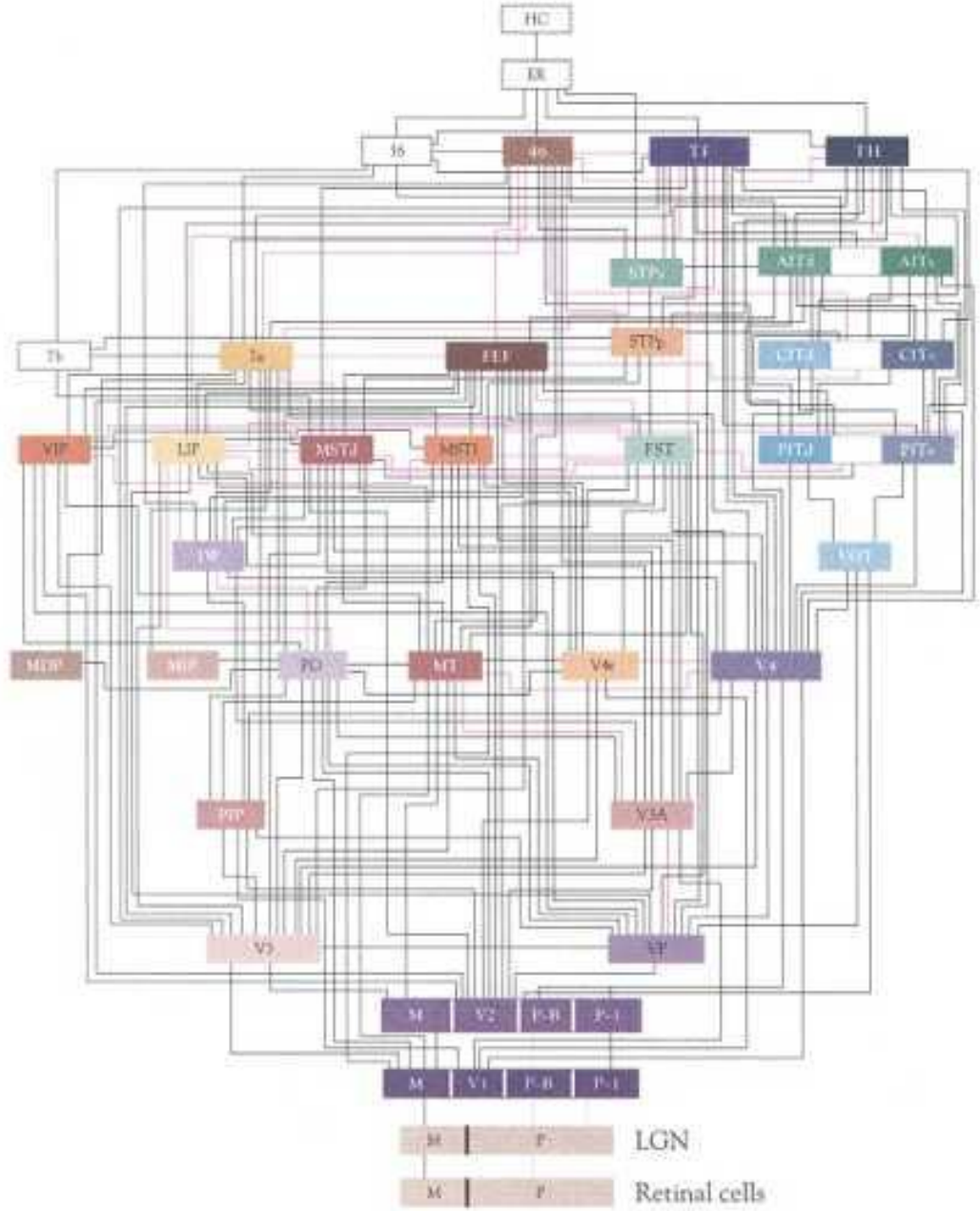
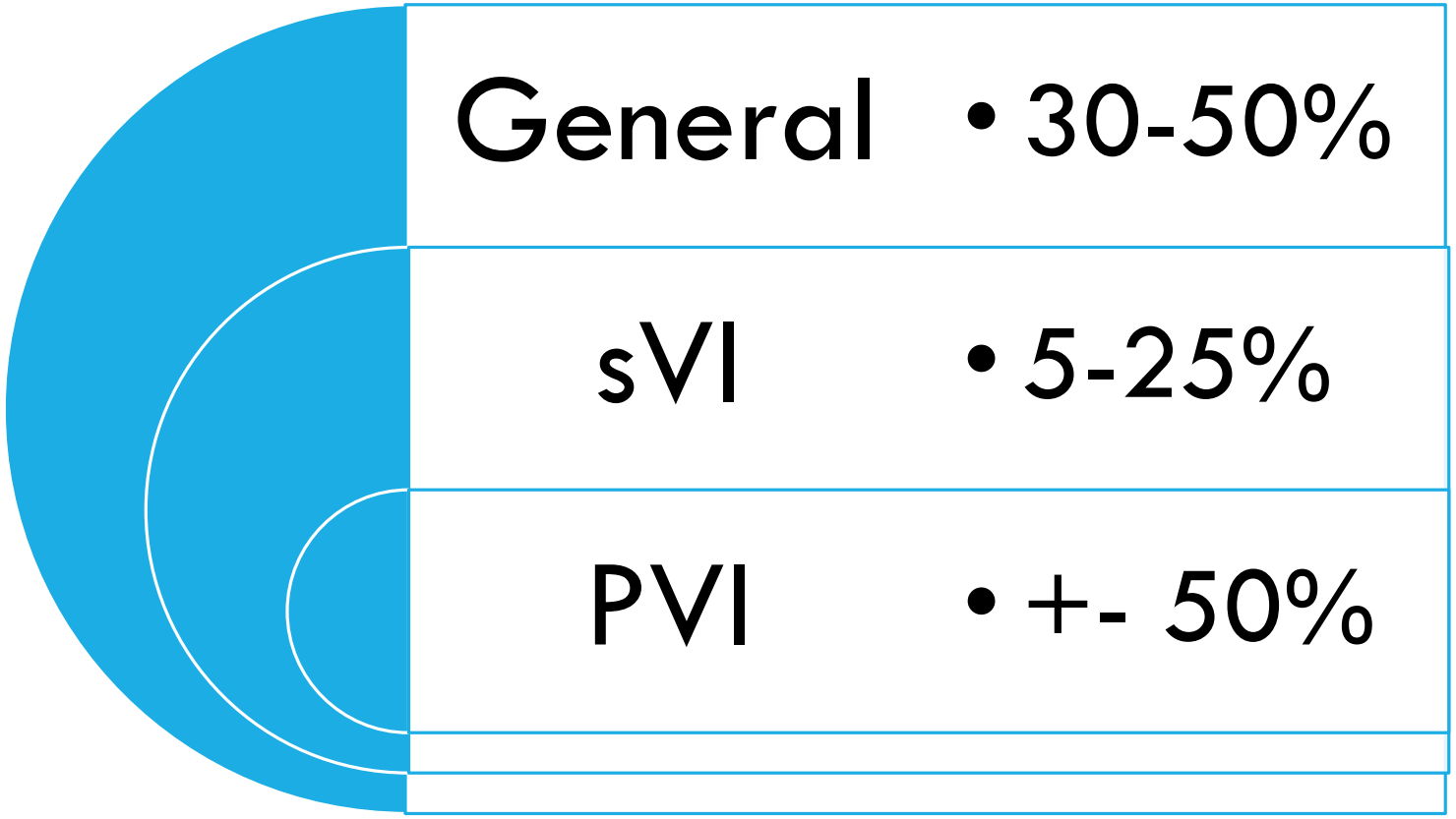
TO SEE OR NOT TO SEE: THAT'S THE QUESTION

Els Ortibus, MD, PhD
Child neurologist
University Hospitals, KU Leuven and Center for Developmental Disabilities, Leuven, Belgium

