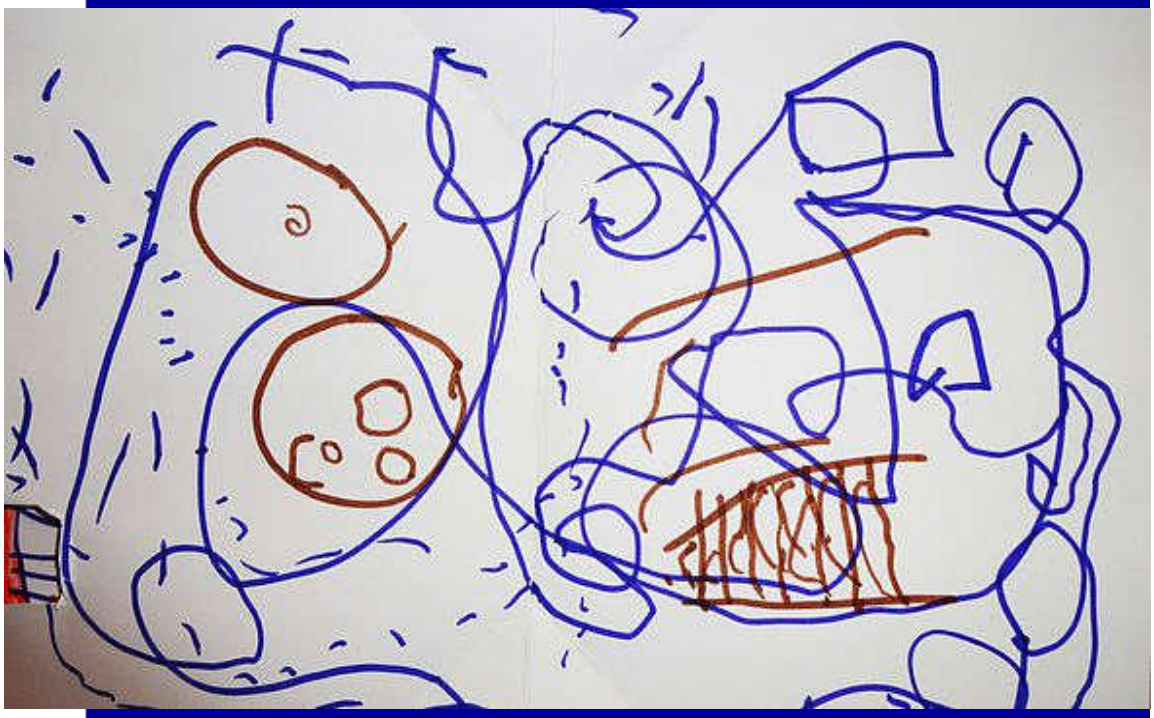
Cerebral Visual Impairment

TEACH CVI materials for training of teachers



"My home: stairs, people, and windows"
Drawing by S.H., a five year old girl with CVI.

http://www.teachcvi.net

Erasmus+

Teach CVI materials for training of teachers
Content

TEACH CVI MATERIALS FOR TRAINING OF TEACHERS

CHAPTER I

TEACH CVI MATERIALS FOR TRAINING OF TEACHERS

CHAPTER I: General information about CVI and practical tools

- Material produced by the TEACH CVI project members
- This publication was supported by the ERASMUS+ Programme of the European Commission
- Please note that information provided into this folder for teacher training is not exhaustive
- This publication reflects the views of the authors. Therefore, the Commission cannot be held responsible for any use of the information contained herein.

CHAPTER I

General information about CVI and practical tools

Part 1: General information about CVI

1. CEREBRAL VISUAL IMPAIRMENT AND THE IMPACT ON LEARNING

Cerebral Visual Impairment (CVI) is a term used to describe visual impairment due to injury to the visual pathways and centres of the brain. CVI is a neurological impairment occurring in the presence of an intact ophthalmological system. In other words, CVI is not caused by a disorder of the eyes, but the visual systems of the brain do not consistently understand or interpret what the eyes see[1,2].

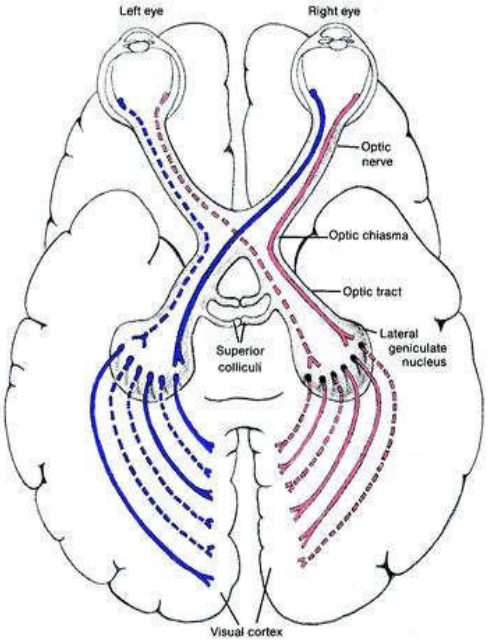
CVI can be considered as one of the principal causes of visual impairment in children, especially in developed countries. The incidence of CVI is increasing due to improved medical care for children[3].

The degree of visual impairment depends on the severity and location of the neurological damage as well as time of onset. The range of possible outcomes is wide, both in terms of vision and associated impairments[3].

Visual outcomes can range from total blindness to mild disturbances in visual perception and frequently these children can also present with neurological disorders such as cerebral palsy, ocular impairments, cognitive impairment, epilepsy, learning disabilities, and communication difficulties[3].

[1] Ortibus, E., Lagae, L., Casteels, I., Demaerel, P., & Stiers, P. (2009). Assessment of cerebral visual impairment with the "L94" visual perceptual battery: clinical value and correlation with MRI findings. *Dev Med Child Neurol., 51*(3), 209-2017.
[2] Ortibus, E., Verhoeven, J., et al. (2011). Screening for Cerebral Visual Impairment: validation of a CVI questionnaire. *Neuropediatrics, 42*, 138-147.
[3] Swift, S. H., Davidson, R. C., & Weems, L. J. (2008). Cortical visual impairment in children: presentation intervention, and prognosis in educational settings. *TEACHNG exceptional children plus, 4*(5), 1-14.

2. COMPONENTS OF THE VISUAL SYSTEM[4]



Components of the visual system:

- Eyes and optic nerve
- Optic chiasm
- Optic tract, lateral geniculate body from the thalamus and optic radiations
- Visual cortex

When arrays of light strike the retina, visual data is transferred to the optic nerve, the visual cortex, and higher areas of the brain[5,6]. The ability to study a visual scene, locate and recognize an object, move towards it, and pick it up requires a hierarchy of processes, from low- to mid- to high-level vision (figure 1)[6,7].

[4] Information shared by Roxana Cziker from the course for teacher training in Iceland, August 2016.
[5] Colenbrander, A. (2010). What's in a name? Appropriate terminology for CVI. *Journal of Visual Impairment & Blindness, 104*(10), 583-585.
[6] Wagemans, J., Wichmann, F. A., & Op de Beeck, H. (2005). Visual perception I: Basic principles. In K. Lamberts & R. Goldstone (Eds.), *Handbook of Cognition* (pp. 3-47). London: Sage Publications.
[7] Dutton, G. N. (2003). Cognitive vision, its disorders and differential diagnosis in adults and children: knowing where and what things are. *Eye, 17*(3), 289-304. doi: 10.1038/sj.eye.6700344

Low-level vision or early vision ensures the registration of light on the retina and the decoding of basic features (such as orientation, colour, size, and length) into neural responses[6].

In the second level of visual processing (i.e., mid-level vision) these signals reach the cerebral cortex and the basic elements are organized into more structured components and representations (e.g., figure-ground segmentation, grouping principles, and segregation of figures from the background)[6,7].

High-level vision interprets the visual input with two visual pathways: the dorsal and ventral stream. These two pathways transmit visual data from the visual cortex to other areas of the brain[6,7].

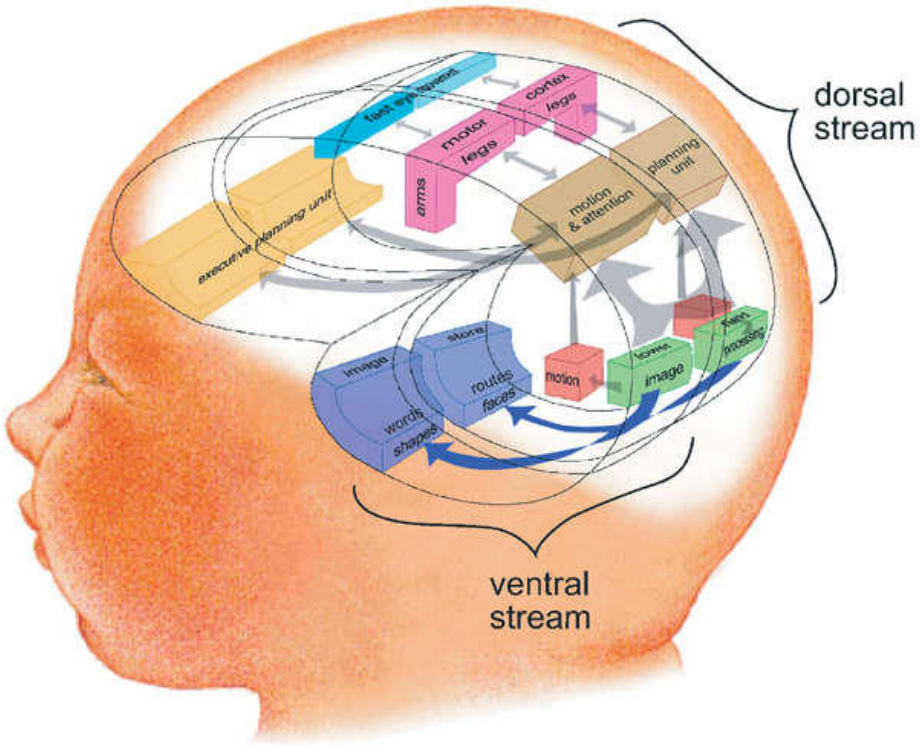


Figure 1. Illustration of the visual processing areas in the brain; Adapted from "Cognitive vision, its disorders and differential diagnosis in adults and children: knowing where and what things are", by G. N. Dutton, 2003, *Eye, 17*(3), p. 291.

The dorsal stream or “the where system” is the visual pathway between the occipital lobes, the posterior parietal lobes, the frontal cortex, and the motor cortex. This visual stream captures a scene, gives attention to a part of this scene, facilitates switching attention from one element in the scene to another, and guides movement. This is mostly automatic and unconscious[8,9].

The visual pathway between the occipital lobes and the temporal lobes is called the ventral stream or “the what system”. It supports the process of conscious recognition of people and objects, orientation, and visual memory[8,9].

Dysfunction of the dorsal stream is thought to be more common in children than ventral stream dysfunction. Both result in a variety of problems, occurring in any combination and severity[8,9].

[8] Lueck, A. H. (2010). Cortical or cerebral visual impairment in Children: A brief overview. *Journal of Visual Impairment and Blindness, 104*(10), 585-592.
[9] Lueck, A. H., & Dutton, G. N. (2015). *Vision and the Brain: Understanding Cerebral Visual Impairment in Children.* New York: AFB Press.

Dorsal stream - "Where are people / objects?"

This stream is reposible for:

- Processing of stimuli in movement
- Grasping of objects under visual control
- Visual attention

Ventral stream "What is it?"

This stream is resposible for:

- Details of objects
- Recognition of shapes
- Recognition of objects
- Recognition of human faces

It is called a 'stream' as it is a flow of information about the visual world from one place to another like water flowing in a stream.

The damage of the dorsal stream could affect:

- Getting around safely and quickly
- Picking objects up
- Bumping into things
- Using stairs
- Stepping onto pavements
- Seeing a lot of different things at same time, e.g. finding object on a patterned carpet or something pointed out in the distance

The damage of the ventral stream could affect:

- Recognition of familiar faces
- Knowing what common everyday objects are

3. POSSIBLE CHARACTERISTICS OF CEREBRAL VISUAL IMPAIRMENT[10]

Appearance

- Does not appear blind
- Has a blank facial expression
- Does not display visual communication skills
- Eye movements appear smooth but aimless

Visual function

- Varies from day to day, hour to hour
- Sporadic and limited visual attention
- Aware of distance objects but unsure what they are
- Spontaneous visual activity has a short duration
- Visual learning is tiring
- Closes eyes or looks away when listening
- Balance may improve when eyes are closed
- Looks away from people and objects
- Consistently looks to either side when looking
- When visually reaching often looks with a slight downward gaze
- Turns head away to the side when reaching, appears to use peripheral field
- Uses touch to identify objects
- Will usually track at a distance

[10] Source: Rita Thompson Nov 2013 QTVI/QTMSI

Mobility skills

- May see better when traveling in a car
- Difficulties with depth perception / inaccurate reach
- Difficulties with estimating distances
- Difficulties with spatial interpretation
- Will avoid obstacles, but is unable to use vision for close work

Improved visual performance when

- Feeling secure in familiar environments with familiar people / objects
- When told what to look for and where to find it
- Objects are held close to eyes when viewing
- One object is offered at a time
- Objects are widely spaced apart on a surface
- Colour is used to assist in identification of objects or shapes
- Objects are presented on a plain highly contrasting background
- Give TIME to visually process the visual target

4. VISUAL FUNCTION CHARACTERISTICS IN CHILDREN WITH CVI

1. Difficulty focusing when looking at near objects

The focusing power of the eye needs to increase when looking at a close object. In children with CVI the focusing power can be reduced. This means the child can become tired more easily when looking at close objects.

2. Difficulty making fast eye movements

Fast eye movements are important for reading. This means the child may tend to make quick head turns when looking around a room or when reading (and doing other visual tasks). We use fast eye movements to quickly change the direction that our eyes are looking. This means the child may have difficulty following and fixating accurately on a fast moving object that has suddenly changed position.

3. Visual field

The peripheral fields extend our view almost to our shoulders on either side of our body. Our lower field gives us a view of the ground and the upper visual field covers space above our head. Thus the large field of vision allows us to easily manoeuvre safely in space.

- The right side of the brain is responsible for seeing the left side of the visual world. This means if the right side of the child's brain is damaged, the left side of the visual world may not be seen and vice versa.
- The upper part of the back of the brain is responsible for seeing the lower part of the visual world. This means a child with damage in this area will not see the ground when looking straight ahead and may have a tendency to trip up.

4. Impaired visual memory and impaired visual imagination

This means the child has problems remembering things seen and in learning new tasks as visual imagination is used to work out the sequence of moves to complete a task.

5. Impaired depth perception

This means the child has a lack of understanding of 3-dimensional images impacting on:

- Walking up and downstairs
- Stepping up and down pavements
- Reaching out for an object accurately

6. Impaired perception of movement

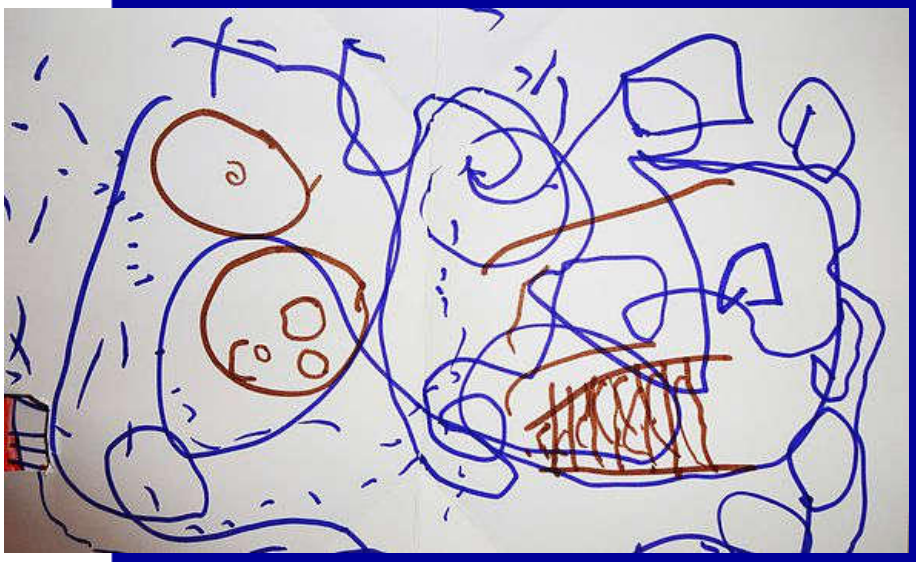
This means the child has difficulty in:

- Visually following moving objects (tracking)
- Seeing detail in moving targets such as the television
- Seeing and interpreting their own movements through space

Part 2: Guidelines

Cerebral Visual Impairment

Guidelines for health care professionals
and educational professionals



"My home: stairs, people and windows"
Drawing by S.H., a five years old girl with CVI.

http://www.teachcvi.net

Cerebral Visual Impairment (CVI) is considered as one of the principal causes of visual impairment in children, especially in developed countries. Yet ***CVI*** is still often misunderstood and misdiagnosed.

These guidelines, developed by the TeachCVI team, are designed as a tool to assist health care and educational professionals who are working with children at risk for ***CVI***. For more information on the following topics, see http://teachcvi.net/.

We provide guidance on:

- What is Cerebral Visual Impairment?
- Risk factors
- Signs and symptoms
- Consequences
- Assessment
- Access to literacy
- Treatment / Intervention
- Teaching strategies
-

What is Cerebral Visual Impairment?

Cerebral Visual Impairment (CVI) is a term used to describe visual impairment due to injury to the visual pathways and centres of the brain.

CVI is not caused by a disorder of the eyes, but the visual system of the brain do not consistently understand or interpret what the eyes see. Thus, processing of visual information is impaired.

The degree of visual impairment depends on the severity and location of the neurological damage as well as time of onset. The range of possible outcomes is wide, both in terms of vision and associated impairments.

Visual outcomes can range from total blindness to mild disturbances in visual perception and frequently these children can also present neurological disorders such as cerebral palsy, epilepsy and learning disability.

