

Development of Vision from Infancy to Early Adolescence

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Transdisciplinary approach
in rehabilitation and integration

The goal of the continued education in visual functioning.

How can we together learn more about functioning of visually impaired children?

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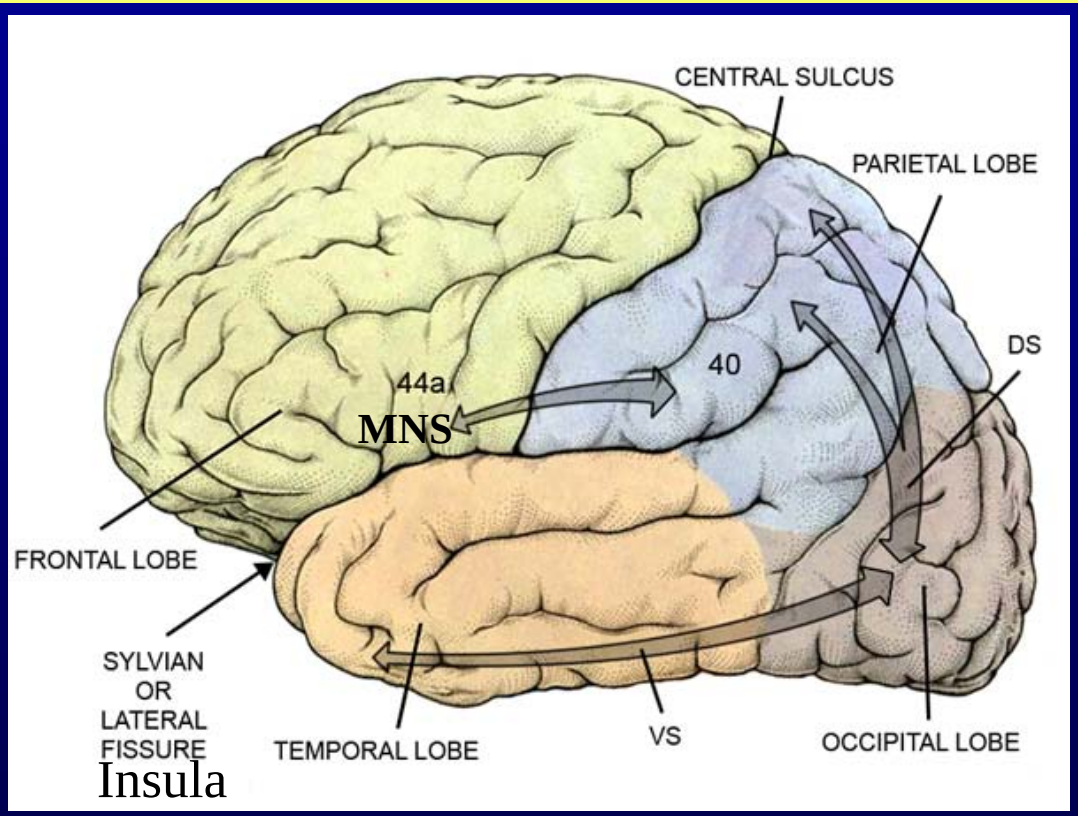
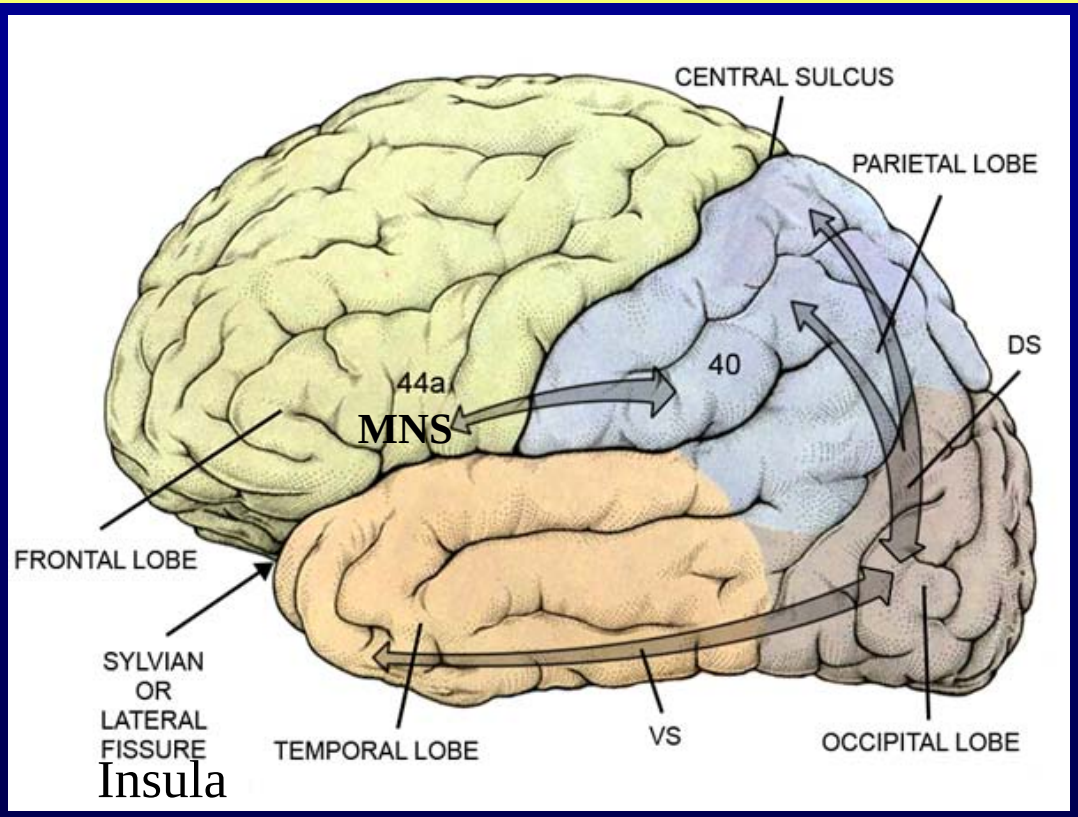
Processing of visual information



Early processing in the occipital lobe:

Ventral stream
Dorsal stream
Mirror neuron system

Processing of visual information



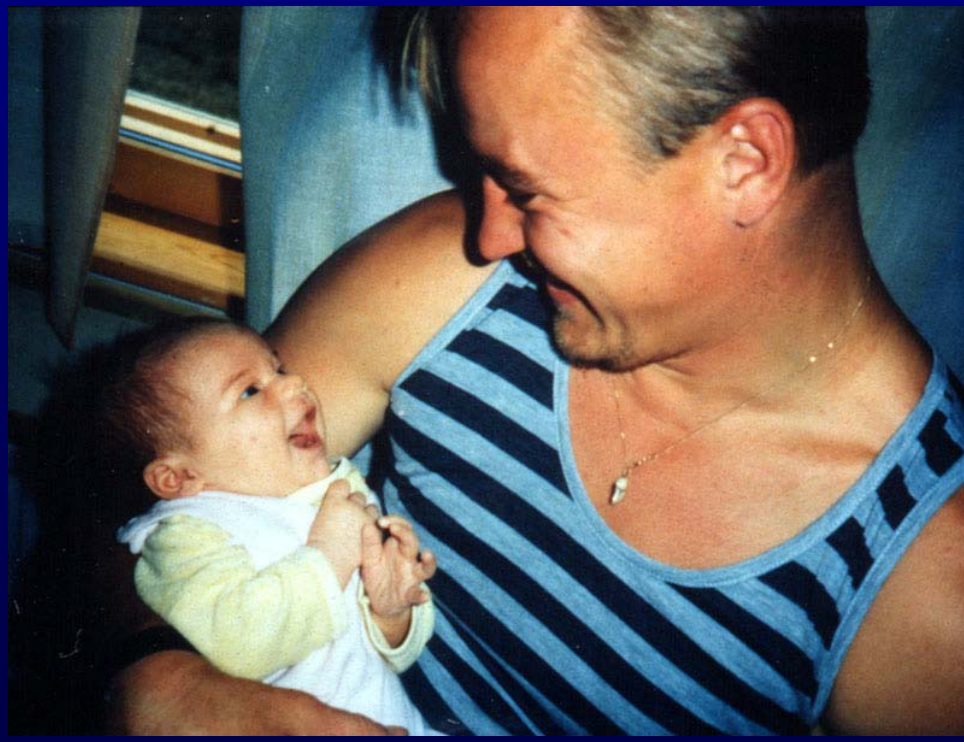
Early processing in the occipital lobe:

Ventral stream
Dorsal stream
Mirror neuron system

Visual communication

Eye contact, copying of expressions
At 6 weeks, 8 weeks at the latest

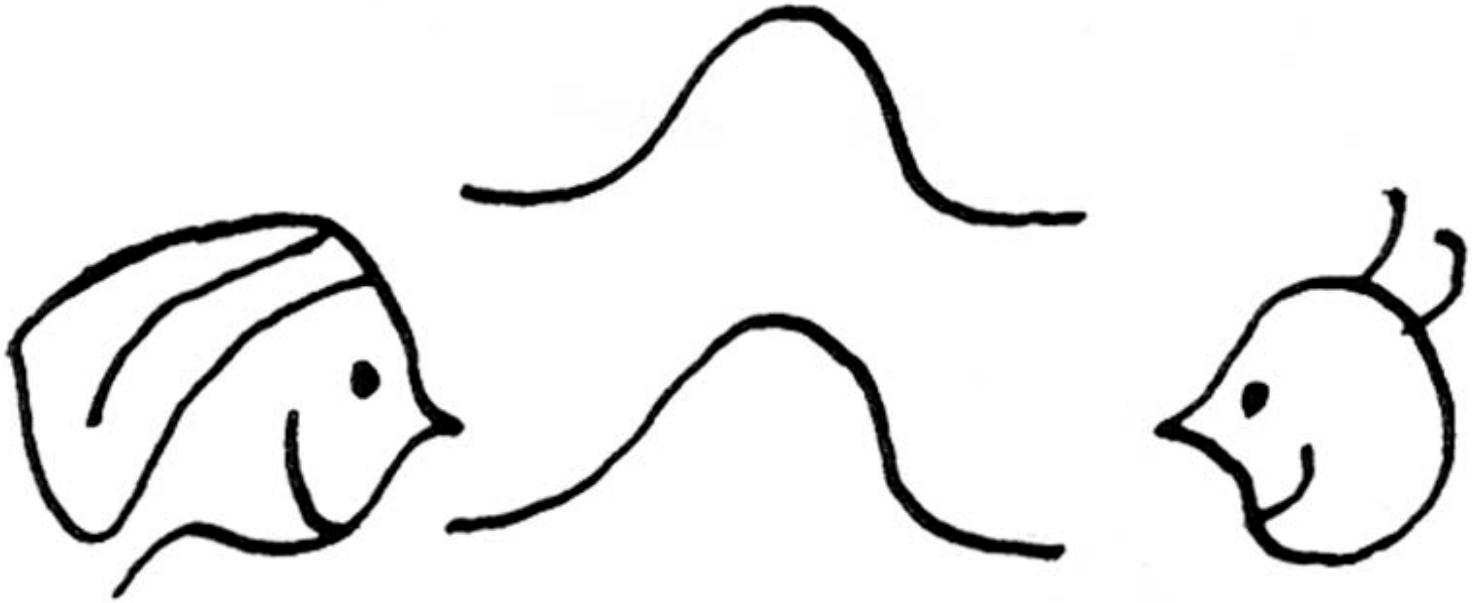
Social smile, active interaction
at the age of 12 weeks.



Communication – at 8 weeks

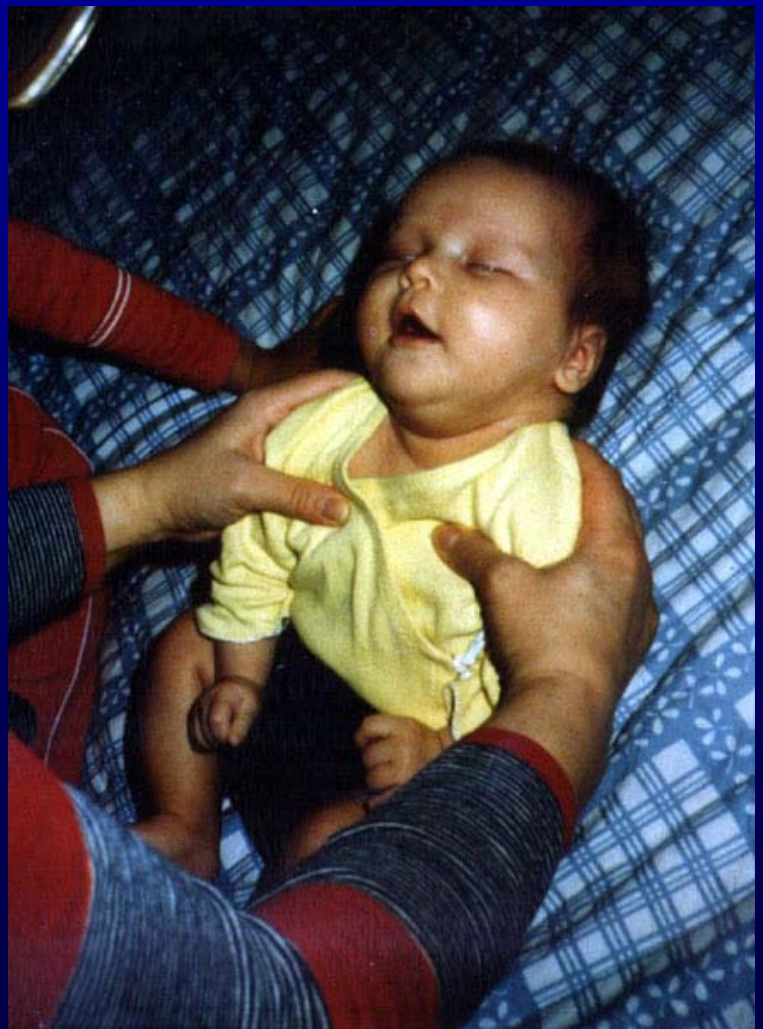
Early Interaction

Anne Nafstad & Inger Rødbroe



Emotional and motoric attunement

When an infant is functionally blind



Congenital glaucoma

Cloudy corneas

F lat anterior chambers

”Developmental emergency”

Patricia Sonksen

After corneal transplant

- Born blind
- clear cornea from
- 5th weeks of age
- **intensive activation** >>
- **awareness of vision**
- interdisciplinary early intervention

After corneal transplant

- Born blind
- clear cornea from 5th
- to 15 weeks of age
- early intervention
- normal milestones in motor development
- effective use of vision
- some form vision and
- colour perception

At 2 years

- born blind
- clear cornea from 5th to 15 weeks of age
- early intervention
- healthy child

  Normal motor development

Fragile baby

Eye contact and social smile

are important to the baby and the parents

4-month-old baby refuses visual communication

Insufficient accommodation?
Mirror neuron system?

Accommodation

eye contact and social smile

Weak accommodation can be compensated with ”reading glasses.”

Penalisation+bifocal

Late development of accommodation may lead to esotropia.

Penalisation+bifocal

Amblyopia did not develop, binocularity remained

In school age

Clinical examination

gives the foundation for the assessment of visual functioning

orthoptists, therapists, nurses, optometrists, technicians, parents, teachers

OBSERVATIONS

Photo: Miguel G. Alvares, MD Brazil

Clinical examination

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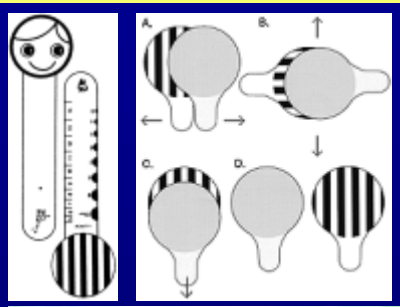
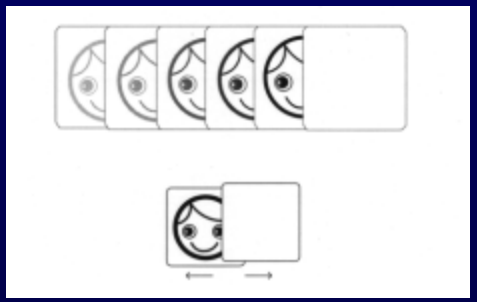


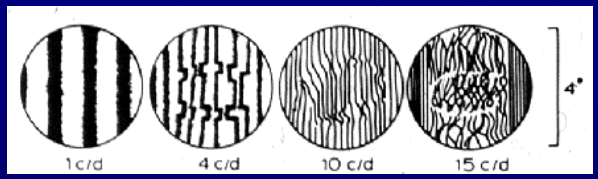


Hiding Heidi test[20]