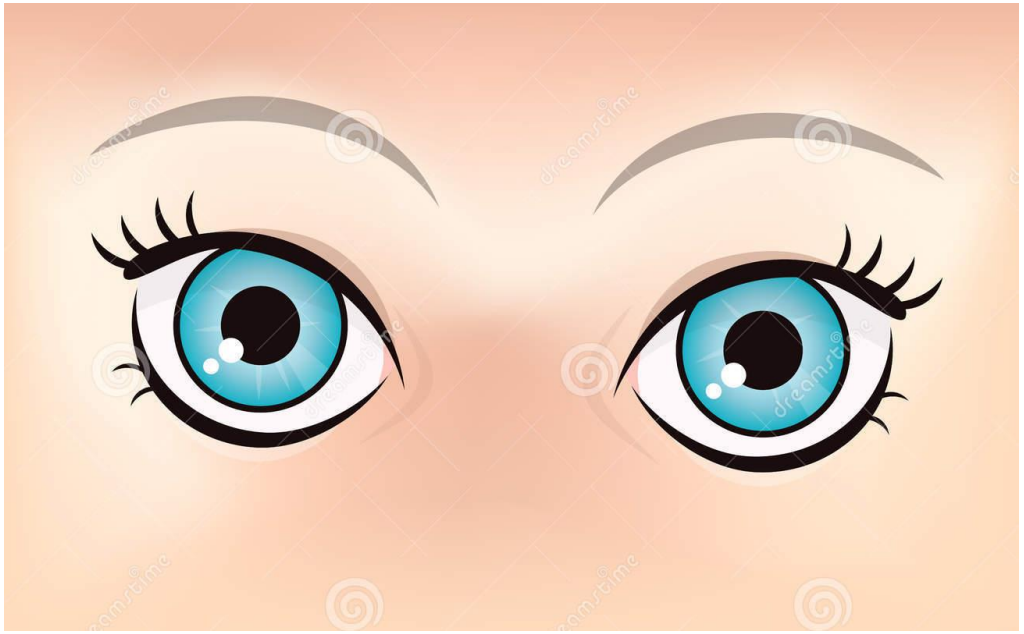
CONTEXT

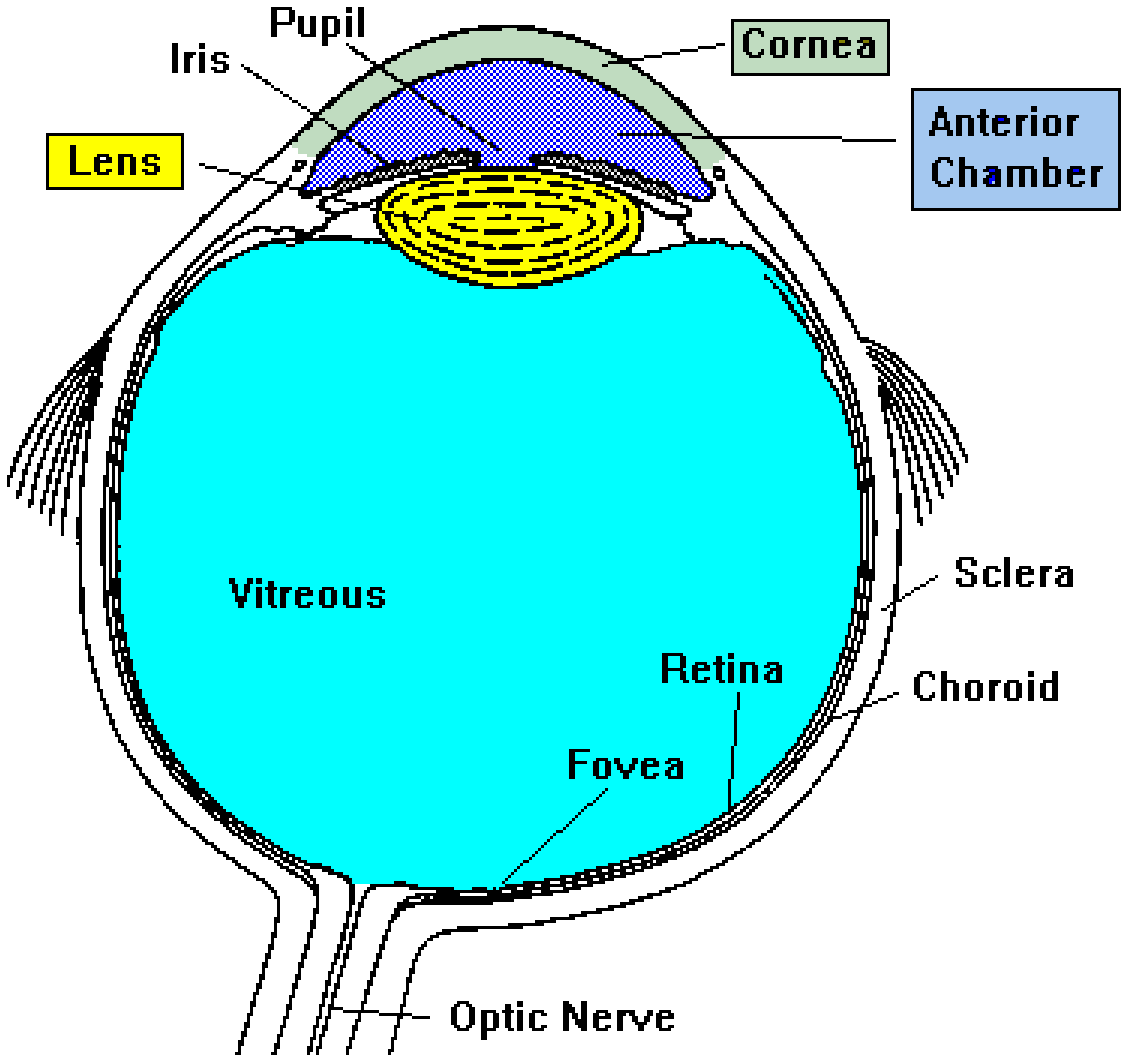

LGN
Retinal cells

PREVALENCE

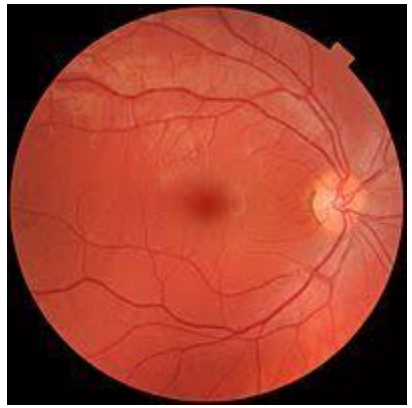


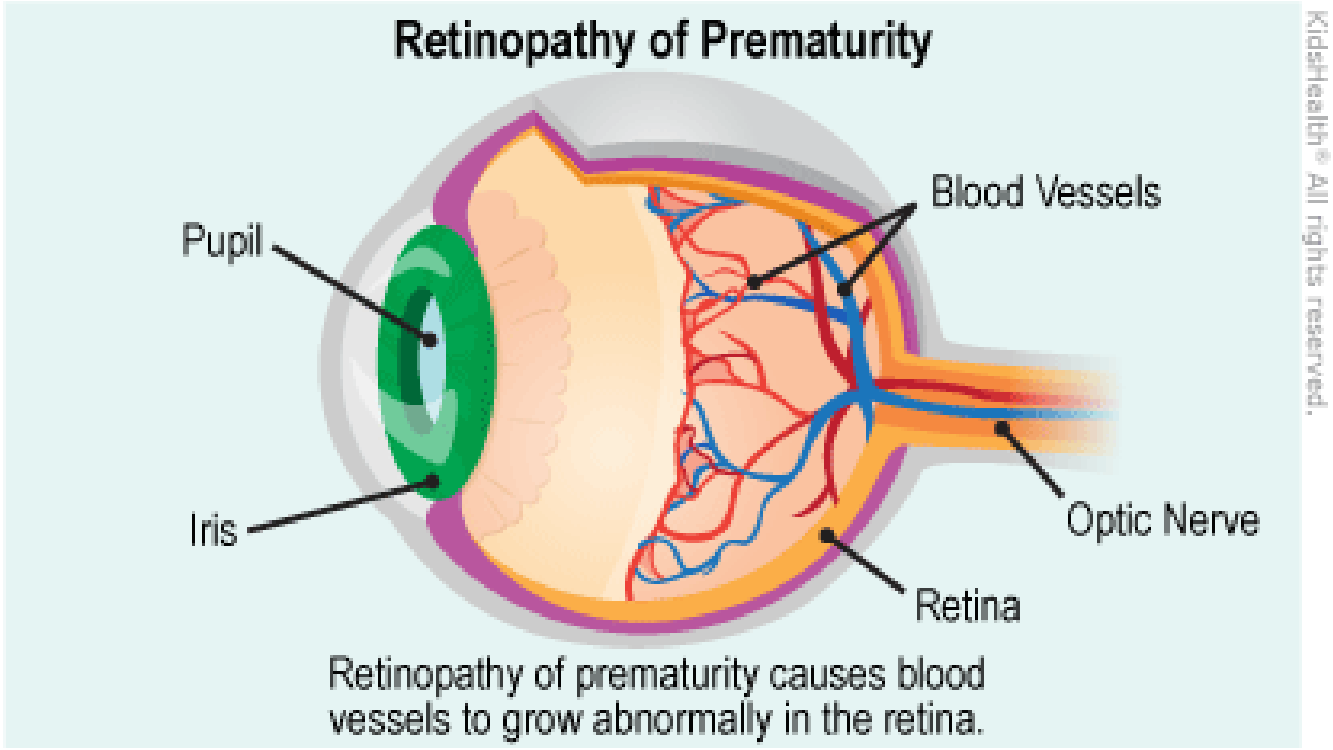
2 ORIGINS OF VISUAL PROBLEMS

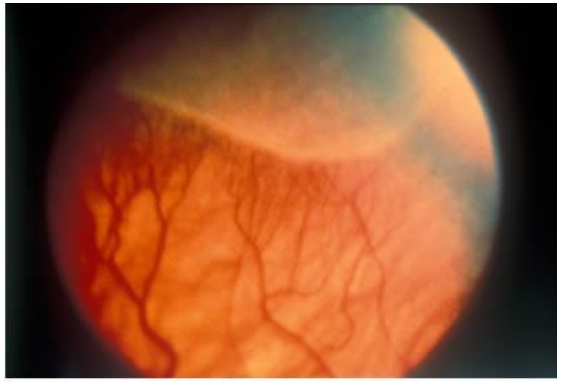


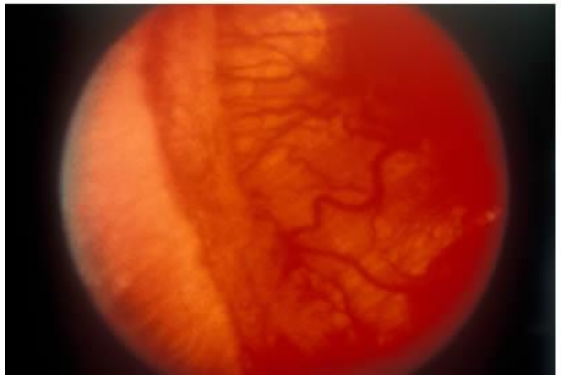

Pupil
Iris
Cornea
Anterior Chamber
Lens
Vitreous
Sclera
Retina
Choroid
Fovea
Optic Nerve