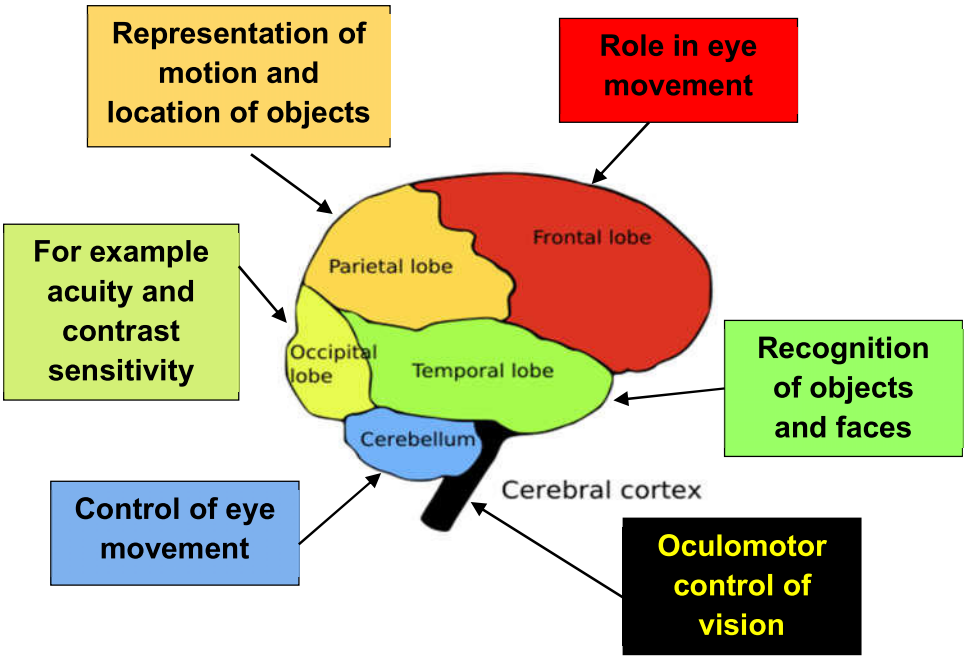
For clinical purposes, children with ***CVI*** can be grouped into three categories:

- Children with profound visual impairment due to ***CVI***, many of whom have additional disabilities
- Children with ***CVI*** who have better functional visual abilities and some cognitive and motor challenges
- Children with ***CVI*** who have sufficient vision, that allows them to work at or near the expected academic level for their age group. Some can have additional motor disorders

CVI is not an indicator of the child´s cognitive ability but it may have an adverse impact on the child´s development.

Risk factors

Because vision involves so many areas of the brain, processing and interpreting visual information is a complex task. Therefore, injury to and malfunction in these areas is likely to impact adversely on the functioning of the visual system.



The brain damage leading to ***CVI*** can occur:

- Before the child is born
- During or immediately after birth
- Later during the child's life

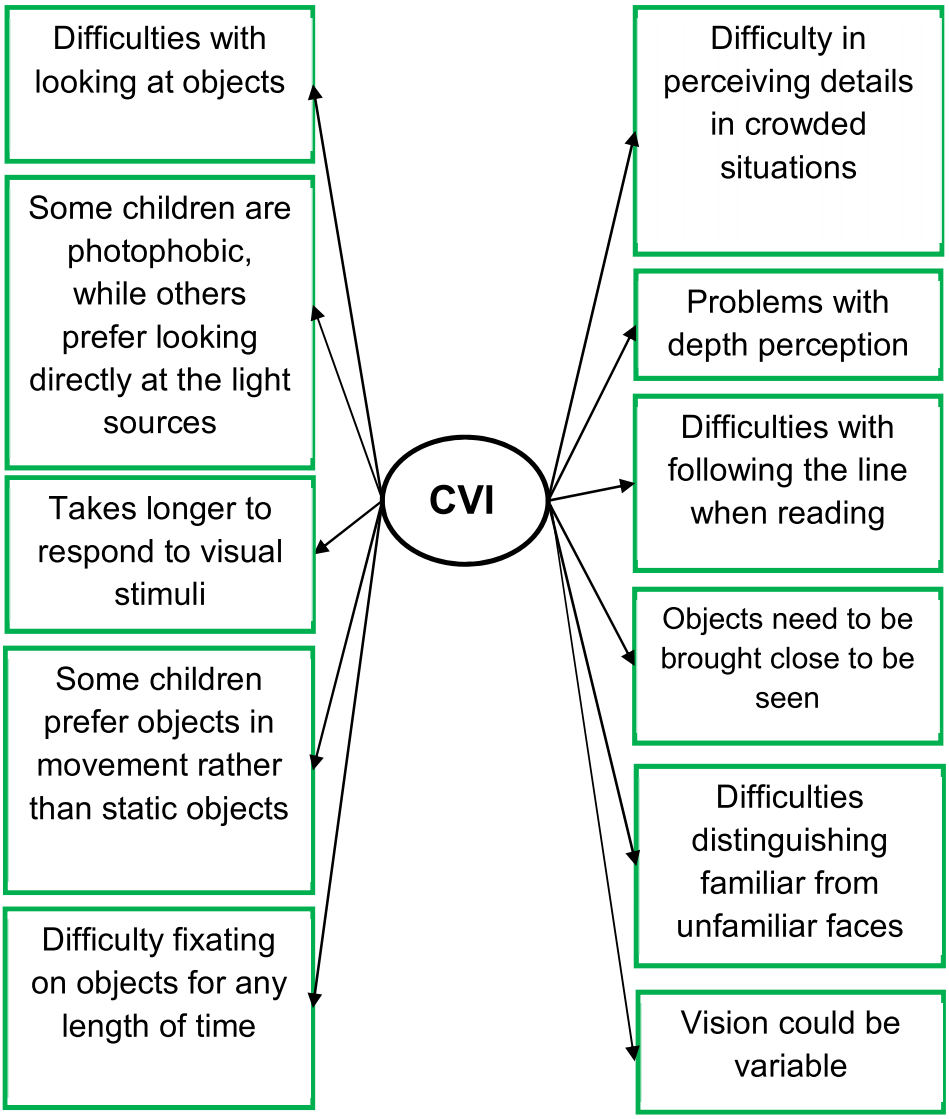
Most common risk factors for ***CVI*** are:

- Prematurity, especially birth before 34 weeks gestation
- Periventricular white matter disease
- Lack of blood supply or oxygen to the brain
- Developmental brain defects
- Low blood sugar at birth
- Hydrocephalus
- Infections of the central nervous system (e.g. meningitis and encephalitis)
- Head injury

Sometimes there is no obvious cause.

Signs and symptoms

Signs of ***CVI*** are variable and no single sign is characteristic of the condition. Common characteristics of visual function demonstrated by children with ***CVI*** may include what is presented in the diagram.



Young children with ***CVI*** can appear blind during the first months but their vision tends to improve. Children with ***CVI*** may also have problems with the basic visual functions such as visual acuity, contrast sensitivity and visual field.

Consequences

CVI can for instance have an impact on:

- Near vision tasks
- Access to literacy
- Communication and social interaction
- Daily living and learning skills
- Orientation and mobility

CVI can also lead to:

- Visual fatigue
- Anxiety

Assessment

CVI should be considered as the cause for visual impairment when the visual behaviour is not fully explained by the ophthalmological examination. The eye movements are frequently abnormal (nystagmus or strabismus) and visual functioning is variable. Clinicians frequently have to rely on observations and the child‘s health history to diagnose ***CVI***.

The assessment is best made by a multidisciplinary team following an ophthalmological evaluation, comprising a visual function and a functional vision assessment, a neurological examination and a (neuro) psychological evaluation. Frequently an MRI scan of the brain is part of the diagnostic process as well.

Early diagnosis of ***CVI*** is crucial, as early intervention may improve the outcome. In order to facilitate early diagnosis, ***CVI*** screening lists have been developed.

On our website, you can find these screening lists and an overview of the regional multidisciplinary teams you can refer to for ***CVI*** assessment.

Access to literacy

Literacy is not only about the ability to read and write. It is an act of liberation and empowerment, of taking a role as an active citizen in society. Literacy is "reading the word and the world" (Freire & Macedo, 1987).

The Convention on the Rights of the Child states:

> *"The child shall have the right to freedom of expression; this right shall include freedom to seek, receive and impart information and ideas of all kinds, regardless of frontiers, either orally, in writing or in print, in the form of art, or through any other media of the child's choice."* (United Nations Convention on the Rights of the Child, Article 13).

Children with ***CVI*** have specific and diverse needs when it comes to literacy exposure and experiences. Many lack opportunities to engage naturally in incidental learning. Professionals from different fields share the responsibility to support children with ***CVI*** to gain access to literacy and give them an opportunity to achieve their maximum potential.

The TeachCVI project supports the concept of literacy as a continuum starting at birth.

Stage	Description	Age*
Building a Foundation for Literacy Development	E.g. chews on books, enjoys rhymes, attends to pictures, understands that an object can be a symbol for an activity, etc.	0 – 2
Early Emergent Literacy	Pretends reading, listens to stories, recites and fills in phrases in a story, scribbles, draws, etc.	2 – 4
Emergent Literacy	Understands that text and pictures convey meaning, begins to recognize familiar environmental print and their name, may write some letters, etc.	4 – 5
Developing Literacy	Awareness that words are made of different sounds, decodes words, writes simple sentences, etc.	6 – 7
Early Independent Literacy	Shifts from “learn to read” to “read to learn”, reads independently for a longer time, writes own ideas and observations, etc.	8 – 9
Independent Literacy	Reads confidently and independently in multiple modes of text, written work is organized, coherent and easily understood, etc.	10 – 11
Expanding Literacy	Reading for acquisition of knowledge, analyses and thinks critically about ideas presented in text, writes for a variety of reasons and in diverse modes, etc.	11+

** Age ranges indicate when one would expect children without disabilities to be engaged in the activities and behaviours listed and are provided for general reference only.*

Treatment / Interventions

The principal aim of all early intervention measures for children with ***CVI*** is to minimise the impact of disability on the child‘s development, facilitate independent daily living skills, minimise social disadvantage and increase the quality of life.

The following approaches are aimed at minimising the consequences of CVI:

- Ensuring that environmental conditions and all communication materials used are accessible and matched to the developing needs of the child
- Developing efficient strategies to maximise visual capacities
- Encouraging functional compensation of other senses like tactile, auditory, etc.

Teaching strategies

A structured programme of support can make a huge difference in outcomes for children with ***CVI*** (see teaching material on http://www.teachcvi.net/).

The following strategies can be used:

- Use multisensory stimulation of vision, hearing, touching and olfaction
- Allow lots of time and intermittent breaks for the child to see and respond to stimuli. A great deal of energy is needed to process information visually and the child might tire easily
- Try to keep visual information as simple, constant and predictable as possible
- Use toys and activities that motivate the child
- Try to interpret the child´s subtle response cues: for instance changes in breathing patterns, shifts of gaze or head and body position

Resources

1. Blaikie, A. (n.d.). *Medical information on Cerebral Visual Impairment.* Retrieved from http://www.ssc.education.ed.ac.uk/resources/vi&multi/eyeconds/cereVI.html
2. Freire, P., & Macedo, D. (1987). *Literacy: Reading the word and world.* South Hadley, MA: Bergin & Garvey.
3. Harwood, J. (2015). *Cerebral Visual Impairment.* Retrieved from http://www.rnib.org.uk/insight-online/cerebral-visual-impairment
4. http://literacy.nationaldb.org
5. Lueck, A. H. (2010). Cortical or Cerebral Visual Impairment in Children: A brief overview. *Journal of Visual Impairment and Blindness*, *104*(10), 585-592.
6. Lueck, A. H., & Dutton, G. N. (2015). *Vision and the Brain. Understanding Cerebral Visual Impairment in Children*. AFB Press: New York.
7. Ortibus, E., Laenen, A., Verhoeven, J., De Cock, P., Casteels, I., Schoolmeesters, B., et al. (2011). *Screening for Cerebral Visual Impairment: Value of a CVI Questionnaire.* Neuropediatrics*, 42*(4), 138-147.
8. Cziker, R., Seceleanu, A., Guttman, T., Joanta, A., Margineanu, L. (2008). *The relation among functional vision, neuropsychological development, MRI and visual evoked potential in cerebral visual impairment.* Oftalmologia, 52(4), 67-76.
9. United Nations Convention on the Rights of the Child (1990). *Article 13: Freedom of expression*. Retrieved from http://www.ohchr.org/EN/ ProfessionalInterest/Pages/CRC.aspx
10. Zihl, J., & Dutton, G. N. (2015). *Cerebral Visual Impairment in Children.* Springer-Verlag: Wien.

Part 3: Screening tool for children with CVI

1. INSTRUCTION SCREENING LISTS FOR CHILDREN WITH CVI

These screening tools are developed as a first step to decide when to refer children with a suspicion of CVI to specialised centres for further assessment. The screening tools cover lower, middle and higher visual functions.

Note: these are screening tools, not diagnostic tools!

Each screening list starts with some general questions about the child (e.g. medical, developmental and visual problems). Next, there is a list of questions that screen for CVI. The parents, teacher, health care professionals or other interested persons need to fill in every question to the best of their ability by indicating the number that is the most applicable to the child. The numbers correspond to: (1) never, (2) occasionally, (3) frequently and (4) always. At the end of the screening list, we have provided some space to allow further comments if necessary and to clarify which questions were hard to answer.

There are three screening lists for three different groups:

- Screening list CVI 1: This screening list is focused on children with a motor disability who are non-ambulant.
- Screening list CVI 2: This screening list is focused on children with a developmental age between two and six years old.
- Screening list CVI 3: This screening list is focused on children with a developmental age between six and twelve years old.

So far there is no ICD-10 code for the diagnosis of CVI. Most often the ICD-10 code H47.6, disorders of visual cortex, and H47.7, unspecified disorder of visual pathways, are used. For your convenience, we refer to CVI diagnosis although this isn't specified in ICD-10.

The following offers a guide on how to apply the screening lists:

1. Parents, teachers, health care professionals and other interested persons fill in the screening list.
   - On the introductory page questions 1 and 2 are for parents, teachers, health care professionals and other interested persons. Questions 3 to 5 only apply to parents.
   - It is important to emphasise that the screening list needs to be filled into the best of participants' knowledge. Considered responses will provide the most useful information.
   - Provide an opportunity to discuss the screening lists with the parents/teachers/health care professionals/other interested persons, particularly about questions they are not sure about. This will maximise the likelihood that every question can be filled in to the best of each participants´ knowledge.

2. Healthcare professionals score and review the screening tools.
   - At the moment there is no scientific research carried out on these screening lists. The scoring is based on previous research[11] and professional experience.

[11] Ortibus, E., Laenen, A., Verhoeven, J., De Cock, P., Casteels, I., Schoolmeesters, B., et al. (2011). Screening for cerebral visual impairment: value of a CVI questionnaire. *Neuropediatrics, 42*(2), 138-147. doi: 10.1055/s-0031-1285908

- The answers that are indicative for CVI are marked bold for each question and specific screeners are indicated for each screening list:
  - Scoring list 1
  - Scoring list 2
  - Scoring list 3
- Healthcare professionals need to count the number of bold answers.
- The healthcare professionals should also check whether or not screeners are marked:
  - Screeners list 1: **6 screeners**
    - Item 6: Use of vision can fluctuate.
    - Item 10: Does not recognise common objects.
    - Item 12: Can find a favourite toy easily when it is amongst other toys.
    - Item 14: Looks away while reaching out for an object.
    - Item 17: Notices an object only when it moves.
    - Item 19: Reacts to sound rather than to visual stimuli.
  - Screeners list 2: **8 screeners**
    - Item 4: Tilts head to look at something.
    - Item 15: Looks away while reaching out for an object.
    - Item 20: Does not recognise common objects.
    - Item 22: Recognises common objects only when drawn in colour.
    - Item 25: Has difficulties with interpreting more complex drawings (e.g. overview picture/situation picture).
    - Item 26: Can find a favourite toy easily when it is amongst other toys.
    - Item 31: Has difficulty walking down steps.
    - Item 34: Touches an object in preference to looking at it.

- Screeners list 3: **8 screeners**
    - Item 4: Tilts head to look at something.
    - Item 15: Looks away while reaching out for an object.
    - Item 22: Does not recognise common objects.
    - Item 27: Can find a favourite toy easily when it is amongst other toys.
    - Item 32: Has difficulties with interpreting more complex drawings (e.g. overview picture/situation picture).
    - Item 33: Has difficulties with following the line when reading.
    - Item 39: Has difficulties walking down steps.
    - Item 43: Has difficulties perceiving the movement of objects (e.g. movement of a car or movement of a ball).

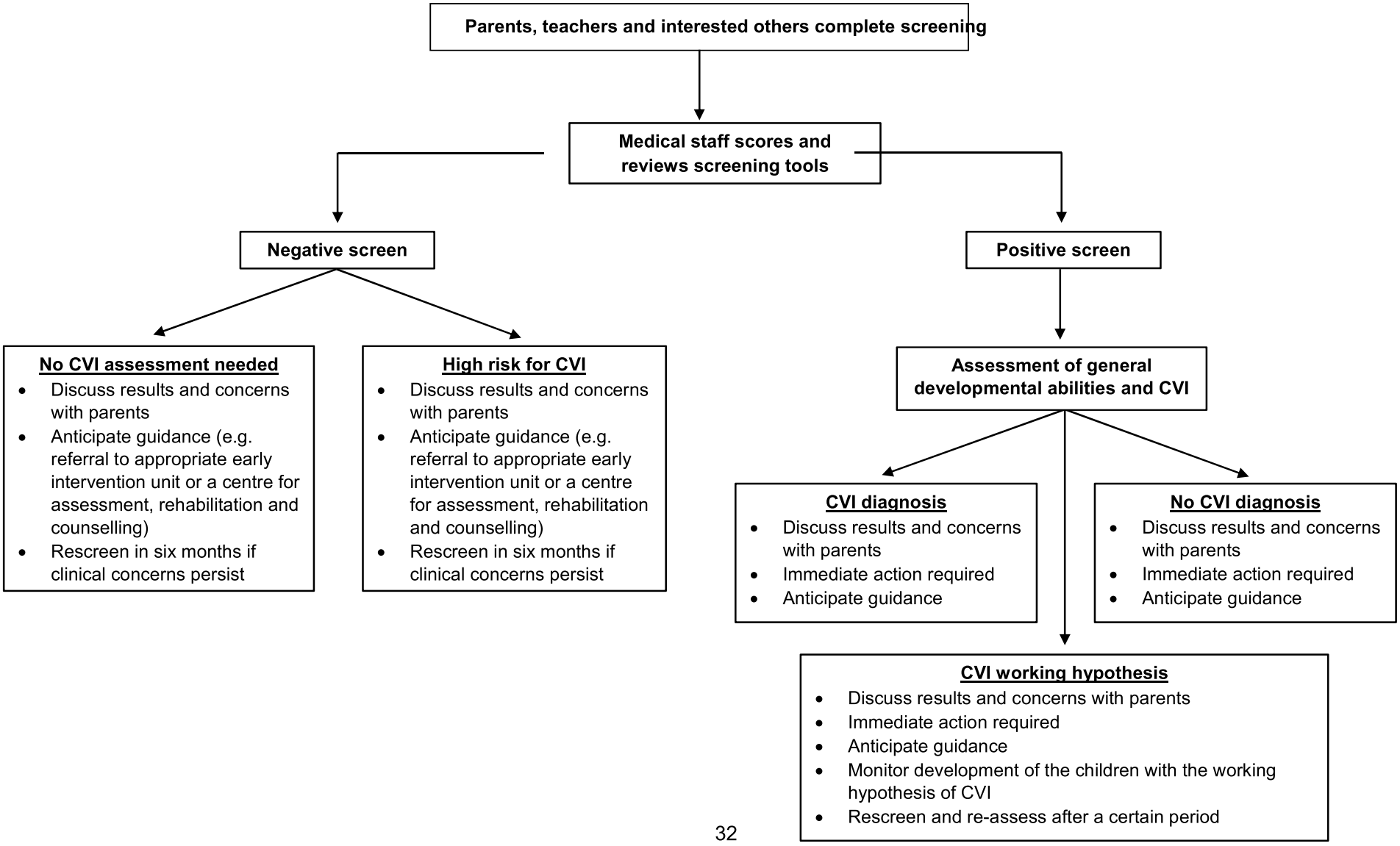
- A positive screen is based on the number of marked screeners and/or the number of marked items:
    - Screening list CVI 1 – There is a positive screen if:
        - 3 out of 6 screeners are indicated with or without additional marked items;
        - Or 6 or more items are marked (1/3 of the screening list).
    - Screening list CVI 2 – There is a positive screen if:
        - 4 out of 8 screeners are indicated with or without additional marked items;
        - Or 11 or more items are marked (1/3 of the screening list).
    - Screening list CVI 3 – There is a positive screen if:
        - 4 out of 8 screeners are indicated with or without additional marked items;
        - Or 15 or more items are marked (1/3 of the screening list).