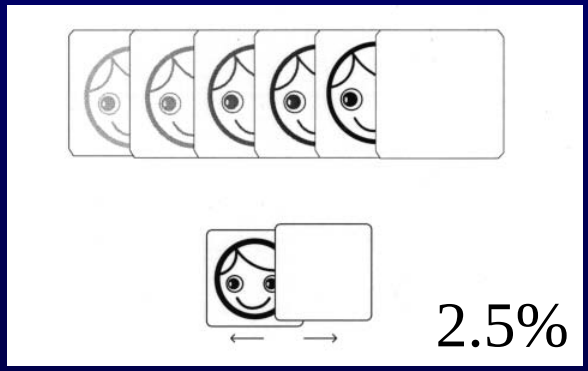
Grating Acuity & Heidi Face

as detection acuity & communcation distance

Preferential looking

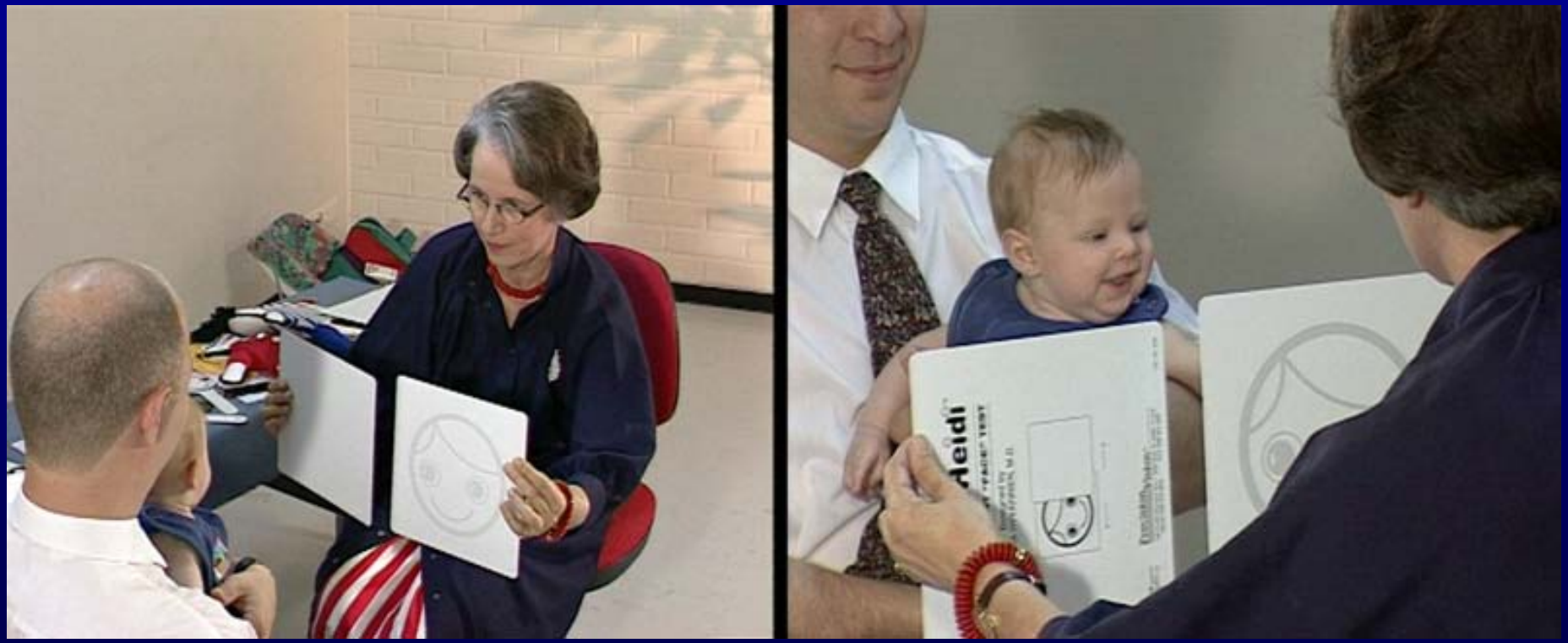


Detection tests



Hiding Heidi

low contrast pictures for assessment of communication distance



Facial expressions are fast moving low contrast shadows.

Figure-in-motion, Pepi-test

Near correction
Head support

Can be copied @
www.lea-test.fi

Vision

in motor development

Head control

Foto: Patricia Sonksen

Low tonus and poor head control

Strong visual stimulus activates motor control

At the Art Museum
Pori, Finland

Infant artists
using
Mirror neuron functions

Photo: Päivi Setälä


Tactile, haptic and auditory confirmation is important!
Multimodal learning.

Periventricular leukomalasia

Delayed motor functions

Combined effect of visual and motor disorder delays the development of an infant in all functional areas.

Constricted visual field

Large illuminated ball used by child’s own therapist.

Assessment >> Early Intervention

1. Normal hand
2. Spastic hand

Awareness of hands
⇨ Fixation

Accommodation

difficult to measure when the infant does not look at a target

Near correction
is always
worth trying.

Eye contact

when reading lenses give a clear image on the retina

Visually active infant

ten weeks later: improved visual and motor functions

RE: GrA less than in LE >> training as a part of physiotherapy

Infants at risk

Accommodation in hypotonic infants is often very weak.

Compensating accommodation

Watching simple pictures

two years later

High myopia fully corrected

The child is happy to have +4 near correction.

Near vision is vision for learning.
Spectale corrections should be for the functionally important distances.

Decisions

can be followed by observing infant's fixations

Fixation in the communication with a 5-month old infant:what is the preferred object?

Object in hand helps fixation

Turning of gaze and turning of attention can be helped with simultaneous information from the hands: tactile, haptic, and kinesthetic.

Perception of space

”visual cliff”

Playmat
orientation in space

Light coloured surfaces rough, dark surfaces smooth> vision and touch coinside.

Structured play situation

Finnish version (needs to be modified for other countries)

Structured play situation

Siblings and grandparents training

”Little room”

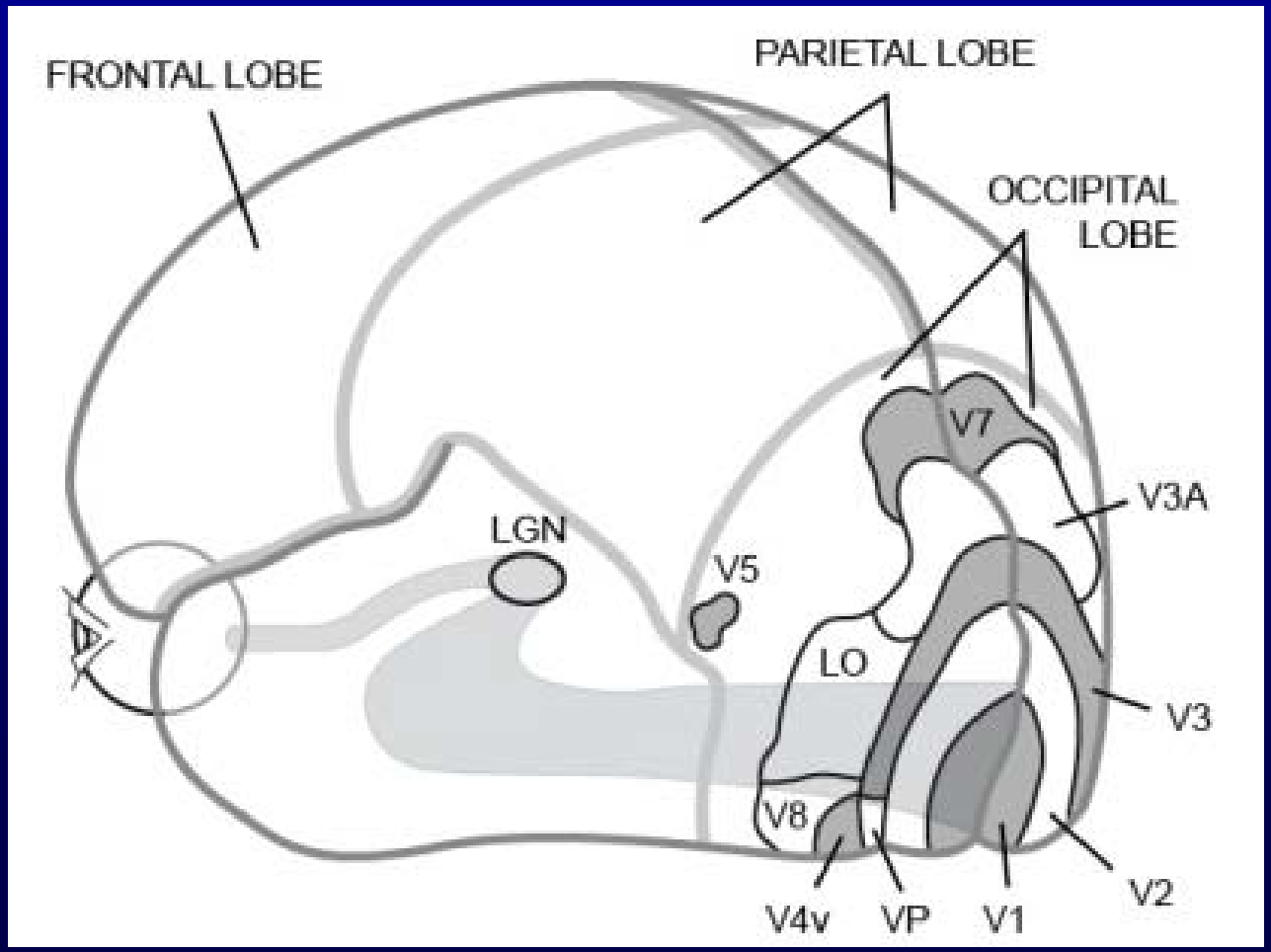
made of a brown paper box

Vision, touch, echos,
measuring space with his own body.

Tea break

Pathways

Retinocalcarine pathway



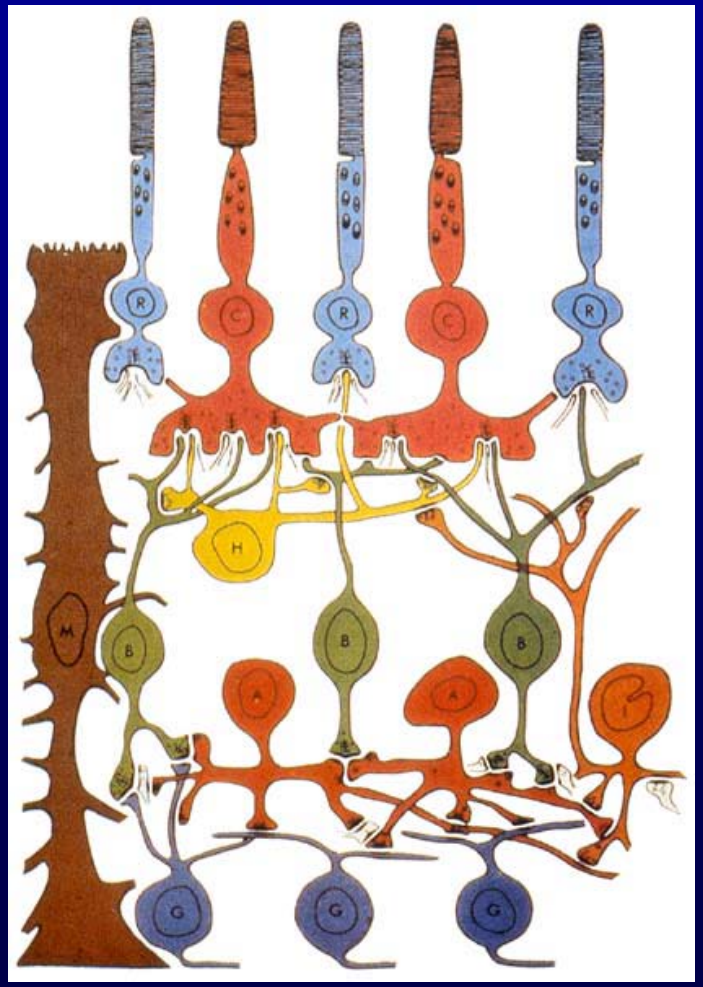
Changes in the information

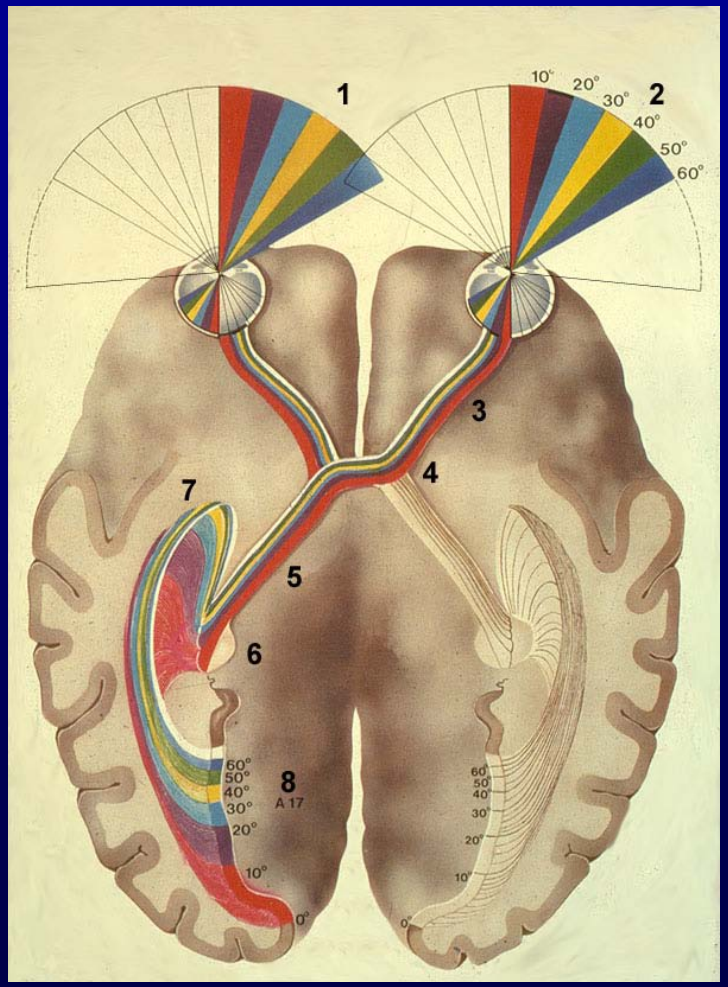
that can occur in the eye

Cornea
Lens
Vitreous
Retina
Optic nerve

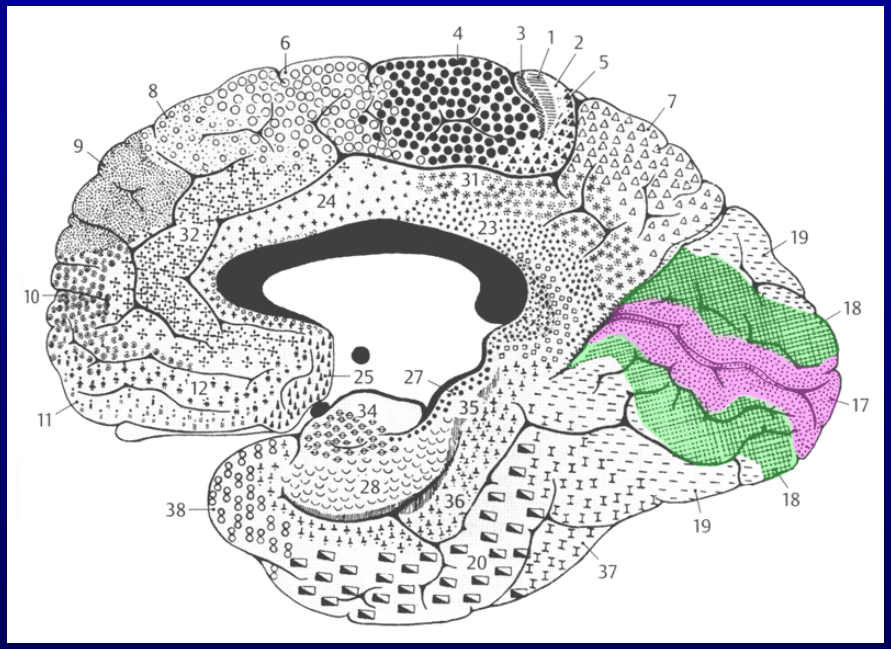
Use of 3D eye to explain the structures that have been affected and how that changes the quality of information that flows into the brain for processing.

