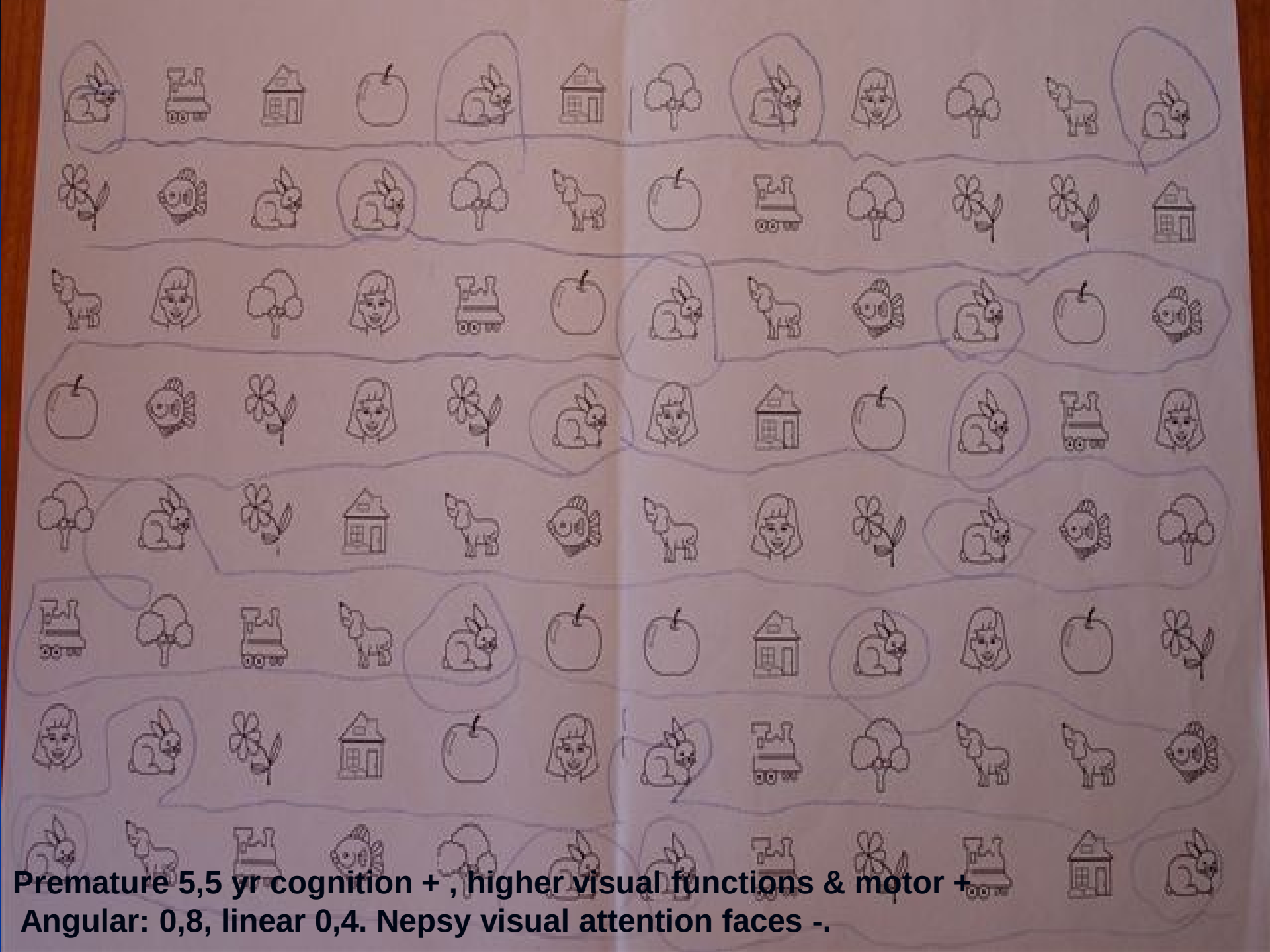
Received 8 December 2006; received in revised form 17 September 2007; accepted 30 December 2007