3. Healthcare professionals provide feedback of the screening results to the parents.
4. The following offers guidance on how to address the findings from the screening:
   - Negative screen:
     - No further assessment for CVI needed: No immediate concern for CVI and further assessment is not needed. Some reassurance may be needed and other worries must be taken care of. Re-screen after 6 months if clinical concerns persist.
     - High risk for CVI: No immediate CVI diagnosis but there are grounds for concern (e.g. prematurity, cerebral palsy …) that given the presence of certain characteristics a CVI diagnosis might emerge in the future, suggesting the need for ongoing monitoring and assessment. Re-screen after 6 months if clinical concerns persist.
   - Positive screen: This requires immediate assessment by a multidisciplinary team. This team should have involvement from a number of specialists, such as paediatrician or paediatric neurologist, ophthalmologist, low vision therapist, (neuro)psychologist, physiotherapist … to assess the child's general developmental abilities. For more information about the multidisciplinary team, see www.teachcvi.net/.

     - No CVI diagnosis: Visual perceptual and functional visual abilities are within normal range. Reasons for clinical problems should be sought elsewhere and, if possible, guidance for the child and his caregivers.

- CVI diagnosis: Visual perceptual and functional visual abilities are impaired. Healthcare providers need to anticipate the need for guidance and start the (re)habilitation plan.
- CVI working hypothesis: Suspicion of CVI remains, but the assessment does not reveal clinical results. Therefore it is important to monitor the development of the child and re-screen and re-assess the child after a certain period. Follow-up and guidance is needed.

SCREENING MODEL FOR CHILDREN WITH A SUSPICION OF CVI



2. SCREENING LIST CVI 1

Screening list for children with a suspicion of Cerebral Visual Impairment (CVI)

1) General information

Date questionnaire filled in: ……

Filled in by (name): ……..

Relation to the child:

- ❑ Parent
- ❑ Teacher
- ❑ Health care professional
- ❑ Other interested person (please specify: ……....)

2) Information about the child

Name: ……

Date of birth: …… Age: ……y……m

Gender:

- ❑ Male
- ❑ Female
- ❑ Other

3) Pregnancy and birth

Pregnancy duration: …….. weeks Birth head circumference: ……. cm

Birth weight: ..... grams

Multiple births:

- ❑ Yes: ……..(e.g. twin or triplet)
- ❑ No

Were there any problems during the pregnancy?

- ❑ Yes
- ❑ No

If yes, please specify the problems:

……

……

……

……

Delivery:

- ❑ Normal/vaginal delivery
- ❑ Caesarean delivery
- ❑ Using specific medical procedures (e.g. forceps in childbirth or vacuum extraction)
- ❑ Don't know (e.g. adoption)

Were there any problems during the delivery?

- ❑ Yes
- ❑ No

If yes, please specify the problems:

……

……

……

……

4) Medical and/or developmental issues

Is your child being seen for any medical or developmental issues such as ADHD, Autism Spectrum Disorder, epilepsy, motor problems, growth disorders, or others issues?

- ❑ Yes
- ❑ No

If yes, please specify the issues:

……

……

……

……

Does your child receive therapy/help for these issues?

- ❑ Yes
- ❑ No

If yes, from whom?

……

……

……

……

Is your child on medication?

- ❑ Yes
- ❑ No

If yes, please specify which medication and why your child takes medication.

……

……

……

……

5) Visual problems

Does your child have known visual problems?

- ❑ Yes
- ❑ No

If yes, has the child been examined by an ophthalmologist/orthoptist/optometrist?

- ❑ Yes
- ❑ No

If yes, what problems were determined?

- ❑ Problems with visual acuity: Acuity right: ……..... Acuity left: …….....
- ❑ Visual field loss
- ❑ Strabismus
- ❑ Amblyopia/lazy eye
- ❑ Refractive errors
- ❑ Other:

……

……

……

Have glasses been prescribed?

- ❑ Yes
- ❑ No

If yes, please specify why the child has glasses.

……

……

……

……

For each question, circle the number that applies to your child

Below there is a list of questions that screen for Cerebral Visual Impairment (CVI).

Circle the number that is the most applicable to the child. Please do so for each question and trust your instinct.

The numbers correspond to:
1 = Never **2 = Occasionally** **3 = Frequently** **4 = Always**

1. Makes eye contact.	1	2	3	4
2. Has difficulties with looking at objects.	1	2	3	4
3. Has difficulties with looking at people.	1	2	3	4
4. Stares at light sources (e.g. lights or windows).	1	2	3	4
5. Notices objects positioned at waist level or below.	1	2	3	4
6. Use of vision can fluctuate.	1	2	3	4
7. Smiles in response to you smiling at him/her.	1	2	3	4
8. Recognizes familiar people only when they speak.	1	2	3	4
9. Prefers certain colours over others.	1	2	3	4
10. Does not recognise common objects.	1	2	3	4
11. Does not recognise common pictures/images.	1	2	3	4
12. Can find a favourite toy easily when it is amongst other toys.	1	2	3	4
13. Can find a favourite toy easily when it is on a patterned surface (e.g. a rug or blanket).	1	2	3	4
14. Looks away while reaching out for an object.	1	2	3	4
15. Hesitates when there is a change of floor surface (e.g. from a wooden floor to a carpet).	1	2	3	4
16. Closes his/her eyes when listening to voices or sounds.	1	2	3	4
17. Notices an object only when it moves.	1	2	3	4
18. Notices a person only when he/she moves.	1	2	3	4
19. Reacts to sound rather than to visual stimuli.	1	2	3	4

Further comments and questions that were difficult to answer:

……

……

……

……

……

……

……

……

……

……

3. SCORING LIST CVI 1

Screening list for children with a suspicion of Cerebral Visual Impairment (CVI)

Scoring

The answers that are indicative for CVI are marked bold for each question and specific screeners are indicated for each screening list.

Healthcare professionals need to check whether the responses of the parents/teachers/interested others correspond with these bold answers and need to count the number of these responses. They should also check whether or not screeners are marked.

A positive screen is based on the number of marked screeners and/or the number of marked questions. There is a positive screen if:

- 3 out of 6 screeners are indicated with or without additional marked items;
- Or 6 or more items are marked (1/3 of the screening list).

1=Never **2=Occasionally** **3=Frequently** **4=Always**

1. Makes eye contact.	**1**	**2**	3	4
2. Has difficulties with looking at objects.	1	2	**3**	**4**
3. Has difficulties with looking at people.	1	2	**3**	**4**
4. Stares at light sources (e.g. lights or windows).	1	2	**3**	**4**
5. Notices objects positioned at waist level or below.	**1**	**2**	3	4
6. Use of vision can fluctuate.	1	2	**3**	**4**
7. Smiles in response to you smiling at him/her.	**1**	**2**	3	4
8. Recognizes familiar persons only when they speak.	1	2	**3**	**4**
9. Prefers certain colours over others.	1	2	**3**	**4**
10. Does not recognise common objects.	1	2	**3**	**4**

11. Does not recognise common pictures/images.	1	2	**3**	**4**
12. Can find a favourite toy easily when it is amongst other toys.	**1**	**2**	3	4
13. Can find a favourite toy easily when it is on a patterned surface (e.g. a rug or blanket).	**1**	**2**	3	4
14. Looks away while reaching out for an object.	1	2	**3**	**4**
15. Hesitates when there is a change of floor surface (e.g. from a wooden floor to a carpet or when encountering steps).	1	2	**3**	**4**
16. Closes his/her eyes when listening to voices or sounds.	1	2	**3**	**4**
17. Notices an object only when it moves.	1	2	**3**	**4**
18. Notices a person only when he/she moves.	1	2	**3**	**4**
19. Reacts to sound rather than to visual stimuli.	1	2	**3**	**4**

Number of screeners: ……

Number of answers that are indicative for CVI: ……

4. SCREENING LIST CVI 2

Screening list for children with a suspicion of Cerebral Visual Impairment (CVI)

1) General information

Date questionnaire filled in: ……

Filled in by (name): ……

Relation to the child:

- ❑ Parent
- ❑ Teacher
- ❑ Health care professional
- ❑ Other interested person (please specify: ……..)

2) Information about the child

Name: ……

Date of birth: …… Age: ……y……m

Gender:

- ❑ Male
- ❑ Female
- ❑ Other

3) Pregnancy and birth

Pregnancy duration: …….. weeks Birth head circumference: ……. cm

Birth weight: ..... grams

Multiple births:

- ❑ Yes: ……..(e.g. twin or triplet)
- ❑ No

Were there any problems during the pregnancy?

- ❑ Yes
- ❑ No

If yes, please specify the problems:

……

……

……

……

Delivery:

- ❑ Normal/vaginal delivery
- ❑ Caesarean delivery
- ❑ Using specific medical procedures (e.g. forceps in childbirth or vacuum extraction)
- ❑ Don't know (e.g. adoption)

Were there any problems during the delivery?

- ❑ Yes
- ❑ No

If yes, please specify the problems:

……

……

……

……

4) Medical and/or developmental issues

Is your child being seen for any medical or developmental issues such as ADHD, Autism Spectrum Disorder, epilepsy, motor problems, growth disorders, or others issues?

- ❑ Yes
- ❑ No

If yes, please specify the issues:

……

……

……

……

Does your child receive therapy/help for these issues?

- ❑ Yes
- ❑ No

If yes, from whom?

……

……

……

……

Is your child on medication?

- ❑ Yes
- ❑ No

If yes, please specify which medication and why your child takes medication.

……

……

……

……

5) Visual problems

Does your child have known visual problems?

- ❑ Yes
- ❑ No

If yes, has the child been examined by an ophthalmologist/orthoptist/optometrist?

- ❑ Yes
- ❑ No

If yes, what problems were determined?

- ❑ Problems with visual acuity: Acuity right: ……....
  Acuity left: ……....
- ❑ Visual field loss
- ❑ Strabismus
- ❑ Amblyopia/lazy eye
- ❑ Refractive errors
- ❑ Other:

  ……

  ……

  ……

Have glasses been prescribed?

- ❑ Yes
- ❑ No

If yes, please specify why the child has glasses.

……

……

……

……

For each question, circle the number that applies to your child

Below there is a list of questions that screen for Cerebral Visual Impairment (CVI).

Circle the number that is the most applicable to the child. Please do so for each question and trust your instinct.

The numbers correspond to:
1 = Never **2 = Occasionally** **3 = Frequently** **4 = Always**

1.	Makes eye contact.	1	2	3	4
2.	Has difficulties with looking at objects.	1	2	3	4
3.	Has difficulties with looking at people.	1	2	3	4
4.	Tilts head to look at something.	1	2	3	4
5.	Has difficulties following moving objects (e.g. following a moving car).	1	2	3	4
6.	Has difficulties following moving people (e.g. following a person who is walking).	1	2	3	4
7.	Stares at light sources (e.g. lights or windows).	1	2	3	4
8.	Falls over clearly visible objects.	1	2	3	4
9.	Orientates the head downwards when walking.	1	2	3	4
10.	Easily bumps into things.	1	2	3	4
11.	Pays attention only to objects in front of him/her.	1	2	3	4
12.	Use of vision can fluctuate.	1	2	3	4
13.	Clutter in the room appears to interfere with visual attention.	1	2	3	4
14.	Objects need to be brought close to be seen.	1	2	3	4
15.	Looks away while reaching out for an object.	1	2	3	4
16.	Reacts adversely in a strange or unfamiliar environment (e.g. shop or street).	1	2	3	4
17.	Has difficulties distinguishing familiar from unfamiliar faces.	1	2	3	4
18.	Reacts adversely to traffic sounds or suddenly produced sounds.	1	2	3	4
19.	Reacts adversely to, e.g. passing children, cyclists or cars.	1	2	3	4
20.	Does not recognise common objects.	1	2	3	4

1 = Never **2 = Occasionally** **3 = Frequently** **4 = Always**

21. Does not recognise common pictures/images.	1	2	3	4
22. Recognises common objects only when drawn in colour.	1	2	3	4
23. Recognises people by their voice, clothes and posture rather than looking at their faces.	1	2	3	4
24. Has difficulties when the lay-out of a room/class has changed.	1	2	3	4
25. Has difficulties with interpreting more complex drawings (e.g. overview picture/situation picture).	1	2	3	4
26. Can find a favourite toy easily when it is amongst other toys.	1	2	3	4
27. Can find a favourite toy easily when it is on a patterned surface (e.g. a rug or blanket).	1	2	3	4
28. Has difficulties distinguishing familiar from unfamiliar faces in a crowd.	1	2	3	4
29. Hesitates when there is a change of floor surface (e.g. from a wooden floor to a carpet or when encountering steps).	1	2	3	4
30. Hesitates where a floor pattern changes (e.g. from black to white tiles).	1	2	3	4
31. Has difficulty walking down steps.	1	2	3	4
32. Has difficulty perceiving the movement of objects (e.g. movement of a car or movement of a ball).	1	2	3	4
33. Has difficulty perceiving the movement of people.	1	2	3	4
34. Touches an object in preference to looking at it.	1	2	3	4
35. The child appears to try to compensate by talking a lot.	1	2	3	4

Further comments and questions that were difficult to answer:

……

……

……

……

……

……

5. SCORING LIST CVI 2

Screening list for children with a suspicion of Cerebral Visual Impairment (CVI)

Scoring

The answers that are indicative for CVI are marked bold for each question and specific screeners are indicated for each screening list.

Healthcare professionals need to check whether the responses of the parents/ teachers/interested others correspond with these bold answers and need to count the number of these responses. They should also check whether or not screeners are marked.

A positive screen is based on the number of marked screeners and/or the number of marked questions. There is a positive screen if:

- 4 out of 8 screeners are indicated with or without additional marked items;
- Or 11 or more items are marked (1/3 of the screening list).

1 = Never **2 = Occasionally** **3 = Frequently** **4 = Always**

1. Makes eye contact.	**1**	**2**	3	4
2. Has difficulties with looking at objects.	1	2	**3**	**4**
3. Has difficulties with looking at people.	1	2	**3**	**4**
4. Tilts head to look at something.	1	2	**3**	**4**
5. Has difficulties following moving objects (e.g. following a moving car).	1	2	**3**	**4**
6. Has difficulties following moving people (e.g. following a moving person).	1	2	**3**	**4**
7. Stares at light sources (e.g. lights or windows).	1	2	**3**	**4**
8. Falls over clearly visible objects.	1	2	**3**	**4**

9. Orientates the head downwards when walking.	1	2	**3**	**4**
10. Easily bumps into things.	1	2	**3**	**4**
11. Pays attention only to objects in front of him/her.	1	2	**3**	**4**
12. Use of vision can fluctuate.	1	2	**3**	**4**
13. Clutter in the room appears to interfere with visual attention.	1	2	**3**	**4**
14. Objects need to be brought close to be seen.	1	2	**3**	**4**
15. Looks away while reaching out for an object.	1	2	**3**	**4**
16. Reacts adversely in a strange or unfamiliar environment (e.g. shop or street).	1	2	**3**	**4**
17. Has difficulties distinguishing familiar from unfamiliar faces.	1	2	**3**	**4**
18. Reacts adversely to traffic sounds or suddenly produced sounds.	1	2	**3**	**4**
19. Reacts adversely to, e.g. passing children, cyclists or cars.	1	2	**3**	**4**
20. Does not recognise common objects.	1	2	**3**	**4**
21. Does not recognise common pictures/images.	1	2	**3**	**4**
22. Recognises common objects only when drawn in colour.	1	2	**3**	**4**
23. Recognises people by their voice, clothes and posture rather than looking at their faces.	1	2	**3**	**4**
24. Has difficulties when the lay-out of a room/class has changed.	1	2	**3**	**4**
25. Has difficulties with interpreting more complex drawings (e.g. overview picture/situation picture).	1	2	**3**	**4**
26. Can find a favourite toy easily when it is amongst other toys.	**1**	**2**	3	4
27. Can find a favourite toy easily when it is on a patterned surface (e.g. a rug or blanket).	**1**	**2**	3	4
28. Has difficulties distinguishing familiar from unfamiliar faces in a crowd.	1	2	**3**	**4**
29. Hesitates when there is a change of floor surface (e.g. from a wooden floor to a carpet or when encountering steps).	1	2	**3**	**4**

30. Hesitates where a floor pattern changes (e.g. from black to white tiles).	1 2 **3** **4**
31. Has difficulty walking down steps.	1 2 **3** **4**
32. Has difficulty perceiving the movement of objects (e.g. movement of a car or movement of a ball).	1 2 **3** **4**
33. Has difficulty perceiving the movement of people.	1 2 **3** **4**
34. Touches an object in preference to looking at it.	1 2 **3** **4**
35. The child appears to try to compensate by talking a lot.	1 2 **3** **4**

Number of screeners: ……

Number of answers that are indicative for CVI: ……

6. SCREENING LIST CVI 3

Screening list for children with a suspicion of Cerebral Visual Impairment (CVI)

1) General information

Date questionnaire filled in: ……...

Filled in by (name): …….

Relation to the child:

- ❑ Parent
- ❑ Teacher
- ❑ Health care professional
- ❑ Other interested person (please specify: ……..)

2) Information about the child

Name: ……

Date of birth: …… Age: ……y……m

Gender:

- ❑ Male
- ❑ Female
- ❑ Other

3) Pregnancy and birth

Pregnancy duration: …….. weeks Birth head circumference: …… cm

Birth weight: ..... grams

Multiple births:

- ❑ Yes: ……..(e.g. twin or triplet)
- ❑ No

Were there any problems during the pregnancy?

- ❑ Yes
- ❑ No

If yes, please specify the problems:

……

……

……

……

Delivery:

- ❑ Normal/vaginal delivery
- ❑ Caesarean delivery
- ❑ Using specific medical procedures (e.g. forceps in childbirth or vacuum extraction)
- ❑ Don't know (e.g. adoption)

Were there any problems during the delivery?

- ❑ Yes
- ❑ No

If yes, please specify the problems:

……

……

……

……

4) Medical and/or developmental issues

Is your child being seen for any medical or developmental issues such as ADHD, Autism Spectrum Disorder, epilepsy, motor problems, growth disorders, or others issues?

- ❑ Yes
- ❑ No

If yes, please specify the issues:

……

……

……

……

Does your child receive therapy/help for these issues?

- ❑ Yes
- ❑ No

If yes, from whom?

……

……

……

……

Is your child on medication?

- ❑ Yes
- ❑ No

If yes, please specify which medication and why your child takes medication.