REFRACTION PROBLEMS

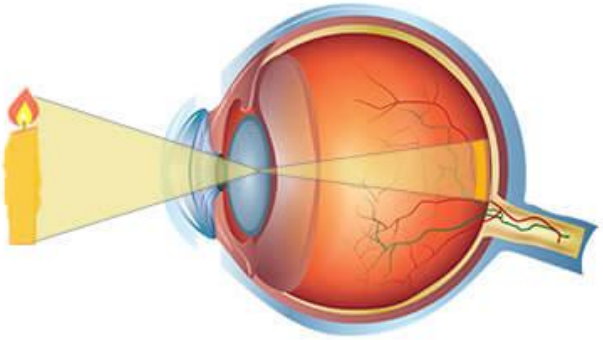




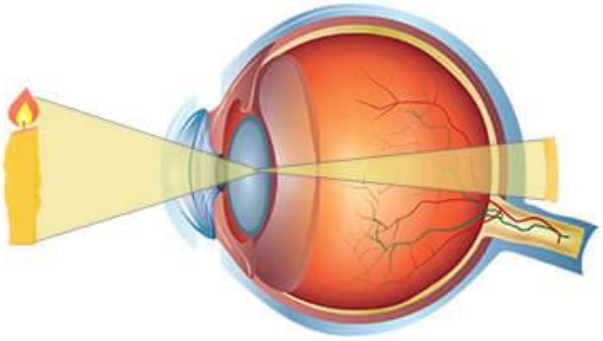




REFRACTION

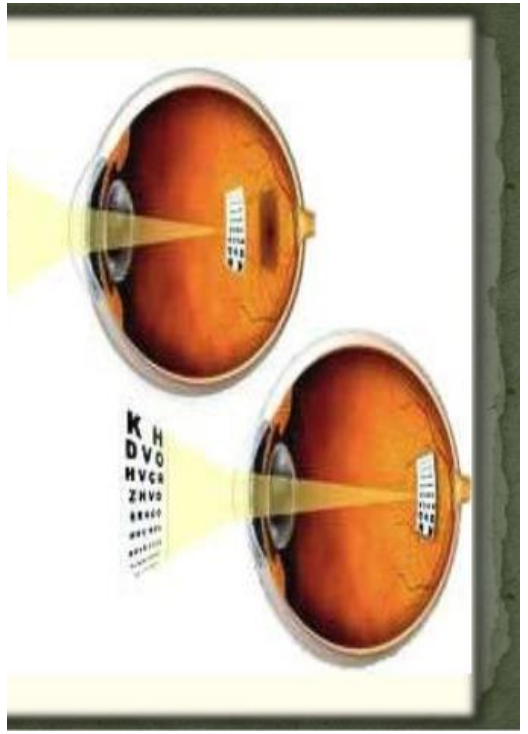


Normal Vision

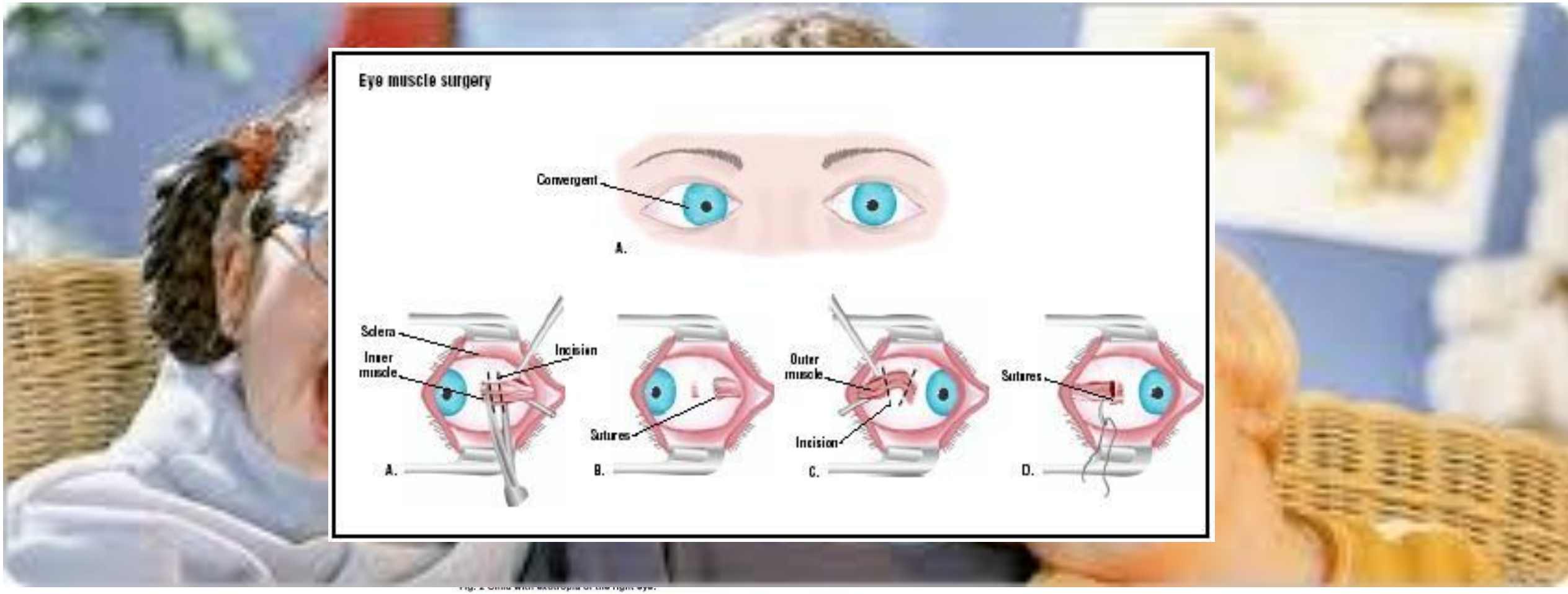


Farsighted

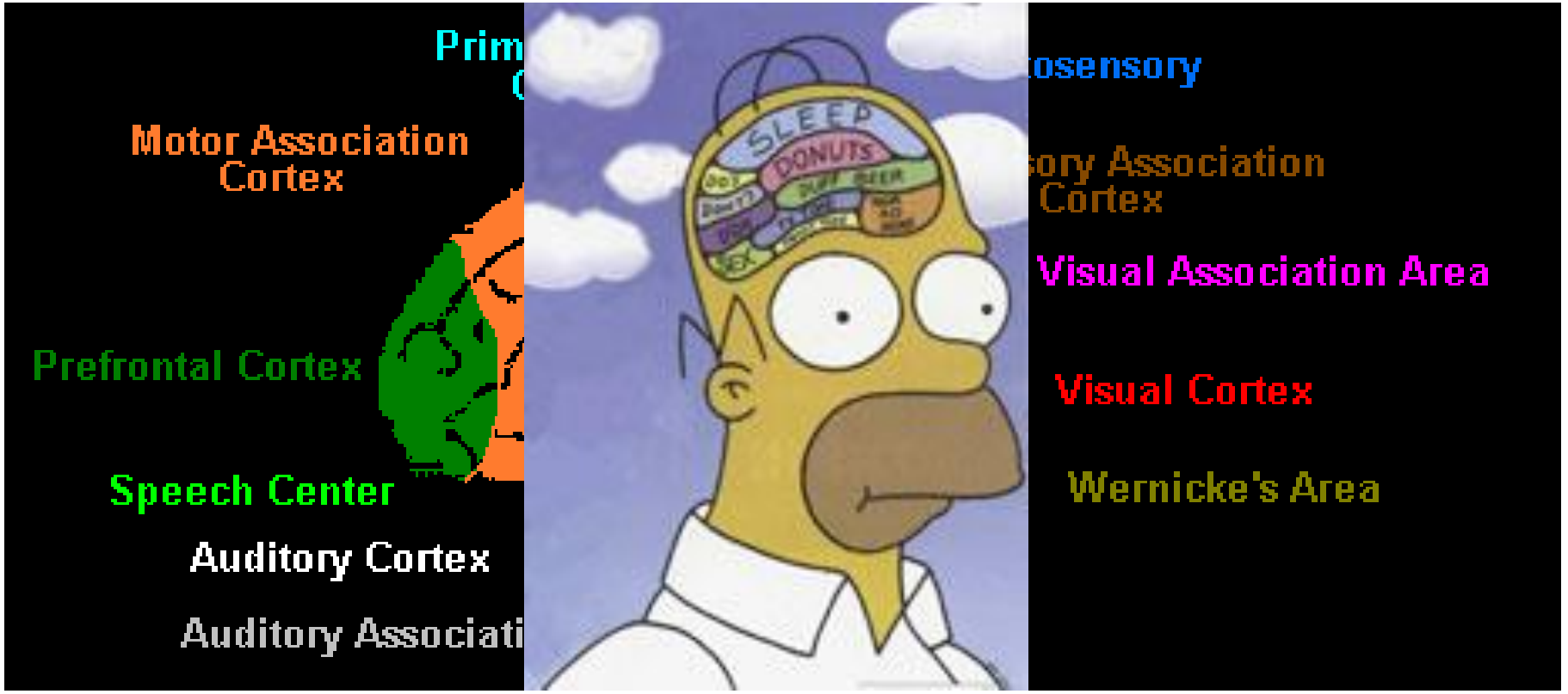
nisometropia



STRABISMUS


Eye muscle surgery
Convergent
A.
Sclera
Inner muscle
Incision
A.
Sutures
B.
Outer muscle
Incision
C.
Sutures
D.

FROM THE RETINA TO THE CORTEX

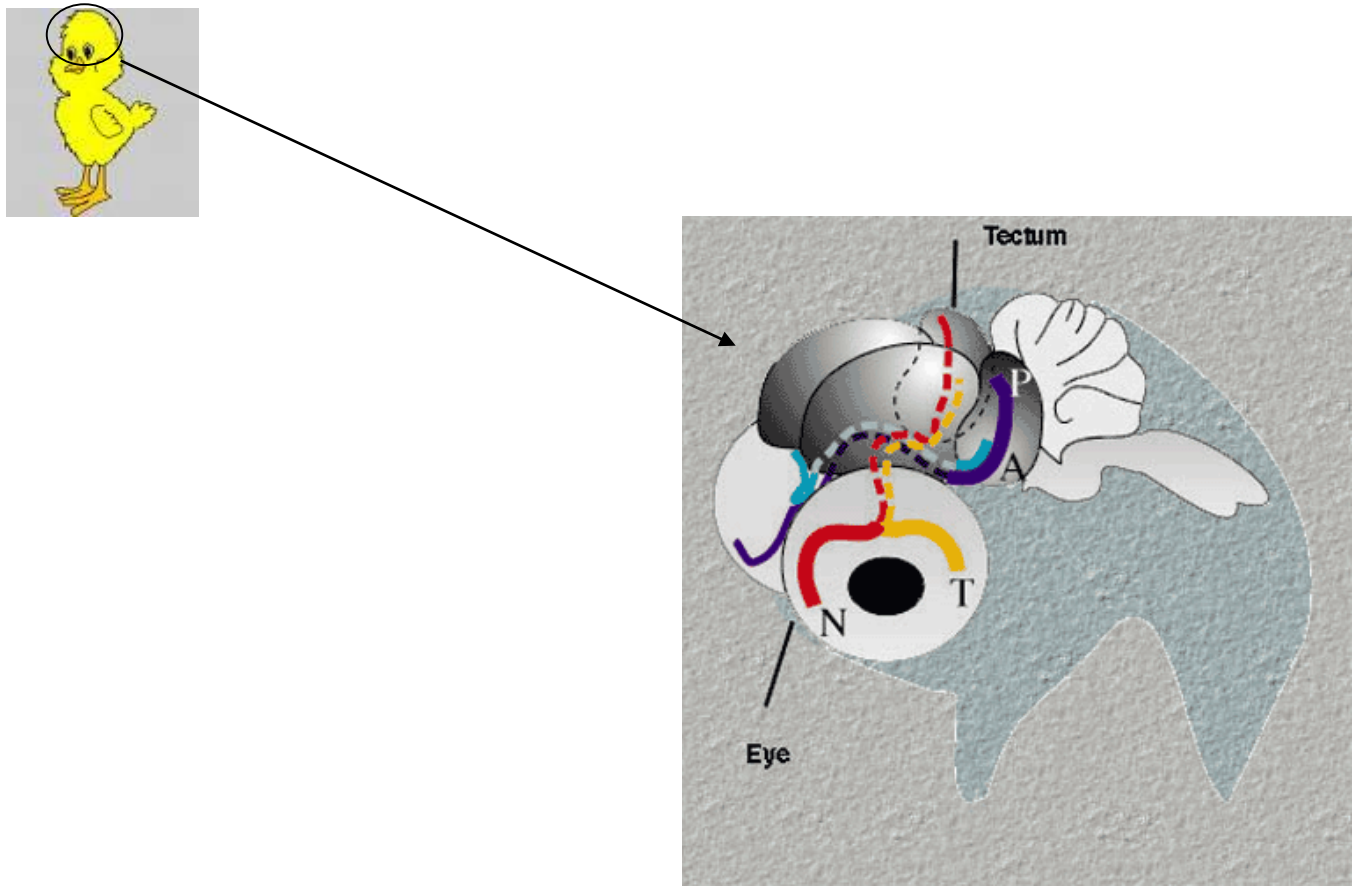


2 VISUAL SYSTEMS

Primary/retinocortical system

Subcortical/retinotectal visual system

RETINOTECTAL SYSTEM

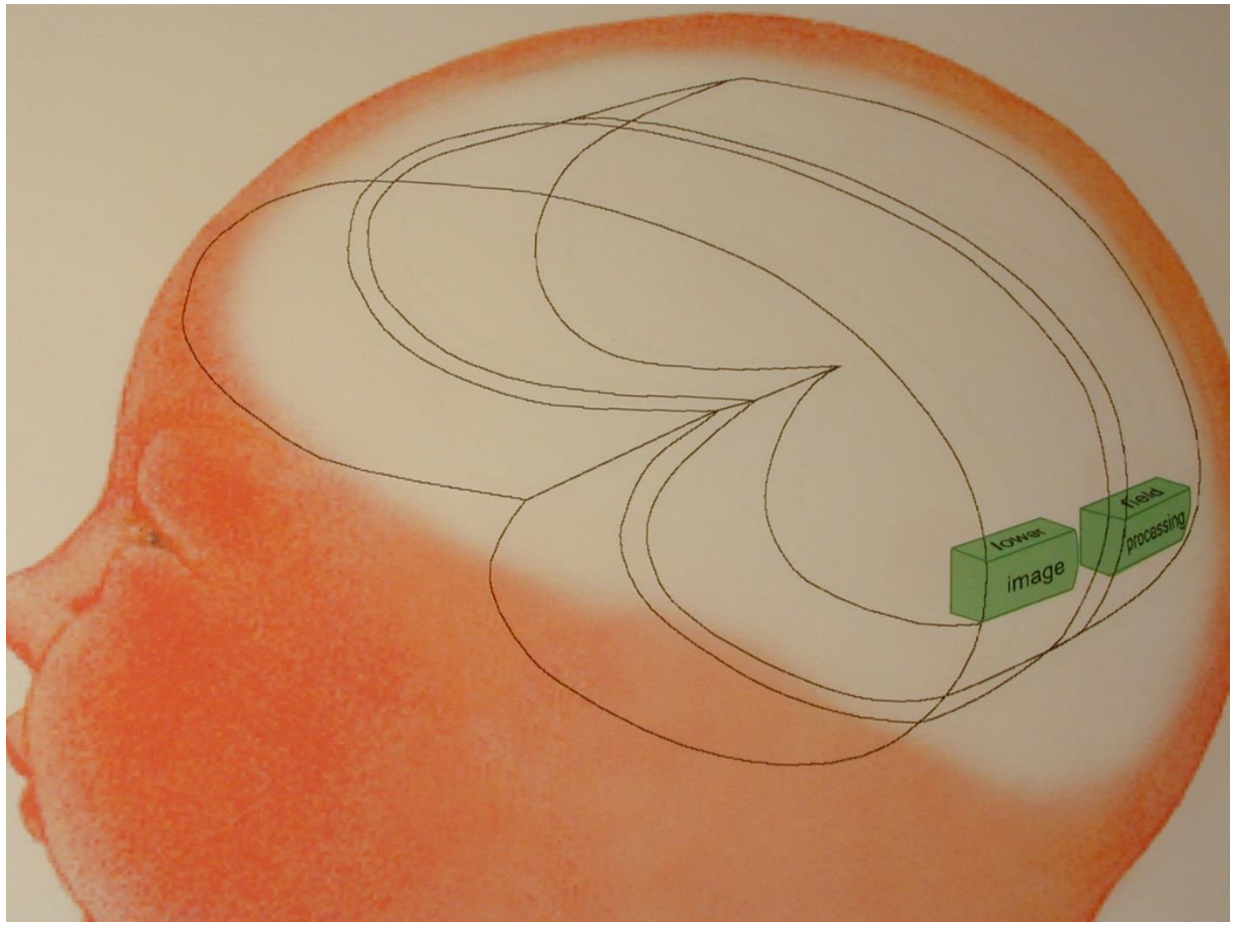


RETINOTECTAL SYSTEM

Orienting behaviors

Seeing what you don't see?