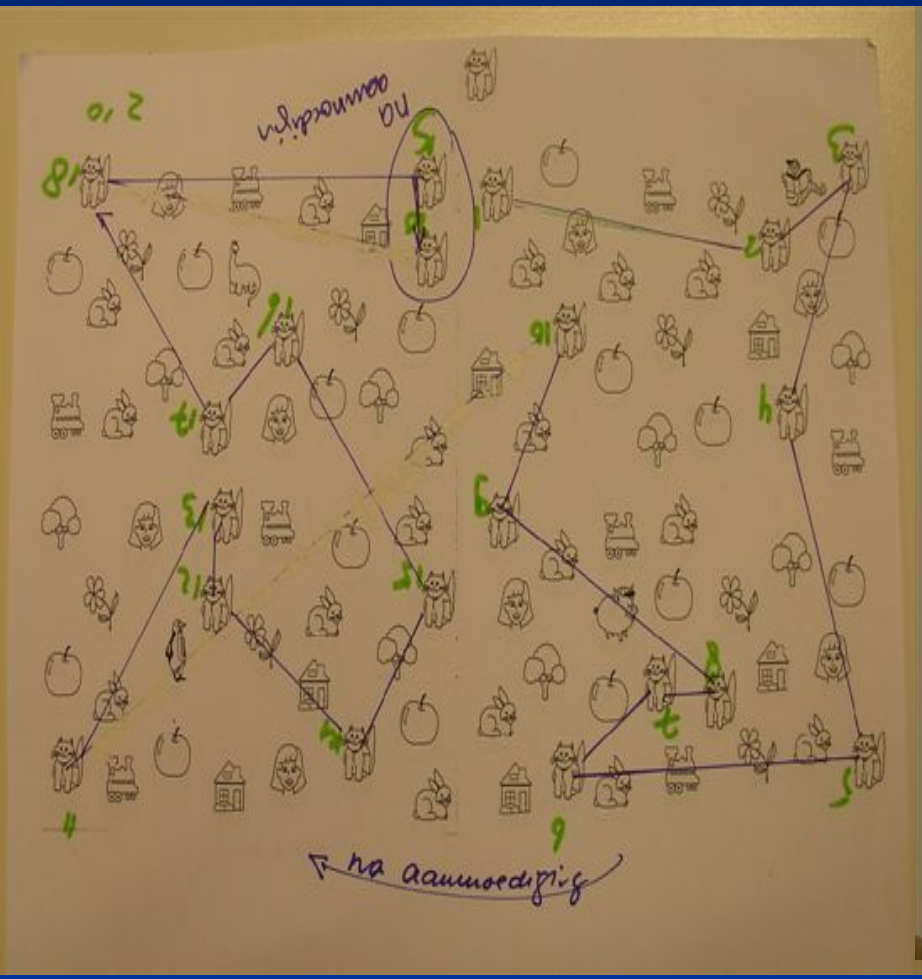
Abstract

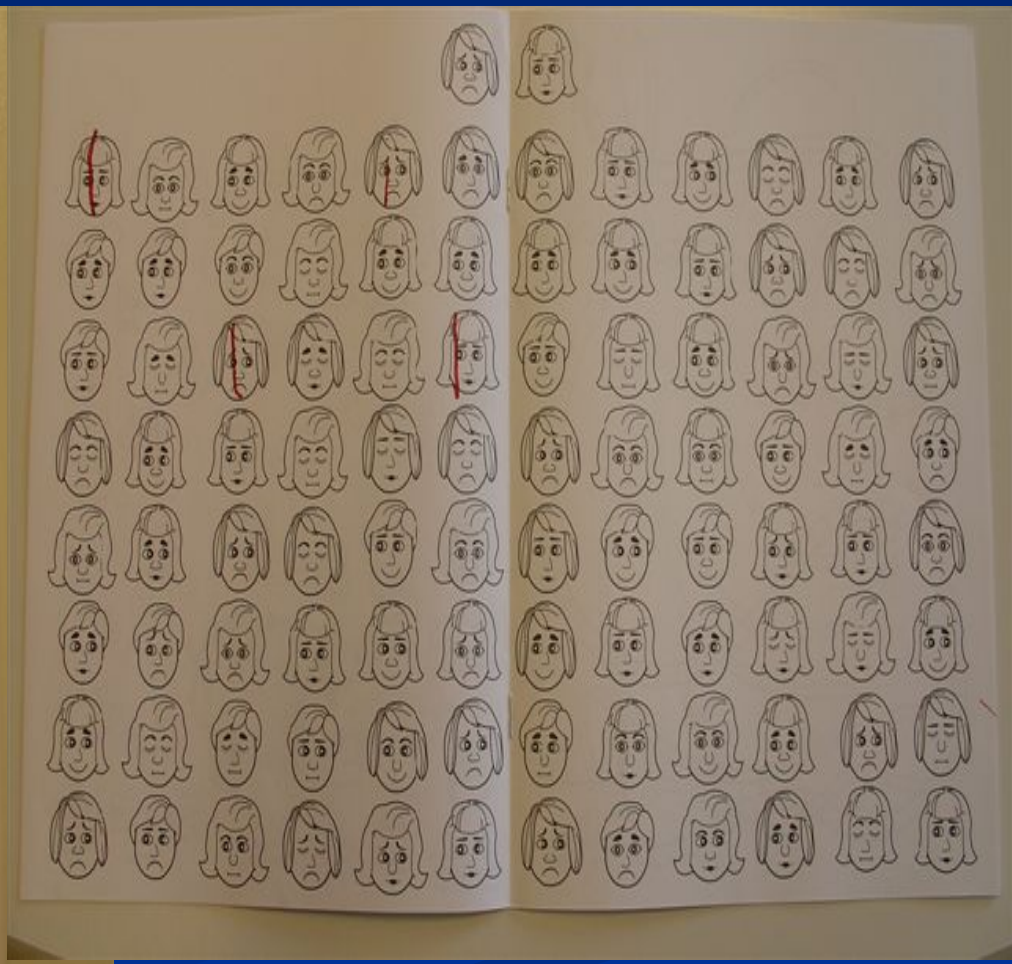
A potential mechanism that can explain preterm children's heightened risk for the development of later cognitive and behavioral problems is attention. Attention is the ability of an infant or child to orient to, to shift between and to maintain focus on events, objects, tasks, and problems in the external world, processes which are all dependent on the functioning of attentional networks in the brain. The aim of this paper is to provide a review of the literature on attention development in children born preterm during the first 4 years of life. First, research examining the differences between preterm and full-term children indicates that early attention development in infants born preterm is less optimal and that these differences increase when infants grow into toddlers. Second, studies investigating individual differences *within* preterm populations reveal the influence of both biological factors and environmental factors. Third, individual differences in early orienting and sustained attention have been shown to be predictive of later attentional, cognitive and behavioral functioning in children born preterm. The importance of long-term follow-up studies, with a focus on individual developmental trajectories in orienting, sustained and executive attention, is emphasized.