……

……

……

……

5) Visual problems

Does your child have known visual problems?

- ❑ Yes
- ❑ No

If yes, has the child been examined by an ophthalmologist/orthoptist/optometrist?

- ❑ Yes
- ❑ No

If yes, what problems were determined?

- ❑ Problems with visual acuity: Acuity right: ……....
  Acuity left: ……....
- ❑ Visual field loss
- ❑ Strabismus
- ❑ Amblyopia/lazy eye
- ❑ Refractive errors
- ❑ Other:

  ……

  ……

  ……

Have glasses been prescribed?

- ❑ Yes
- ❑ No

If yes, please specify why the child has glasses.

……

……

……

……

For each question, circle the number that applies to your child

Below there is a list of questions that screen for Cerebral Visual Impairment (CVI).

Circle the number that is the most applicable to the child. Please do so for each question and trust your instinct.

The numbers correspond to:

1 = Never **2 = Occasionally** **3 = Frequently** **4 = Always**

1. Makes eye contact.	1	2	3	4
2. Has difficulties with looking at objects.	1	2	3	4
3. Has difficulties with looking at people.	1	2	3	4
4. Tilts head to look at something.	1	2	3	4
5. Has difficulties following moving objects.	1	2	3	4
6. Has difficulties following moving people.	1	2	3	4
7. Stares at light sources (e.g. lights or windows).	1	2	3	4
8. Falls over clearly visible objects.	1	2	3	4
9. Orientates the head downwards when walking.	1	2	3	4
10. Easily bumps into things.	1	2	3	4
11. Pays attention only to objects in front of him/her.	1	2	3	4
12. Use of vision can fluctuate.	1	2	3	4
13. Clutter in the room appears to interfere with visual attention.	1	2	3	4
14. Objects need to be brought close to be seen.	1	2	3	4
15. Looks away while reaching out for an object.	1	2	3	4
16. Reacts adversely in a strange or unfamiliar environment (e.g. shop or street).	1	2	3	4
17. Has difficulties distinguishing familiar from unfamiliar faces.	1	2	3	4
18. Reacts adversely to traffic sounds or suddenly produced sounds.	1	2	3	4
19. Reacts adversely to, e.g. passing children, cyclists or cars.	1	2	3	4

1 = Never	2 = Occasionally	3 = Frequently	4 = Always
20. Has difficulties distinguishing familiar from unfamiliar faces in a crowd.	1	2	3	4
21. Has difficulties with finding the way in unfamiliar environments (e.g. in a restaurant or department store).	1	2	3	4
22. Does not recognise common objects.	1	2	3	4
23. Does not recognise common pictures/images.	1	2	3	4
24. Recognises common objects only when drawn in colour.	1	2	3	4
25. Recognises people by their voice, clothes and posture rather than looking at their faces.	1	2	3	4
26. Has difficulties when the lay-out of a room/class has changed.	1	2	3	4
27. Can find a favourite toy easily when it is amongst other toys.	1	2	3	4
28. Has difficulty catching a ball.	1	2	3	4
29. Gets lost in crowded places (e.g. shopping mall or big group of children).	1	2	3	4
30. Is able to find objects/images on a patterned background (e.g. a chair in a room with a lot of furniture or detail in a complex picture).	1	2	3	4
31. Has difficulties placing objects in a certain spatial position (e.g. table in front of a chair, ball on top of the chair or doll at the right side of the chair).	1	2	3	4
32. Has difficulties with interpreting more complex drawings (e.g. overview picture/situation picture).	1	2	3	4
33. Has difficulties with following the line when reading.	1	2	3	4
34. Has difficulties with passing to the next line when reading.	1	2	3	4
35. Can keep writing along the line.	1	2	3	4
36. Has difficulties with passing to the next line of writing.	1	2	3	4
37. Has difficulties with reading the clock.	1	2	3	4
38. Has difficulties with visual representations (e.g. timelines, tables or weekly schedules).	1	2	3	4

1 = Never	2 = Occasionally	3 = Frequently	4 = Always
39. Has difficulty walking down steps.	1	2	3 4
40. Hesitates when there is a change of floor surface (e.g. from a wooden floor to a carpet or when encountering steps).	1	2	3 4
41. Hesitates where a floor pattern changes (e.g. from black to white tiles).	1	2	3 4
42. Likes to play group games (e.g. football or basketball).	1	2	3 4
43. Has difficulty perceiving the movement of objects (e.g. movement of a car or movement of a ball).	1	2	3 4
44. Has difficulty perceiving the movement of people.	1	2	3 4
45. The child appears to try to compensate by talking a lot.	1	2	3 4

Further comments and questions that were difficult to answer:

……

……

……

……

……

……

……

……

……

7. SCORING LIST CVI 3

Screening list for children with a suspicion of Cerebral Visual Impairment (CVI)

Scoring

The answers that are indicative for CVI are marked bold for each question and specific screeners are indicated for each screening list.

Healthcare professionals need to check whether the responses of the parents/ teachers/interested others correspond with these bold answers and need to count the number of these responses. They should also check whether or not screeners are marked.

A positive screen is based on the number of marked screeners and/or the number of marked questions. There is a positive screen if:

- 4 out of 8 screeners are indicated with or without additional marked items;
- Or 15 or more items are marked (1/3 of the screening list).

	1 = Never	**2 = Occasionally**	**3 = Frequently**	**4 = Always**
1. Makes eye contact.	**1**	**2**	3	4
2. Has difficulties with looking at objects.	1	2	**3**	**4**
3. Has difficulties with looking at people.	1	2	**3**	**4**
4. Tilts head to look at something.	1	2	**3**	**4**
5. Has difficulties following moving objects.	1	2	**3**	**4**
6. Has difficulties following moving people.	1	2	**3**	**4**
7. Stares at light sources (e.g. lights or windows).	1	2	**3**	**4**
8. Falls over clearly visible objects.	1	2	**3**	**4**
9. Orientates the head downwards when walking.	1	2	**3**	**4**
10. Easily bumps into things.	1	2	**3**	**4**

11. Pays attention only to objects in front of him/her.	1	2	**3**	**4**
12. Use of vision can fluctuate.	1	2	**3**	**4**
13. Clutter in the room appears to interfere with visual attention.	1	2	**3**	**4**
14. Objects need to be brought close to be seen.	1	2	**3**	**4**
15. Looks away while reaching out for an object.	1	2	**3**	**4**
16. Reacts adversely in a strange or unfamiliar environment (e.g. shop or street).	1	2	**3**	**4**
17. Has difficulties distinguishing familiar from unfamiliar faces.	1	2	**3**	**4**
18. Reacts adversely to traffic sounds or suddenly produced sounds.	1	2	**3**	**4**
19. Reacts adversely to, e.g. passing children, cyclists or cars.	1	2	**3**	**4**
20. Has difficulties distinguishing familiar from unfamiliar faces in a crowd.	1	2	**3**	**4**
21. Has difficulties with finding the way in unfamiliar environments (e.g. in a restaurant or department store).	1	2	**3**	**4**
22. Does not recognise common objects.	1	2	**3**	**4**
23. Does not recognise common pictures/images.	1	2	**3**	**4**
24. Recognises common objects only when drawn in colour.	1	2	**3**	**4**
25. Recognises people by their voice, clothes and posture rather than looking at their faces.	1	2	**3**	**4**
26. Has difficulties when the lay-out of a room/class has changed.	1	2	**3**	**4**
27. Can find a favourite toy easily when it is amongst other toys.	**1**	**2**	3	4
28. Has difficulty catching a ball.	1	2	**3**	**4**
29. Gets lost in crowded places (e.g. shopping mall or big group of children).	1	2	**3**	**4**
30. Is able to find objects/images on a patterned background (e.g. a chair in a room with a lot of furniture or detail in a complex picture).	**1**	**2**	3	4

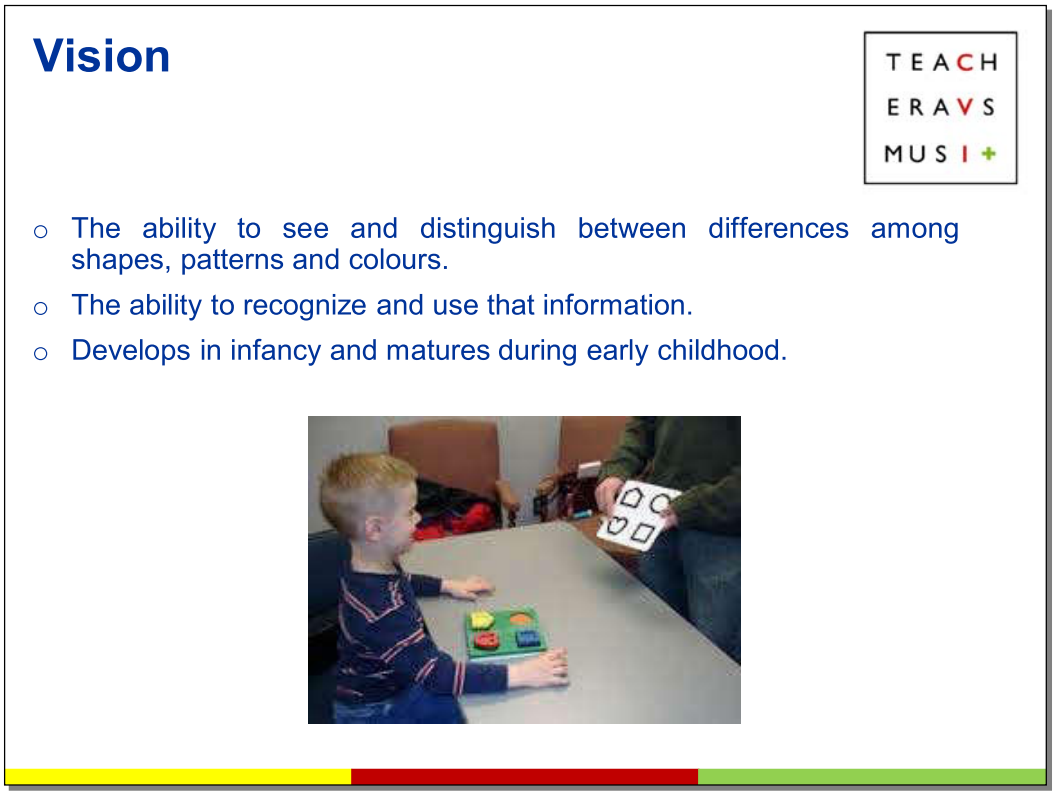
31. Has difficulties placing objects in a certain spatial position (e.g. table in front of a chair, ball on top of the chair or doll at the right side of the chair).	1	2	**3**	**4**
32. Has difficulties with interpreting more complex drawings (e.g. overview picture/situation picture).	1	2	**3**	**4**
33. Has difficulties with following the line when reading.	1	2	**3**	**4**
34. Has difficulties with passing to the next line when reading.	1	2	**3**	**4**
35. Can keep writing along the line.	**1**	**2**	3	4
36. Has difficulties with passing to the next writing line.	1	2	**3**	**4**
37. Has difficulties with clock reading.	1	2	**3**	**4**
38. Has difficulties with visual representations (e.g. timelines, tables or weekly schedules).	1	2	**3**	**4**
39. Has difficulty walking down steps.	1	2	**3**	**4**
40. Hesitates when there is a change of floor surface (e.g. from a wooden floor to a carpet or when encountering steps).	1	2	**3**	**4**
41. Hesitates where a floor pattern changes (e.g. from black to white tiles).	1	2	**3**	**4**
42. Likes to play group games (e.g. football or basketball).	**1**	**2**	3	4
43. Has difficulty perceiving the movement of objects (e.g. movement of a car or movement of a ball).	1	2	**3**	**4**
44. Has difficulty perceiving the movement of people.	1	2	**3**	**4**
45. The child appears to try to compensate by talking a lot.	1	2	**3**	**4**

Number of screeners: ……

Number of answers that are indicative for CVI: ……

Part 4: An example of assessment program of children with CVI

1. OPHTHALMOLOGICAL ASSESSMENT



Ophthalmological evaluation

- An ophthalmologist is a medical doctor who specializes in the medical and surgical care of the eyes, the visual system and in the prevention of eye diseases and injury
- A multidisciplinary approach with paediatricians, optometrists, orthoptists and low vision specialists adds to an in depth understanding of the child and their vision

History

- Mother's health before and during pregnancy
- Pregnancy:
  - Duration
  - Birth weight
- Pregnancy and breast feeding:
  - Toxic or infectious agents
  - Use of medication
  - Fever or rash
- Family history
- The child's health and development

History

- Specific questions regarding the child's vision:
  - Eye contact
  - Fixation
  - Behaviour
  - The ability to follow an object
  - Interest in his/her surroundings
  - In play and the interaction with others
  - …
- The parents perception is important – intuition/insight (e.g. the parents perception of the child's eye-sight)
- It's important to also talk to the child, not just the parents and note the given response.

Erasmus+

The ophthalmologist's first general assessment

The ophthalmologists first general assessment

TEACH ERAVS MUSI+

- Observations during the examination:
  - General appearance of the eyes:
    - Strabismus (position of the eyes)
    - Nystagmus (involuntary eye movements)
    - Eye motility
    - Size
    - Asymmetry
    - Surface anatomy of the eyes and the surrounding tissue

Erasmus+

TEACH ERAVS MUSI+

Assessing vision

Assessing vision

- **Overview** – Specific testing: Methods depending age, health and development of the child:
  - Position of the eyes:
    - Observation of deviations
    - Evaluation of size and angle
    - Corneal light reflex
    - Cover/uncover test (for those who can maintain fixation)
    - Fixation behaviour
    - Observation of eye movements

Assessing vision

- **Overview** – Specific testing: Methods depending age, health and development of the child:
  - Pupillary responses:
    - Response to light
    - Accommodation-convergence reflex
  - Stereo vision
  - Visual acuity testing:
    - Preferential looking
    - Optotype testing
  - Measurement of refraction – sciascopy/retinoscopy

Assessing vision

- **Overview** – Specific testing: Methods depending age, health and development of the child:
  - Visual field testing:
    - Confrontational testing
    - Perimetry testing
      - Manual perimetry (e.g. Arc perimeter and Goldmann)
      - Automated perimetry (e.g. Humphrey and Octopus)
  - Colour vision assessment
  - Contrast vision assessment

Assessing vision

- **Overview** – Additional testing which aids in the evaluation of the child's eyes, optic nerves and higher visual system (brainstem and brain):
  - Electrophysiology testing:
    - Visual Evoked Potential (VEP)
    - Electroretinogram (ERG)
  - Neuroimaging (to be discussed with the neuro- or developmental paediatrician)

Assessing vision – Specific testing

- **Position of the eyes**
  - Hirschberg test – Light reflex of the cornea
  - Cover/uncover test – Alternating cover test, prism cover test for quantitative measurement of strabismus
  - Strabismus (squint, deviation of an eye) is caused by lack of coordination between the extraocular muscles, so both eyes do not have parallel lines of sight, thereby hampering proper binocular vision and possibly depth perception. Tropia/phoria. Can cause diminished vision and amblyopia

Assessing vision – Specific testing

- **Fixation behaviour**
  - The visual system at birth is functional but limited
  - Visual fixation is usually present in full-term alert new-borns, but the ability to follow targets is habitually not observed until later (often about 2 months of age)
  - The stability and duration of fixation is also low to begin with (often up until 5 months of age)
  - However, the lack of ability to fixate is usually an indicator of poor visual function as children get older

Assessing vision – Specific testing

- **Fixation behaviour**

Assessing vision – Specific testing

- **Eye movements**
  - The movements of the eyes are voluntary and involuntary
  - To track an object one uses three types of voluntary eye movements and these movements are thought to originate in the frontal lobe of the brain:
    - Smooth pursuit
    - Vergence shifts
    - Saccades
  - Six extra-ocular muscles facilitate the movements of the eyes and three cranial nerves carry signals from the brain to control these muscles

Assessing vision – Specific testing

TEACH ERAVS MUSI+

- **Eye movements**
  - Movements are described as:
    - Elevations – Pupil directed upwards
    - Depression – Pupil directed downwards
    - Abduction – Pupil directed laterally
    - Adduction – Pupil directed medially
    - Extorsion – Top of eye rotating away from the nose
    - Intorsion – Top of eye rotating towards the nose
  - The child's ability to track/follow an object is tested at close range, for one eye and both eyes

Assessing vision – Specific testing

TEACH ERAVS MUSI+

- **Eye movements**
  - Nystagmus:
    - Involuntary repetitive movement of the eyes
    - Can be horizontal, vertical or rotary, slow or fast and usually involves both eyes
    - Pathologic nystagmus can be congenital (3 – 6 months) or acquired, indicating an underlying visual or neurological problem
    - Can cause reduced vision

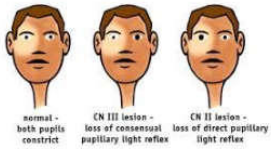
Assessing vision – Specific testing

- **Eye movements**
  - Nystagmus:
    - People with nystagmus from childhood may not be aware of there eye movements because what they see usually doesn't appear shaky to them
    - A tilt or turn of the head in order to see more clearly is common. This helps to dampen or slow the eye movements.