RETINOCORTICAL SYSTEM

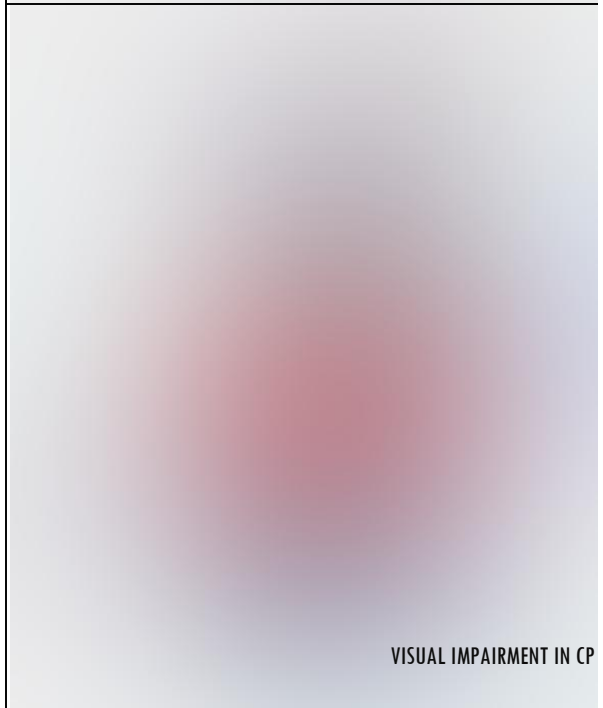


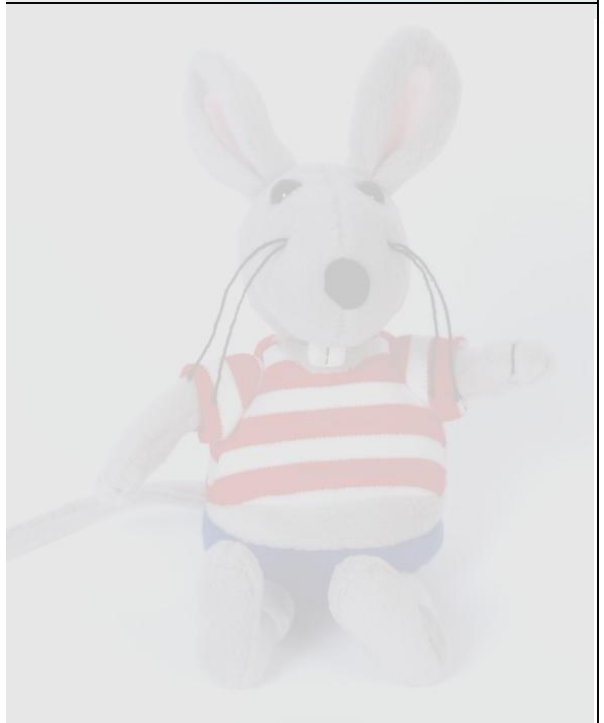
6/6

6/18

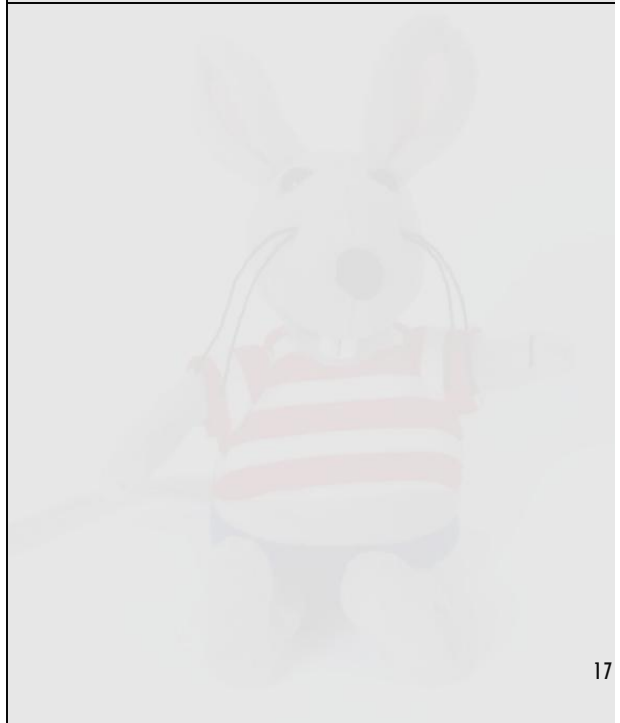
6/120

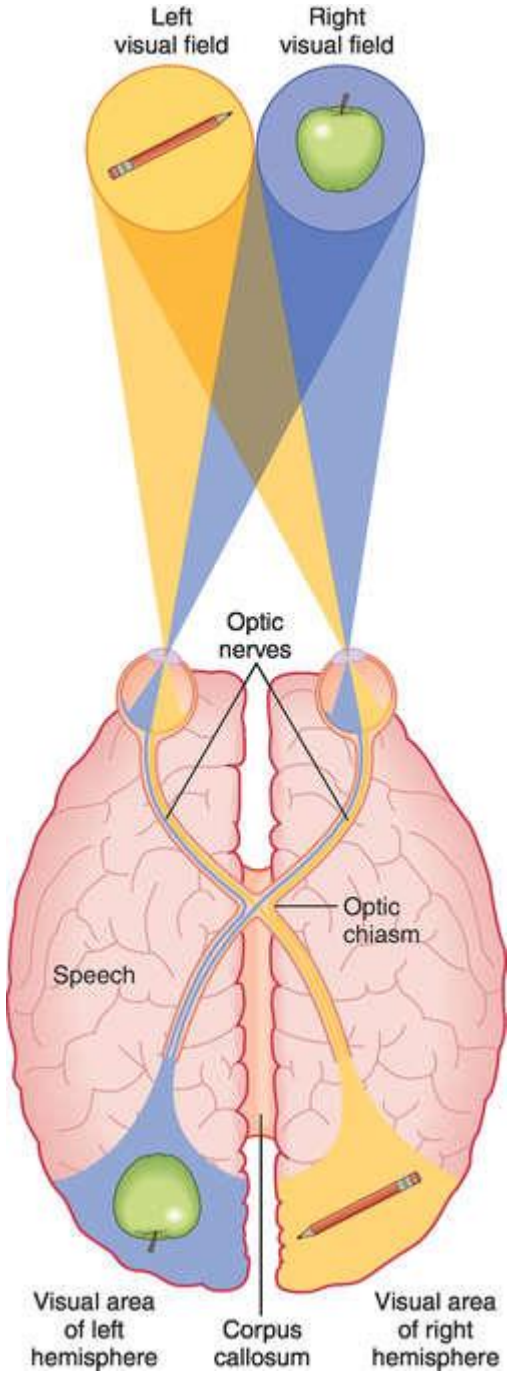
6/500



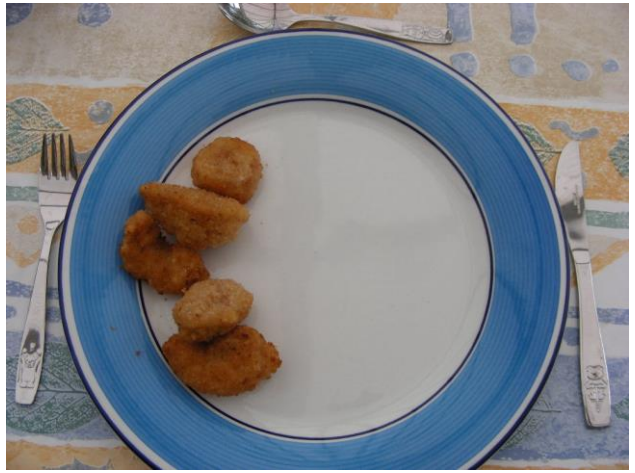


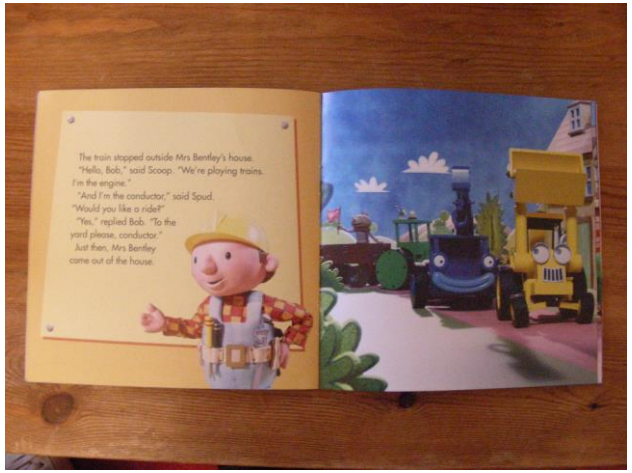
THESE SIMULATED CONTRAST SENSITIVITIES SHOW THAT THE DETAIL IS PRESENT, BUT THE PICTURE IS ‘WASHED OUT’.



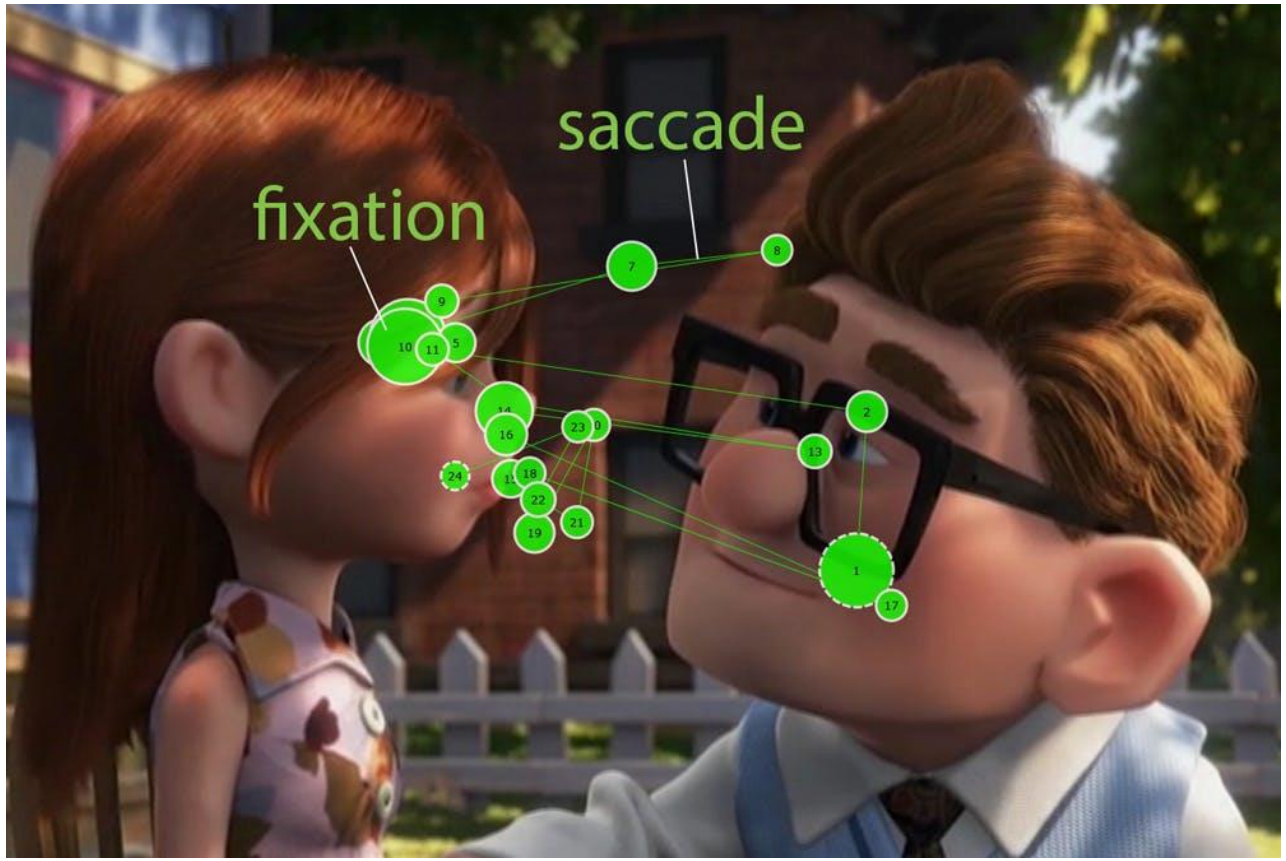

Left
visual field
Right
visual field
Optic
nerves
Optic
chiasm
Speech
Visual area
of left
hemisphere
Corpus
callosum
Visual area
of right
hemisphere

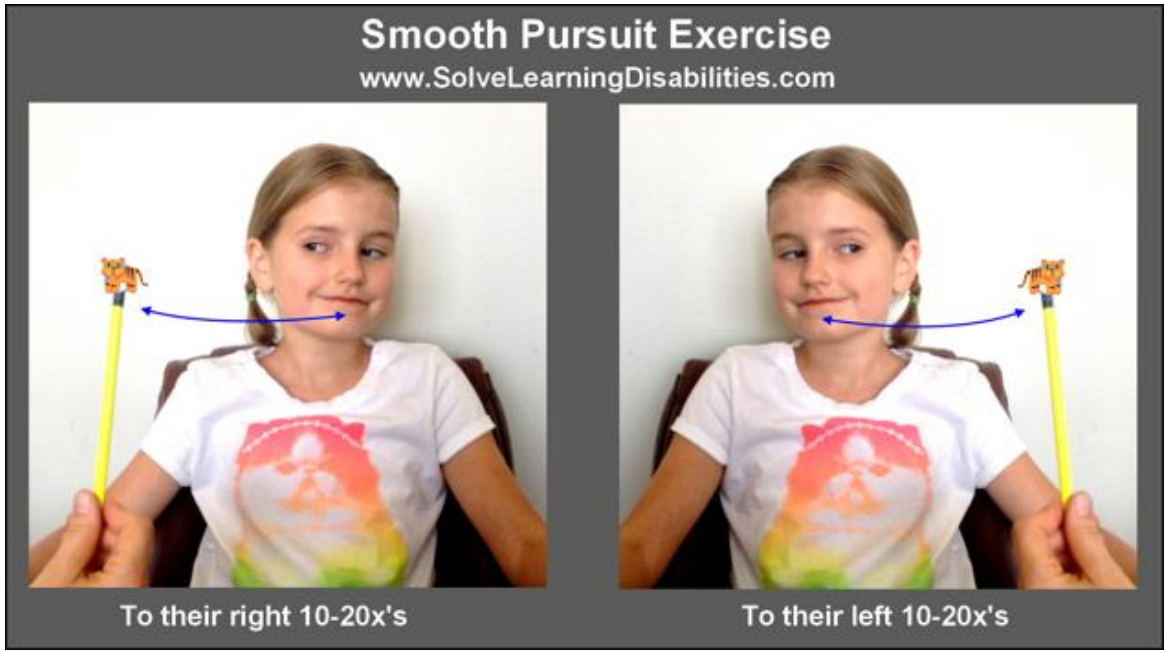
HEMIANOPIA



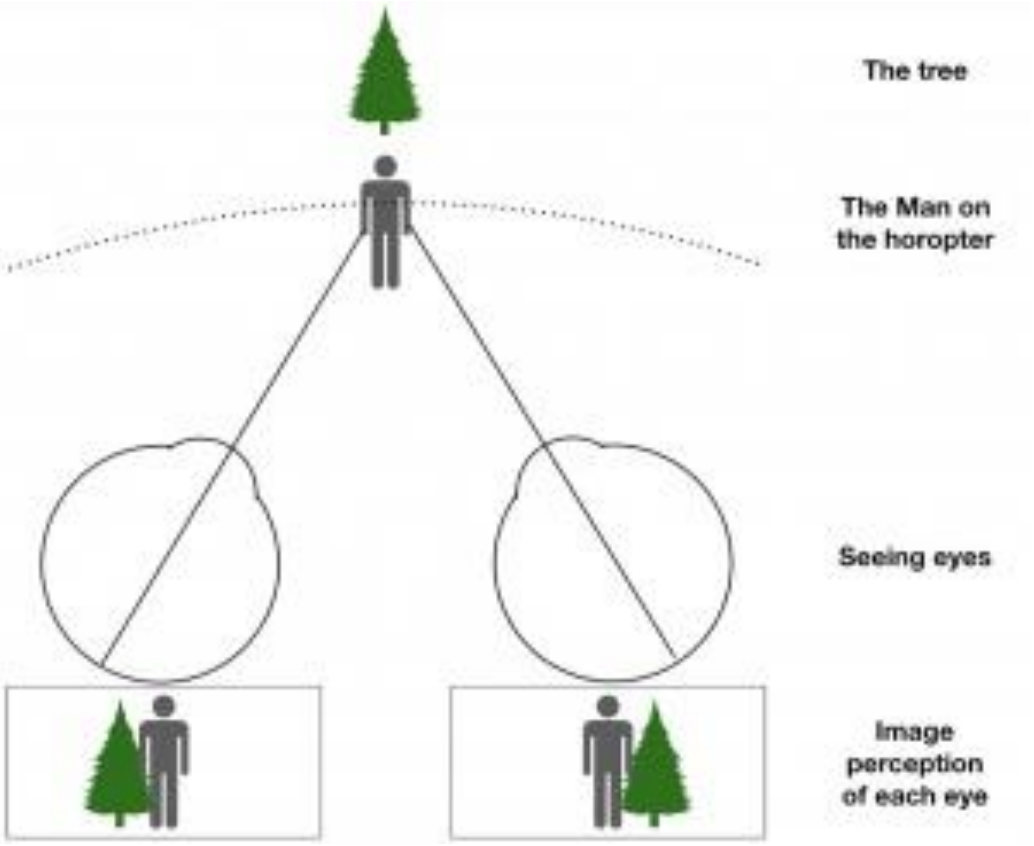

The train stopped outside Mrs Bentley's house.
"Hello, Bob," said Scoop. "We're playing trains.
I'm the engine."
"And I'm the conductor," said Spud.
"Would you like a ride?"
"Yes," replied Bob. "To the
yard please, conductor."
Just then, Mrs Bentley
came out of the house.