Premature 5,5 yr cognition + , higher visual functions & motor +
Angular: 0,8, linear 0,4. Nepsy visual attention faces -.

♂6 yr exprematurе
acuity: 0,5 angular; 0,3 linear

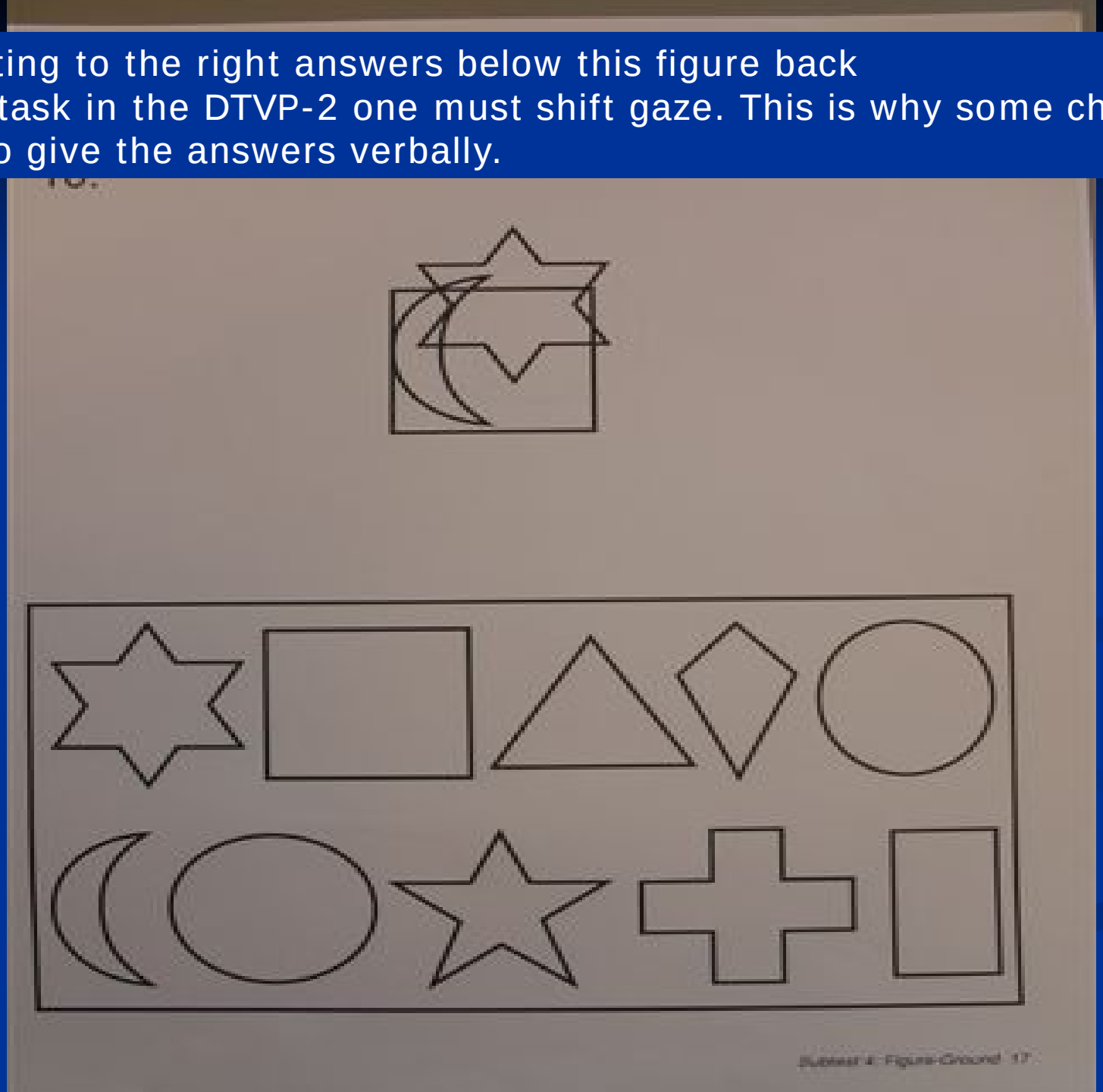


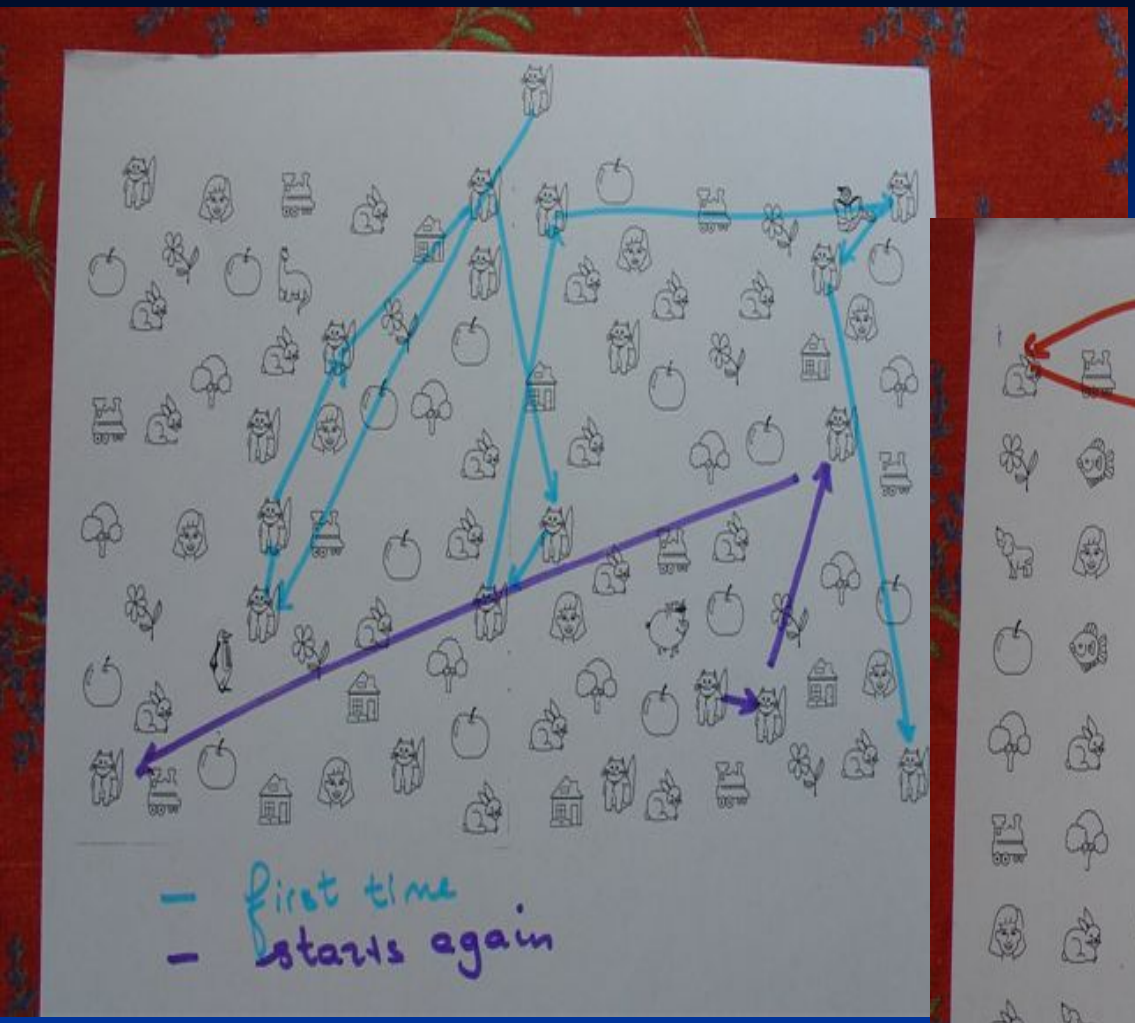


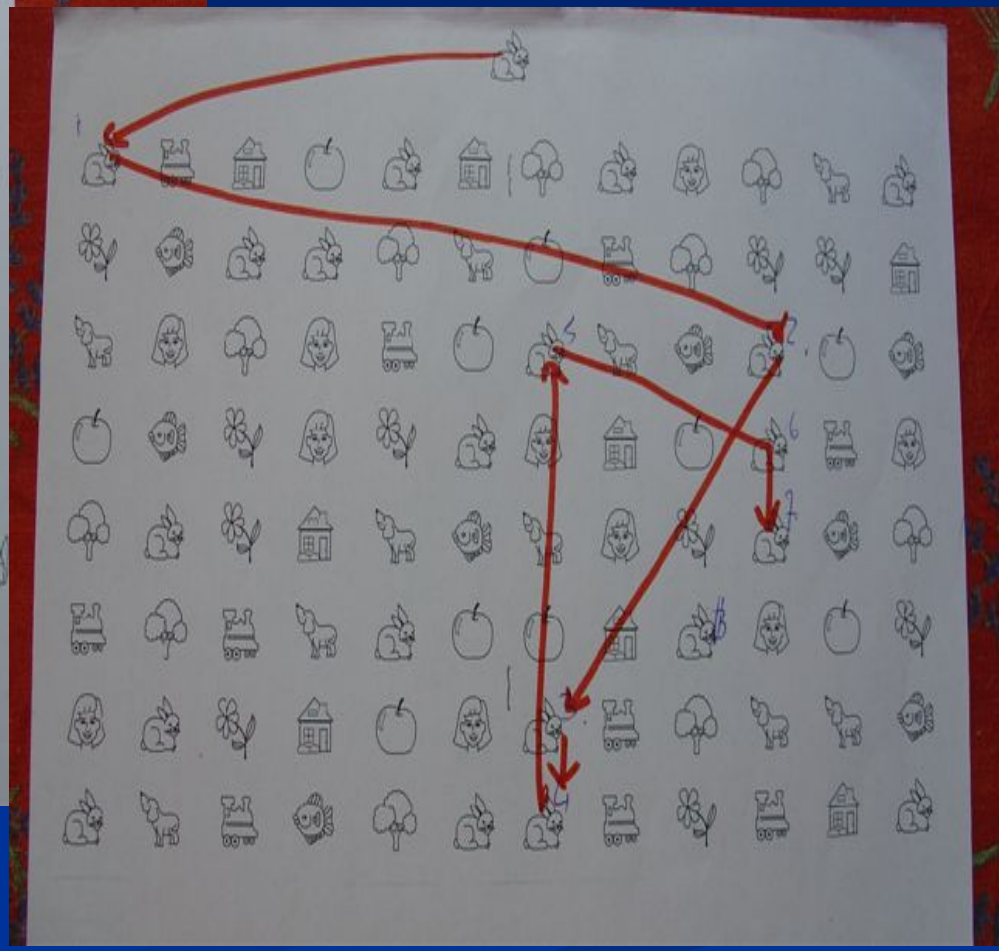
DTVP-2: above average

