Assessment of Vision
in Children with Disabilities
Day 2, afternoon

Lea Hyvärinen, MD, PhD, PhD
Professor h.c., Rehabilitation Sciences, University of Dortmund
Senior Lecturer, Developmental Neuropsychology, Univ. of Helsinki
ICF
ICF-CY

International Classification of Functioning, Disability and Health

Management of low vision in children

Report of a WHO Consultation
Bangkok, 23-24 July 1992

Hosted by the International Council for Education of the Visually Handicapped

World Health Organization Geneva

9 activities
4 activities
ICF$_{2001}$ and ICF-CY$_{2007}$

Nine domains:

• 1) learning and applying knowledge
• 2) general tasks and demands
• 3) communication
• 4) mobility
• 5) self-care
• 6) domestic life
• 7) interpersonal interactions and relationships
• 8) major life areas
• 9) community, social and civic life
Visual Functioning

- Communication and Interaction
- Activities of Daily Life
- Orientation and Moving
- Sustained Near Vision Tasks
Ocular motor functions
Ocular motor functions

- Fixation of gaze:
  - central, eccentric, stable, unstable, lacking (small picture, penlamp)
- Shift of gaze and saccades:
  - exact, fast/slow, irregular, lacking
- Following movements and tracking:
  - smooth, composed of saccades, lacking, compensated with head movements
- Accommodation:
  - normal, insufficient, lacking, spastic, tonic
- Convergence:
  - normal (to the tip of the nose), insufficient, eye loses fixation at __ cm
- Alignment:
  - ortotropia (“straight eyes”), eso/exotropias, -phorias, alternation.
- Nystagmus:
  - amplitude and direction
Fixation
Fixation, convergence, accommodation
Accommodation
Compensating accommodation
Facilitation
head control, fixation and accommodation problems
Accommodation & Fixation

too little of capacity
Damping of nystagmus
Tactile exploration, no use of vision

Lack of visual control of movements
Grating acuity 4cpd
Accommodation

dynamic retinoscopy
Fixation and following movements
Fusion
Beren’s 3 picture test
Visual Acuity

Detection acuity, objects
Detection and discrimination GrA
Optotype acuities
near & distance
Optimal reading acuity
”Same – not same”
training with the LEA Puzzle

eye-hand-coordination  comparison: picture with cut-out
Visual acuity

"koirankoppi"/ dog house
VA = 0.04 (6/150)

If the measurement is disturbed the child’s reaction shows it-
Grating Acuity Tests
Detection and Discrimination tests

Grating acuity values MUST NOT be converted to optotype acuity values.

cycles per degree, cpd
Discrimination is possible even if the lines are distorted.
Grating Acuity Test

Grating acuity 4cpd
Optotype acuity 0.004; 3/750 (not 0.12; 6/50)
Special instrument
for observation of reading strategies

Child’s face and the text are reflected to the camera.

Text on clear film.
Oculomotor functions
recorded with a special camera system

This boy learned to speak 6 months before this video was taken; letter ”V” is difficult and blocks the use of vision and control of eyes and head movements.
Saccades L to R poor, VA 0.01 (50% crowding)
Saccades R to L good, VA 0.05 (50% crowding)
Insufficient accommodation, myopia
0.01 = 1/100 = 10/1000. 0.05 = 10/200
visual acuity later 0.1 (= 10/100) at 60cm (2’)
(LEA Symbols line test on lightbox)
Assisted communication

Eight children needed assistance in communication.
School age

Visual field for communication and O&M

Visual field, visual acuity, contrast sensitivity, vision in dim light (mesopic adaptation). Schoolchildren can demonstrate functioning of their visual field.