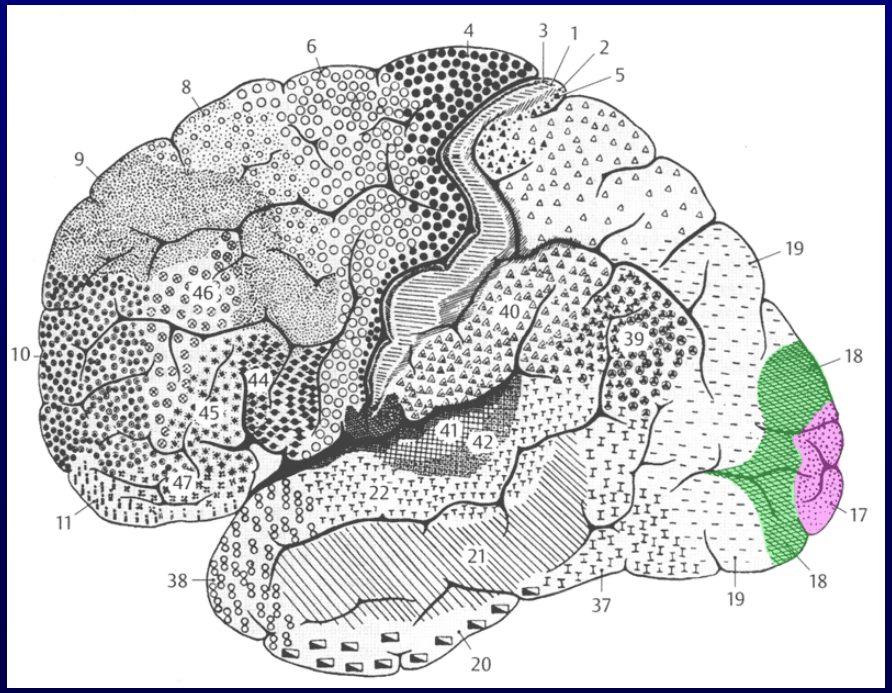
Visual Pathways



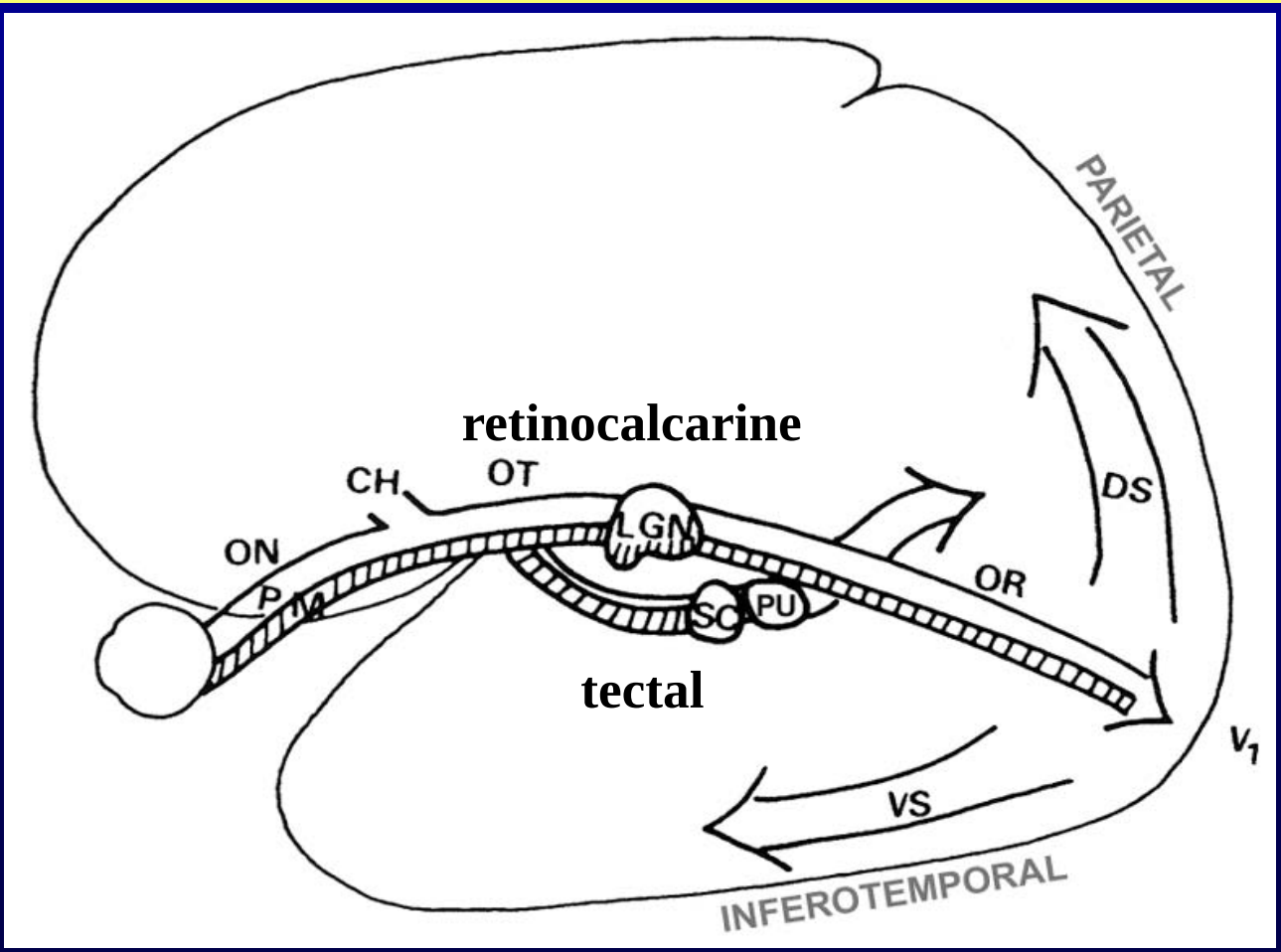


Primary and secundary visual cortex





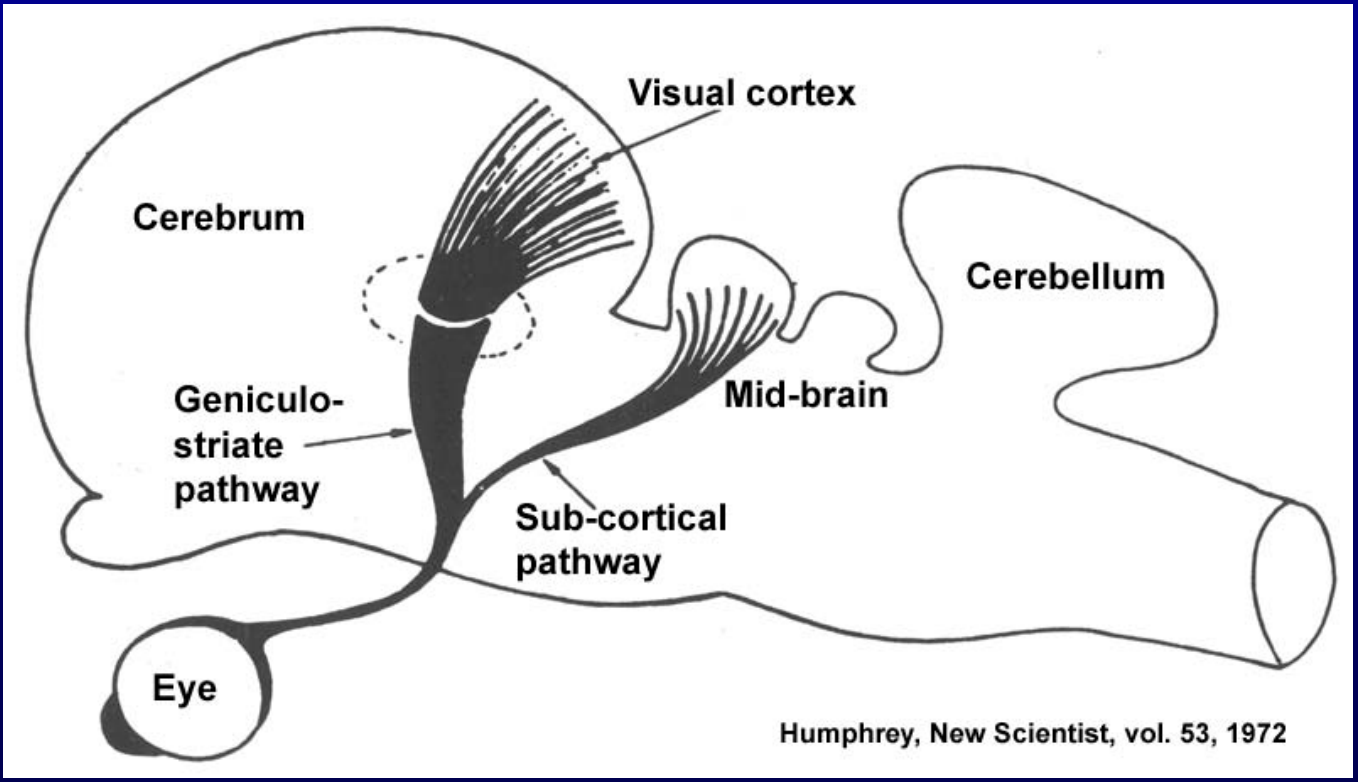
Retinocalcarine and tectal pathway



LGN= Lateral Geniculate Nucleus; SC= Superior Colliculus; PU= Pulvinar

Tectal pathway

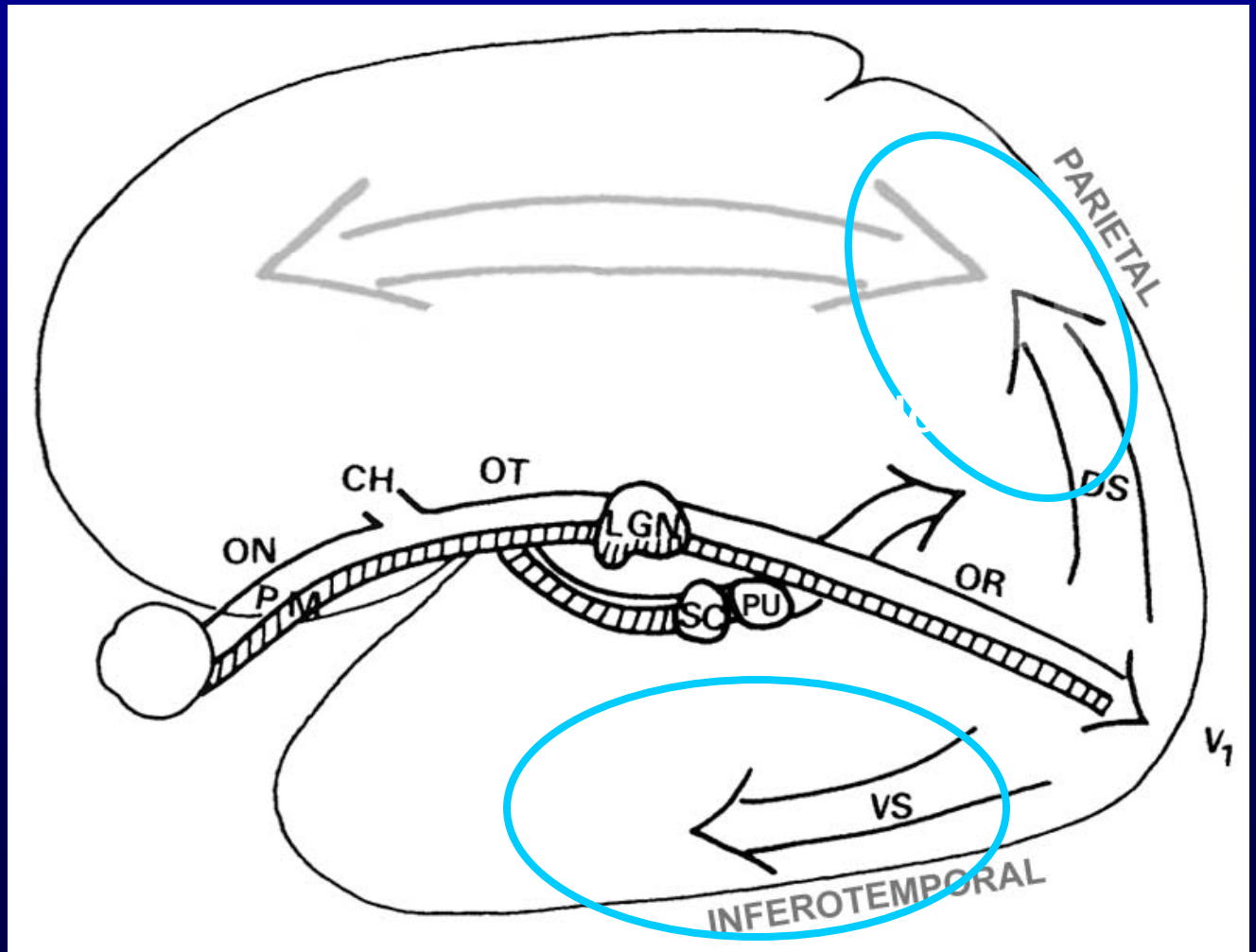
often forgotten in the clinical assessment



Humphrey NK. Vision in a monkey without striate cortex, a case study. Perception 1974 3(3):241-255. New Scientist vol 53, 1972.