Physiological nystagmus: video (Wikipedia)

Assessing vision – Specific testing

- **Pupillary responses**
  - Reflex that controls the diameter of the pupil in response to the intensity of light that falls on the retinal ganglion cells of the eyes, thereby assisting in adaptation to various levels of lightness/darkness regulating the intensity of light entering the eye
  - The optic nerve, or more precisely, the photosensitive ganglion cells through the retino-hypothalamic tract, is responsible for the afferent limb of the pupillary reflex. It senses the incoming light
  - The oculomotor nerve is responsible for the efferent limb of the pupillary reflex. It drives the muscles that constrict the pupil

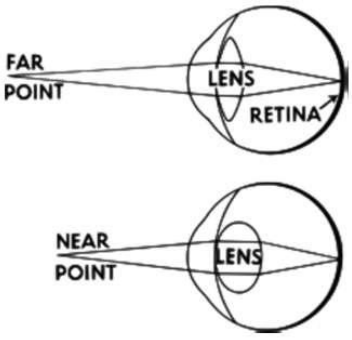


Assessing vision – Specific testing

- **Pupillary responses**
  - Accommodation-convergence reflex
    - The young human eye can change focus from distance (infinity) to 6,7 cm from the eye in 350 milliseconds. A change in focal power of approximately 15 diopeters
    - With the accommodation reflex the eye adapts for near vision. The child focuses on a distant object (dilates the pupils), then shifts the gaze to a near object, whereby a normal response is a pupillary constriction and convergence of the axis of the eyes

Assessing vision – Specific testing

- **Pupillary responses**
  - Accommodation-convergence reflex
    - Vergence is the simultaneous movement of both eyes in opposite directions to obtain or maintain single binocular vision
    - Vergence is closely connected to accommodation. Under normal conditions, changing the focus of the eyes to look at an object at a different distance will automatically cause vergence as well as accommodation. *The accommodation-convergence reflex*



Assessing vision – Specific testing

TEACH ERAVS MUSI+

- **Stereovision**
  - Stereovision is the perception of depth and 3-dimensional structure obtained on the basis of visual information deriving from two eyes. It's the highest degree of binocular vision
  - Binocular disparities are processed in the visual cortex of the brain to yield depth perception
  - Fine stereopsis is mainly based on static differences. It allows the individual to determine the depth of objects in the central visual area end is therefore also called quantitative stereopsis. It is typically measured in random-dot tests
  - Testing stereovision:
    - Random dot stereotests (e.g. Lang stereotest)
    - Contour stereotests (e.g. Titmus stereotest)

Assessing vision – Specific testing

TEACH ERAVS MUSI+

- **Stereovision**
  - Testing stereovision – Lang stereotest
    - Random dot stereotest
    - Consists of a random dot stereogram upon which a series of parallel strips of cylindrical lenses are imprinted in certain shapes, which separate the views seen by each eye in these areas, similarly to a hologram

Assessing vision – Specific testing

TEACH ERAVS MUSI+

- **Stereovision**
  - Testing stereovision – Titmus stereotest
    - Contour stereotest
    - The most well-known example is the Titmus Fly Stereotest where a picture of a fly is displayed with disparities on the edges. The patient uses 3D glasses to look at the picture and determine whether a 3D figure can be seen

Assessing vision – Specific testing

TEACH ERAVS MUSI+

- Visual acuity testing – **Preferential looking**
  - Infants demonstrate a greater tendency to look at a patterned stimulus than a homogeneous field
  - Normal values for development of "acuity" in the first year of life were estimated by identifying spatial stripe frequencies that were fixated longer than a homogeneous field by 75% of infants at a given age
  - Forced choice preferential looking tests:
    - Teller cards (masked observer looks through peeping whole in the boards)
    - Lea gratings

Assessing vision – Specific testing

- Visual acuity testing – **Preferential looking**
  - Forced choice preferential looking tests:

Teller cards

Lea gratings

Assessing vision – Specific testing

- Visual acuity testing – **Preferential looking**
  - Administration
    - The infant responds by turning the eyes or the head toward the striped target
    - Multiple trials are often needed
    - Detection of the finest grading gives the visual acuity
    - Measured in cycles/cm, taken into account the distance from the patient. The evaluation is in cycles/degree, which is converted (table) into Snellen measurements

Assessing vision – Specific testing

- Visual acuity testing – **Optotype testing**
  - An optotype is a symbol that, when correctly identified at a given distance, permits quantification of acuity
  - From 2-3 years old
  - Optotype tests:
    - E-test
    - Picture testing (e.g. Lea symbols or Kay pictures test)
    - Matching technique (e.g. HVOT chart or Sheridan-Gardner)

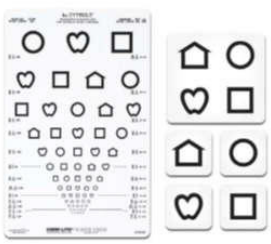
Assessing vision – Specific testing

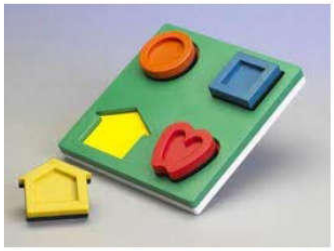
- Visual acuity testing – **Optotype testing**
  - Administration:
    - Repeated tries at different times often necessary – learning curve
    - First tested binocularly, with and without refractive correction, then each eye
    - School age children tested with Snellen/LogMAR

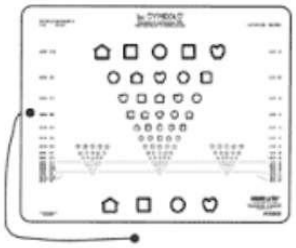
Assessing vision – Specific testing

TEACH ERAVS MUSI+

- Visual acuity testing – **Optotype testing**







Lea symbols

Assessing vision – Specific testing

TEACH ERAVS MUSI+

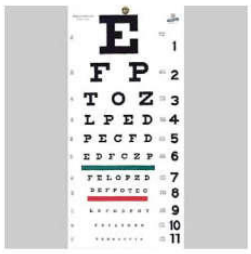
- Visual acuity testing – **Optotype testing**

Kay pictures Test

Assessing vision – Specific testing

TEACH ERAVS MUSI+

- Visual acuity testing – **Optotype testing**



HVOT chart or Sheridan-Gardner

Assessing vision – Specific testing

TEACH ERAVS MUSI+

- Visual acuity testing – **Conversion table**

LogMAR	Snellen	Decimal
0,00	6/6	1,00
0,18	6/9	0,67
0,30	6/12	0,50
0,48	6/18	0,33
0,60	6/24	0,25
0,78	6/36	0,17
1,00	6/60	0,10

Assessing vision – Specific testing

- **Measurement of refraction**
  - The exam:
    - Participation depends on the age of the child as well as its health and development
    - Exam to accurately measure refractive error, slit-lamp examination for evaluation of the anatomy of the eye, for diagnosis of abnormalities of the anterior segment and by indirect ophthalmoscopy (fundoscopy) with a lens to look for subtle abnormalities of the retina or optic nerve/nerve fiber layer
    - Dilation of the pupil for a better view/sciascopy
    - Uncooperative child – Examination under sedation or under anaesthesia

Assessing vision – Specific testing

- **Measurement of refraction**
  - The exam:
    - After dilation of the pupils
    - Subjective measurement in older children
    - Prescription of glasses if needed
    - Prescription of occlusion treatment in younger children with suspected amblyopia
    - Amblyopia (lazy eye) is due to abnormal vision development in one or both eyes in childhood and is the most common cause of monocular blindness

Assessing vision – Specific testing

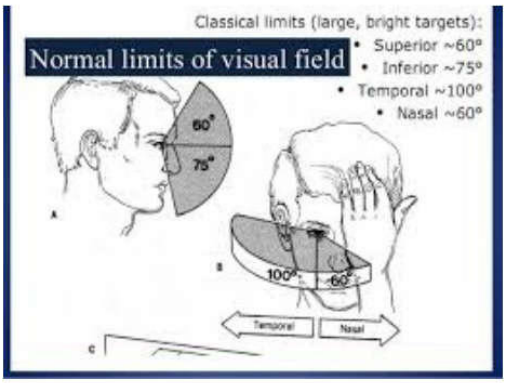
- **Visual field**
  - Young children with severely restricted visual fields can be identified by the confrontation technique
  - Visual field testing:
    - Confrontational testing – A figure is brought in from the periphery by one person while another watches the fixation/eye movements
    - Perimetry testing – Perimetry is a more suitable method to identify relative visual field defects in older children (from 6-7 years):
      - Manual perimetry
      - Automated perimetry

Assessing vision – Specific testing

- **Visual field**
  - Visual field testing – Perimetry testing
    - Manual perimetry (e.g. Arc perimeter and Goldmann):
      - Is a technique in which changes in size and intensity of a stimulus are used to detect relative visual field defects
      - A continuously monitoring of the fixation and cooperation of the child is important
      - The children are told to say 'yes' when the see the stimulus. Some children have problems saying when they see the stimulus. In these cases, the field can be measured by means of eye movements
    - Automated perimetry (e.g. Humphrey and Octopus)

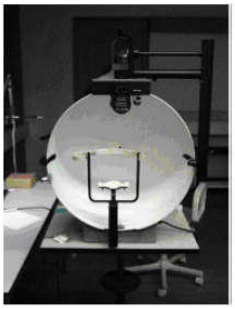
Assessing vision – Specific testing

- **Visual field**
  - Visual field testing



Assessing vision – Specific testing

- **Visual field**
  - Visual field testing



Goldmann

Confrontation testing

Assessing vision – Specific testing

TEACH ERAVS MUSI+

- **Colour and contrast vision**
  - Colour discrimination and contrast sensitivity are present but poorly developed in new-borns
  - During the first six months of life – Rapid anatomic development in the eye and central visual pathway parallels a rapid improvement in visual acuity, contrast sensitivity and colour discrimination:
    - Maturation of the retina and retinal photoreceptor (rod and cone cells)
    - Myelination of the optic nerves and tracts
    - Increased synaptic density of the visual cortex

Assessing vision – Specific testing

TEACH ERAVS MUSI+

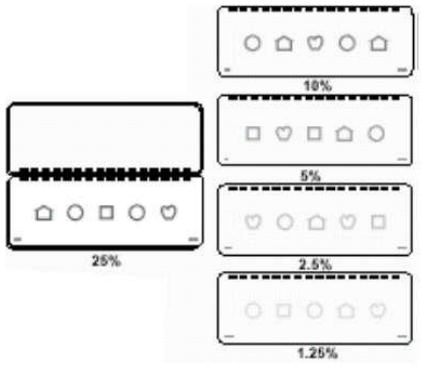
- **Colour and contrast vision**
  - After six months of life – The visual system develops at a slower rate:
    - Myelination continues to increase in the central visual pathways until about four years of age
    - The development of the visual cortex continues throughout the first decade of life

Assessing vision – Specific testing

- **Contrast sensitivity**
  - Is the ability to detect gradations in brightness
  - Is the ability to distinguish between object and background. A test of visual function.
  - Visual acuity drops in situations of low contrast and the quality of vision suffers
  - Contrast testing provides information about the visual performance (visual acuity is tested in high contrast), face recognition, stairs and different lightning conditions
  - Contrast sensitivity tests:
    - Pelli Robson – Contrast Sensitivity Chart
    - Lea Hyvarinen – Heiding Heidi Low Contrast Test
    - Preferential looking

Assessing vision – Specific testing

- **Contrast sensitivity**



Assessing vision – Specific testing

TEACH ERAVS MUSI+

- **Contrast sensitivity**

Pelli Robson – Contrast Sensitivity Chart

Lea Hyvarinen – Heiding Heidi Low Contrast Test

Assessing vision – Specific testing

TEACH ERAVS MUSI+

- **Colour vision**
  - Is the ability to distinguish objects based on the wavelengths (or frequencies) of the light they reflect, emit or transmit
  - Colours can be measured an quantified in various ways
  - A person's perception of colours is a subjective process whereby the brain responds to the stimuli that are produced when incoming light reacts with the several types of cone cells in the eye
  - In essence, different people see the same illuminated object or light source in different ways
  - Parallel channels lead from the retina to the thalamus carrying information into the visual cortex, where colour is ultimately determined

Assessing vision – Specific testing

TEACH ERAVS MUSI+

- **Colour vision**
  - In very low light levels, vision is scotopic – Light is detected by rod cells of the retina. Rods are maximally sensitive to wavelengths near 500nm and play little, if any, role in colour vision
  - In brighter light, such as daylight, vision is photopic – Light is detected by cone cells, which are responsible for colour vision
  - Colour blindness can be:
    - Total or partial (more common)
    - Blue/yellow or red/green (more common, 8% of males)

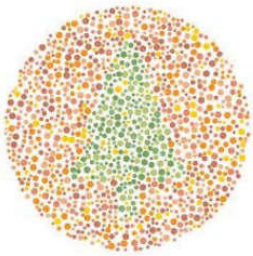
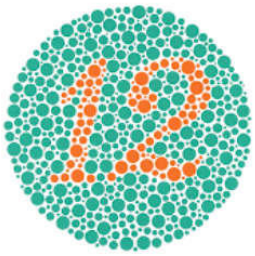
Assessing vision – Specific testing

TEACH ERAVS MUSI+

- **Colour vision**
  - Colour vision testing:
    - Ishihara Color Test – red/green
    - Farnsworth Color Vision Test – red/green and blue/yellow
    - Waggoner computerized color test
    - Functional implications

Assessing vision – Specific testing

- **Colour vision**
  - Colour vision testing:


Ishihara Color Test

Assessing vision – Specific testing

- **Colour vision**
  - Colour vision testing:

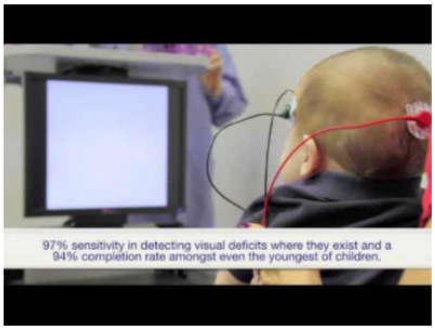

Farnsworth Color Vision Test

Assessing vision – Additional testing

- **Visually Evoked Potential (VEP)**
  - Can be useful for assessing visual function in children with developmental disabilities, ocular motor apraxia and cortical visual impairment
  - The occipital lobe's electrical response to retinal stimulation is measured
  - It takes about 100ms from light stimulation of the retina until the response of the cortex. In case of damage somewhere between the retina and the cortex, the response is altered (longer duration or reduced amplitude)
  - The interpretation takes experience

Assessing vision – Additional testing

- **Visually Evoked Potential (VEP)**



Assessing vision – Additional testing

- **Electroretinogram (ERG)**
  - Measures the electrical responses of various cell types in the retina, including the photoreceptors (rods and cones), inner retinal cells (bipolar and amacrine cells) and the ganglion cells
  - Electrodes are usually placed on the cornea (contact lens) and the skin near the eye, although it is possible to record the ERG from skin electrodes
  - During a recording the patients eyes are exposed to standardised stimuli and the resulting signal is displayed showing the time course of the signals amplitude (voltage)

Assessing vision – Additional testing

- **Electroretinogram (ERG)**
  - ERG is used for the diagnosis of various retinal diseases
  - Used under anaesthesia in children with suspected retinal problems/visual impairment

Erasmus+

TEACH ERAVS MUSI+

Children with a suspicion of CVI

Children with a suspicion of CVI

TEACH ERAVS MUSI+

- **Evaluation of each child**
  - The evaluation of each child is different
  - Which methods are chosen for vision assessment depends on the problems at hand as well on the child itself

Children with a suspicion of CVI

TEACH ERAVS MUSI+

- **Children with suspected CVI**
  - Are evaluated the same as all other children
  - Other pathology, if present, must be accounted for and attended to
  - Refraction and amblyogenic factors must be evaluated and corrected if needed
  - The history and examination is very indicative and important in the evaluation and diagnosis of children with suspected CVI
  - Evidence provided by imaging procedures, such as MRI, is important

Children with a suspicion of CVI

TEACH ERAVS MUSI+

- **Children with suspected CVI**
  - The diagnosis and follow-up is a multidisciplinary approach with pediatricians and ophthalmologists. Also genetics and imaging specialists (radiologists) work together
  - Early intervention with detailed assessment and visual training is paramount, with special pedagogues, low vision specialists and opticians working closely with the parents and caregivers of the child

Erasmus+

TEACH ERAVS MUSI+

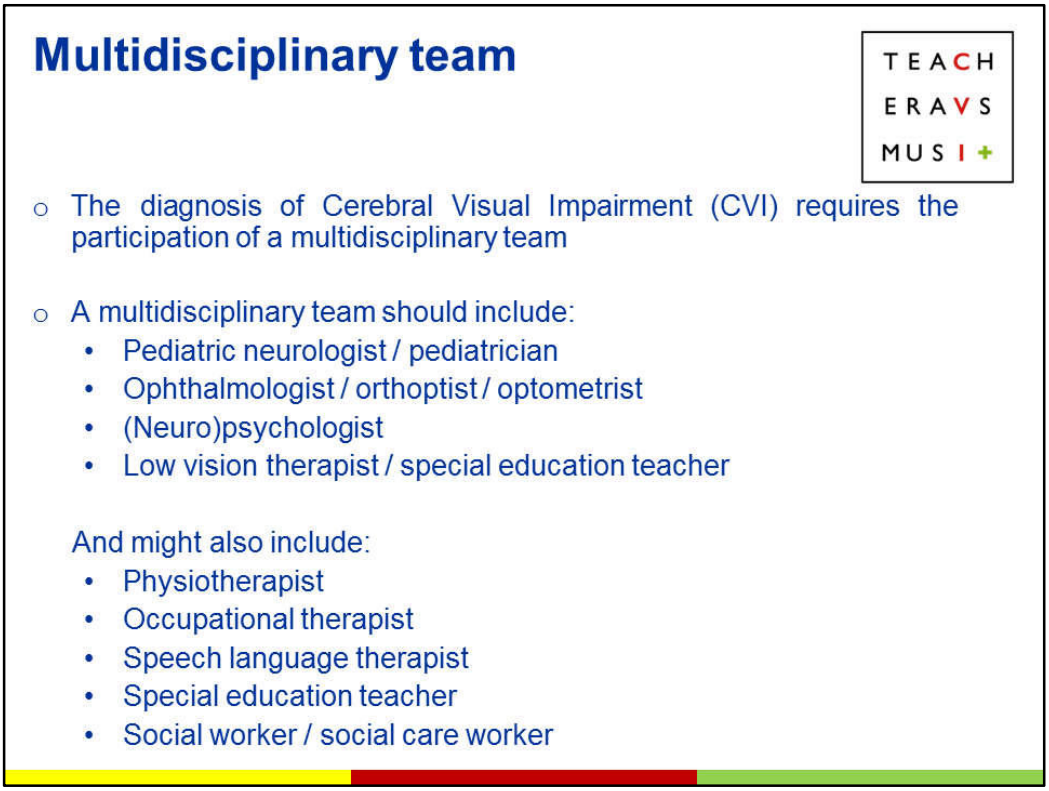
Final thoughts

Final thoughts

TEACH ERAVS MUSI+

- Please note that provided information are not exhaustive
- This publication was supported by the Erasmus+ Programme of the European Commission
- This publication reflects the views of the authors, partners of the TeachCVI projects. Therefore, the Commission cannot be held responsible for any use of the information contained herein
- Find more information about the TeachCVI project on the website: http://www.teachcvi.net
-

2. NEUROPSYCHOLOGICAL / PSYCHOLOGICAL ASSESSMENT



Assessment tools

- The physiotherapist assesses the motor skills, and more specific the visuo-motor skills
- The (neuro)psychologist / educationalist is responsible for:
  - The (neuro)psychological assessment
  - Observations of free play or in a classroom
  - Interactions with caregivers
  - Interviews with parents or caregivers
- There are various assessments and observational tools available that can be used as part of the diagnosis of CVI. This list is intended to be comprehensive, but should not be taken to be exhaustive. These tools are currently used by professionals in the countries participating in the TEACH CVI project

Note: it is always necessary to assess the cognitive abilities of the child as well!