FIXATION – SACCADES – PURSUIT

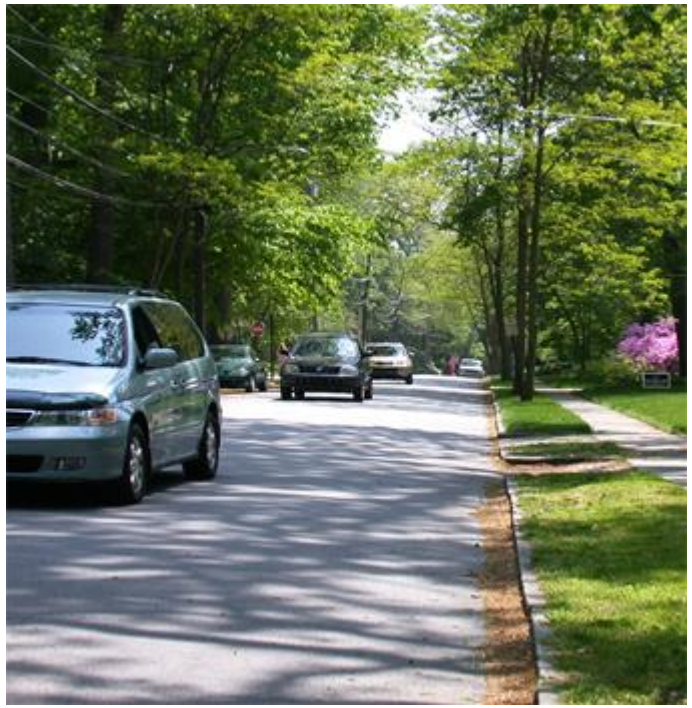




STEREOPSIS AND DEPTH PERCEPTION



STEREOPSIS AND DEPTH PERCEPTION



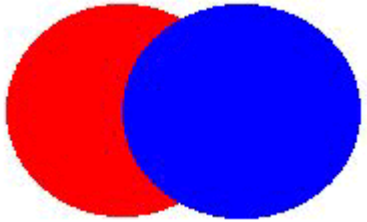
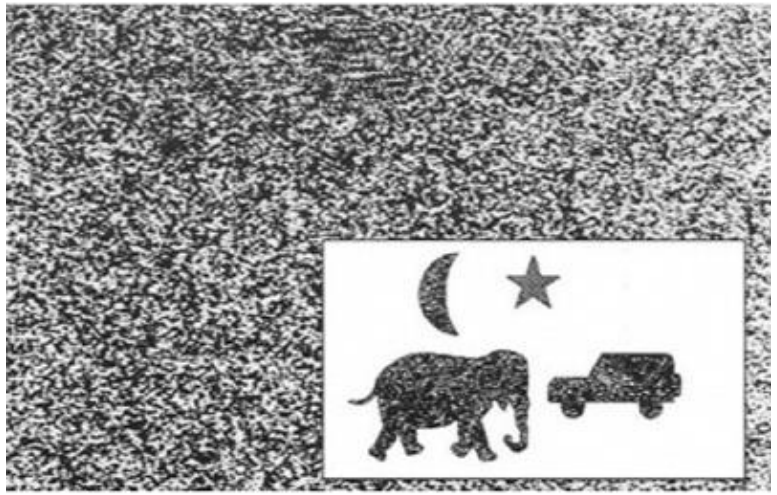
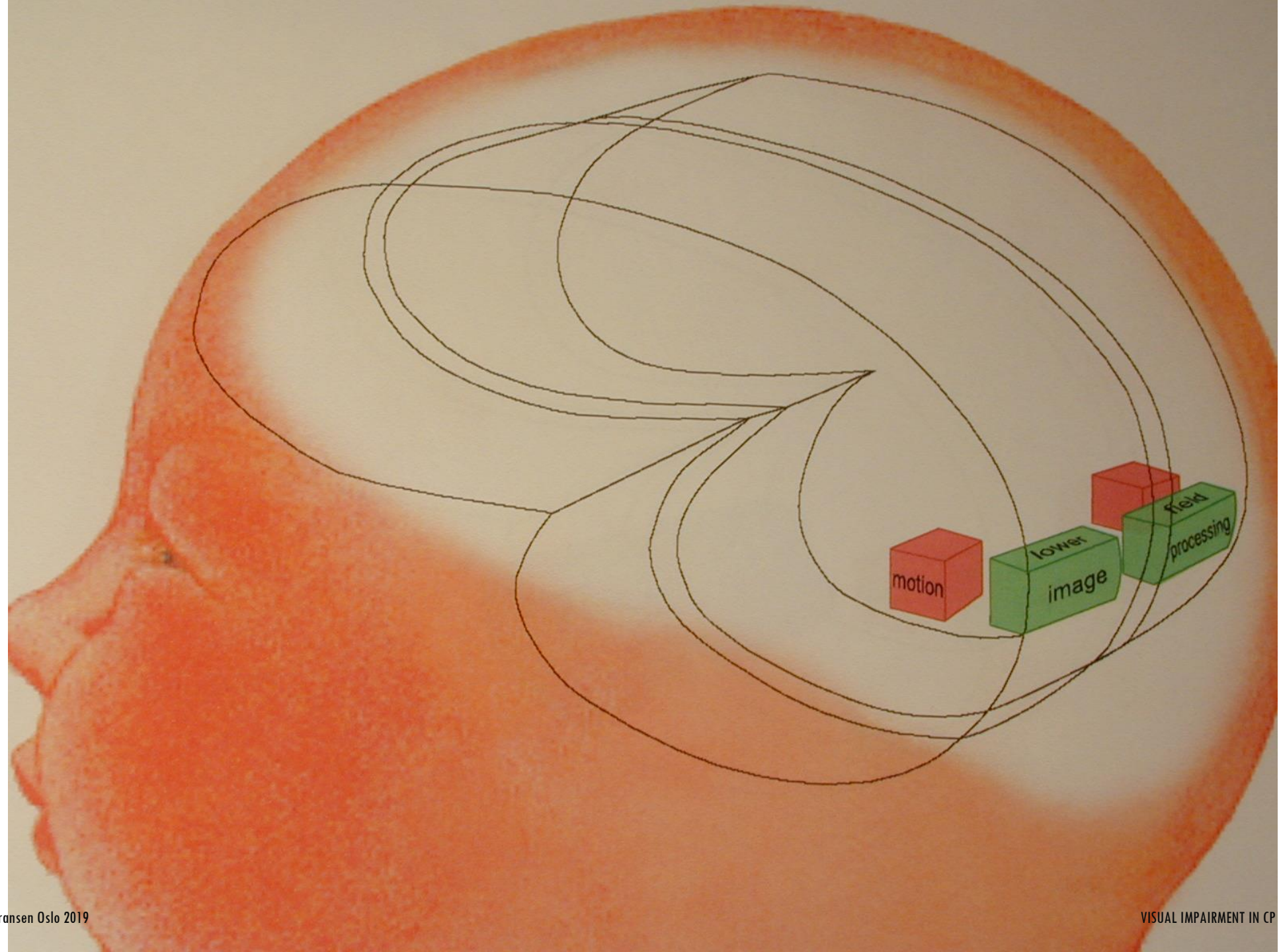


Figure 8. Titmus Fly Stereotest

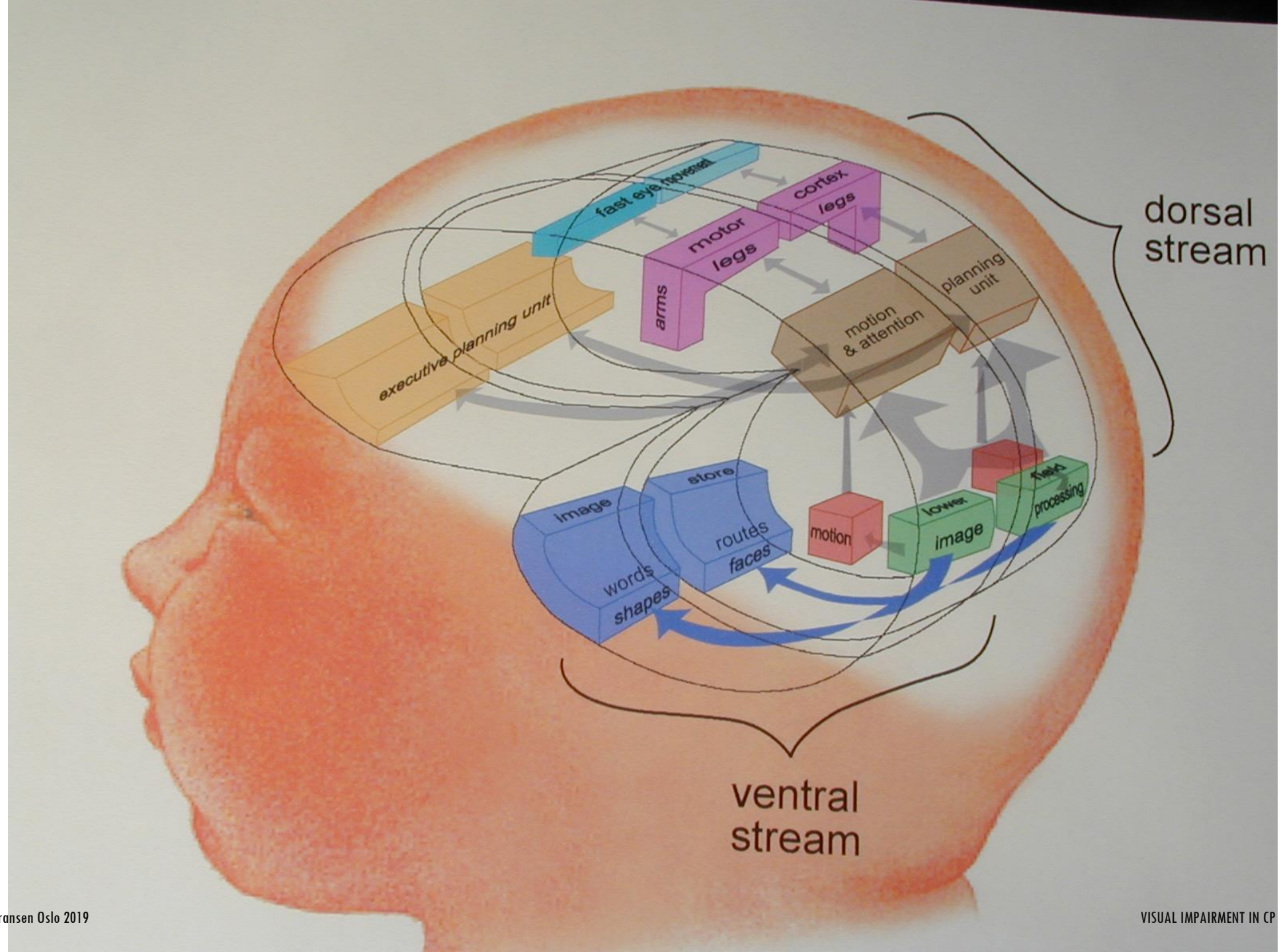



motion
lower
image
field
processing

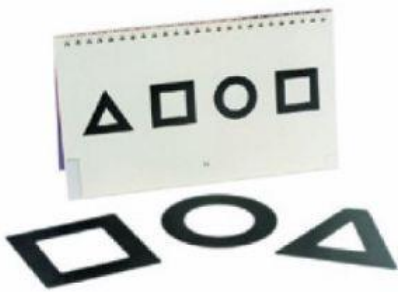
AKINETOPSIA

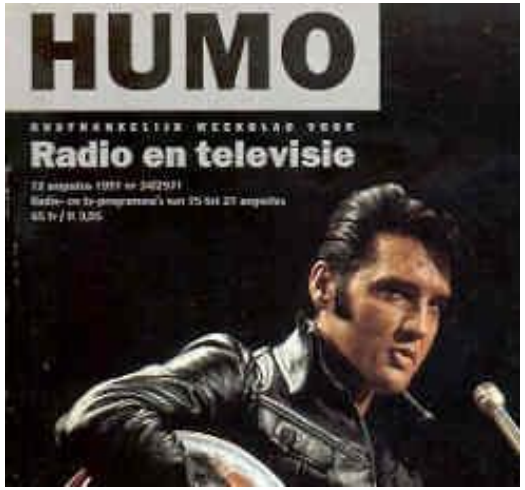
Akinetopsia is an inability to detect motion, so that a moving object such as a car will appear to “jump” from one stationary position to another.