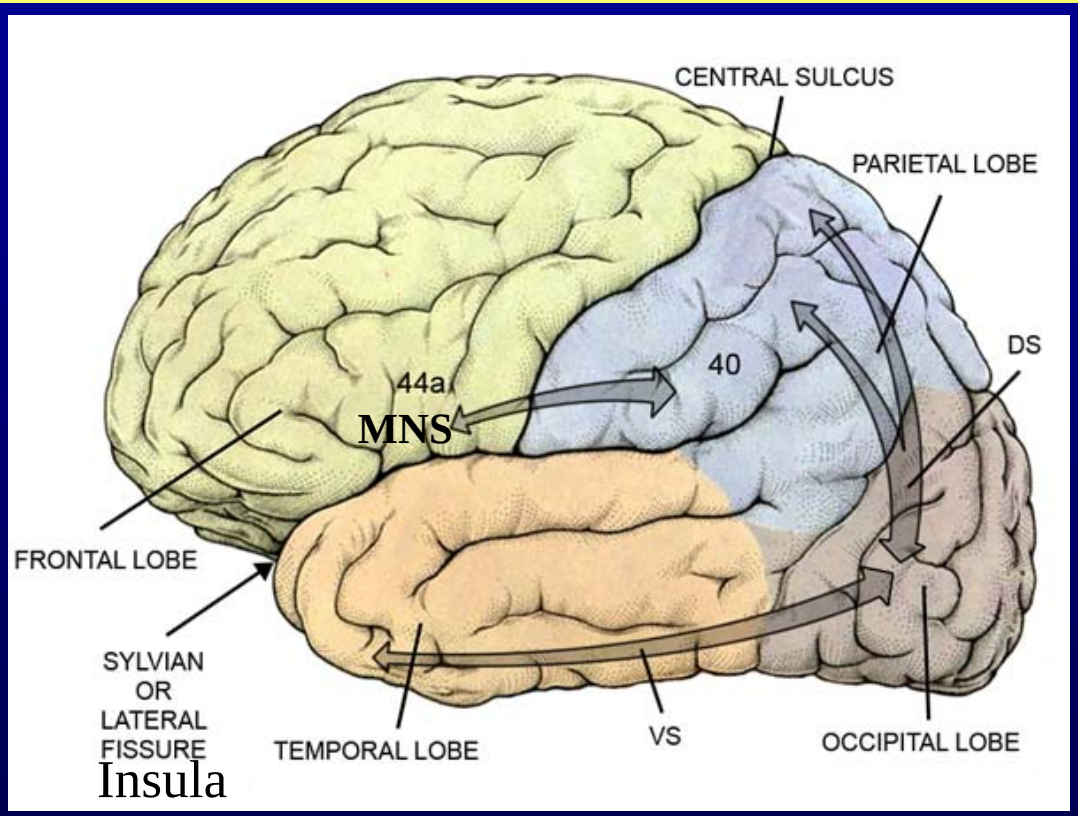
Ventral & dorsal stream

inferotemporal & parietal stream



Processing of visual information

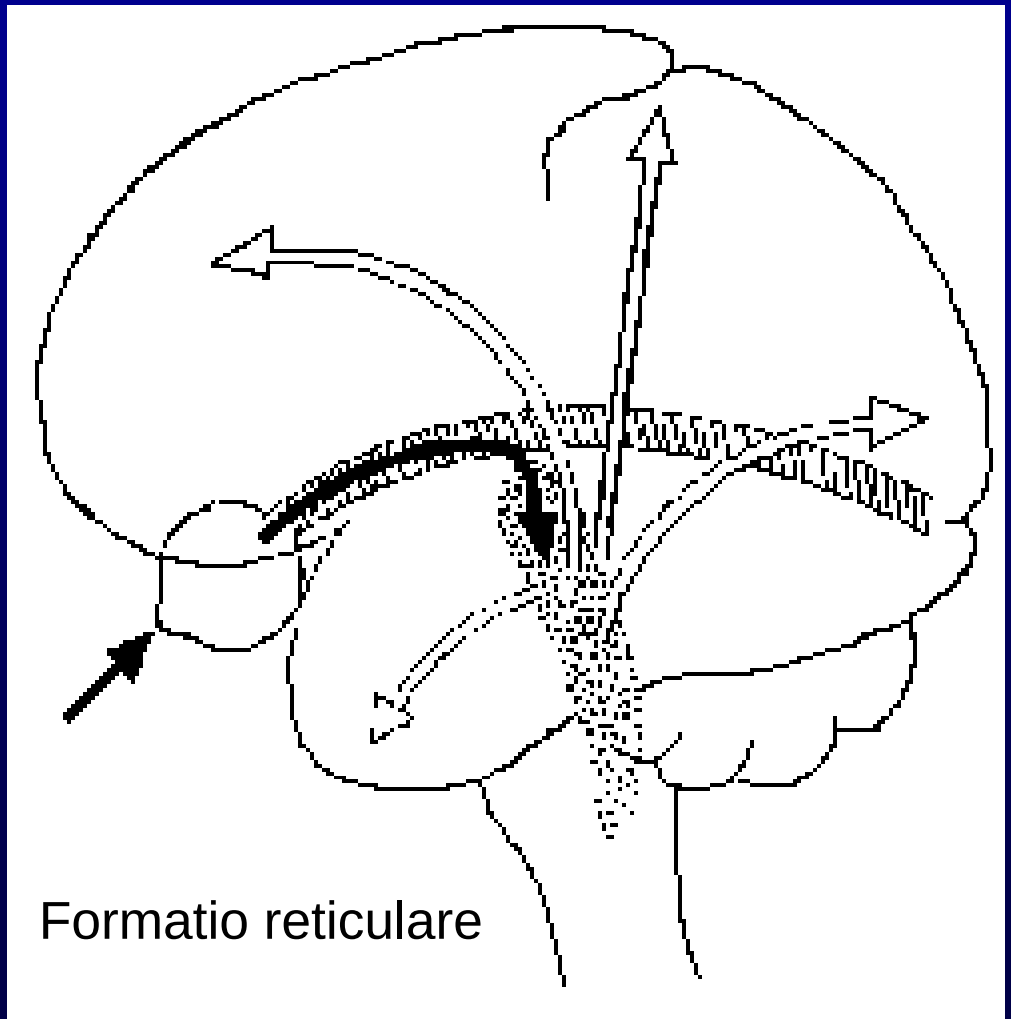
two-way networks of visual processing



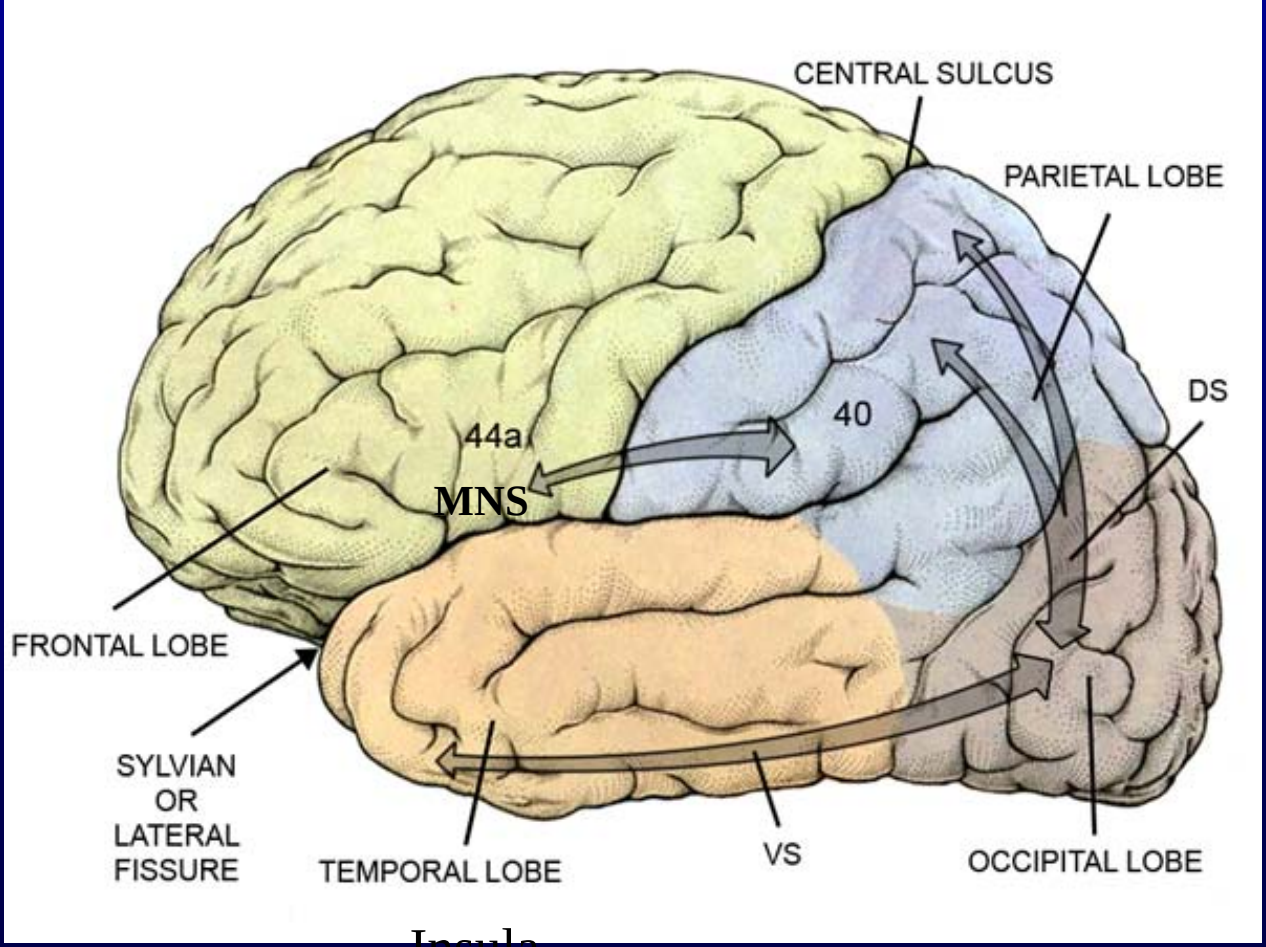
Early processing in the occipital lobe:

Ventral stream
Dorsal stream
Mirror neuron system

Arousal- Wakefulness



Early processing in occipital lobe
Ventral and dorsal stream/network

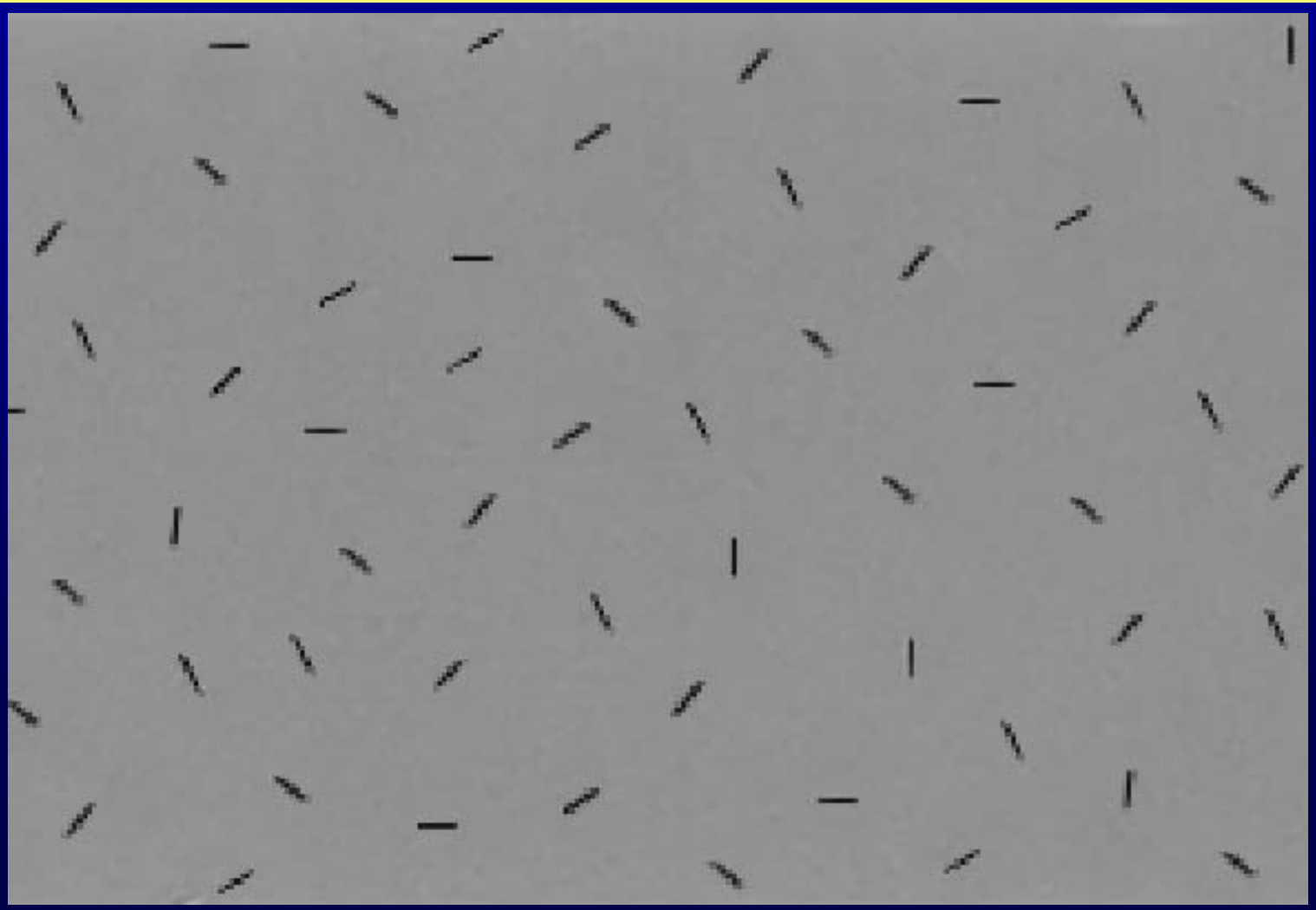


Early processing:
Colours
Contrast edges
Movement/ motion

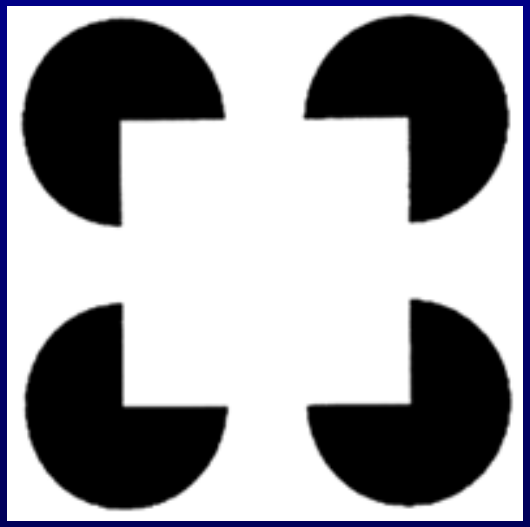
Line directions & length
Stereovision
Object/ background
Figure/ ground
Visual closure, filling-in
Visual illusions

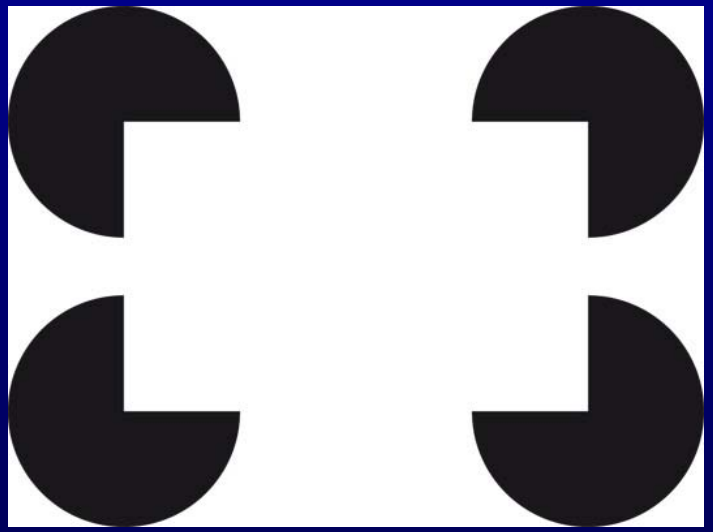
Figure-in-motion

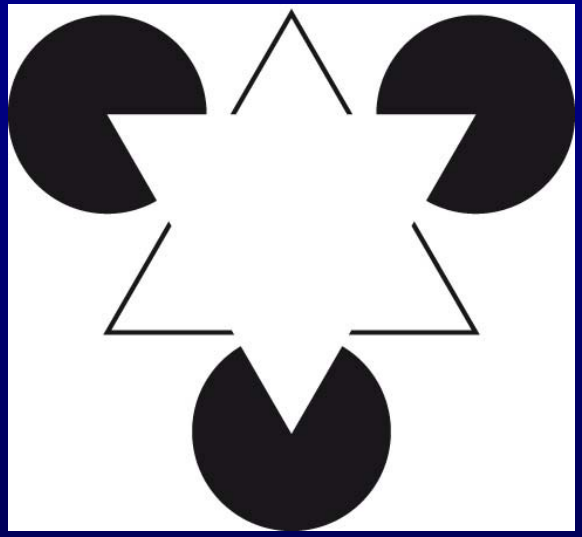
Visual closure, filling-in



Visual illusions







Binocularity tests - fusion

Worth 4-dot test

Stereovision

Lang test

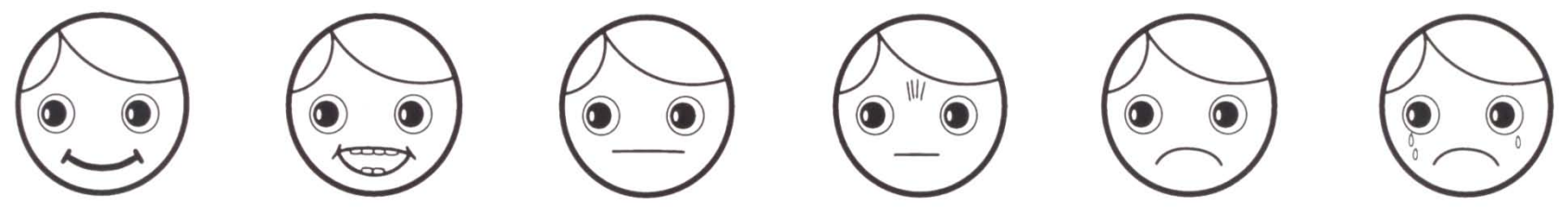
9 months

Effron rectangles

Rectangles – Mailbox
Heidi Expressions- Colorama

Testing early and higher visual processing

Vision for communication



- Real life situations, drawing/making pictures
- Photographs, colour and B&W
- Videos, tactile exploration, magnifying mirror
- Intervener in communication situations

Training facial expressions

Drawing with the child

Magnifying mirror

Visuotactile pictures

Matching and recognition of pictures

Recognition of faces

Re-cognition:

- facial features are seen well enough
- a template is formed in memory
- the face is seen again
- template is found and matched
- the name of the person is remembered
- in normal development infants recognise faces at the age of 6-8 months, latest at 10 months

Discussion

Lunch break

Early Identification
Vision Screening

Assessment of Visual Functioning

1. OCULOMOTOR FUNCTIONS

2. QUALITY OF VISUAL INFORMATION CLINICAL TESTS

3. OBSERSERVATIONS
ON
VISUAL PROCESSING FUNCTIONS

Clinical examination

Foundation for Assessment of Visual Functioning

completed with

Tests and observations

at School/KG/Early Intervention

Children with other Functional Problems

Clinical examination

gives the foundation for the assessment of visual functioning

orthoptists, therapists, nurses, optometrists, technicians, parents, teachers

OBSERVATIONS

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Clinical examination

gives the foundation for the assessment of visual functioning

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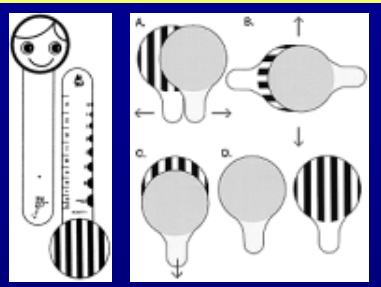
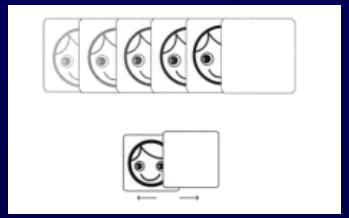


LEA GRATINGS Teller test



Hiding Heidi test

Pepi-test

Hospitals'/ophthalmologists' role
in early intervention and vision rehabilitation

- Early referral to ophthalmologists
- Immediate referral to early intervention
  - need of information and support is greatest on communication, interaction, future, motor development, social skills
- Early diagnosis
- Information to the EI and rehab teams
- Never say "Nothing can be done."
- Remember visual ergonomics

  spectacles, optical and nonoptical devices

Impaired Vision

in infants and children, risk groups

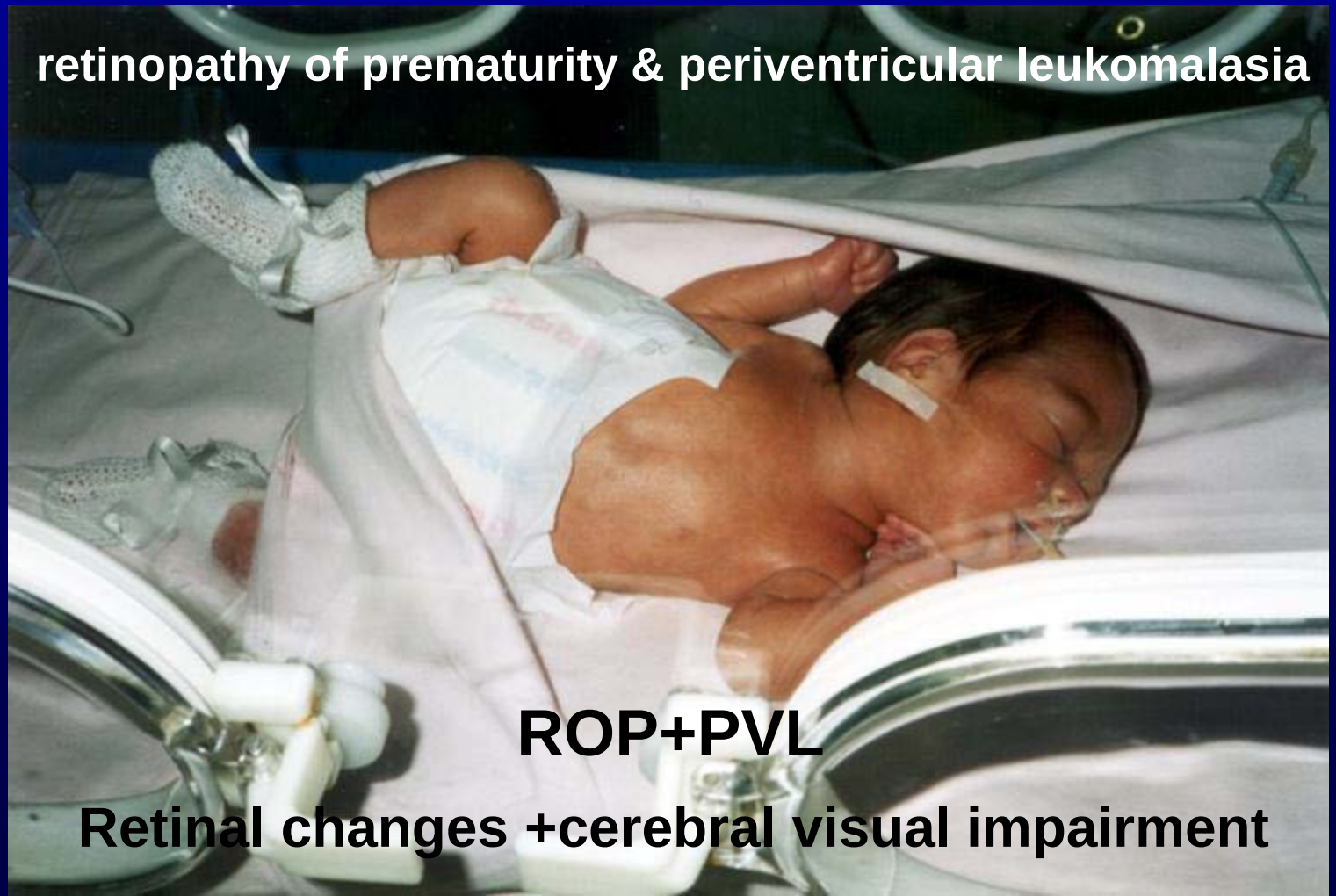
- 60-70 % of VI children have multidisability
- intellectual disability, Down syndrome:refraction, accommodation
- motor impairment, CP, strabismus, accommodation, NVI/CVI
- hearing impairment, cortical
  peripheral (Usher Syndrome)
- prematurely born infants, twins, difficult birth
- chronic illness
- 20% of VI children have ”CVI”, problems in processing of visual information due to brain damage

Vision loss affects

development of following areas of functioning:

- communication
- interaction
- motor development
- spatial concepts
- orientation in space
- object permanence
- language

Prematurely born infants



ROP

Retinopathy of prematurity

After laser treatment[83]

Birth trauma, 3rd nerve palsy> ptosis
right sided hemiplegic condition

Deformation of head after suction cup

Exotropia – Slow miosis

3rd nerve and Ehdinger-Westphal nucleus

After operation looks normal,
but is severely impaired.