This makes me very tired!

By pointing to the right answers below this figure back ground task in the DTVP-2 one must shift gaze. This is why some children prefer to give the answers verbally.



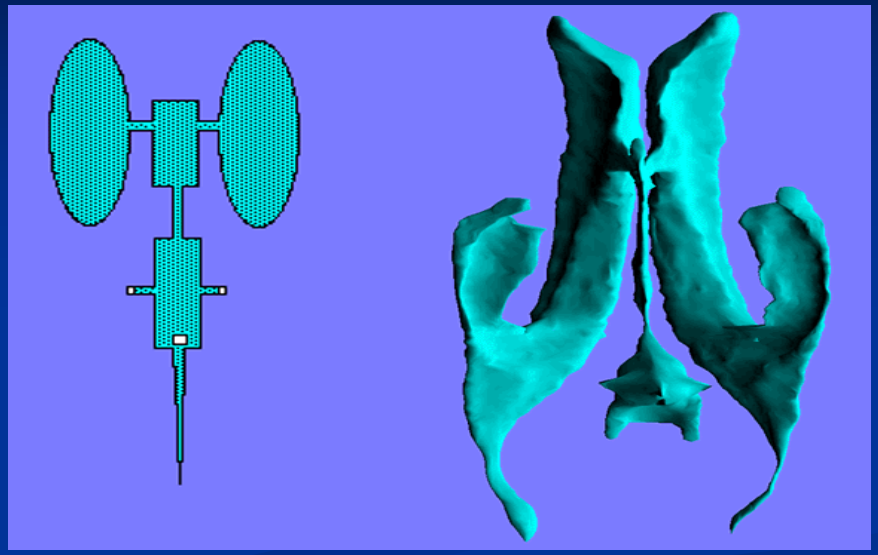


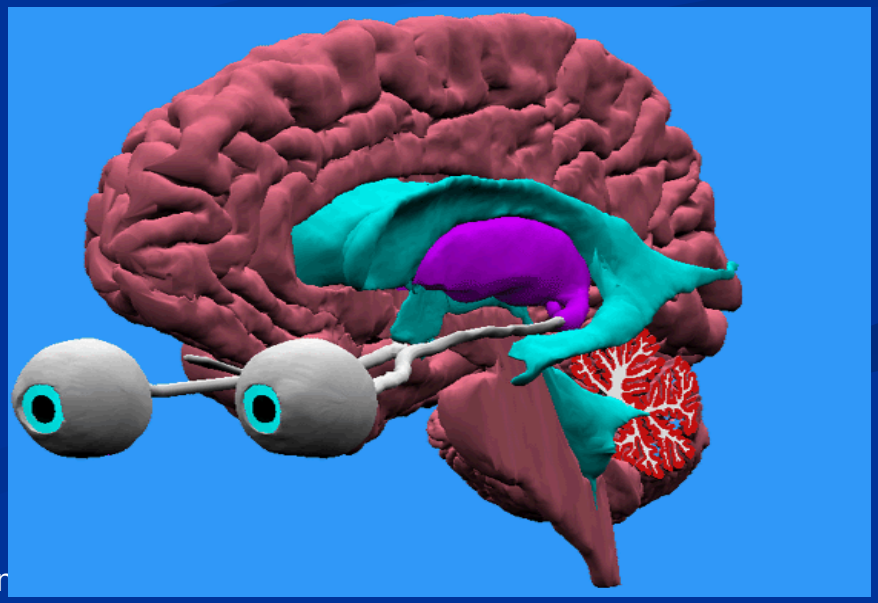


♂'6 yr, expremature (30 wks), PVL, CP, normal IQ
Acuity: 0,8 ang, 0,4 lin, higher visual functions+

hydrocephalus

- ✓ Oversensitivities (hinder by light, noise, fuss)
- ✓ Selective attention problems
- ✓ Sensoric information processing problems
- ✓ Motor problems
- ✓ Crowding
- ✓ Often also the dorsal complexity problems
- ✓ Sometimes changing visual functions