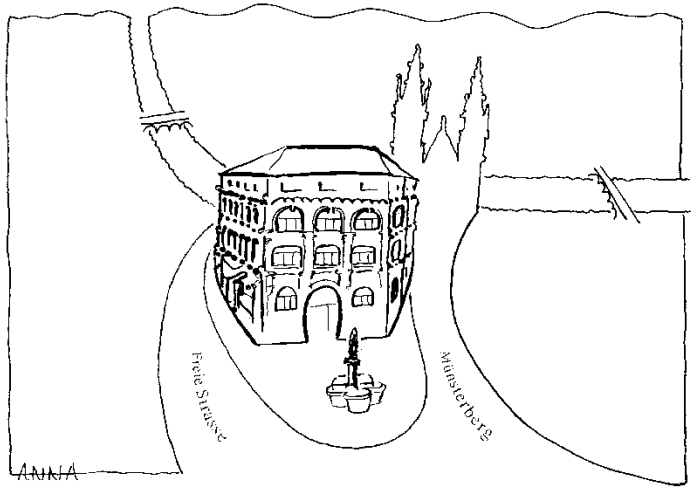
Figure 5.27 For the patient with motion blindness, the world appears as if viewed through a strobe light. Rather than see the liquid rise continuously in the teacup, the patient reports seeing the liquid jump from one level to the next.


dorsal
stream
fast eye movement
cortex
legs
motor
legs
arms
executive planning unit
motion
& attention
planning
unit
store
image
routes
faces
words
shapes
motion
lower
image
field
processing
ventral
stream

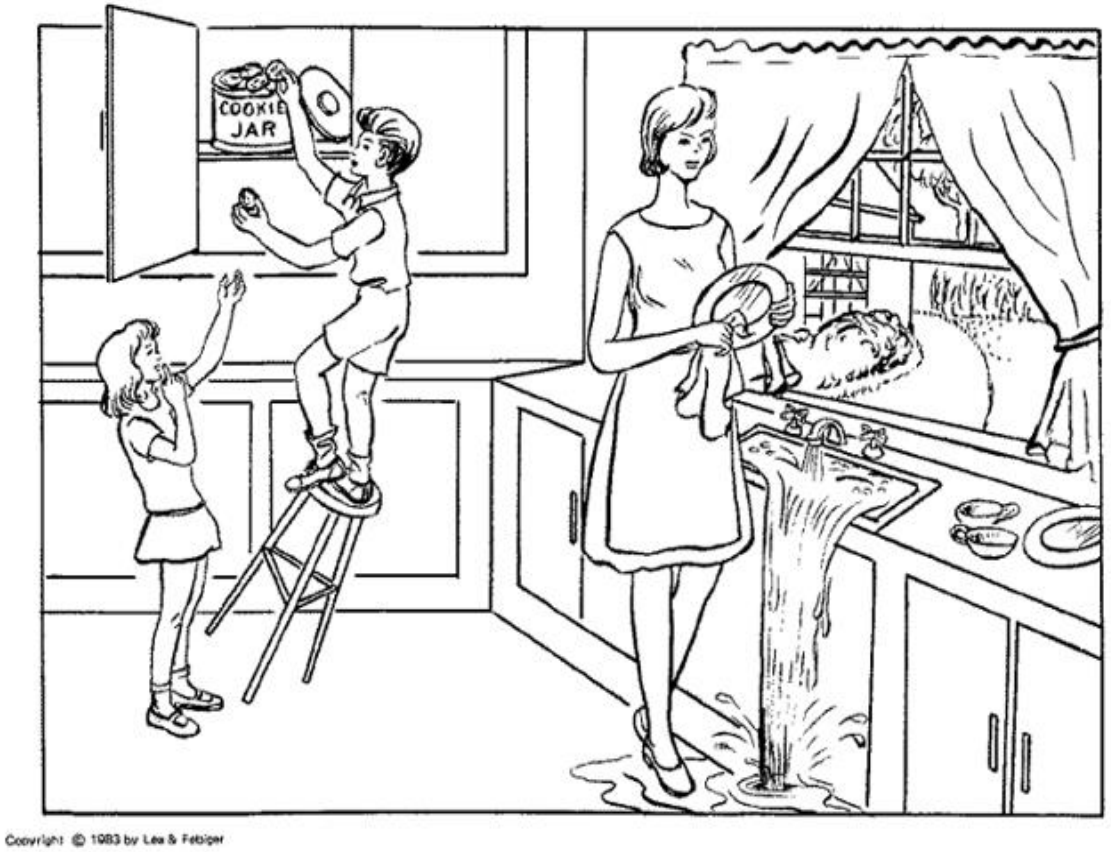
VENTRAL STREAM DYSFUNCTION







DORSAL STREAM DYSFUNCTION



Visualization Ability

Spatial Visualization

Ability to process visual information about spatial relations between objects or their parts and, perform mental spatial transformations and manipulations

Allocentric

Ability to mentally manipulate objects from a stationary point of view

Egocentric

Ability to imagine taking a different perspective in space

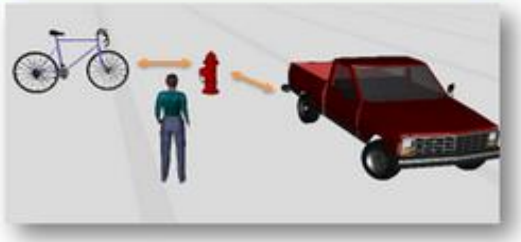
Object Visualization

Ability to process visual information about appearances of objects and scenes in terms of their pictorial properties (e.g., shape, color and texture)

Spatial Coding Systems

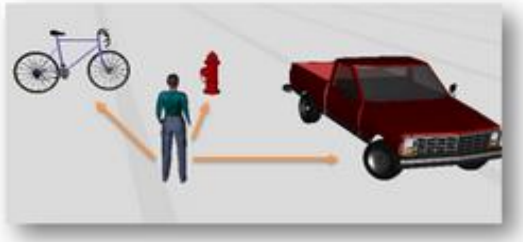
Allocentric (object-to-object)

Encodes information about the location of one object or its parts with respect to other objects. The location of one object is defined relative to the location of other objects.



Egocentric (self-to-object)

Represents the location of objects in space relative to the body axes of the self (left-right, front-back, up-down).



Kozhevnikov et al, 2001, 2006, 2010
Belmonti et al, 2016

CVI-PROBLEMS IN DAILY LIFE…

focussing

finding a white object on a white background

pictures

- prefering simple pictures
- difficult to listen and look at the same time

recognising people

- in group
- with new clothes, new haircut

CVI-PROBLEMS IN DAILY LIFE…

finding an object on a patterned background

making work sheets

getting lost in crowded locations

BUT ALSO…

visual fatigue

social problems

learning problems

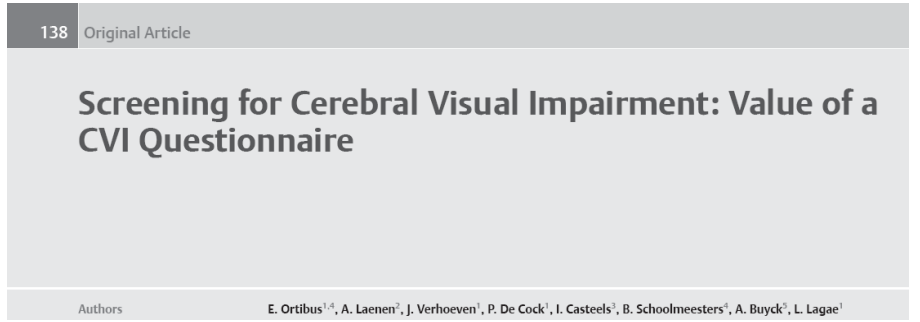
motor problems

SCREENING AND DIAGNOSIS

Neurobiological level	• Brain imaging (structural and functional) • EEG • Eye tracking
Neurocognitive level	• Visual perceptual testing • Visuomotor testing • Link between both
Behavioural level	• Questionnaires/surveys • Observations

Frith, 2001

FLEMISH CVI QUESTIONNAIRE



3	Tilts head to look at objects
22	Does not recognize everyday objects such as an apple, bike, ..
23	Recognizes familiar objects only when they are drawn in color
31	Has no interest in complex pictures
34	Cannot find the chocolate spread on the table
40	Manipulates an object rather than looks at it
47	Tries to compensate by talking a lot

Quick screener during routine public health school controls?

Bibliography
DOI http://dx.doi.org/10.1055/s-0031-1285908
Published online: September 12, 2011
Neuropediatrics 2011; 42: 138–147

ISSN 0174-304X

QUESTIONNAIRES

TEACH
ERAVS
MUSI+

- 0-3y/MDVI
- 3-6y
- 6-12y

- www.teachcvi.net

Erasmus+

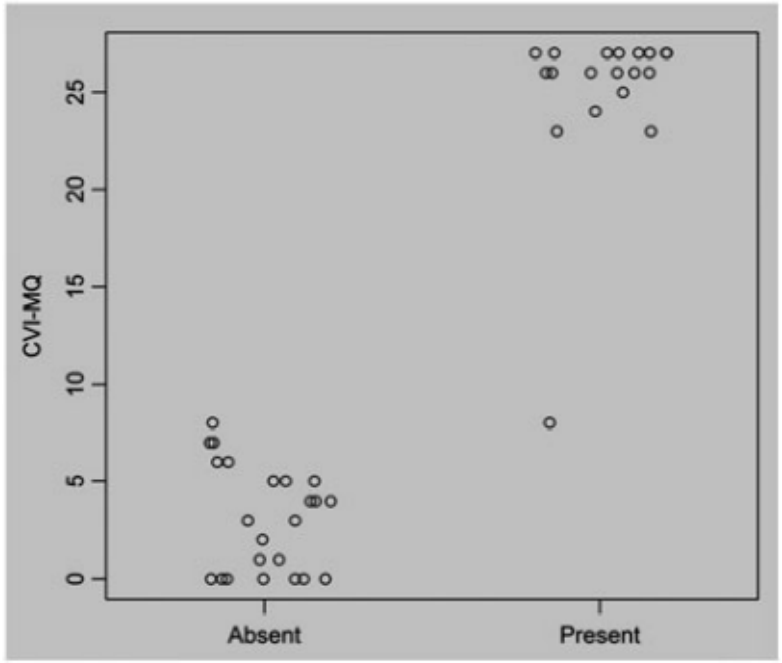
Development and face validity of a cerebral visual impairment motor questionnaire for children with cerebral palsy

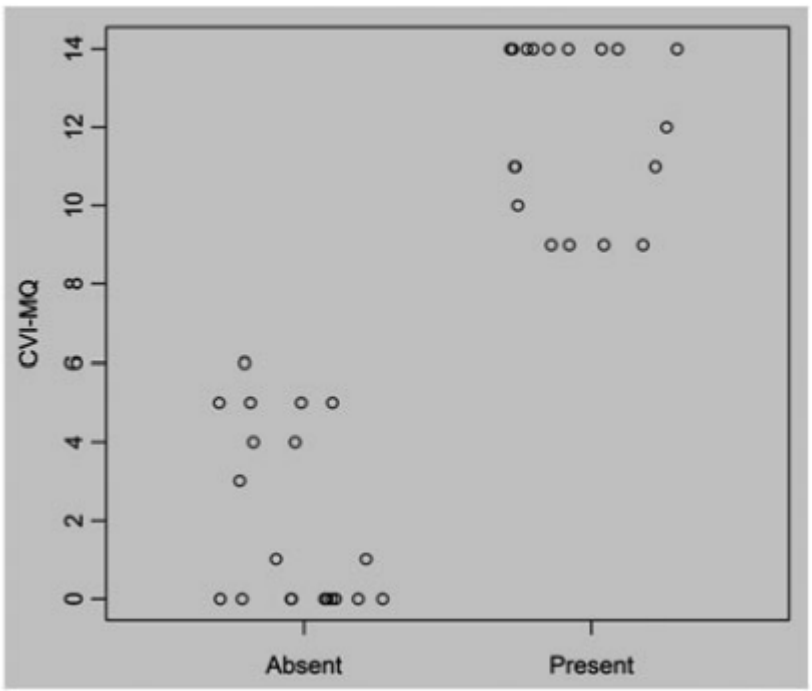
M. Salavati,*† A. Waninge,*† E.A.A. Rameckers,‡§¶ J. van der Steen,*|| W.P. Krijnen,† C.P. van der Schans†** and B. Steenbergen†††‡‡

© 2016 John Wiley & Sons Ltd, *Child: care, health and development*, **43**, 1, 37–47

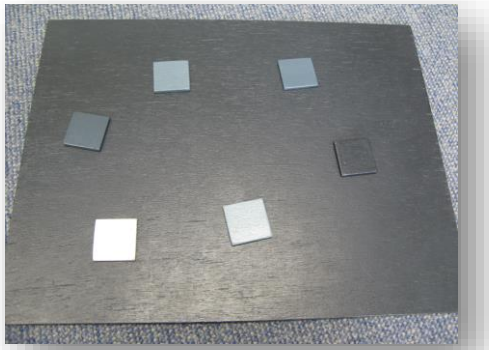
Fine motor skills/ reaching and grasping

9	The child reaches more precisely for moving objects than for non-moving objects.
10	The child reaches more precisely for sound-producing*, high-contrast*, fluorescent*, illuminating* objects than for non-sound-producing*, non-high-contrast*, non-fluorescent*, non-illuminating* objects.
11	The child looks away when it grabs an object.
12	The child reaches for a toy but has difficulty finding the toy in a crowded background. For example, finding a block on a full table or in a basket filled with toys.
13	The child grabs an object if it produces sound.
14	The child explores*/manipulates* toys with its mouth or hands instead of exploring it with its eyes.