Symptoms of impaired vision

- exotropia, outward squint operated
- brought objects close to the eyes =

  geometric magnification
- looked at the hair line, not at the eyes =

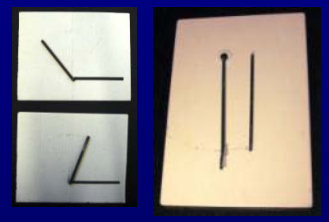
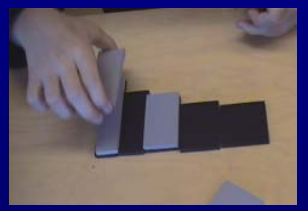
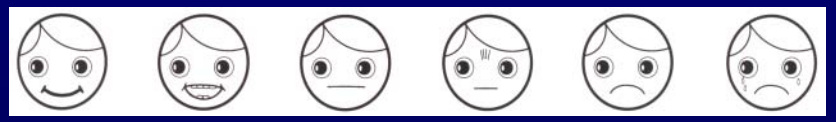
  central scotoma
- explored carefully with hands and mouth
- recognised people first at 18 months of age
- moved freely and knew his way at home.

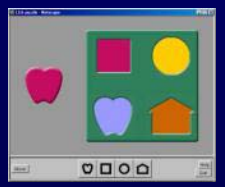
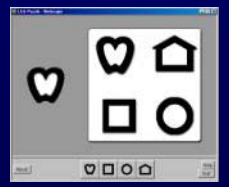
Usual story of children with brain damage in all countries.

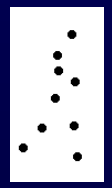
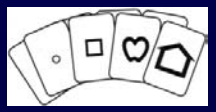
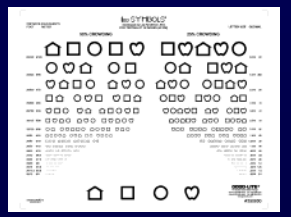
Cognitive vision tests

- Hiding Heidi for communication
- LEA-Mailbox
- LEA-Rectangles
- Face pictures
- Heidi Expressions
- LEA Puzzle
- Crowding effekt
- Pepi-test, Johansson’s Walking Man
- **Reading tests**
- OBSERVATIONS



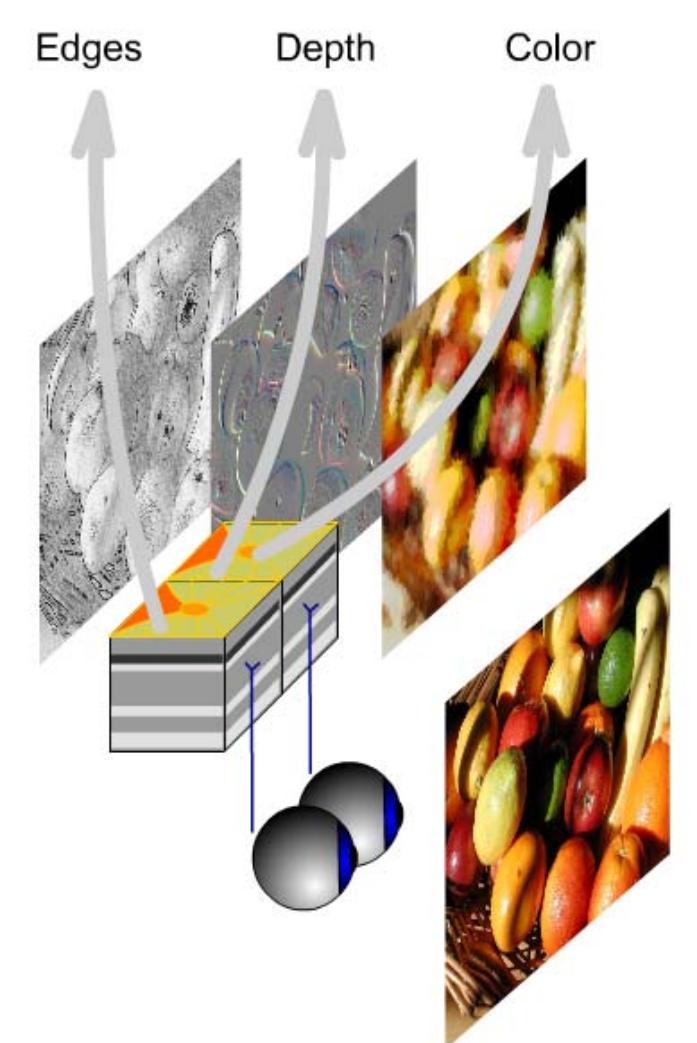




Primary visual cortex, V1

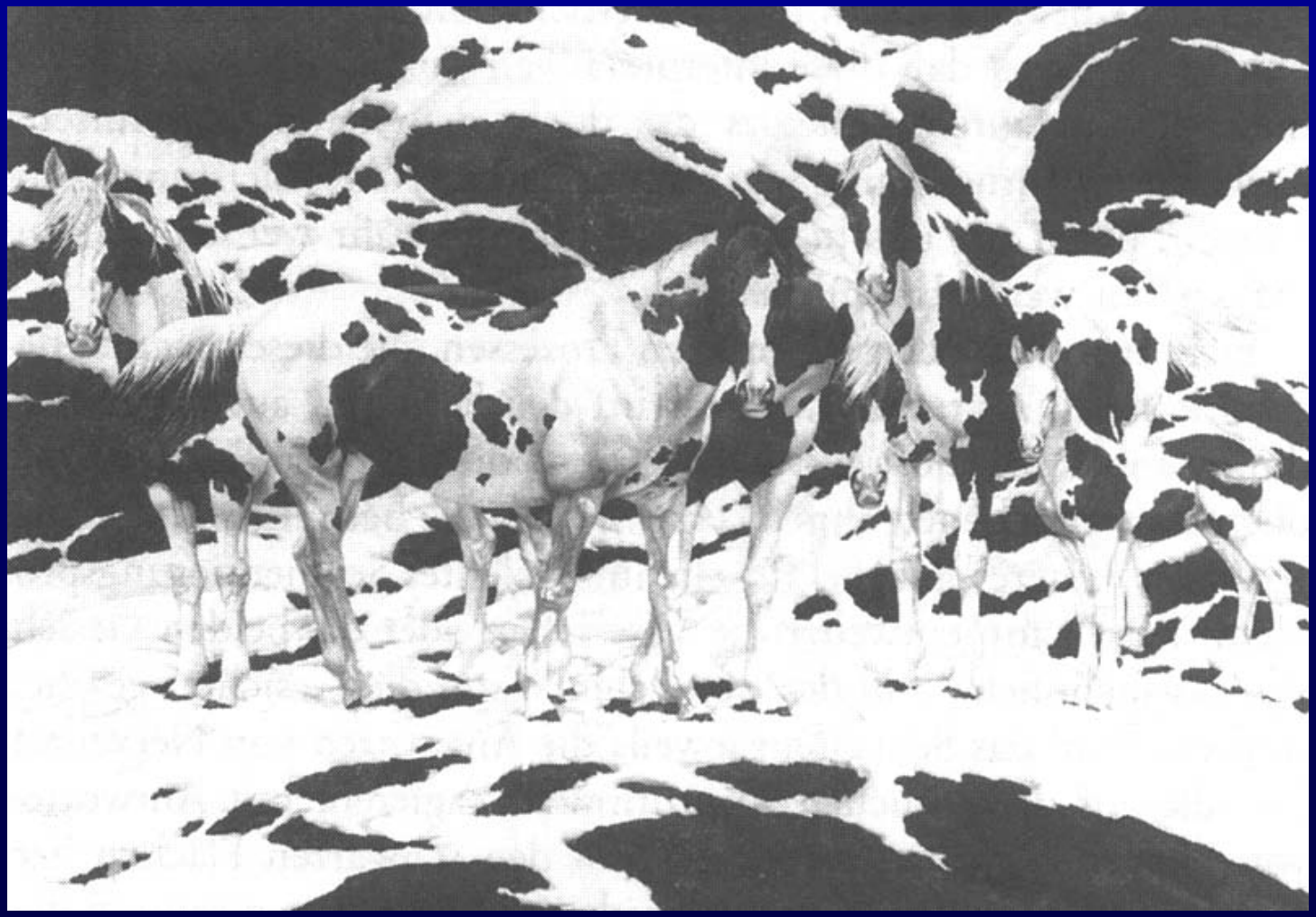
Decoding – encoding:
- contrast edges
- lines, length, direction
- binocular fusion > stereo depth
- movement, also directly to V5

- ”filling-in” of scotomas

- hyperacuity



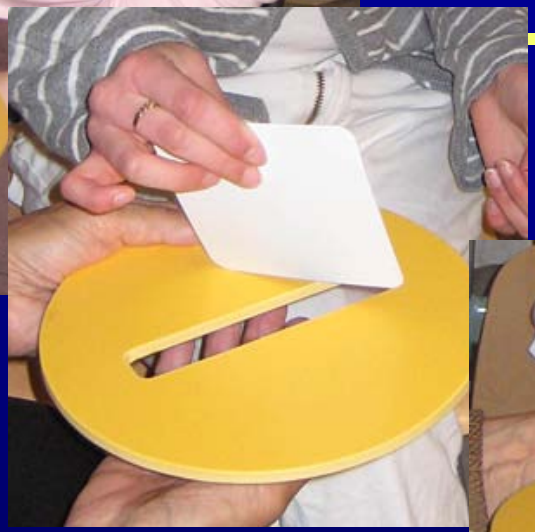
Looking for contrast edges

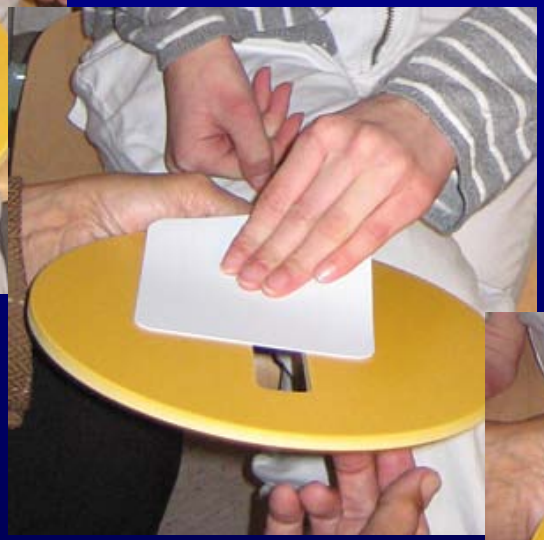


Mailbox Game

Mailbox Game – Orientation of lines

in eye-hand coordination



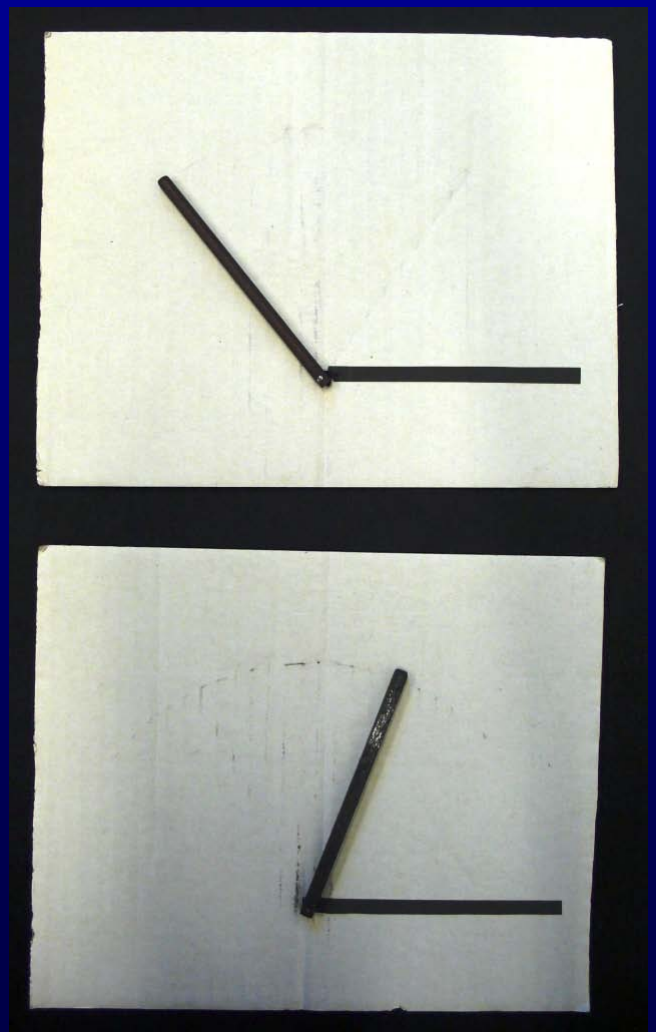


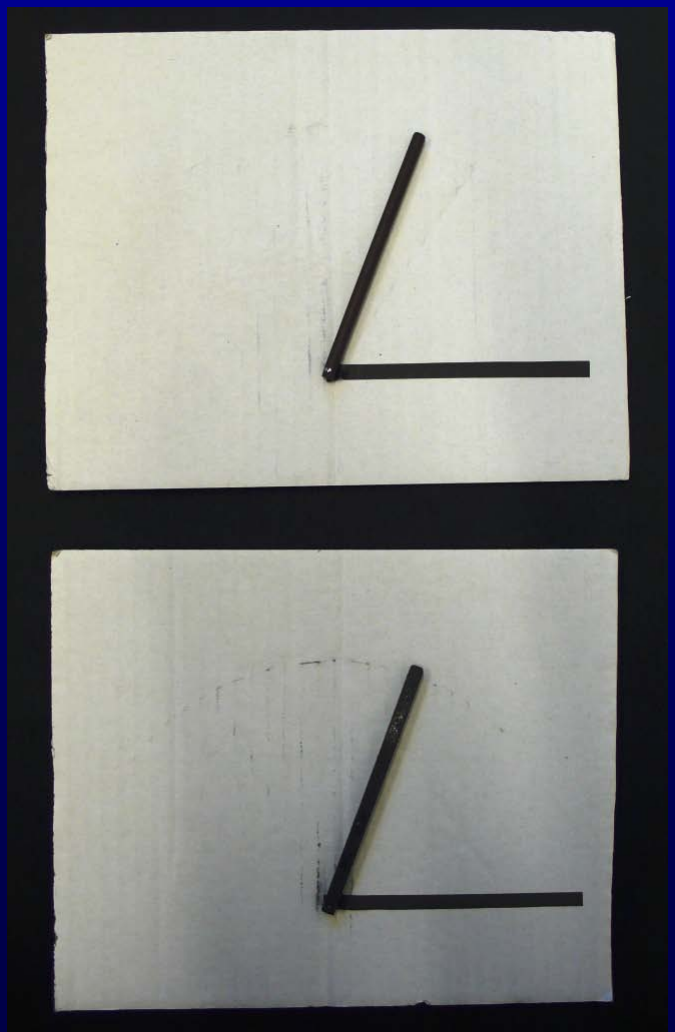
Directions as purely visual task

Ventral stream function

One rod is fixed, the other
can be rotated until parallel

Angles





Eye-hand coordination

in assessment of awareness of directions

Stereovision

Children with severely impaired vision may have normal visual acuity and stereovision. VA does NOT depict disability.