Erasmus+

Attention / Neglect

Overview

< 3y	3y – 6y	6y – 12y	12y – 18y	> 18y
• BSID-II • Bayley-III • G.CVI.Tods	• NEPSY-II • Visual search task	• NEPSY-II • TEA-Ch • Cookie Theft Picture • CDT • Line bisection task	• NEPSY-II • TEA-Ch • Cookie Theft Picture • CDT • Line bisection task	• UFOV • Cookie Theft Picture • Bells test • CDT • Line bisection task • BIT

BSID-II – Bayley Scales of Infant Development, 2nd edition

- **Aim** — Determine the mental and motor development level
- **Specification** — The BSID-II consists of:
  - Mental scale
  - Non-verbal scale
  - Motor scale
  - Behavioral scale
- **Age** — 1m – 42m
- **Time** — 45 minutes

Bayley-III – Bayley Scales of Infant and Toddler Development, 3th edition

- **Aim** — Examines all facets of a young child's development
- **Specification** — Developmental domains of the Bayley-III:
  - Adaptive behavior
  - Cognitive
  - Language
  - Motor
  - Social-emotional
- **Age** — 1m – 42m
- **Time** — 30 – 90 minutes

G.CVI.Tods (ongoing research)

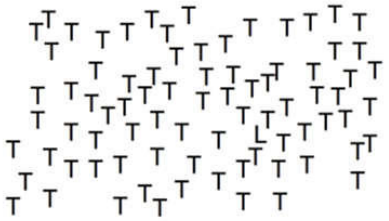
- **Aim** — Visual perceptual test for toddlers
- **Specification** — Test battery for toddlers aged 22 till 33 months:
  - Visual recognition subtests
  - Pursuit of motion subtest
  - Visual field subtest
- **Age** — 22 till 33 months
- **Time** — 30 – 45 minutes

NEPSY-II – Developmental Neuropsychological Assessment

- **Aim** — Provides comprehensive information about the neuropsychological functioning of the child
- **Specification** — Measures 6 domains: memory and learning, sensomotor functioning, social perception, visuospatial processing, executive functioning/ attention and language
- **Age** — 3y 0m – 16y 11m
- **Time** — 45 minutes – 3 hours

Visual search task

- **Aim** — The visual search task measures visual attention
- **Specification** — The child has to search and indicate the target stimulus as soon as possible
- **Age** — 3y – 6y
- **Time** — 10 – 15 minutes



TEA-Ch – Test of Everyday Attention for Children

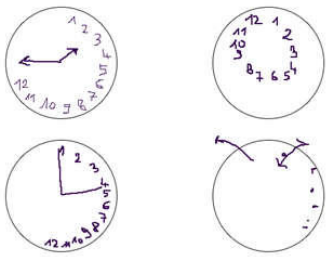
- **Aim** — The aim of this test is to measure attention problems in children
- **Specification** — The battery measures: selective attention, sustained attention, attention control/switching and response inhibition
- **Age** — 6y – 16y
- **Time** — 60 minutes

Cookie Theft Picture

- **Aim** — The Cookie Theft Picture measures visual attention
- **Specification** — This is a subtest of the Boston Diagnostic Aphasia Examination (BDAE). The subject has to examine the picture and describe everything he/she sees happening
- **Age** — Children and adults
- **Time** — 10 minutes

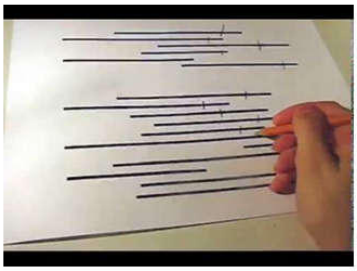
CDT – Clock Drawing Test

- **Aim** — The CDT provides information about memory, information processing and vision
- **Specification** — The CDT consists of 2 tasks:
  - Free drawn clock
  - Clock copying task
- **Age** — Children and adults
- **Time** — 15 – 20 minutes



Line bisection task

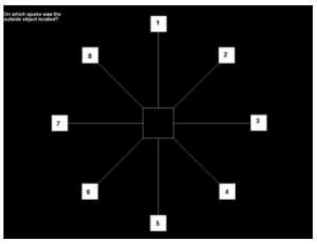
- **Aim** — This is a quick measure to detect the presence of unilateral spatial neglect
- **Specification** — The subject must place a mark through the center of a series of horizontal lines.
- **Age** — Children and adults
- **Time** — 15 – 20 minutes



UFOV – Useful Field of View Test

TEACH ERAVS MUSI+

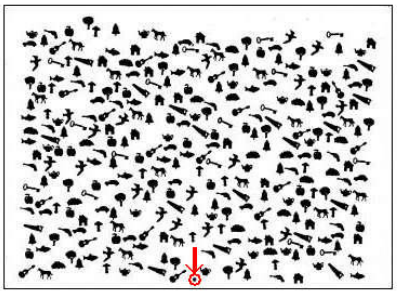
- **Aim** — This is a test that assesses parallel attention processing
- **Specification** — The test contains 3 subtests which measure the ability to perform a central visual identification task, to divide attention between central and peripheral stimuli and to select peripheral stimuli among distracters
- **Age** — Adults
- **Time** — 30 minutes



Bells Test

TEACH ERAVS MUSI+

- **Aim** — The Bells Test is a cancellation test that assesses visual neglect
- **Specification** — The subject has to circle 35 bells embedded within 280 distractors (houses, horses …)
- **Age** — Adults
- **Time** — 5 minutes



BIT – Behavioral Inattention Test

TEACH ERAVS MUSI+

- **Aim** — The BIT is a test for assessing unilateral visual neglect
- **Specification** — The test consists of 2 subtests:
  - Conventional subtests (6): line crossing, letter cancellation, star cancellation …
  - Behavioral subtests (9): phone dialing, article reading, map navigation …
- **Age** — 19y – 83y
- **Time** — 60 minutes

Erasmus+

TEACH ERAVS MUSI+

Lines / Visuospatial processing

Overview

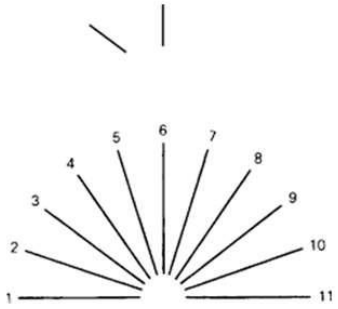
< 3y	3y – 6y	6y – 12y	12y – 18y	> 18y
• BSID-II • PDMS-2	• Preschool JLO • DTVP-2 • MVPT-3 • Beery VMI • TVPS-3 • EFT • PVMIA • NEPSY-II • M-ABC-II • WRAVMA • Bender-Gestalt II • PDMS-2	• JLO • DTVP-2 • MVPT-3 • Beery VMI •TVPS-3 • EFT • RCFT • NEPSY-II • M-ABC-II • WRAVMA • BVRT • Bender-Gestalt II	• JLO • DTVP-A • MVPT-3 • Beery VMI • TVPS-3 • EFT • RCFT • NEPSY-II • M-ABC-II • WRAVMA • BVRT • Bender-Gestalt II	• JLO • DTVP-A • MVPT-3 • MVPT-V • Beery VMI • EFT • RCFT • BVRT • VOSP • L-Post • Bender-Gestalt II

PDMS-2 – Peabody Developmental Motor Scales, 2nd edition

- **Aim** — This is an early childhood motor development program that assesses the motor skills of children
- **Specification** — The test contains 6 subtests: reflexes, stationary, locomotion, object manipulation, grasping, and visual-motor integration
- **Age** — 0y – 5y
- **Time** — 45 – 60 minutes

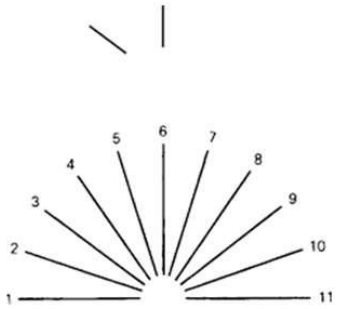
Preschool JLO – Preschool judgement of line orientation

- **Aim** This test measures visuospatial judgement
- **Specification** The subject is asked to indicate which line on the bottom of the page is in exactly the same position and points in the same direction as the line on top of the page
- **Age** 3y – 6y
- **Time** 25 minutes



JLO – judgement of line orientation

- **Aim** This test measures visuospatial judgement
- **Specification** The subject is asked to indicate which line on the bottom of the page is in exactly the same position and points in the same direction as the line on top of the page
- **Age** 7y – 74y
- **Time** 25 minutes



DTVP-2 – Developmental Test of Visual Perception, 2nd edition

- **Aim** — This test measures both visual perception and visual-motor integration skills
- **Specification** — The test consists of:
  - 4 visual perceptual tasks: position in space, figure ground, visual closure and form constancy
  - 4 visuo-motor tasks: eye hand coordination, copying, spatial relations and visual motor speed
- **Age** — 4y 0m – 10y 11m
- **Time** — 35 – 60 minutes

DTVP-A – Developmental Test of Visual Perception, A version

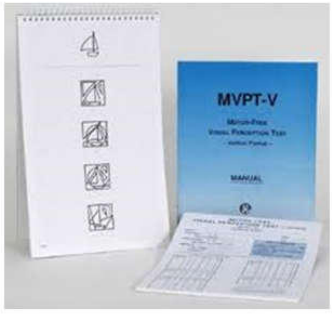
- **Aim** — This test measures both visual perception and visual-motor integration skills
- **Specification** — The test consists of 6 subtests: copying, figure-ground, visual-motor search, visual closure, visual-motor speed and form constancy
- **Age** — 11y 0m – 74y 11m
- **Time** — 25 minutes

PVPT-3 – Motor-free Visual Perception Test, 3th edition

- **Aim** — This test measures an individuals visual perceptual ability, with no motor involvement needed to make a response
- **Specification** — 5 categories of visual perception are measured: spatial relationship, visual closure, visual discrimination, visual memory and figure ground
- **Age** — 4y – 94y
- **Time** — 20 – 30 minutes

MVPT-V – Motor-free Visual Perception Test-Vertical

- **Aim** — This test assesses problems in visual perception in individuals with hemispatial visual neglect
- **Specification** — All stimuli are presented vertically at the visual midline
- **Age** — 18y – 94y
- **Time** — 25 minutes



Beery VMI – Beery-Buktenica Test of Visual Motor Integration

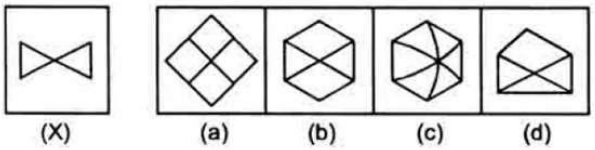
- **Aim** — This test examines the integration of motor and visual skills
- **Specification** — The test consists of a visuo-motor part and 2 additional tests: visual-motor integration, visual perception and motor coordination
- **Age** — Full form: 2y – 100y; Short form: 2y – 8y
- **Time** — 25 minutes

TVPS-3 – Test of Visual Perceptual Skills, 3th edition

- **Aim** — This test examines visual-perceptual skills without the involvement of motor ability
- **Specification** — The test consists of 7 subtests: visual discrimination, visual memory, spatial relationships, form constancy, sequential memory, visual figure-ground, and visual closure
- **Age** — 4y 0m – 18y 11m
- **Time** — 30 – 40 minutes

EFT – Embedded Figures Test

- **Aim** — The EFT is a visual perceptual test
- **Specification** — The test requires the subject to locate a previously seen figure within a larger complex figure. The test is comprised of 18 complex figures
- **Age** — Different age groups
- **Time** — 20 minutes



PVMIA – Preschool Visual Motor Integration Assessment

- **Aim** — This test identifies visual motor integration deficits in preschoolers
- **Specification** — Specific skills addressed by the PVMIA include: perception of position in space, awareness of spatial relationships, color and shape discrimination, matching two attributes simultaneously and the ability to reproduce what is seen
- **Age** — 3y 6m – 5y 6m
- **Time** — 20 – 30 minutes

M-ABC-II – Movement Assessment Battery for Children

- **Aim** — This test determines motor impairment in children
- **Specification** — The test contains 8 tasks for each range in three categories: manual dexterity, ball skills and static and dynamic balance
- **Age** — 3y 0m – 16y 11m
- **Time** — 20 – 40 minutes

WRAVMA – Wide Range of Visual Motor Abilities

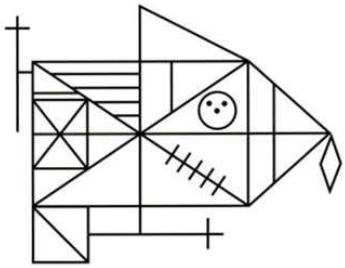
- **Aim** — This test examines how children deal with visual-motor, visuospatial and fine motor tasks
- **Specification** — The test contains 3 subtests: drawing test, matching test and pegboard test
- **Age** — 3y 0m – 17y 11m
- **Time** — 15 minutes

Bender-Gestalt II

- **Aim** — This test is a motor and perception test
- **Specification** — Administration consists of two phases:
  - Copy phase
  - Recall phase
- **Age** — 3y 0m – 85y 11m
- **Time** — 10 – 15 minutes

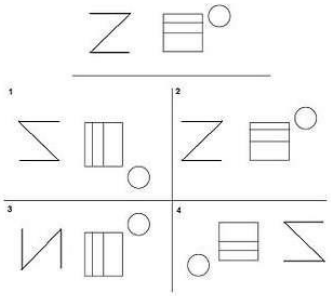
RCFT – Rey Complex Figure Test and Recognitial Trial

- **Aim** — This test examines various cognitive processes including planning, organization, problem solving, memory, and perceptual-motor functions
- **Specification** — The test consists of 4 trials: copy trial, immediate recall, delayed recall and recognition
- **Age** — 6y 0m – 17y 11m
  18y – 89y
- **Time** — 45 minutes



BVRT – Benton Visual retention Test, 5th edition

- **Aim** — This test measures visual perception and visual memory
- **Specification** — The subject is given a booklet containing 10 blank pages on which he reproduces the design. The test can be administered in 5 different ways
- **Age** — 8y – 74y
- **Time** — 30 – 60 minutes



VOSP – Visual Object and Space Perception Battery

- **Aim** — This test assesses object and space perception
- **Specification** — The test consists of 8 subtests divided into 2 categories:
  - Object recognition: incomplete letters, silhouettes, shape decision, progressive silhouettes
  - Spatial relations: dot counting, position discrimination, number location, cube analysis
- **Age** — Adult
- **Time** — 60 minutes

L-Post – Leuven Perceptual Organization Screening Test

- **Aim** — This test is a computerized visual perceptual screening test
- **Specification** — The test consists of 15 subtests that measure a wide range of processes of perceptual organization, such as segregation, local and global processing, grouping … The test is freely available at http://gestaltrevision.be/tests/
- **Age** — Adult
- **Time** — 20 – 40 minutes

Erasmus+

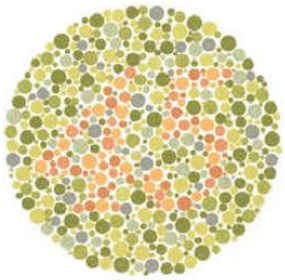
Colour

Overview

< 3y	3y – 6y	6y – 12y	12y – 18y	> 18y
• Ishihara	• Ishihara • AOHRR • PVMIA	• Ishihara • AOHRR	• Ishihara • AOHRR	• Ishihara • AOHRR

Ishihara Color Test

- **Aim** — This test is a color perception test for red-green color deficiencies
- **Specification** — The test consists of 38 colored plates each of which contains a circle of dots appearing randomized in color and size. Within the pattern are dots which form a number or shape
- **Age** — Children and adult
- **Time** — 15 – 20 minutes



AOHRR – American Optical Hardy-Rand-Rittler Color Vision Plates

TEACH ERAVS MUSI+

- **Aim** — This test is a color perception test for red-green color deficiencies
- **Specification** — The test consists of 38 colored plates each of which contains a circle of dots appearing randomized in color and size. Within the pattern are dots which form a number or shape
- **Age** — Children and adult
- **Time** — 15 – 20 minutes

Erasmus+

TEACH ERAVS MUSI+

Objects

Overview

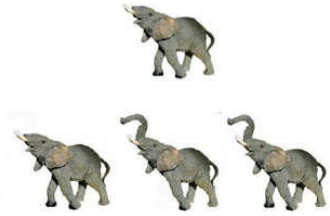
< 3y	3y – 6y	6y – 12y	12y – 18y	> 18y
• BSID-II • Bayley-III • G.CVI.Tods	• VOT • CVIT 3-6 • L94	• VOT	• VOT	• VOT • BORB • Poppelreuter-Ghent-s Overlapping Figures Test • VOSP • L-Post

VOT – Hooper Visual Organization Test

- **Aim** — This test assesses neurological impairment through a quick measure of visual integration, relatively unaffected by situational factors
- **Specification** — The test consists of 30 line drawings, each showing a common object that has been cut into several pieces. The subjects task is to tell you what the object would be if the pieces were put back together
- **Age** — 5y and older
- **Time** — 15 minutes

CVIT 3-6 (ongoing research)

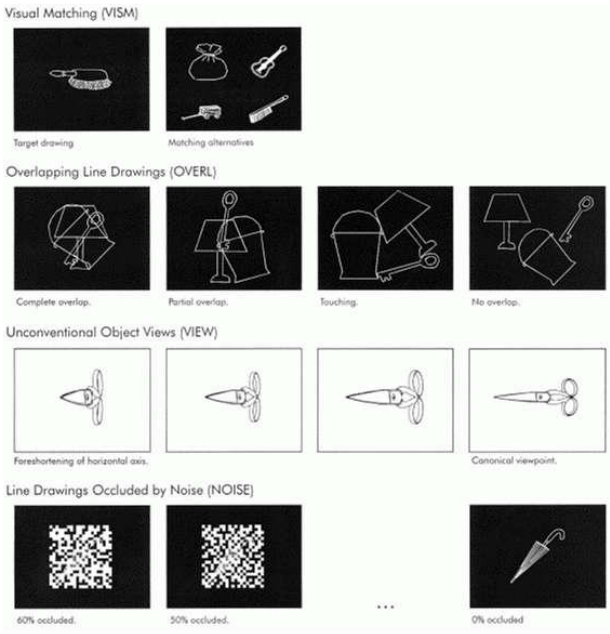
- **Aim** — Newly developed computerized test battery to measure different aspects of visual perception
- **Specification** — The subtests can be divided in 4 domains:
  - Object recognition in scene
  - Degraded object recognition
  - Perception of movement
  - Local and global processing
- **Age** — 2y 9m – 6y 3m
- **Time** — 30 – 45 minutes



L94 visual perceptual battery (1)

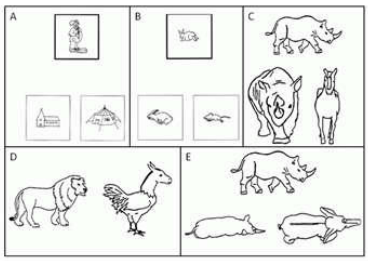
- **Aim** — This computerized test examines visual perceptual abilities
- **Specification** — The test consists of 5 subtests: the VOS-task, figures in noise, overlapping figures, visual matching, and non-conventional viewpoints
- **Age** — 2y 9m – 6y 3m
- **Time** — 45 minutes

L94 visual perceptual battery (2)



BORB – Birmingham Object Recognition Battery

- **Aim** — The BORB provides a set of standardized procedures for assessing neuropsychological disorders of visual object recognition
- **Specification** — The test consists of 14 subtests: drawing from memory, copying, length match task, size match task, orientation match task, position of gap match task, overlapping figures
- **Age** — Adults
- **Time** — 60 minutes



Poppelreuter-Ghent's Overlapping Figures Test

TEACH ERAVS MUSI+

- **Aim** This test measures visual recognition
- **Specification** Subjects need to name and point out each of the overlapping figures (multiple choice)
- **Age** Adults
- **Time** 20 – 30 minutes