OPHTHALMOLOGICAL AND ORTHOPTIC ASSESSMENT



Be creative

NEUROPSYCHOLOGICAL WORK UP

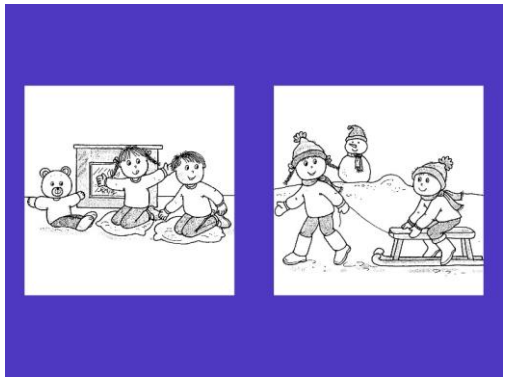
- Visual attention
- Object recognition
- Visuospatial abilities
- Visuomotor abilities

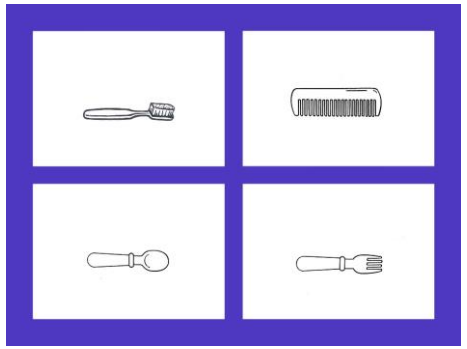
Domain	Tea-Ch Subtests	TEA-Ch2 J (Junior) (ages 5:0 - 7:11) Equivalent Subtestes	TEA-Ch2 A (Adolescent) (ages 8:0 - 15:11) Equivalent Subtests
Selective Attention	Sky Search	Balloon Hunt	Hector Cancellation
	Sky Search DT		Troy Dual Task
	Map Mission	Hide & Seek Visual	Hecuba Visual Search
Sustained Attention	Score	Barking	Vigil
	Score DT	SART	SART
	Walk Don't Run	Simple RT (SRT)	Simple RT (SRT)
	Code Transmission	Hide & Seek Auditory	Cerberus
Switching Attention	Creature Counting	N/A	Red & Blues, Bags & Shoes (RBBS)
	Opposite Words	N/A	

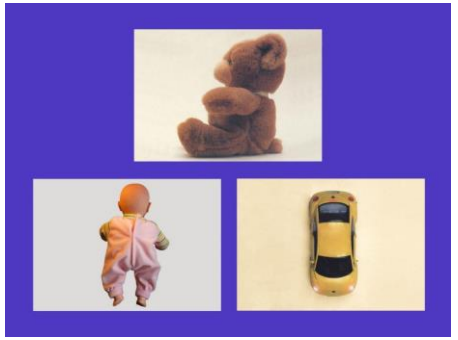
OBJECT RECOGNITION

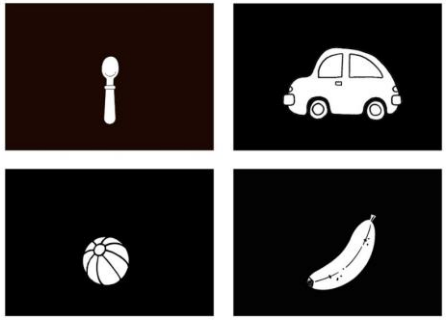
< 3y	3y – 6y	6y – 12y	12y – 18y	> 18y
• BSID-II • G.CVI.Tods	• CVIT 3-6 • L94		• L-Post	• BORB • Poppelreuter-Ghent's Overlapping Figures Test • VOSP • L-Post

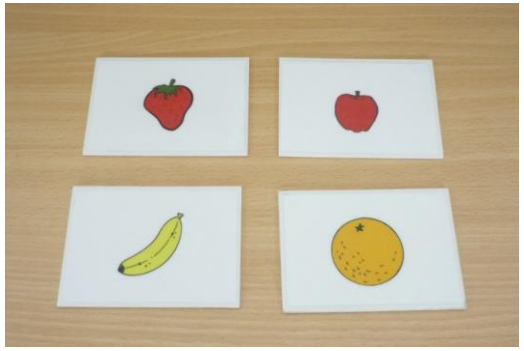
G.CVI.TODS
GANSPOEL **CVI TOD**DLERS











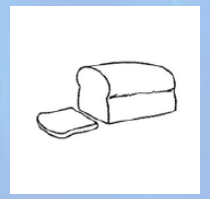
The test

CVIT 3-6

- Object Recognition

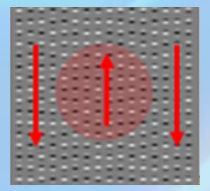
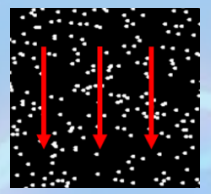
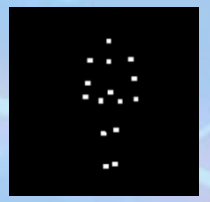


- Degraded Object Recognition

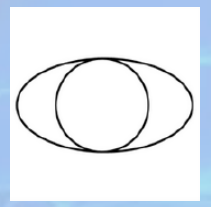




- Motion Perception

- Global – Local Processing

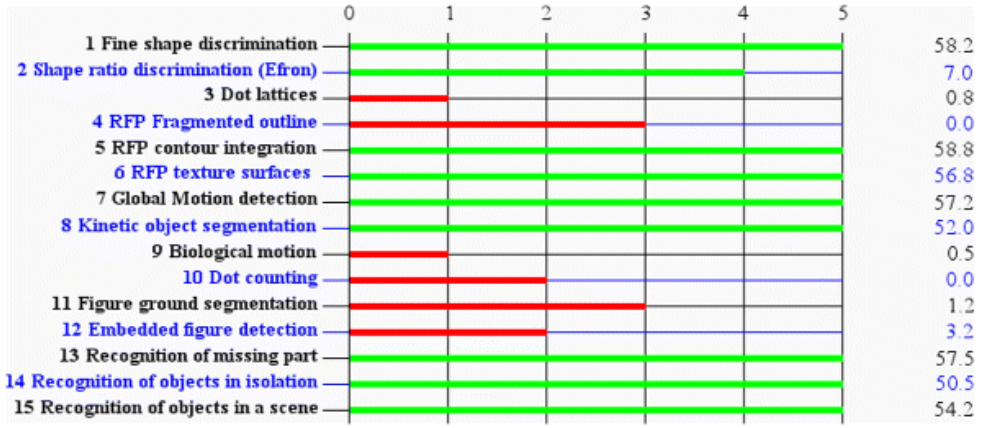

Vancleef et al, DMCN, under review

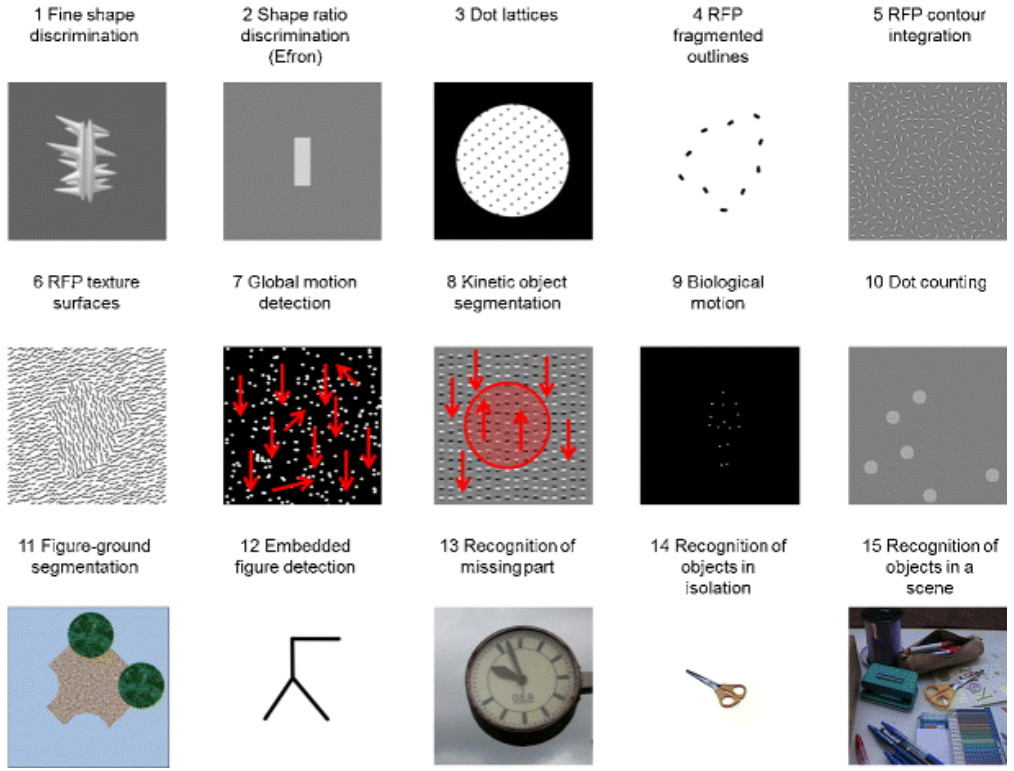
L- POST

Name clinician	Example clinician
Date test (YY-MM-DD)	2012-12-21
Patient ID	Example participant
Year of birth	1960

In total 56 out of 75 correct, thus 74.66 %. Number of subtests below the threshold of the 10th percentile: 6 (percentile 0.4). If 4 or more subtests are scored below the threshold, there are indications of problems in perceptual organization because only 10% (or less) of the healthy norm group will get this score.

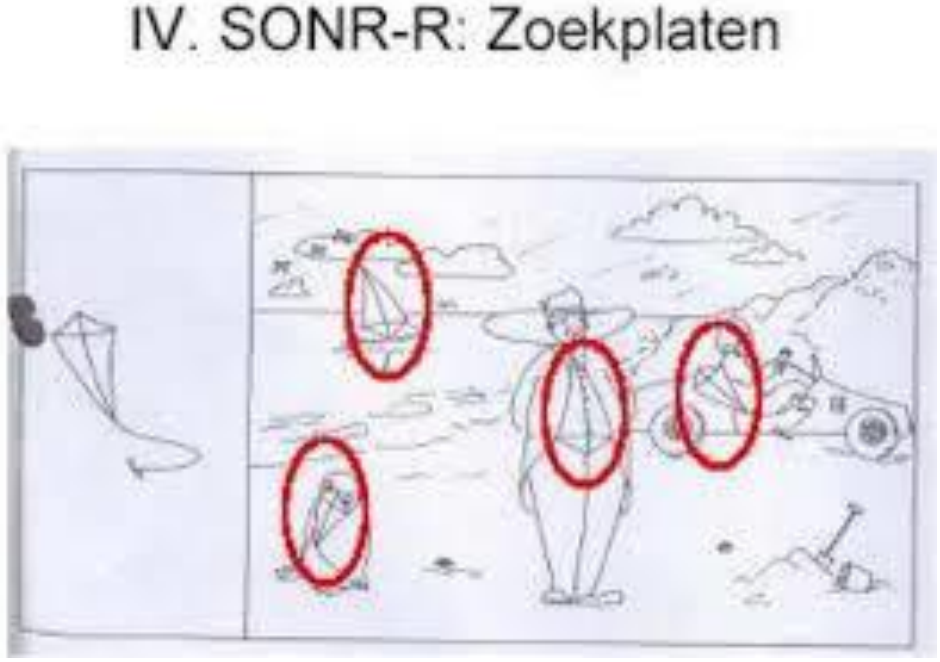
Scores for each subtest.