Object-background, figure.ground

Other functions of visual cortex

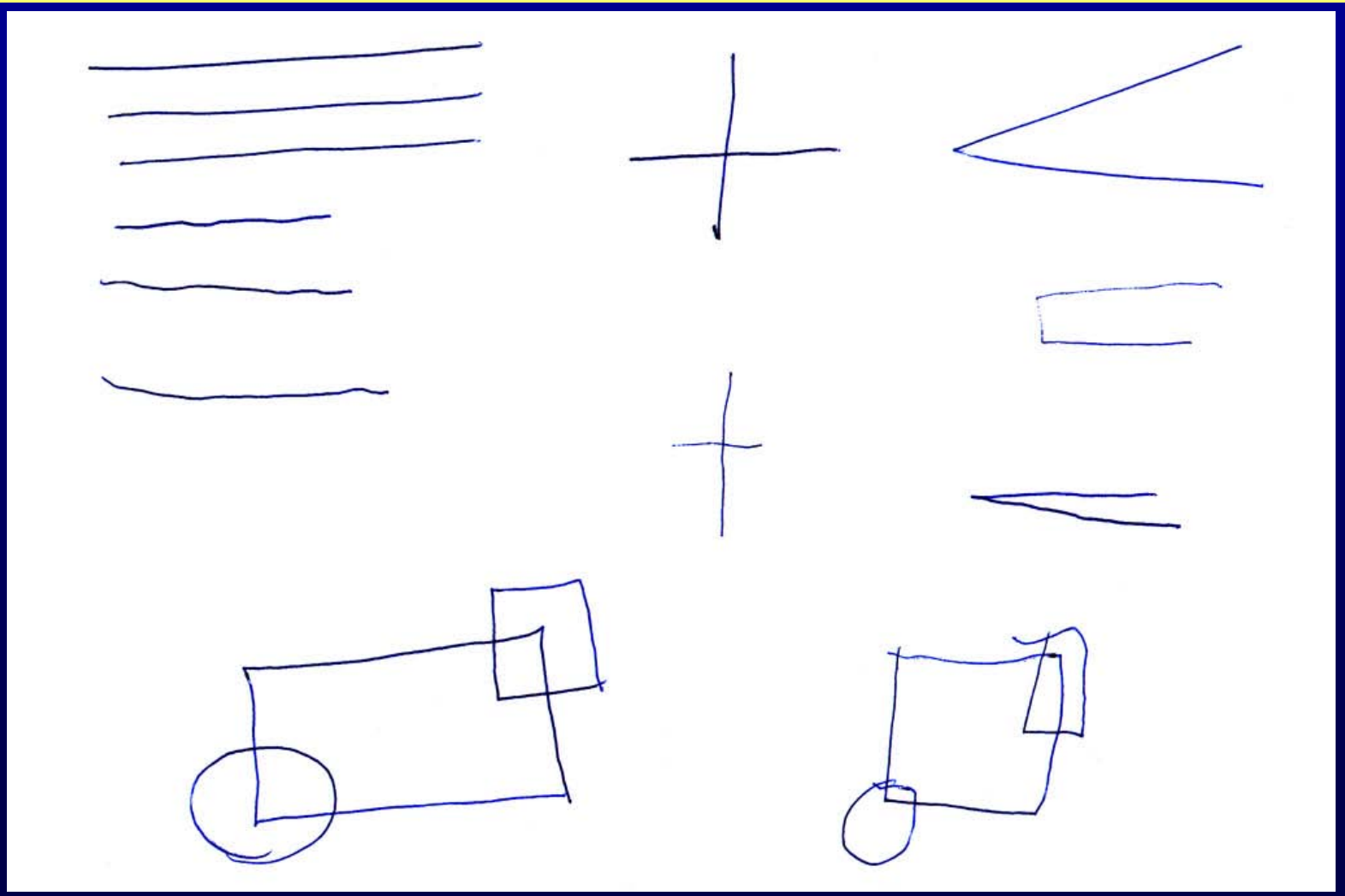
Auditory space
Haptic space
Tactile information, Braille
Working memory

Transcranial Magnetic Stimulation

Transcranial Magnetic Stimulation

Copying

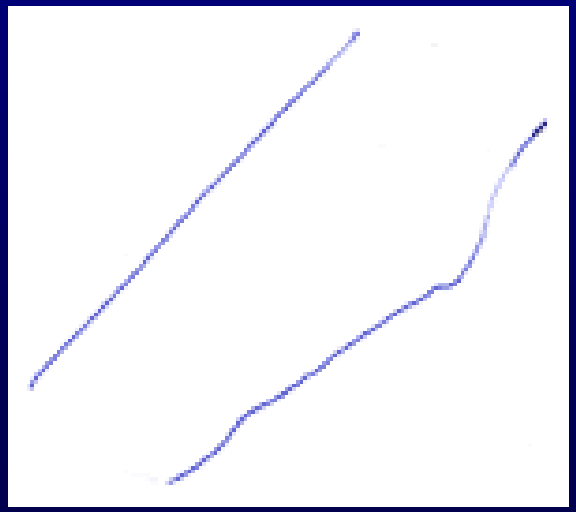
parietal, eye-hand-coordination task

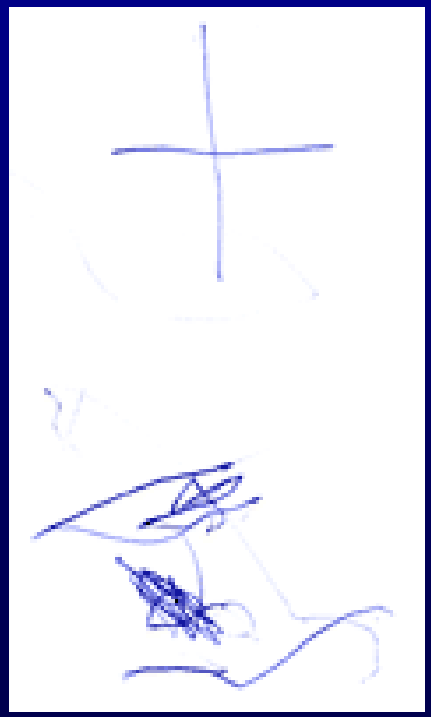


Copying angle & cross

Tester
draws the figure.

Parallel lines, angle, and cross





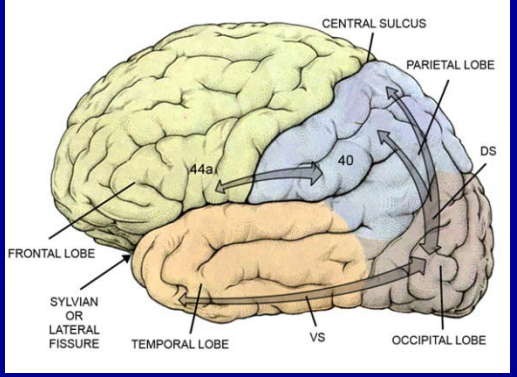
Picture perception

Composing picture of its parts

Communication pictures
figure-ground problems

Ventral Stream

Inferotemporal Networks



Details in pictures, Noticing errors and missing details
Perception of textures and surface qualities

Recognition of familiar and unfamiliar faces
Facial expressions, Body language

Landmarks, Concrete objects, Pictures of concrete objects

Abstract pictures of objects of different categories

Abstract forms (letters, numbers), Sequencing
Reading words and lines of texts, Optimal reading strategy

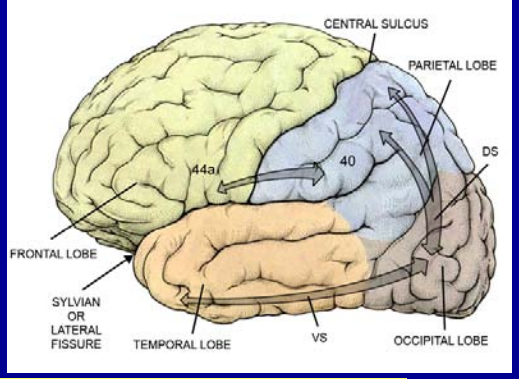
Comparison with pictures in memory, ‘Reading’ series of pictures

Visual problems in copying pictures from blackboard and/or at near

Crowding effect, Scanning lines of text

Dorsal Stream

Parietal Networks



Awareness of surrounding space, directions and distances in space

Body awareness

Perception of near and far space

Orientation in space, map based, Memorising routes

Motion perception, Depth perception, Simultaneous perception

Eye-hand coordination, Grasping and throwing objects

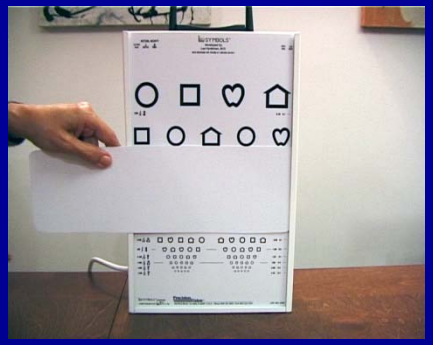
Drawing, free hand, visual imagination

Copying from near/ from blackboard, motor planning and execution

Mathematics, Visual attention

Tea break






Vision Screening

in Health Care Centres

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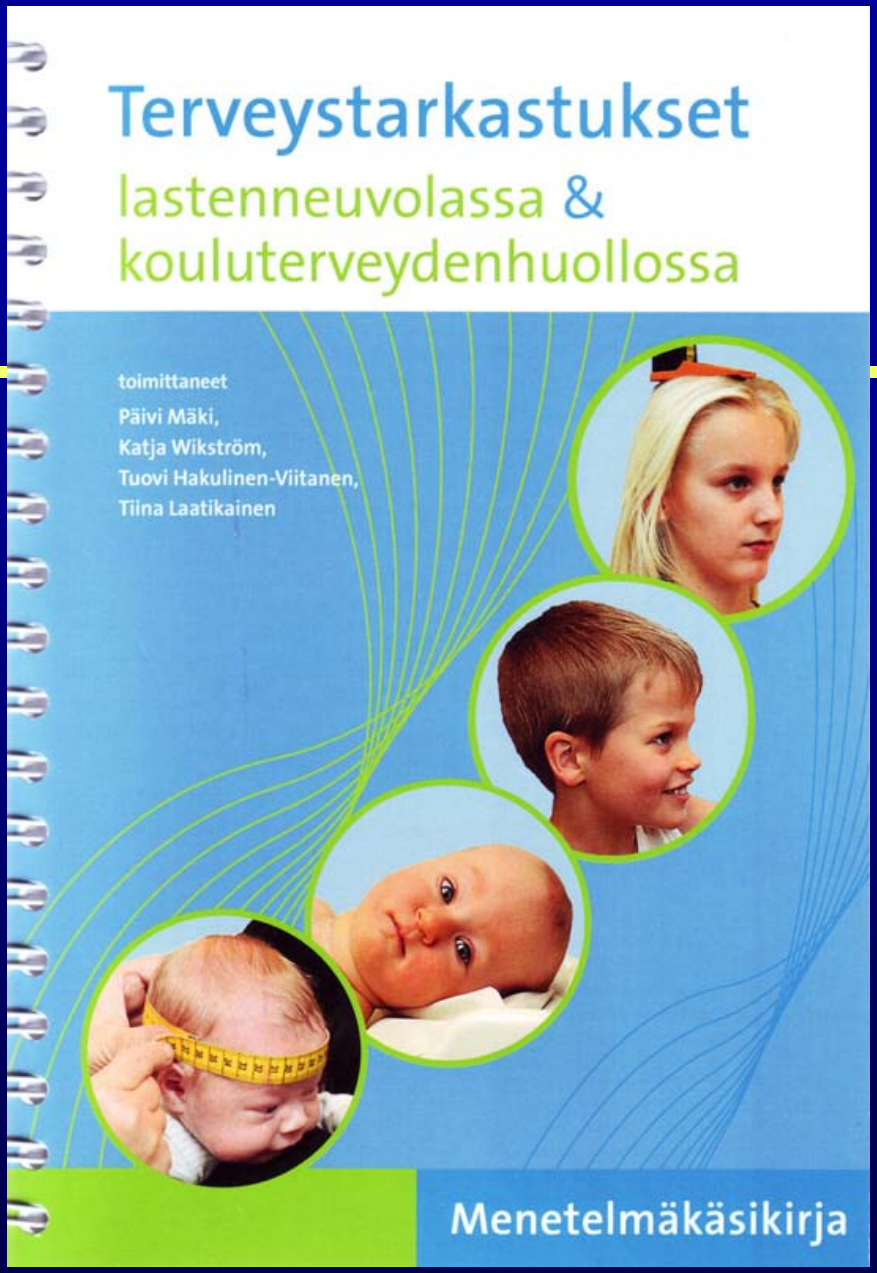


New Fnnish Instruction Manual for follow-up and screening of functions and Functioning 2011

Recommended follow-up

in Finland 2011

- Birth: structure of the eyes, red reflex, strabismus
- 6th – 8th weeks: good eye contact
- 3rd – 4th month: - active visual communication, hands found
- - baby follows hand movements of children and adults
- - fixation, following movements, convergence
- 7th- 8th months: pincer grasp, face recognition, Hirschberg
- 18 months: face recognition, Hirschberg, cover test (H+c)
- 3rd year: (H+c), near vision acuity
- 4th year: (H+c), near and far vision acuity
- 5th year: if visual perceptual problems >> ophthalmologist
- 7th year: visual acuity as a part of general health, first grade in Finland
- 7th grade, visual acuity and colour vision

Recommended assessments

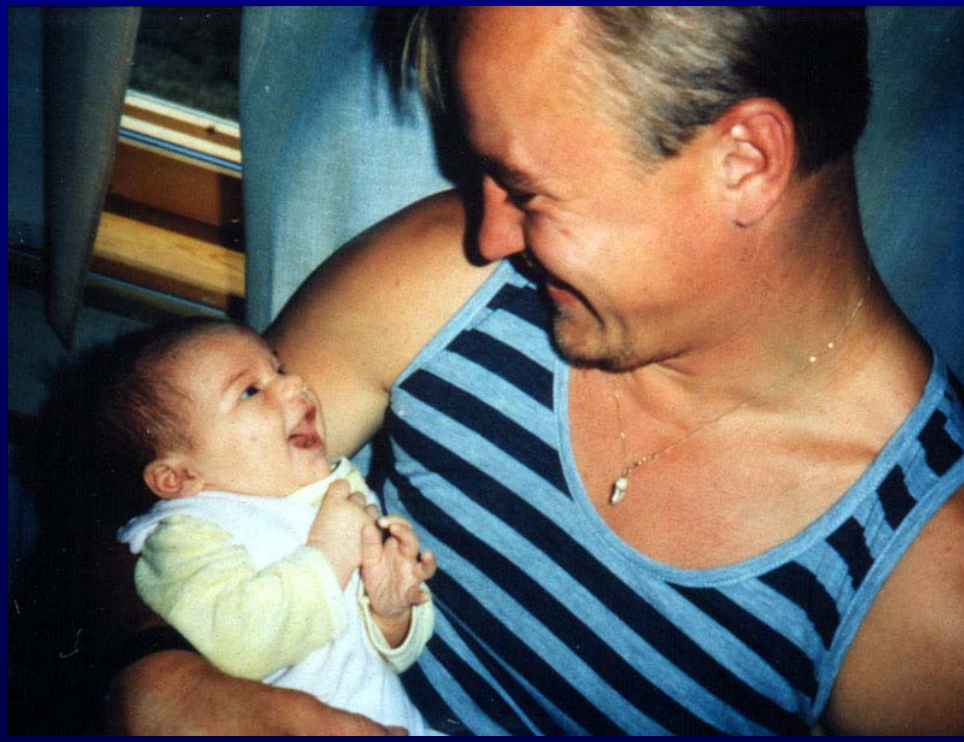
in Finland 2011

- Following functions should be assessed in all infants – stressed in the new recommendations:
- eye contact and social smile
- observation of hand functions and copying them
- face recognition of family members

Visual communication

Eye contact, copying of expressions
At 6 weeks, 8 weeks at the latest

Social smile, active interaction
at the age of 12 weeks.



Accommodation

eye contact and social smile

Weak accommodation can be compensated with ”reading glasses.”

At the Art Museum
Pori, Finland

Infant artists
using
Mirror neuron functions

Photo: Päivi Setälä

Infants at risk

- Infants with delays/difficulties in communcation
- All *hypotonic* infants: brain damage, Down
- All infants with *Down syndrome, refraction*
- *Premature infants*
- Infants with *strabismus*
- All *deaf and hard of hearing* infants
- All infants with *syndrome based risk of VI*
- Spectacle correction without delay
- Support for development of binocularity

Infants at risk

- Infants with delays/difficulties in communcation
- All hypotonic infants: brain damage, Down
- All infants with Down syndrome, refraction
- Infants with strabismus
- All deaf and hard of hearing infants
- All infants with syndrome based risk of vision loss

Paediatricians, Paediatric neurologists, Audiologists

Paediatric genetisists, Psychologists, Therapists, Parents

Early Intervention

should start EARLY

It should start during the assessment.

For Early Intervention

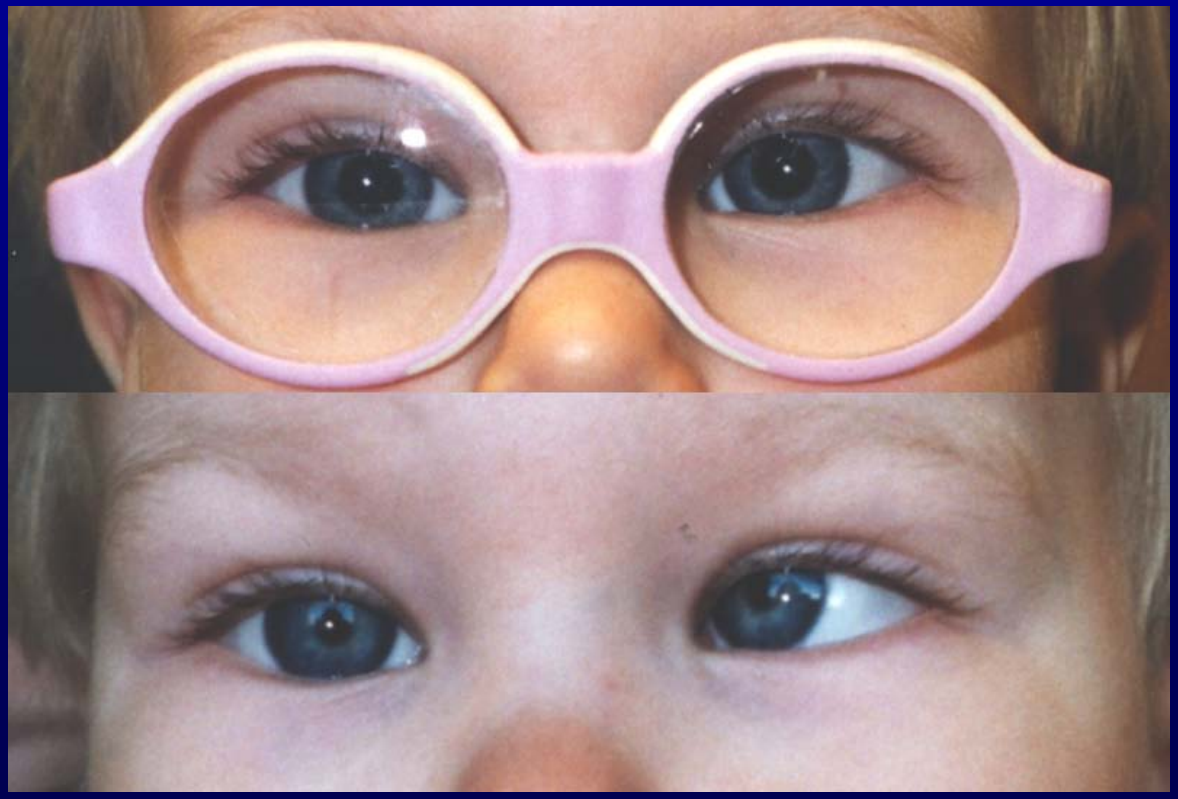
Observations at the age of 4 months

- Problems in early interaction are usually no more present if nothing was found in the assessment of vision and hearing and the family situation is stable.
- Eyes are symmetric and their structure is normal.