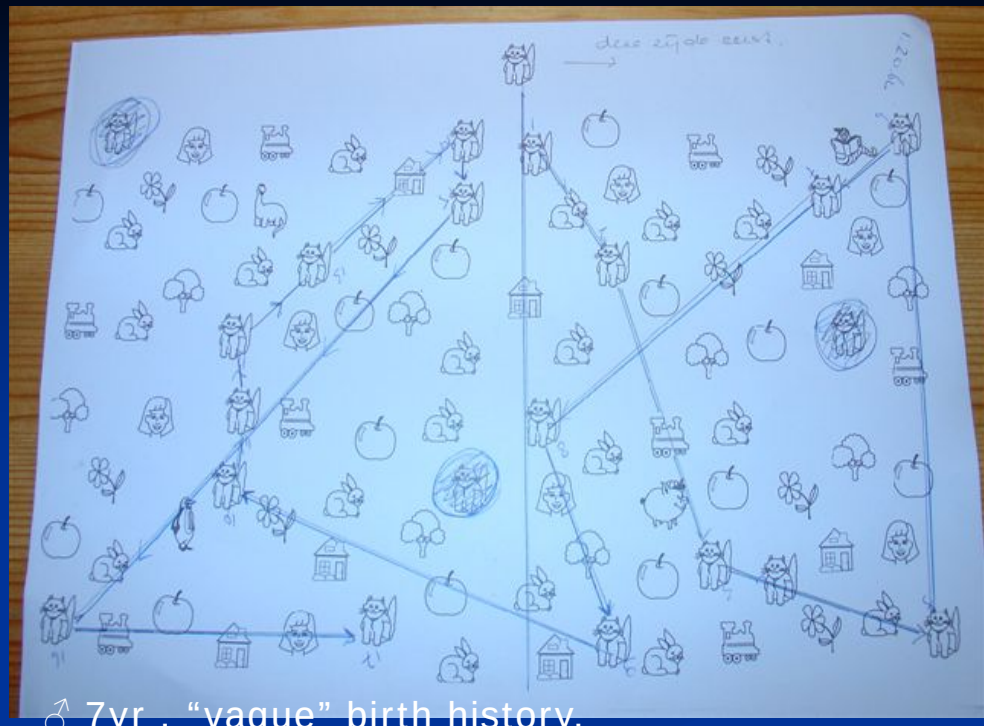




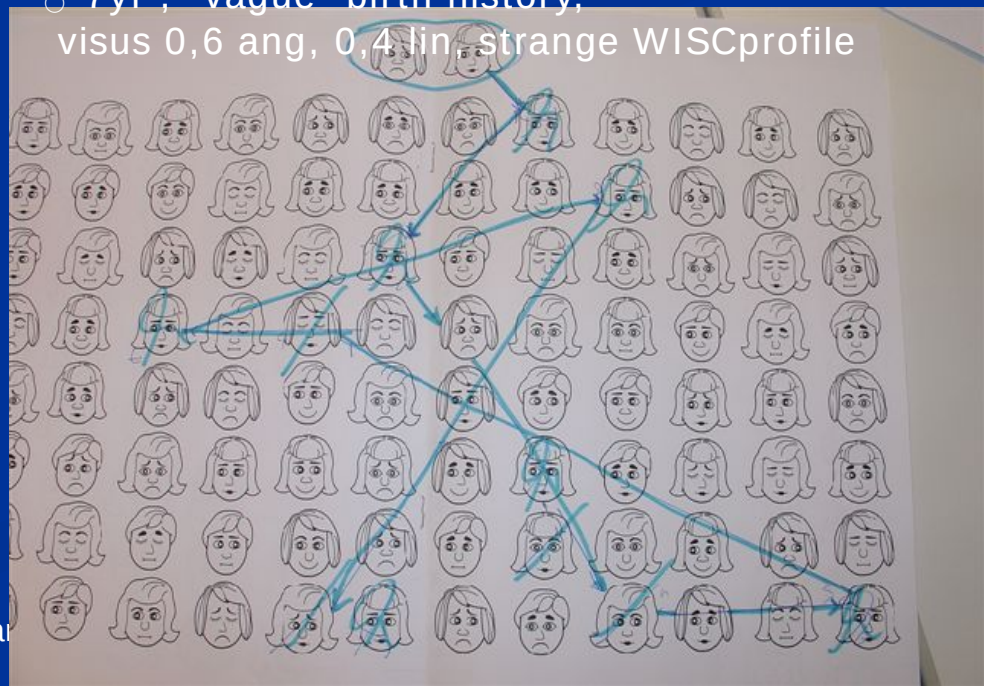
site Marjolein

Asfyxia

- ✓ Slow start of visual development, sometimes nystagmus or torticollis
- ✓ Slow start of motor development
- ✓ Muscle tone, balance ±
- ✓ Sometimes swollowing, sometimes mouth (muscle) control±
- ✓ Sometimes oversensitivities and/or sensoric information-processing problems
- ✓ Sometimes somewhat formalistic, not childlike according age
- ✓ Sometimes stop- and go problems
- ✓ Higher functions (cognitions, language, memory) better
- ✓ Often attentional problems!