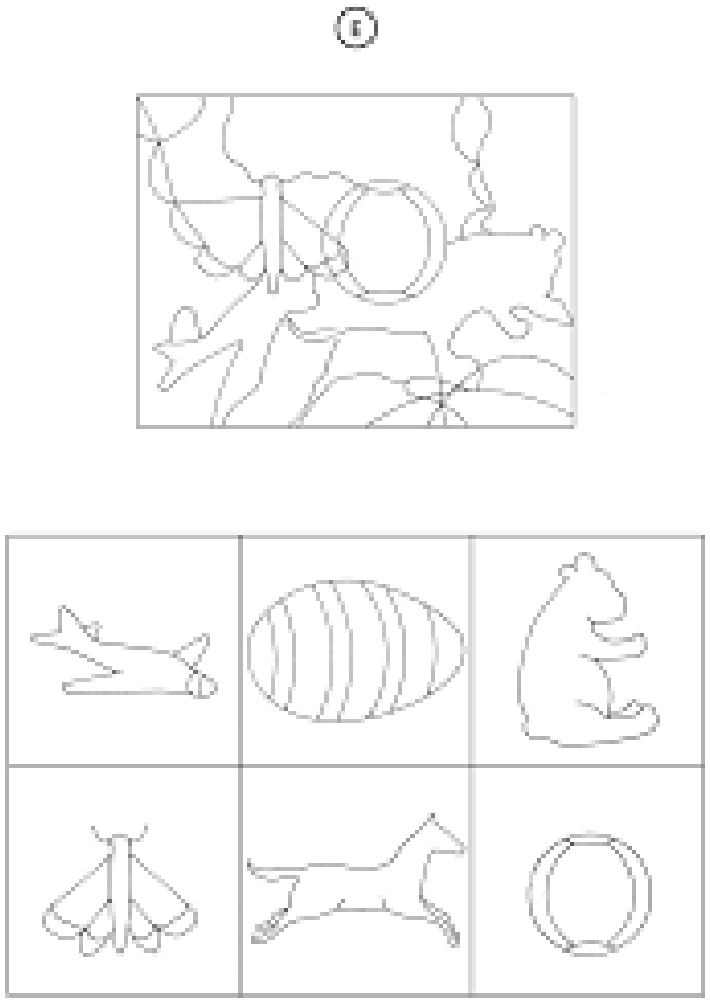




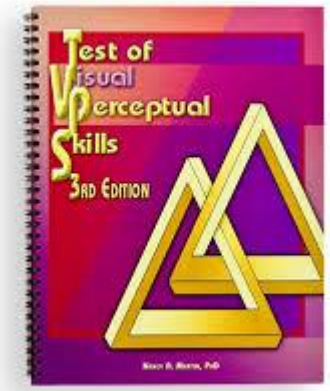
Vancleef et al, J Neuropsychol, 2015

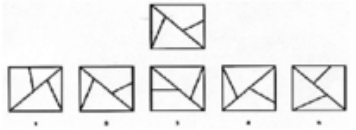
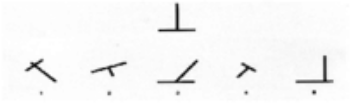
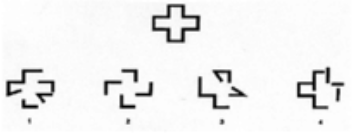
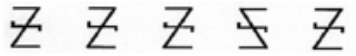
FIGURE GROUND



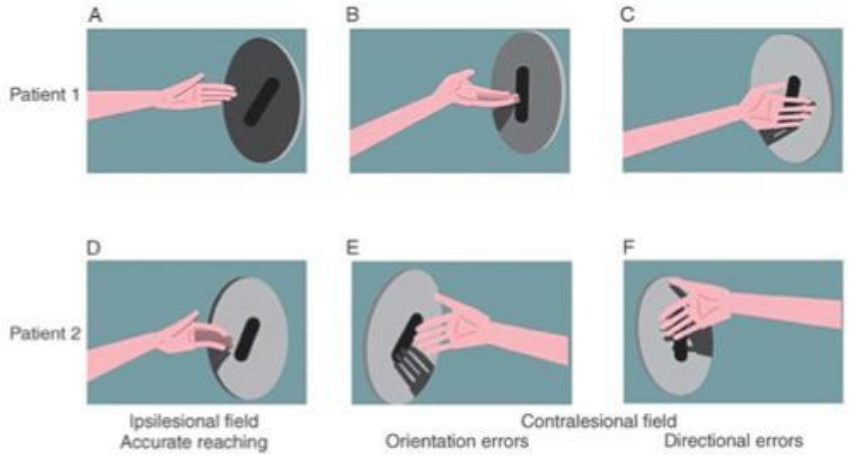


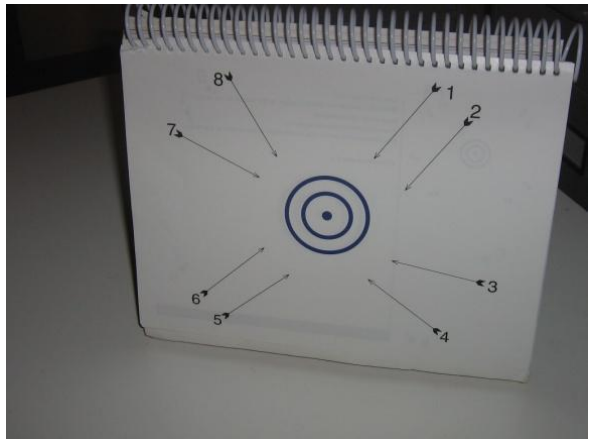
PERCEPTION OF ABSTRACT MATERIAL

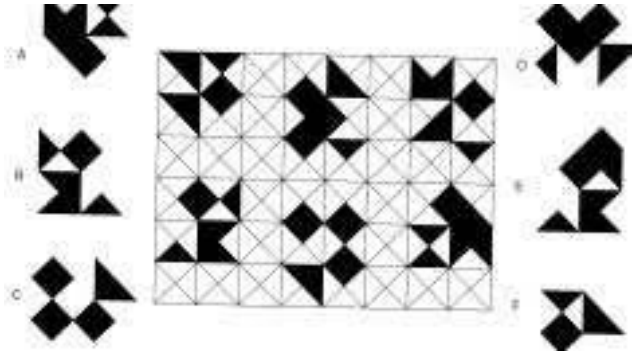


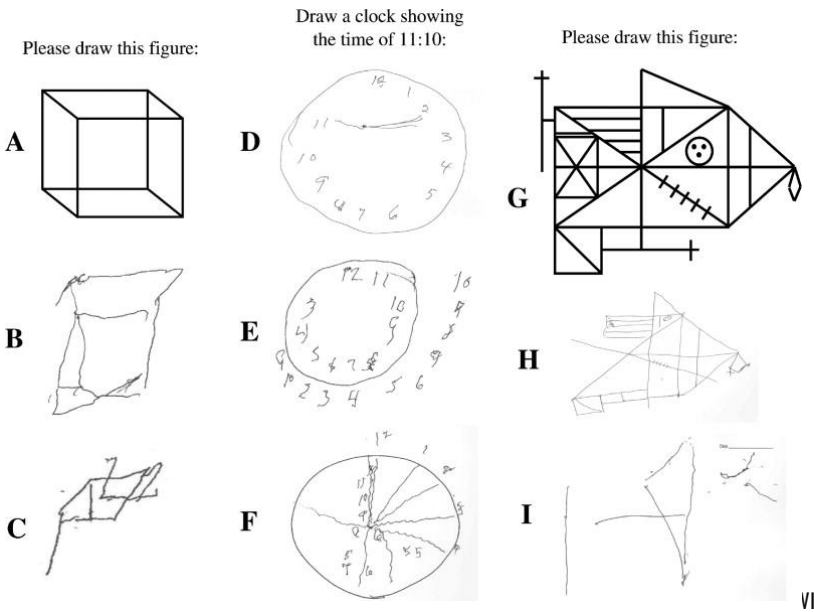
Visual skill	Example	Relavence
Visual Discrimination		– Ability to determine similarities between objects – needed for sorting objects eg Silverware, laundry
Visual Form Constancy		– recognize object despite change in size/ location
Visual Figure Ground		– find object of interest from background – finding milk in the fridge
Visual Closure		– fill in information to complete visual image – Finding objects in busy environment e.g. messy room
Visual Spatial Relations		– tell how objects relate to each other – Telling time on a clock
Visual Memory		– recall a visual image – recognizing faces, objects, remembering where items were left in a room
Visual Sequential Memory		– recall a visual sequence – phone numbers/ spelling

VISUOSPATIAL - VISUOMOTOR

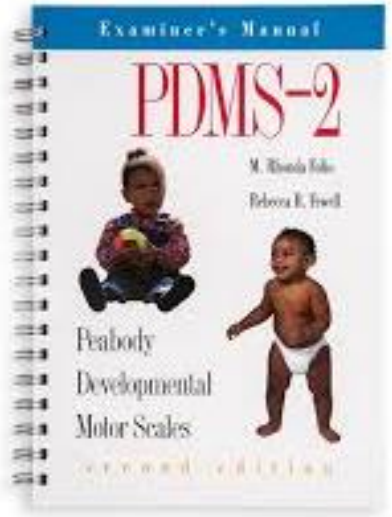


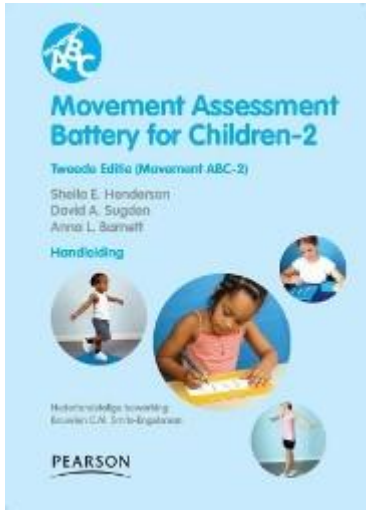


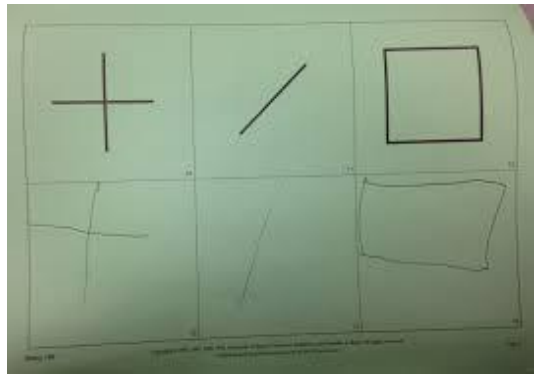


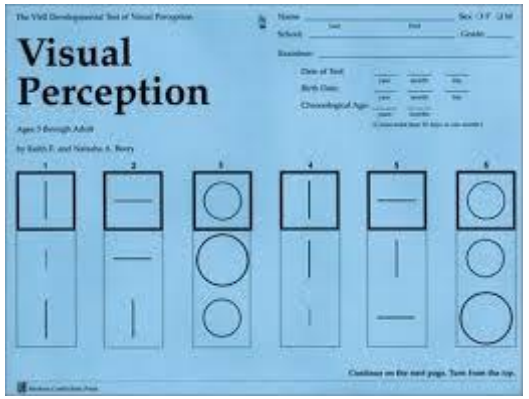


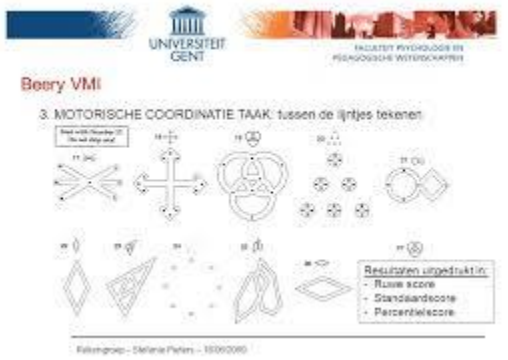
VISUOMOTOR - VISUOSPATIAL











RECOMMENDATIONS FOR VISUAL FOLLOW UP

Regular check with the ophthalmologist

- 1st year
- 2nd year
- 5 years of age
- More frequent if problems

Screening for CVI

- Observation, Questionnaires, Assessment tools
- As soon as possible
- Up into adolescence

VISUAL FUNCTIONS AND FUNCTIONAL VISION

	Visual Functions *How the visual system functions*	**Functional Vision** *How the person functions*
Examples	*Visual acuity, visual field, contrast, visual adaptation, color vision etc.*	*Orientation and Mobility, Daily Living Skills, Communication, Sustained near activities*
Measured	*For each eye separately*	*For the person as a whole*
Method	*Variable stimulus; fixed, threshold performance.*	*Standardized task; variable performance or difficulty.*
Tests	*Single variable, under controlled conditions.*	*Multiple variable, under complex, real-life conditions.*
Criteria	*Threshold performance.*	*Sustainable, supra-threshold performance.*
Involves	*Visual parameters only.*	*May also reflect non-visual factors.*

TEACH ERAVS MUSI+

THE CVI TEAM

Gestaltrevision lab

Johan Wagemans

Kathleen Vancleef

Newcastle University

Centre for Developmental Disabilities University Hospitals Leuven

Els Ortibus

Eva Janssens

Mieke Destrooper

Annelies Verstraeten

Jeannine Vanbussel

Kristien Jacobs

Geertrui Peirens

Bie Schoolmeesters

Flemish CVI Network

CENTRUM GANSPOEL

KONINKLIJK INSTITUUT SPERMALIE

Els.ortibus@uzleuven.be