  Large eyes - glaukooma?
- Red reflex
- Fixation and convergence
- Following movements
- Hirschberg test
- Strabismus, also if reported by parents – is sometimes not present during the visit to the health care centre.

Strabismus – spectacles

good fitting, not too small



When spectacle frames are large enough, looking over is not possible.

Observations at the age of 8 months

eequal to obsrvations at the aage f 4 months +

- If the family has early intervention because of difficulties in interaction, is the situation developing positively.
- Eyes are symmetric and their structure is normal.

  Large eyes - glaukooma?
- Red reflex
- Fixation and convergence
- Following movements
- Hirschberg test
- Strabismus, also if reported by parents – is sometimes not present during the visit to the health care centre.
- The infant recognises parents' faces before they talk.
- Tear pathway problems.

Cover test

Small accommodative fixation target should be at the level of he child’s eyes and the child fixates at a small detail. Ask for example ”Does giraff’s tail move?” at the moment when you place the cover on the other eye.

Training of direct cover test

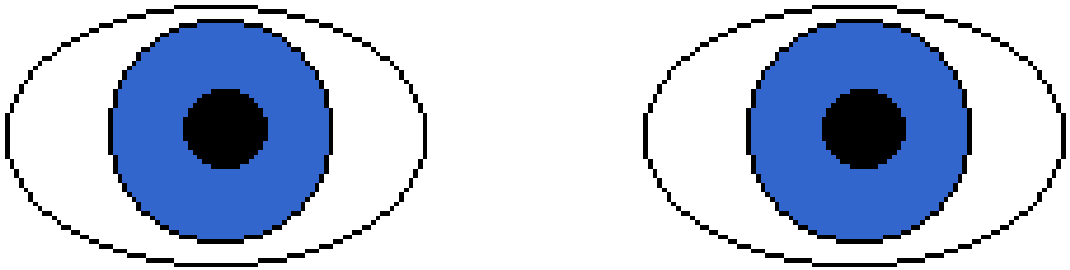
- Following slides show findings during cover test. Observe:
- 1. What happens to the eye that is NOT covered

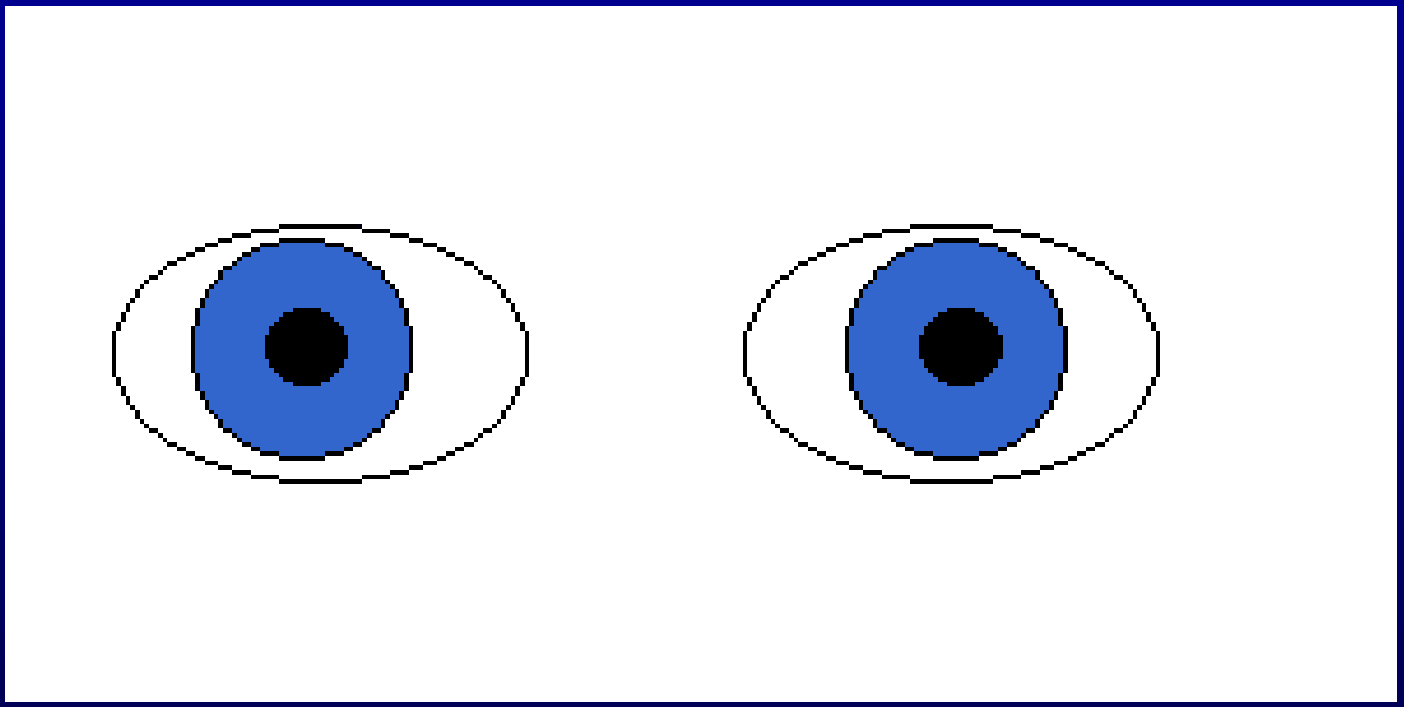
  a.- if it does not move = no strabismus in that eye

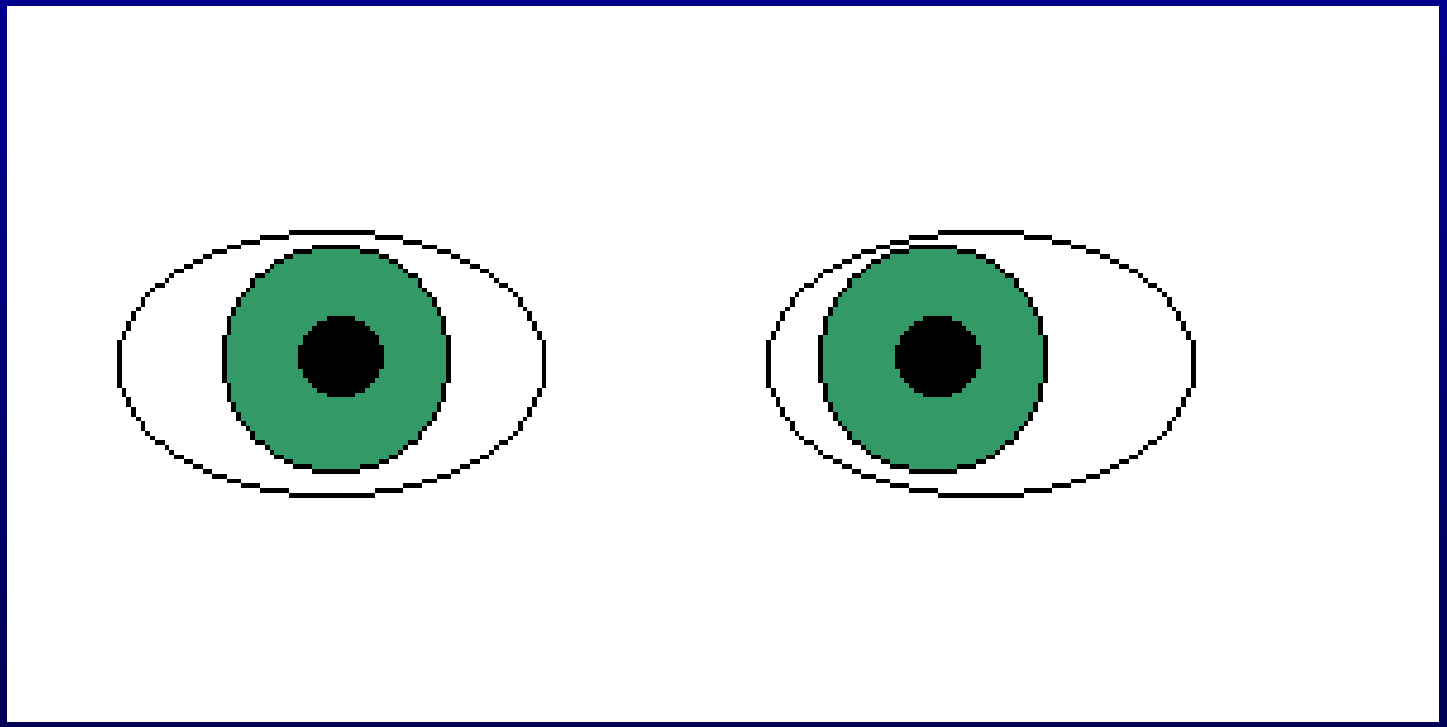
  b. – if it moves toward midline from the inner corner = constant esotropia;

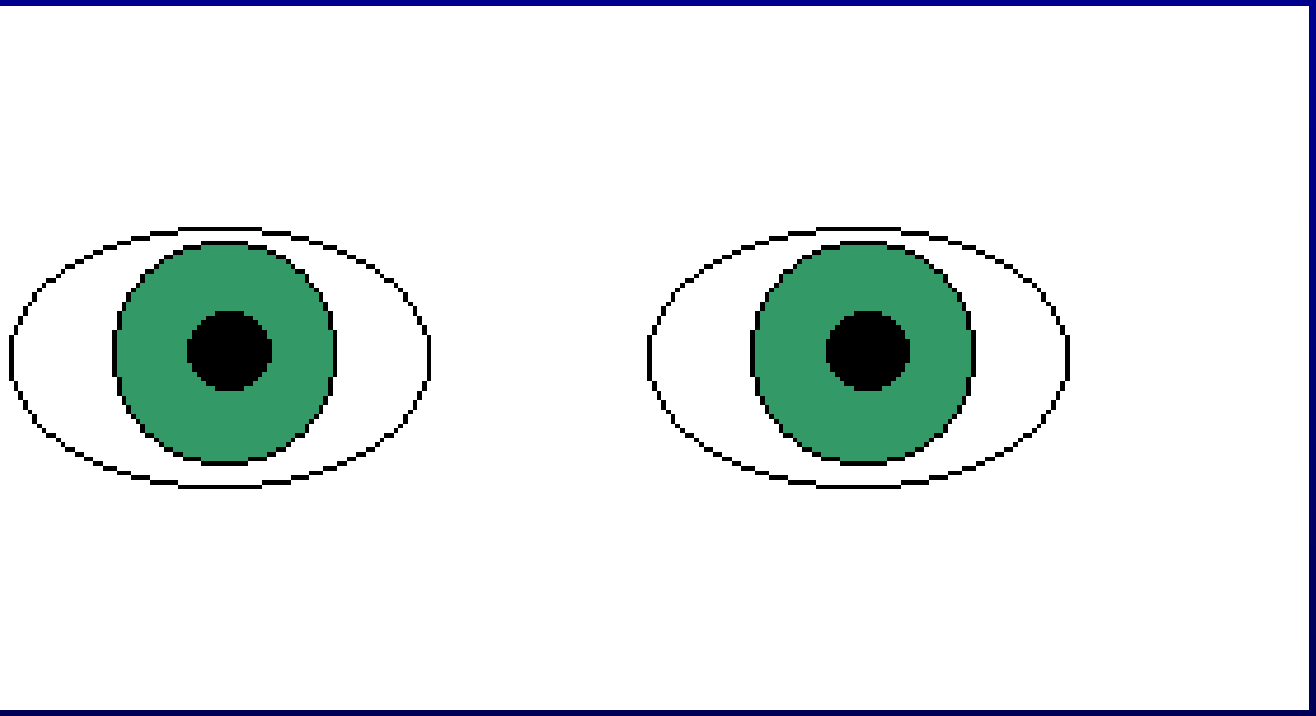
  when the cover is removed, the eye moves back to the corner and the covered eye moves to the middle

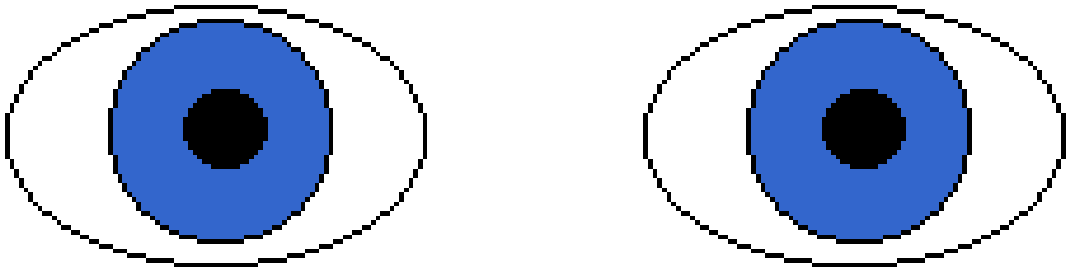
  - if it moves toward midline from the outer corner = constant exotropia.











Observations at the age of 18 months

- As at he age of 8 months +
- If an eye that has been in normal position , has started to squint, remember the rare possibility of retinoblastooma and refer withi´´out delay.
- Direct cover test

At the age of 3, 4 and 5 years

- 3 years: Hirschberg + cover test, visual acuity with near card
- 4 years: Hitschberg + covertest , VA near an distance
- 5 years: if problems in visual perception >> ophthalmologist and neurologist before therapies