Erasmus+

TEACH ERAVS MUSI+

Faces

Overview

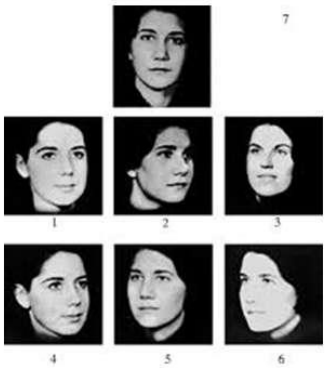
< 3y	3y – 6y	6y – 12y	12y – 18y	> 18y
• BSID-II • Bayley-III	• NEPSY-II • CMS	• NEPSY-II • CMS • BFRT	• NEPSY-II • CMS • BFRT • WMS-IV	• Mooney closure faces test • BFRT • WMS-IV

CMS – Children Memory Scale

- **Aim** — This test is a comprehensive learning and memory test for children
- **Specification** — The test measures learning in a variety of memory dimensions: attention and working memory, verbal and visual memory, short- and long-term memory, recall and recognitions, and learning characteristics
- **Age** — 5y – 16y
- **Time** — 60 minutes

BFRT – Benton Facial Recognition Task

- **Aim** — The test assesses face perception
- **Specification** — The subject has to recognize faces by matching a target face with the identical face out of 6 options
- **Age** — 6y – 99y
- **Time** — 30 minutes



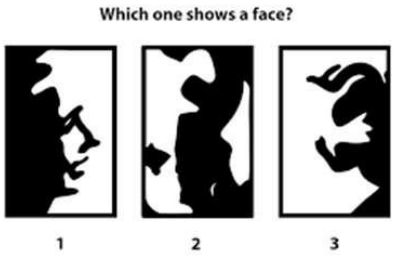
WMS-IV – Wechsler Memory Scale, 4th edition

- **Aim** — The test measures the ability to learn and remember information presented verbally and visually
- **Specification** — The test measures a variety of memory dimensions: auditory memory, visual memory, visual working memory, immediate memory and delayed memory
- **Age** — 16y – 90y
- **Time** — 45 – 60 minutes

Mooney Closure Faces Test

TEACH ERAVS MUSI+

- **Aim** The test assesses face perception
- **Specification** The subject needs to indicate a face
- **Age** Adults
- **Time** 30 minutes



Erasmus+

TEACH ERAVS MUSI+

Memory

Overview

< 3y	3y – 6y	6y – 12y	12y – 18y	> 18y
	• NEPSY-II • CMS • TVPS-3	• NEPSY-II • CMS • TVPS-3 • RCFT • CMVT • BVRT	• NEPSY-II • CMS • TVPS-3 • RCFT • BVRT • WMS-IV • CMVT	• CMVT • BVMT-R • WMS-IV • RCFT • BVRT

CMVT – Continuous Visual Memory Test

- **Aim** The test measures visual learning and memory
- **Specification** The test consists of 3 tasks:
  - The acquisition task
  - The delayed recognition task
  - The visual discrimination task
- **Age** 7y – 80y
- **Time** 45 – 50 minutes

BVMT-R – Brief Visuospatial Memory Test - revised

- **Aim** The test measures visuospatial memory
- **Specification** The test consists of 3 subtests:
  - Learning trial
  - Delay trial
  - Copy trial
- **Age** 17y – 79y
- **Time** 45 minutes

Erasmus+

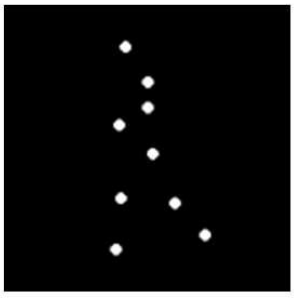
Motion

Overview

< 3y	3y – 6y	6y – 12y	12y – 18y	> 18y
• G.CVI.Tods	• CVIT 3-6 • Biological motion • Motion speed • Form from motion • Motion Coherence			• L-Post

Biological motion

- **Aim** The test measures the perception of movement
- **Specification** There are two patterns of moving dots presented on the screen. One of them seems like a walking man. The child has to indicate this pattern of dots
- **Age** 4y 0m – 6y 11m
- **Time** 10 – 15 minutes



Motion speed

- **Aim** — The test measures the perception of movement
- **Specification** — There are moving dots presented in two cars. One car seems to move faster because of faster moving dots. The child has to indicate this car
- **Age** — 4y 0m – 6y 11m
- **Time** — 10 – 15 minutes

Form from motion

- **Aim** — The test measures the perception of movement
- **Specification** — There are three levels per item:
  - Level 1: in a square of moving dots there are several coherent moving dots that form a figure
  - Level 2: in a square of moving dots a figure is shown (not moving dots)
  - Level 3: in a square of moving dots a figure is shown in black
- **Age** — 4y 0m – 6y 11m
- **Time** — 10 – 15 minutes

Motion coherence

TEACH ERAVS MUSI+

- **Aim** — The test measures the perception of movement
- **Specification** — There are two squares with moving dots presented on the screen. In one square there is a stripe with coherent moving dots moving to the right and left. The child has to indicate the square with the moving stripe
- **Age** — 4y 0m – 6y 11m
- **Time** — 10 – 15 minutes

Erasmus+

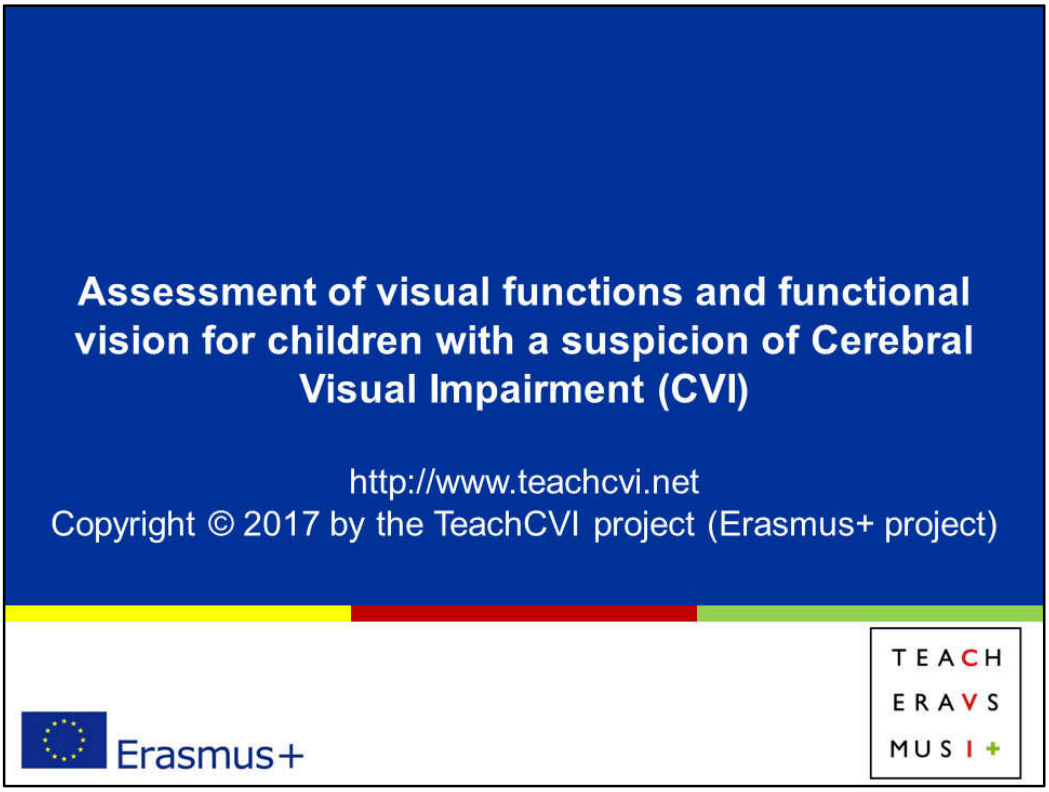
TEACH ERAVS MUSI+

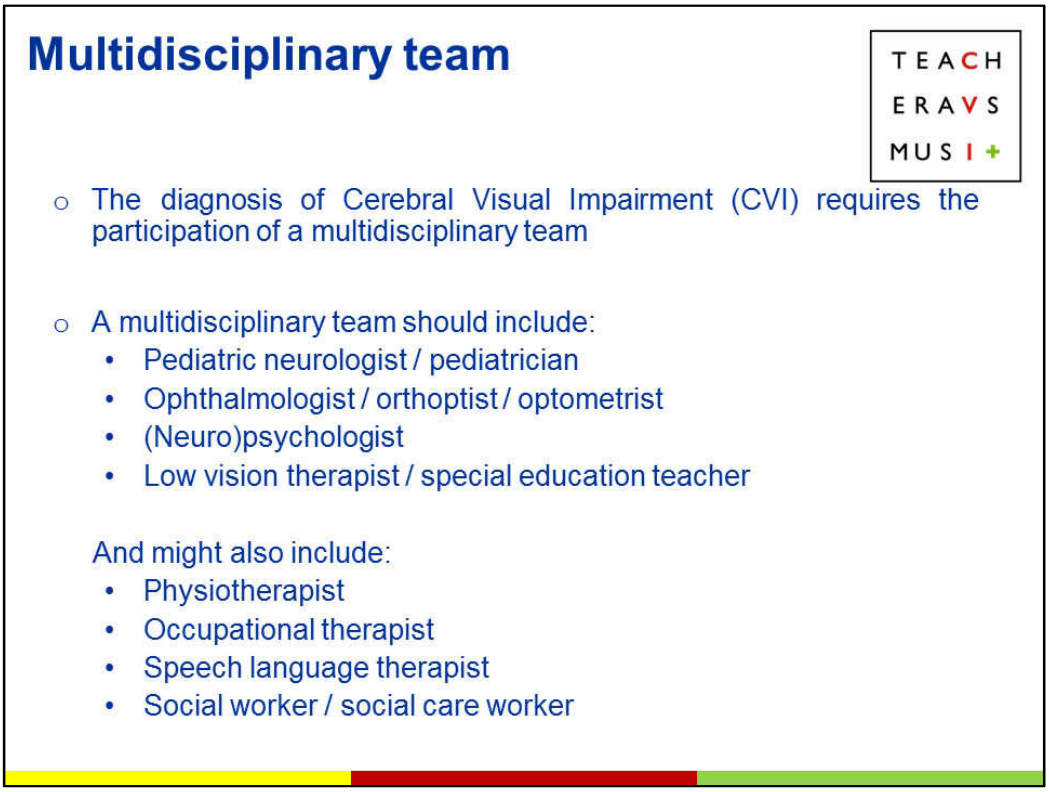
Final thoughts

Final thoughts

- Please note that provided information are not exhaustive
- This publication was supported by the Erasmus+ Programme of the European Commission
- This publication reflects the views of the authors, partners of the TeachCVI projects. Therefore, the Commission cannot be held responsible for any use of the information contained herein
- Find more information about the TeachCVI project on the website: http://www.teachcvi.net
-

3. ASSESSMENT OF VISUAL FUNCTIONS AND FUNCTIONAL VISION





Assessment of visual functions and functional vision

TEACH ERAVS MUSI+

- There are various assessments and observational tools available that can be used as part of the diagnosis of CVI. This list is intended to be comprehensive but should not be taken to be exhaustive. These tools are currently used by professionals in the countries participating in the TEACH CVI project.

Erasmus+

TEACH ERAVS MUSI+

Definition and framework

Definition – Visual functions and functional vision

- **Visual functions**
  - Describes how the eyes and the basic visual system functions.[1]
  - Is the ability to process visual stimuli of a particular dimension, e.g. form, colour or motion [2]
- **Functional vision**
  - Describes how the person functions [1]
  - The way vision is used in everyday life [2]
  - The assessment of functional vision determines the impact of visual function on everyday life [2]

Definition – Visual functions and functional vision

- **Overview**
  - Basic visual functions – Oculomotor functions [3,4]
  - Basic and middle visual functions. [3,4] – Sensory functions [2]
  - Relation between basic and middle visual functions and functional vision [3,4]
  - Higher visual functions – Visual perception (dorsal stream) [2,3]
  - Higher visual functions – Visual perception (ventral stream) [2,3]
  - Relation between higher visual functions and functional vision [3,4]

Definition – Visual functions and functional vision

- **Check the visual status in children**
  - Visual interest sphere / working distance: the best visual reaction within the visual field (e.g. angle, position or distance)
  - Body position: comfortable position in order to maximize functional vision and visual reactions
  - Basic visual functions: oculomotor and sensorial functions [3,4]
  - Middle visual functions: motion perception
  - High visual functions: visual perceptual functions (if the intellectual level of the child supports this type of assessment) [3,4]
  - Functional vision: using vision in communication / social interaction, daily living and learning skills, near vision tasks, orientation and mobility

Framework – Visual functions and functional vision [1]

	Visual Functions *How the visual system functions*	**Functional Vision** *How the person functions*
Examples	*Visual acuity, visual field, contrast, visual adaptation, colour 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*

Erasmus+

TEACH ERAVS MUSI+

Basic visual functions – Oculomotor functions

Basic visual functions – Oculomotor functions

TEACH ERAVS MUSI+

- Overview
  - Visual interest sphere / working distance
  - Fixation and following movements – Ability to detect visual stimuli
  - Shift of gaze and saccades
  - Nystagmus
  - Strabismus – Alignment of the eyes ortophoria , esotropia or exotropia
  - Accommodation ex. eye contact and social smile
  - Convergence / divergence [3]

Basic visual functions – Oculomotor functions

TEACH ERAVS MUSI+

- **Visual interest sphere / working distance**: the areas within the visual field where children give the best visual feedback




Examples of materials and toys than can be used for establishing visual interest sphere / working distance in children with a suspicion of CVI (materials shared by Roxana Cziker)

Basic visual functions – Oculomotor functions

TEACH ERAVS MUSI+

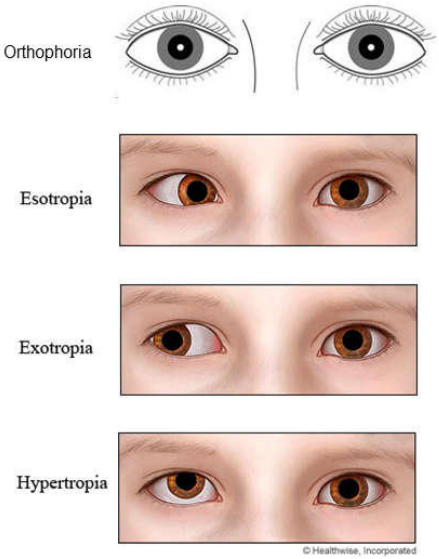
- **Visual fixation –** holding the image on the fovea or maintaining of the visual gaze on a single location
- **Eye movements** - allow the eyes to closely follow a moving object
- **Shift of gaze and saccades –** quick eye movements from one stimulus to another

Examples of materials and toys than can be used for checking fixation and eye movements in children with CVI

Basic visual functions – Oculomotor functions

Black and white puppet and colour faces for assessing eye movements – visual fixation, following and saccades

Basic visual functions – Oculomotor functions



- **Alignment of the eyes** – Ortophoria, esotropia, exotropia, hypo- and hypertropia
- **Strabismus** – Deviation of the eyes, when directing the gaze to the same point in space
- The ophthalmologist is responsible for the assessment of strabismus. But it's necessary for the members of the multidisciplinary team to recognize the effect of strabismus in functional vision assessment, since strabismus can have an effect on depth perception.

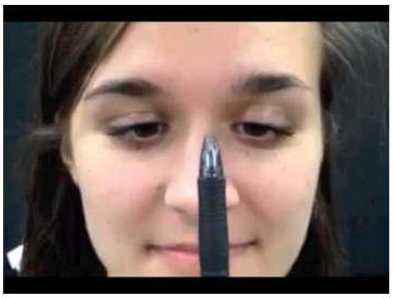
Basic visual functions – Oculomotor functions

- **Nystagmus**: fast involuntary and repetitive eye movements
- It often takes the form of horizontal oscillatory eye movements, which seem to badly disturb fixation
- Nystagmus should be observed during reading, play and training situations and observations
- How the child compensates for the nystagmus should be noted (position of head, eyes, etc.), when possible

Basic visual functions – Oculomotor functions

- **Accommodation** – Changing the focus from near to distance and vice versa

- **Convergence / divergence**
  - Convergence – Turning inward of the eyes when looking at close distances
  - Divergence – Turning outward of the eyes when looking on objects farther away
  - Assessment – Objects or images brought closer to the eyes and the gaze should shift from close to target far away



Basic visual functions – Oculomotor functions

- **Accommodation - Eye contact and social smile**: e.g. distance, reactions and visual behaviour
- **Eye contact** is one of the most important sign which confirms the accommodation and the first stage of visual communication

Eye contact and copying facial epxression of mother (pictures from Lea Hyvarinen)

Basic visual functions – Oculomotor functions

- **Role of oculomotor functions in daily life activities** – Oculomotor functions are important in:
  - Selecting and detecting information within the environment
  - Noticing objects, people or actions in different areas of the visual field
  - Following visual stimuli in movement in playing situations, detection of landmarks in orientation situations, both indoor and outdoor
  - Using eye contact in communication with people
  - Seeing objects clearly both near and in distance
  - Able to switch the eyes from one point to another – e.g. from one picture to another in order to find the target picture or from one text line to another when reading

Erasmus+

TEACH ERAVS MUSI+

Basic and middle visual functions – Sensory functions

Basic and middle visual functions – Sensory functions

TEACH ERAVS MUSI+

- **Overview**
  - Visual acuity
  - Visual field
  - Contrast sensitivity
  - Colour vision
  - Stereopsis
  - Visual adaptation
  - Motion perception[3]
  - Role of sensorial visual functions and movement in daily life activities

Basic visual functions – Sensory functions

- **Visual acuity (VA)** – Ability to resolve or recognise fine details [3]
  - The ability to see details provides information about forms of objects, surfaces and textures
  - Recognition of very fine detail supports reading, which requires recognition of small images placed closely together
  - Visual acuity should be tested both near and at distance
  - You can use one of the three types of VA (detection, resolution and recognition) according to the child´s level of development

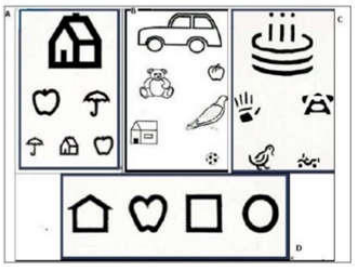
Basic visual functions – Sensory functions

- **Visual acuity at distance (3m or less) – Detection acuity**
  - Target detection requires only the perception of the presence or absence of an aspect of the stimuli, not the discrimination of target detail
  - The task of detection involves stating wheater the spot or line is present:
    a) Bright test object on a dark background
    b) Dark test object on a bright background

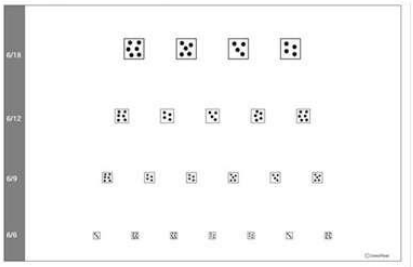
(a) (b)

Basic visual functions – Sensory functions

- **Visual acuity at distance (3m or less) – Detection acuity**
  - Dot visual acuity test
  - Catford Drum Test
  - Boek Candy Bead Test
  - STYCAR graded ball´s test