♂ 7yr , “vague” birth history,
visus 0,6 ang, 0,4 lin, strange WISCprofile



site Mar

Learning to read with mals

Reading and theoretical clusters

- Language related; phonological awareness and recoding (orthografic-phonological conversion rules)
- Temporal processing; rapid stimulus sequences
- Visual and magnocellular processing

Alan A. Beaton (2004). *Dyslexia, reading and the brain.* A sourcebook of psychological and biological research New York, Psychology Press

Sireteanu, R., Goebel, C., Goertz, R., Werner, I, Nalewajko, M., Thiel, A. (2008). *Impaired serial visual search in children with developmental dyslexia.* Ann. N. Y. Academic Science 1145: 199-211.

Lassus-Sangosse, D., N'guyen-Morel, M., Valdois, S. (2008). *Sequential or simultaneous visual processing deficit in developmental dyslexie?.* Vision Research 48, 979-988.

Some aspects of reading are visual

- magno path involved in early reading problems
  - lin <ang, (selective visual attention)
  - engaging/disengaging speed ↓

  Solution: early magnifying

  - visual orienting

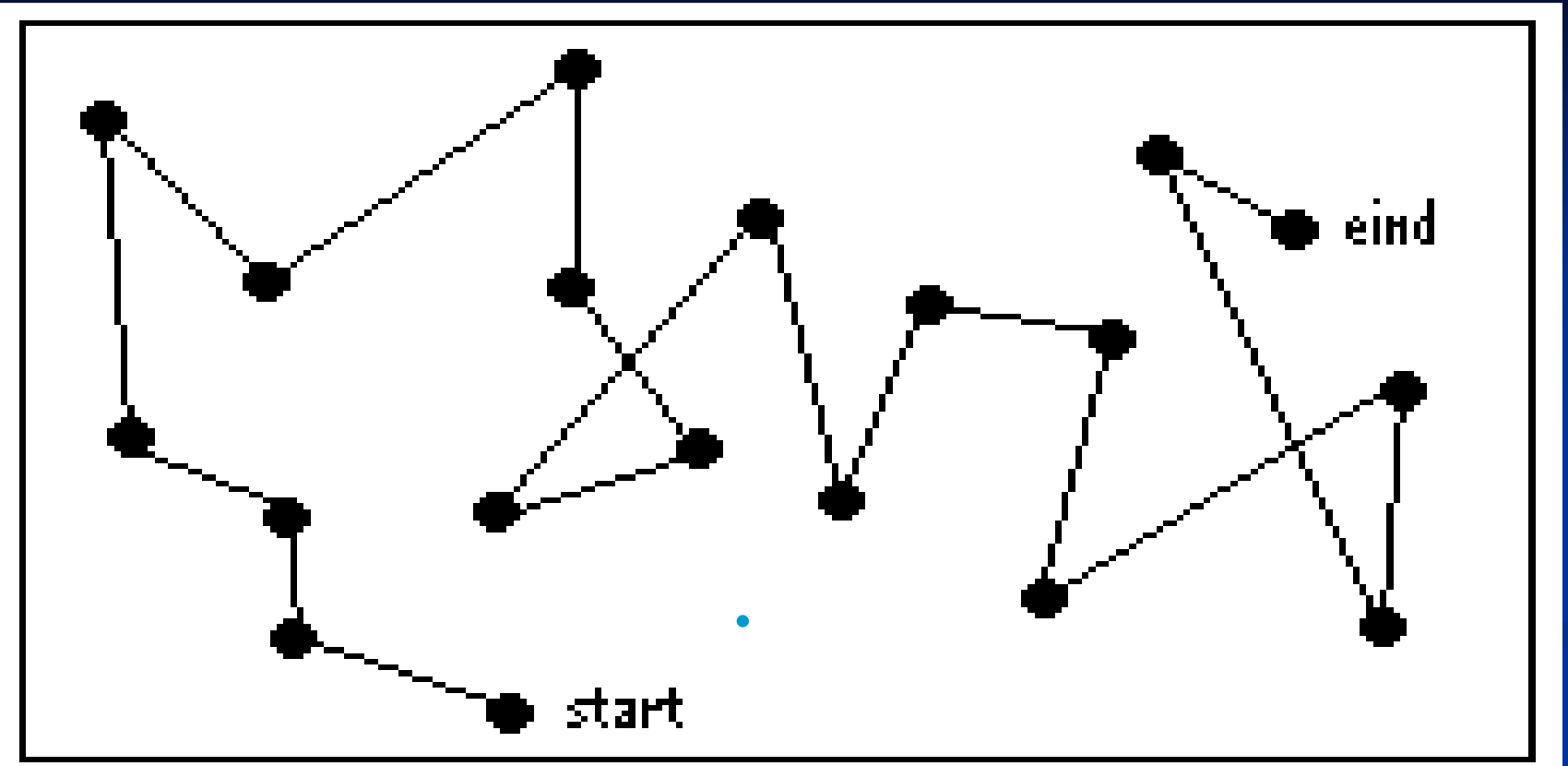
  Solution: mals, frames and windows –

  The attentional spotlight seems to learn what to do this way

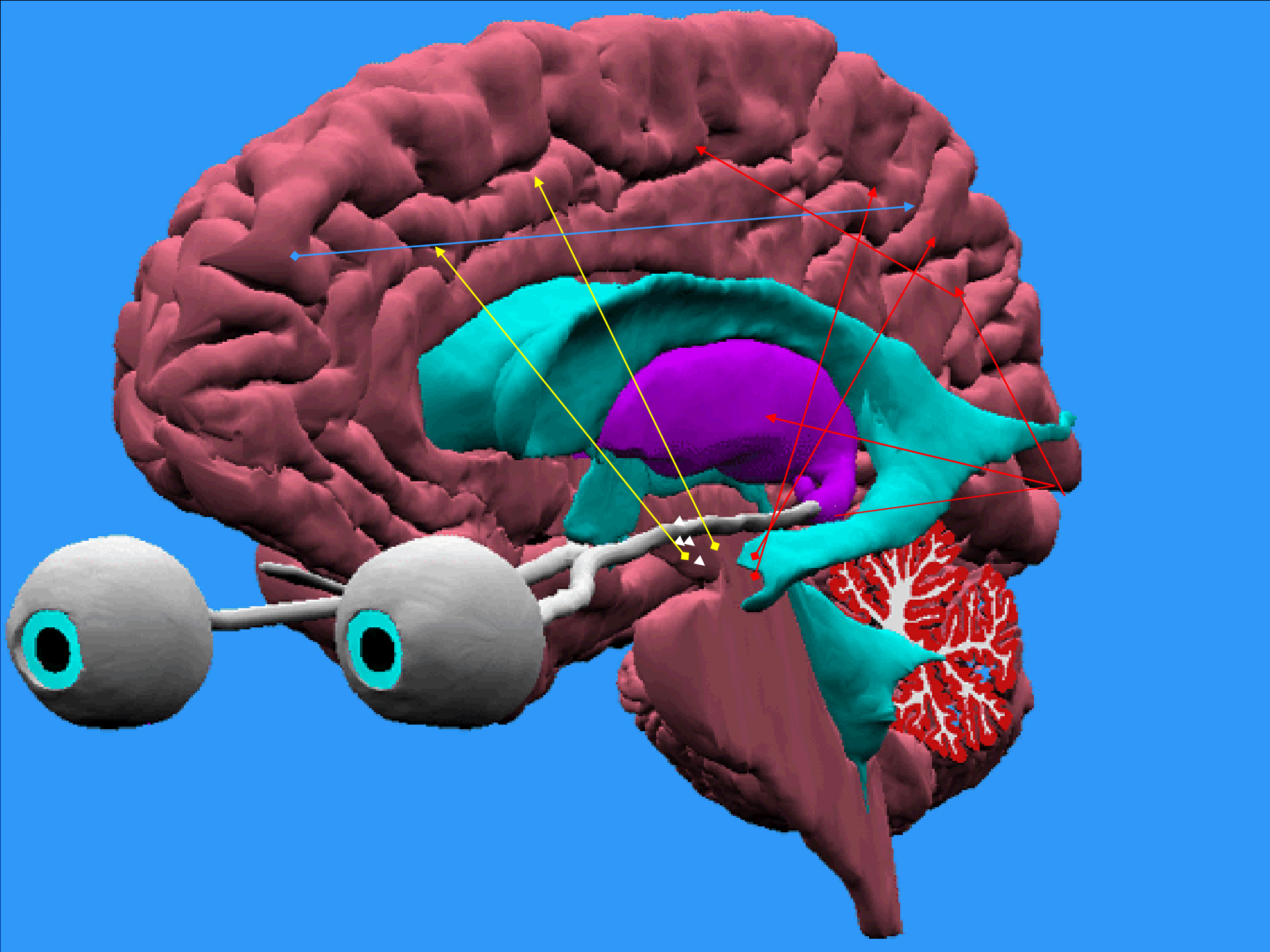
- dorsal path involved in later reading problems
  - visual complexity, too much letters and lines too close to each other (simultaneous visual processing)

  Solutions:covering/splitting up, magnifying, computer use

- CP: the above + frontal presentation



Scanningpattern 16 y with balloonstest, after left parietal tumoroperation → hemianopsy R. Higher visual functies OK, but attention loss R (neglect). Mobility problems , finding stuff, readingproblems.



Indications for visual perceptual assessment

- Acuity loss c.i.(often subnormal)
- Inexplicaple visual spatial problems considering visual acuity and field
- Be aware with cerebral palsy, hydrocephalus, prematurity, asfyxia and acquired braindamage through operations or trauma.

Literatuur

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