Near vision test at 40 cm

binokular measurement first

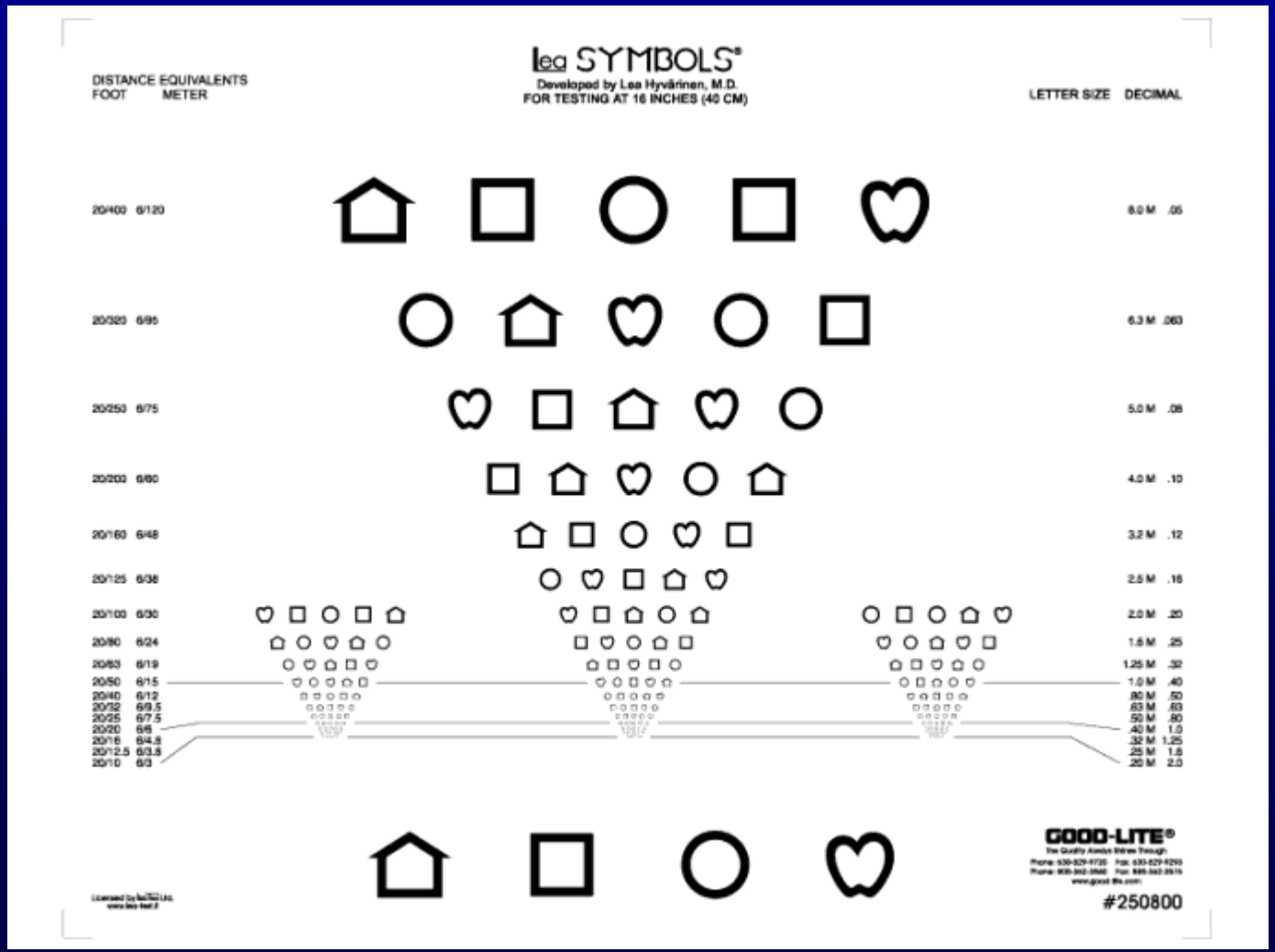
Near vision test at 40 cm

binokular measurement without pointing

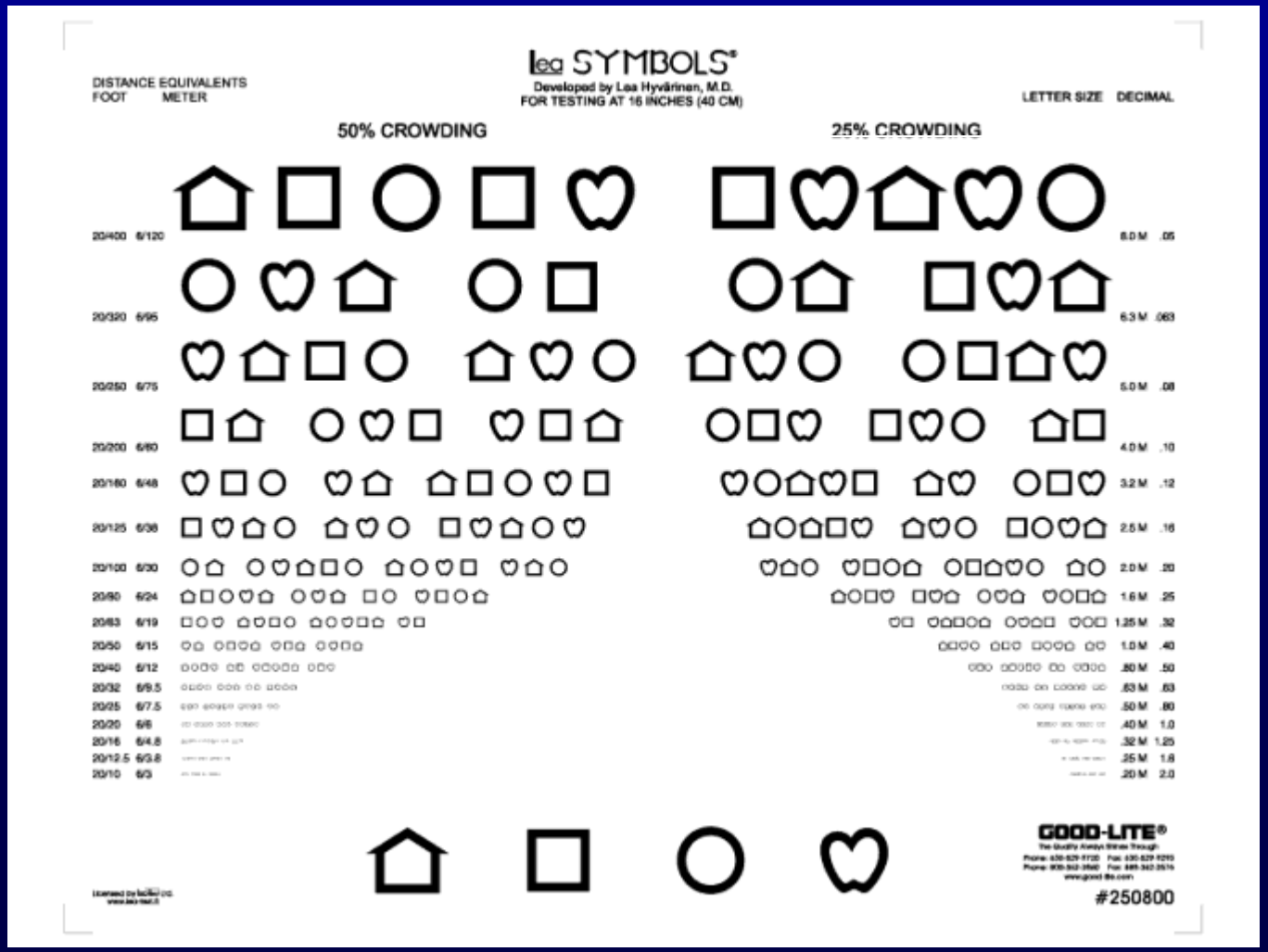
Near vision test

monocular measurement

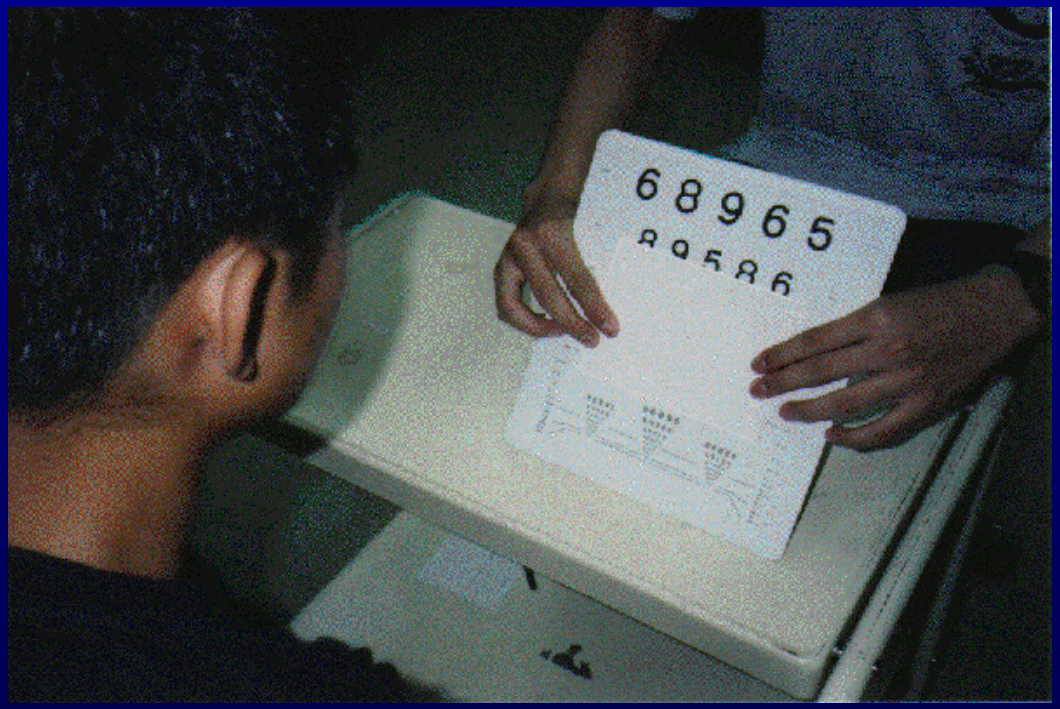
Near vision test



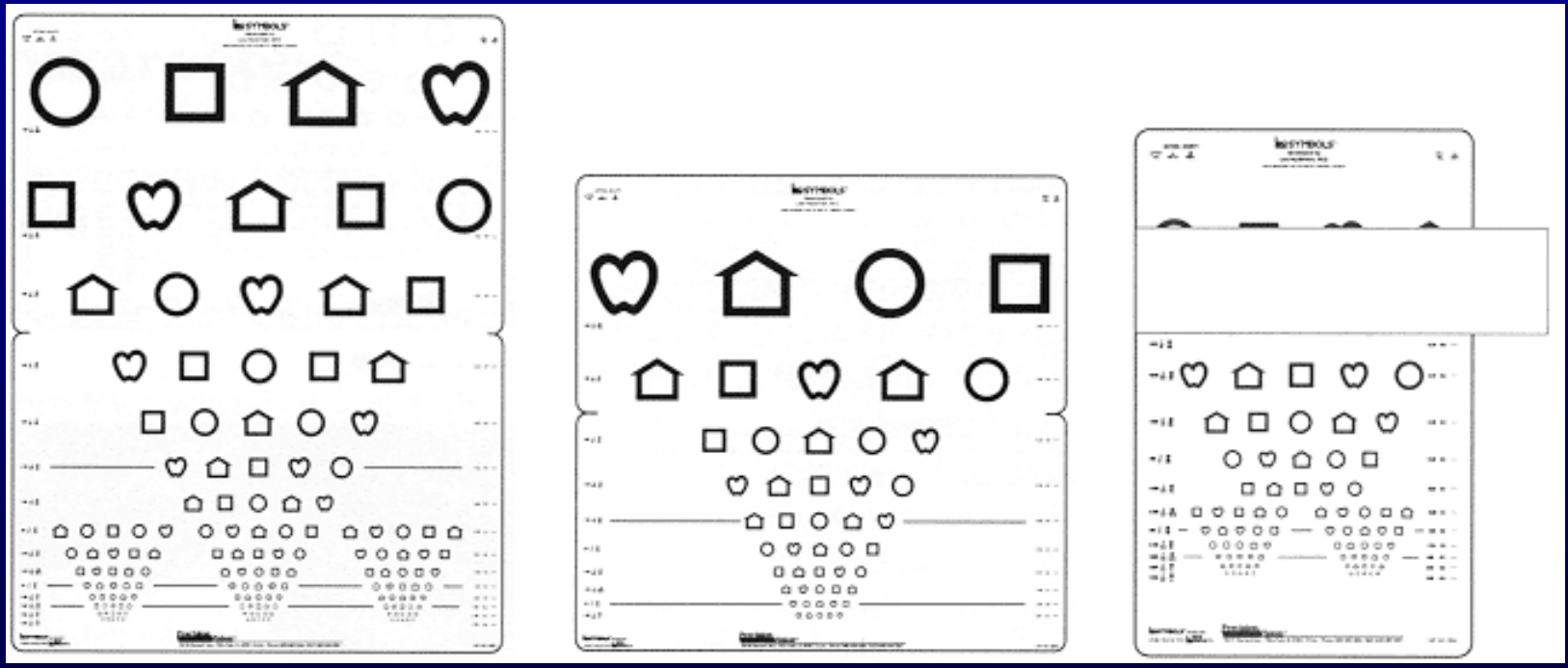
50% & 25% spacing



Near vision test with Numbers

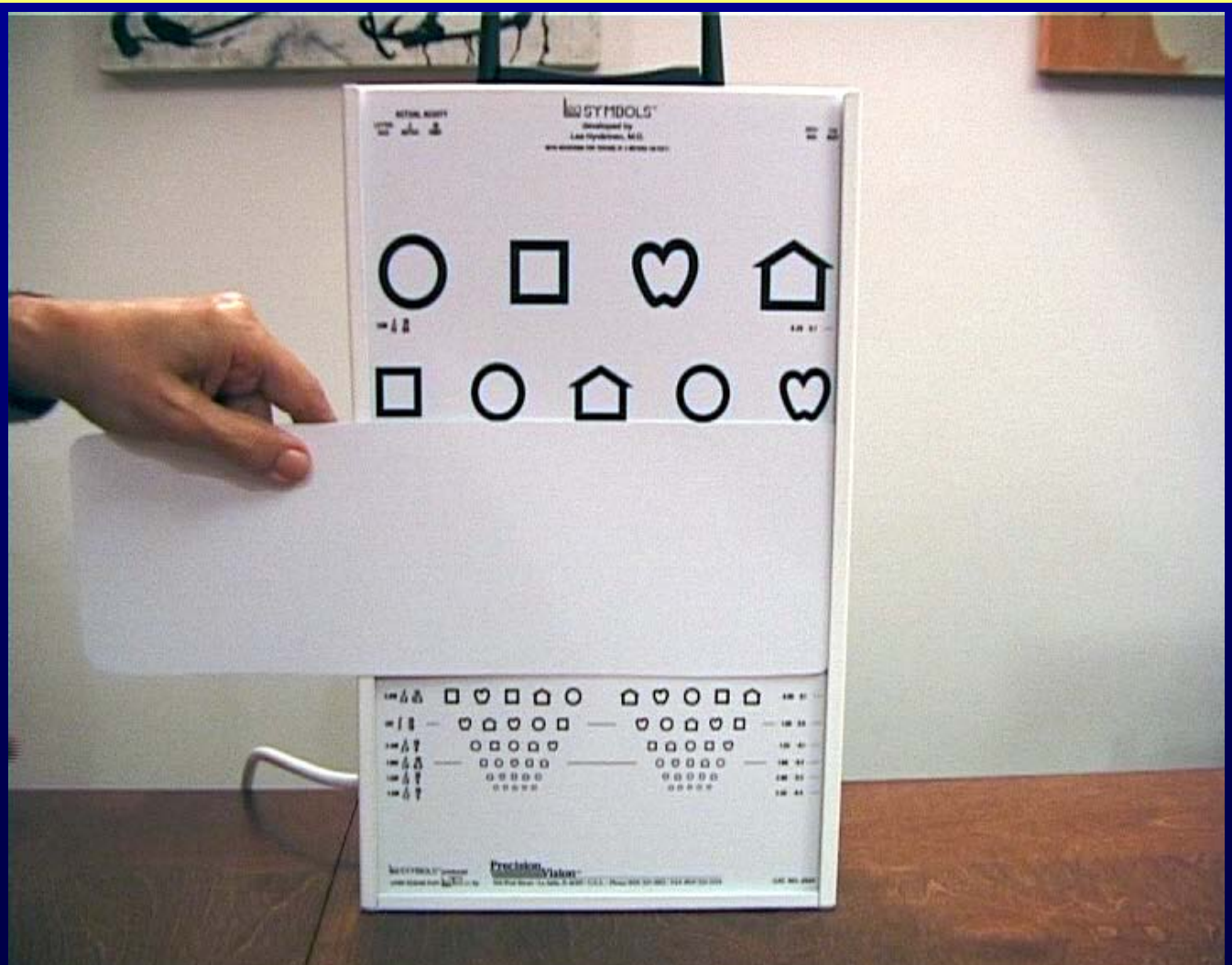


Distance VA tests

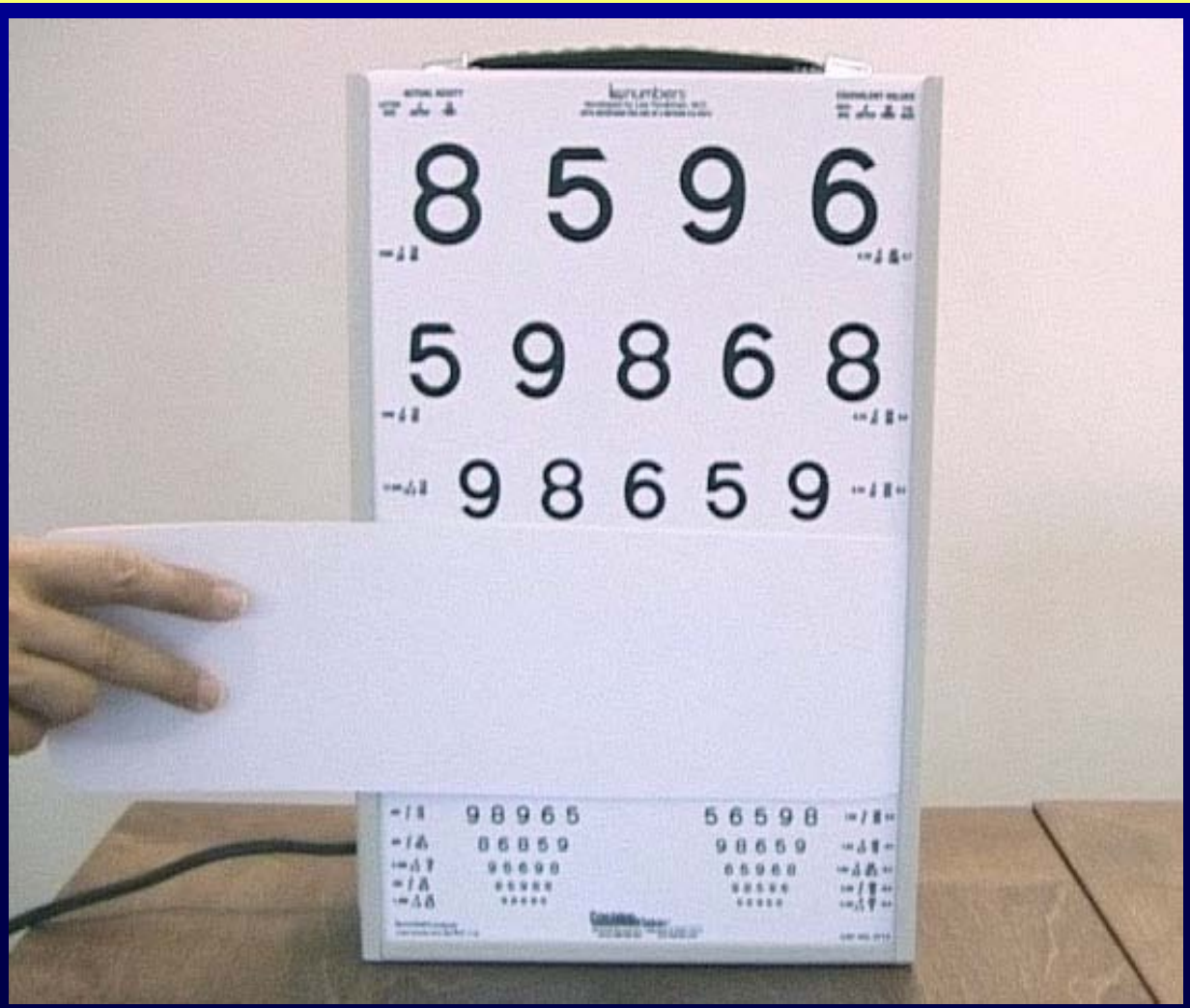


LEA Symbols test in lightbox

standard illumination for VA and CS tests



LEA Numbers test in lightbox



WORLD HEALTH ORGANIZATION

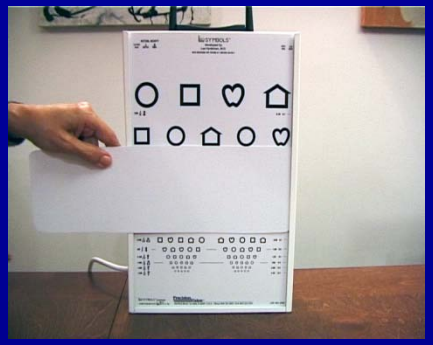
WHO/PBL/03.91

Prevention of Blindness & Deafness

CONSULTATION ON DEVELOPMENT OF STANDARDS FOR CHARACTERIZATION OF VISION LOSS AND VISUAL FUNCTIONING

Geneva, 4-5 September 2003



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