10 cd/m²

CONE Adaptation test
Constricted visual field
tested by her own therapist in order not to frighten the infant

At school 2010:
Nystagmus, head turn to block
Ocular motor functions compensated by head movements
VA 0.3 (10/30), at 10% 0.1 (10/100)
GrA 24cpd, 10% contrast: 7cpd
Visual field with 10Hz flicker

Illuminated ball used by child’s own therapist.
Visual ergonomics

Testing ergonomics at the resource centre, JNK 2008
Condition after removal of a brain tumour in the left occipital area.
Visual field
right eye or left eye fixating

Right eye fixating

Left eye fixating
Visual Ergonomics
11.1.2012 morning
Comparing basic colours
Concept “same”
Clinical examinations

- Ocular motor functions
- Grating acuity
- Recognition acuity, single, line, crowded
- Contrast sensitivity
- Visual field
- Colour vision
- Visual adaptation, filters
- Motion perception

Tests need to be repeated at day care and school - train the educational personnel to test and observe.
Video sequencies
for training of the personnel
to observe
to repeat test situations
to record with video camera
to analyse sequencies
Right exotropia

Finger on the fixation-object (face). Left eye fixates, right eye moved outward.
Cover test
with hand

Difference in fixation behaviour.
Fiksaatio valoon on hyvin lähellä mustuaisen keskipistettä.
Fixation at penlight varies
Kuvaa katsoessa silmä kääntyy nenään pääin eli fiksaatio siirtyy pois foveasta.
LEA Puzzle

B&W side

Correct direction is not yet important.
Difference between tight and wide picture

Best recording would be using tight near picture from below and straight on the face.
LEA Playing cards, big pictures

Visus = m/M
LEA Playing cards, small

Visual acuity:
distance m/M-size

0.4 m/ 2.5 M =
4/25 = 16/100 = 0.16
Screening near test
difficult, 1/3 of the value with single symbols

Tuloksen näyttäminen viereisessä huoneessa oleville ja kameralle: 2.5M kuviot (0.16) nähtiin yksittäisillä kuvioilla. Seulontalähitesti, rivitesti oli selvästi vaikeampi kuin yksittäiset kuviot: 0.05 - rivi osittain oikein.
Low contrast Heidi test

Test is in upper right corner.

3 month old baby
2.5% contrast at a distance slightly more than a metre is good. Enough for communication at close distances.
Too large a picture

The camera should not be on other persons, except when specifically planned. If the frames are cut, image quality decreases. Compare with the next slide.
10M low contrast test
24%, 10%, 5%, 2.5% and 1.25% test lines

If only a part of the video frames is used, image quality is poor but the functions can be recognized. Compare with the previous picture.
Accommodation
In this situation no change toward minus

Teachers, therapists and doctors had seen the testing through an one-way mirror.
When the object with interesting details comes closer, the eyes normally converge, Pupils become smaller and the eyes accommodate. None of these functions was clearly present this time. Pupil became a little smaller a few times.
Better? A difficult question
Short observation distance
geometric magnification
Training the moving along the lines

Movement along the broad (1 cpcm) lines good. The (4 cpcm) lines difficult. Training with straight and different non-straight lines at school.
Waggonerin screening test for red-green deficiency is a low contrast test. This “Color Vision Testing made easy” uses easy pictures but at low contrast.
Examples on positioning and facilitation
Limited positions
Facilitation
Test caps in a row
Facilitation
Tea
“Nearly blind”
Crying as communication

RE: phtisis, no pressure
LE: buphthalmous, lateral iridectomia, cataract
Following movements

test stimulus in the hand of the child
Hole in iris

peripheral iridectomy
Fixation and visual field
Tactile stimulation

Vibration is pleasant, it relaxes and increases awareness of the structure and functions of the body. Light increases child’s activity and learning.
Visual field for flicker at 10 Hz

Only one reaction on the left side.
Toy as an activator

Notice shifting between visual and auditory dominance

Visual information is supported with tactile information and the movements of the hand.
From crying -> to curious

The less there is vision the better we should help the child to use it BUT at the same time training of strategies of the blind children.
Severe teraplegic condition

First assessment in Nov. 2011. Movements in right wrist disappeared during scoliosis operation. Right arm can be lifted to activate switches. Tactile information in hands is good and enjoyable, Chinese meditation balls were fun, several other balls as well.
Fixation target in child’s hand

Difficult to shift attention across midline, own favourite toy.
Chinese meditation ball
Masage ball
+4 lenses and Gogo doll
Presentation of large symbols (LH)
Presentation of large symbols (NN)