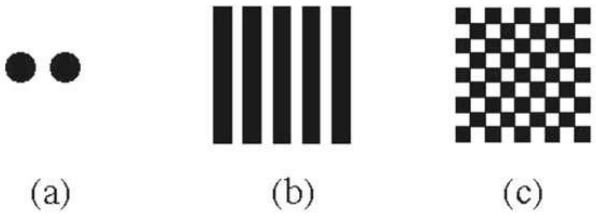
STYCAR test



Dot Visual Acuity Test

Basic visual functions – Sensory functions

- **Visual acuity at distance (3m or less) – Resolution acuity**
  - Target resolution thresholds are usually expressed as the smallest angular size at which subjects can discriminate the separation between critical elements of a stimulus pattern such as a pair of dots, a grating or a checkerboard
  - The task of resolution:
    a) Double dot target
    b) Acuity grating
    c) Checkerboard



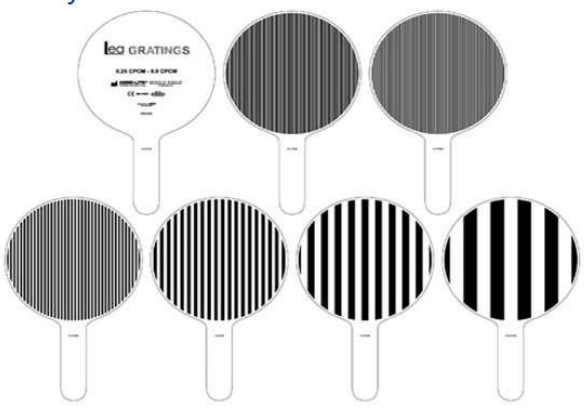
(a) (b) (c)

Basic visual functions – Sensory functions

- **Visual acuity at distance (3m or less)**
  - **Resolution acuity**- Grating acuity
    - Preferential looking methods - LEA Paddles
    - Tellers Acuity Cards
    - Cardiff Acuity Test

Basic visual functions – Sensory functions

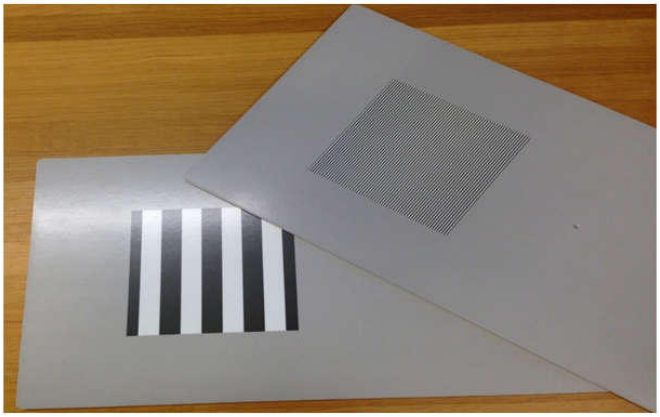
- **Visual acuity at distance (3m) – Resolution acuity**
  - Grating acuity



Lea Grating Preferential Looking Test

Basic visual functions – Sensory functions

- **Visual acuity at distance (3m) – Resolution acuity**
  - Grating acuity



Teller Acuity Cards

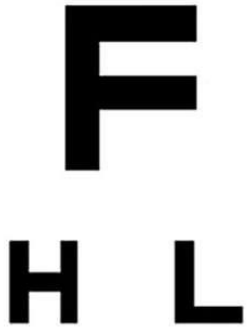
Basic visual functions – Sensory functions

- **Visual acuity at distance (1m or 0,5m) – Resolution acuity**

Cardiff Acuity Test

Basic visual functions – Sensory functions

- **Visual acuity at distance (6m or less) – Recognition acuity**
  - Target recognition tasks, which are most commonly used in clinical visual acuity measurements, require the recognition or naming of a target, such as Snellen letters or Lea tests



The task of recognition: naming the test objects, in this case letters of the alphabet (Snellen)

Basic visual functions – Sensory functions

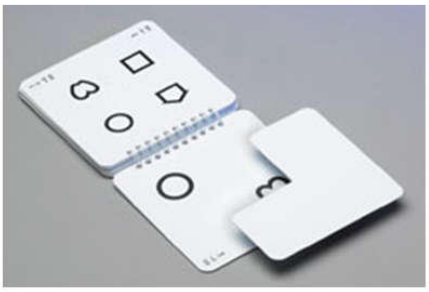
- **Visual acuity at distance (6 m or less) – Recognition acuity**
  - Optotypes
    - Symbol pictures: LEA or BUST (perception of form/visual acuity test)
    - Letters: HVOT or KM
    - Single symbols
    - Symbols in line (crowding)
    - Kay Pictures Test

Basic visual functions – Sensory functions

TEACH ERAVS MUSI+

- **Visual acuity at distance (6m or less) – Recognition acuity**
  - Optotypes

LEA Symbols Flash Cards



LEA Symbols Single Symbol Book

Basic visual functions – Sensory functions

TEACH ERAVS MUSI+

- **Visual acuity at distance (6m or less) – Recognition acuity**
  - Optotypes

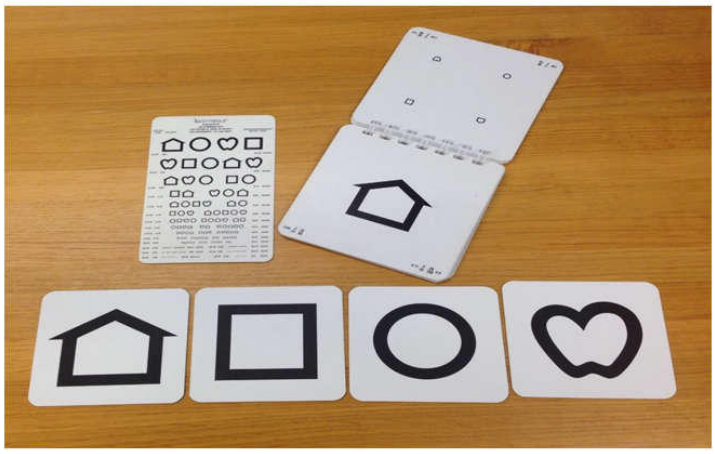
Kay Pictures Test

Basic visual functions – Sensory functions

- **Visual acuity near (40cm or less)**
  - Symbols (LEA or BUST) or letters
    - Single symbols or letters
    - Linear array of symbols or letters
    - Crowding
  - Maclure reading test
    - Reading acuity
    - Words and sentence in sizes N5 – 48

Basic visual functions – Sensory functions

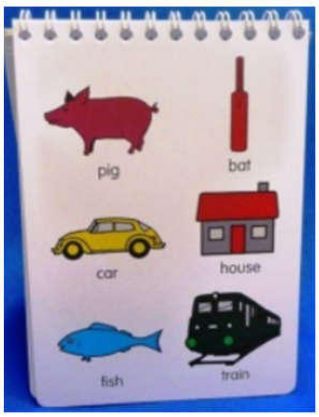
- **Visual acuity near (40cm or less)**



LEA symbols

Basic visual functions – Sensory functions

- **Visual acuity near (40cm or less)**



Maclure reading test

Basic visual functions – Sensory functions

- **Visual field** – The peripheral fields extend our view almost to our shoulders on either side of our body. Our lower field gives us a view of the ground and the upper visual field covers space above our head. Thus the large field of vision allows us to easily manoeuvre safely in space.
- The binocular field is around 120 degrees.
- The monocular field extends 90 degrees from the midline to the sides and it is limited by the nose to the midline
- The vertical field extends 60 degrees above and 70 degrees below [3]

Assessing the visual field in young children can be a challenge

Basic visual functions – Sensory functions

- **Visual field**
  - Assessment can be done by observation and by using standardized instruments
  - Examples of assessment tools
    - Rolling balls – observational tool
    - Ball on a stick – observational tool
    - LEA Flicker Wand (light spot) - observational tool
    - LEA Campimeter - standardized
    - Goldmann perimeter - standardized; best results when children are older then 7 to 12 years of age

Basic visual functions – Sensory functions

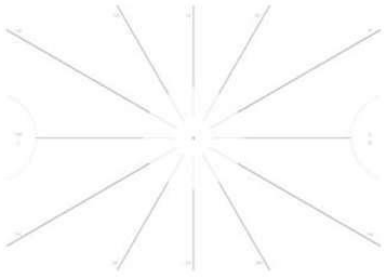
- **Visual field**

Ball on a stick – observational tool

Basic visual functions – Sensory functions

- **Visual field**

Lea Flicker Wand – observational tool



Lea Campimeter – standardized tool

Basic visual functions – Sensory functions

- **Visual field**

Arc perimeter – standardized tool

Basic visual functions – Sensory functions

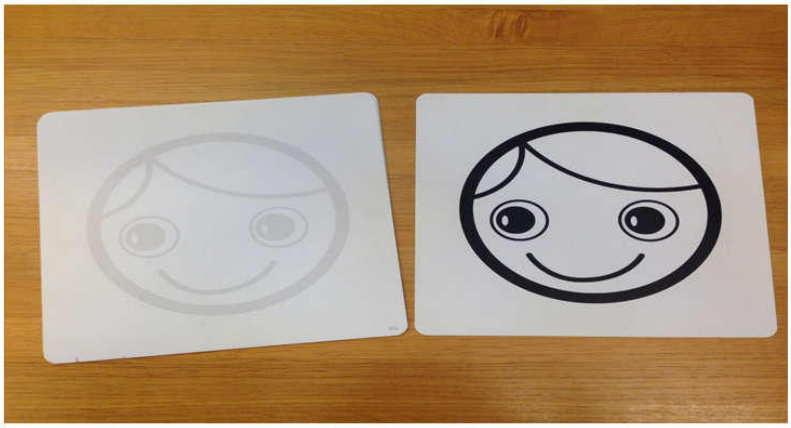
- **Contrast sensitivity**
  - Ability to see differences in the amount of light reflected from adjacent surfaces. The ability allows us to notice edges and shadows that define objects and also shows us their depth and placement in space.
  - It is one of the most important visual functions in assessment, because it gives information about communication and perceiving the environment, which are mostly at low and intermediate contrast. [3]

Basic visual functions – Sensory functions

- **Contrast sensitivity**
  - Assessment tools:
    - Hiding Heidi (schematic faces)
    - LEA contrast test
    - Cardiff Contrast Test
    - KM contrast test (optoypes)

Basic visual functions – Sensory functions

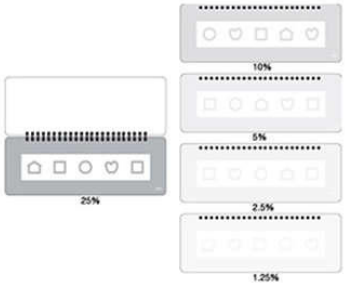
- **Contrast sensitivity**



Hiding Heidi

Basic visual functions – Sensory functions

- **Contrast sensitivity**



Lea Symbols Low Contrast Test 10M Symbol Size

Lea Symbols Low Contrast Visual Acuity Charts

Basic visual functions – Sensory functions

TEACH ERAVS MUSI+

- **Contrast sensitivity**

Cardiff Contrast Test

Basic visual functions – Sensory functions

TEACH ERAVS MUSI+

- **Stereopsis**
  - Fine stereopsis is the highest function of binocular vision
  - Fine depth perception that results from the brain´s interpretation of the slight difference between the disparate pictures of the same visual scene provided by the two eyes[2]
- **Gross stereopsis** appears to be used to judge stereoscopic motion in the periphery. Gross stereopsis is important for orientation in space while moving, for example when descending a flight of stairs
- **Fine stereopsis** is mainly based on static differences. It allows the individual to determine the depth of objects in the central visual area. Fine stereopsis is important for fine-motorical tasks such as threading a needle

Basic visual functions – Sensory functions

Assessment tools:

- Stereo Acuity Test Butterfly – test both gross and fine stereopsis
- Stereo Fly Test – test both gross and fine stereopsis
- Lang stereotest – test both gross and fine stereopsis

Basic visual functions – Sensory functions

- **Stereopsis**
  - Assessment tools

Stereo Acuity Test Butterfly

Stereo Fly Test

Basic visual functions – Sensory functions

- **Stereopsis**
  - Assessment tools

Lang stereotest

Basic visual functions – Sensory functions

- **Visual adaptation**
  - The term visual adaptation describes the processes by which the visual system alters its operating properties in response to changes in the environment.
  - In very low light levels, vision is scotopic: light is detected by rod cells of the retina
  - In brighter light, such as daylight, vision is photopic: light is detected by cone cells which are responsible for colour vision [5]

Basic visual functions – Sensory functions

- **Visual adaptation**
  - Assessment – Cone Adaptation Test [3]

The Cone Adaptation Test is used to assess a person's ability to adapt to lighting changes. The task is to sort the red, blue and white squares in the least amount of light necessary. Disturbed cone function may cause photophobia.

Basic visual functions – Sensory functions

- **Colour vision**
  - Colour vision is possible due to photoreceptors in the retina of the eye known as cones. These cones have light-sensitive pigments that enable us to recognize colour. Found in the central part of the retina, each cone is sensitive to either red, green or blue light.
  - Normally, the pigments inside the cones register different colours and send that information through the optic nerve to the brain. This enables you to distinguish countless shades of colour.

Basic visual functions – Sensory functions

- **Colour vision**
  - Assessment
    - Name, identify and recognize colours
    - Colour images, choose among different colours
    - Discriminate, sort and classify colours
    - Assessment of colour vision defects with standardized tests

Basic visual functions – Sensory functions

- **Colour vision**
  - Examples of assessment tools
    - LEA puzzle
    - Waggoner Colour Vision Testing Made Easy
    - PV 16
    - Ishihara

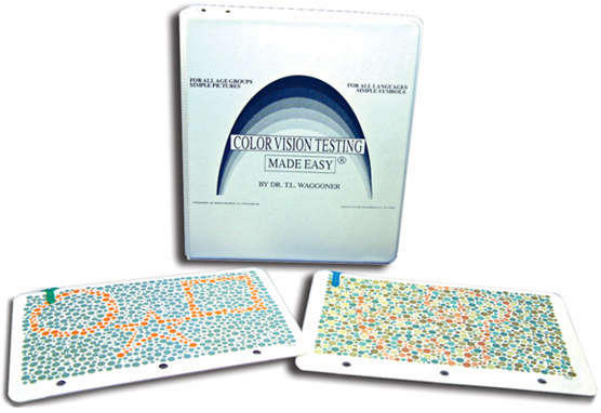
Basic visual functions – Sensory functions

- Colour vision test

Lea Puzzle

Basic visual functions – Sensory functions

- Colour vision



Waggoner Colour Vision Testing Made Easy

Basic visual functions – Sensory functions

TEACH ERAVS MUSI+

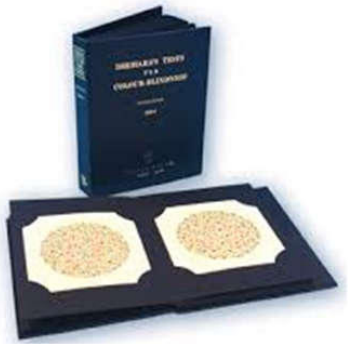
- Colour vision test

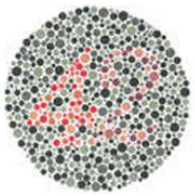
Quantitative Colour Vision Test PV 16

Basic visual functions – Sensory functions

TEACH ERAVS MUSI+

- Colour vision





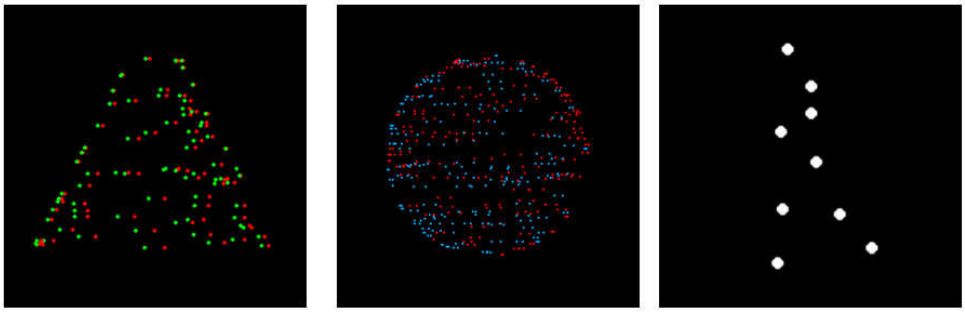
Ishihara Colour Vision Test

Middle visual functions

- **Motion perception**
  - The capacity to see movement
  - Bilateral damage can cause impaired or absent visual perception of movement (akinetopsia) (Zihl et al. 1983) [3]

Middle visual functions – Motion perception

- **Motion perception**
  - Assessment



Animation for assessing the ability to perceive the motion

Relation between basic and middle visual functions and functional vision

- **Role of oculomotor functions in daily life activities** – Oculomotor functions are important in:
  - Selecting and detecting information within the environment
  - Fixate on objects, people or actions in different areas of the visual field
  - Following visual stimuli in movement in playing situations, detection of landmarks in orientation situations, both indoor and outdoor
  - Using eye contact in communication with people
  - Seeing objects clearly both near and in distance
  - Able to switch the eyes from one point to another – e.g. from one picture to another in order to find the target picture or from one text line to another when reading

Relation between basic and middle visual functions and functional vision

- **Role of sensorial visual functions and movements in daily life activities** – Sensorial functions and movement are important in:
  - Clearly seeing details about elements, pictures and text
  - Reading texts in different seizes and different backgrounds
  - Seeing details both near and at distance space
  - Moving freely in space by covering stimuli in different areas of the visual field
  - Noticing people in a group, making difference among stimuli within environment in different levels of contrast

Relation between basic and middle visual functions and functional vision

TEACH ERAVS MUSI+

- **Role of sensorial visual functions and movements in daily life activities** – Sensorial functions and movement are important in:
  - Identifying and discriminating size, colour, shape of objects, pictures, people or actions
  - Adapting the vision in different light situation
  - Being independent in organizing and finding personal things by different criteria (size, shape, colour, etc.)
  - Perceiving movement scenes outdoor or on television

Erasmus+

TEACH ERAVS MUSI+

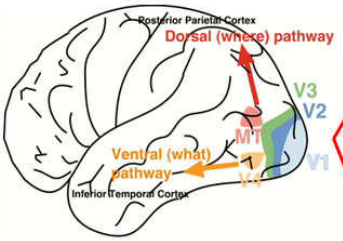
Higher visual functions – Visual perception

Higher visual functions – Visual perception

The ventral stream integrates occipital lobe functions with those of the temporal lobe structures that serve as the brain's 'visual library', serving conscious recognition and visual memory.

The dorsal stream integrates occipital lobe and posterior parietal lobe function. It affords subconscious analysis of the visual scene integrated with analysis of data from other sensory inputs such as hearing. This brain area is thought to continuously map the components of the visual scene, providing a real-time, constantly refreshing, virtual, multimodal mental representation of the surroundings. [2]

Higher visual functions – Visual perception [2, 3, 4]



Dorsal stream "Where" – Parietal Lobe:
- processing of movement stimuli and visual guidance of movement
- control of ocular movements
- prehension of objects, visual guided
- crowding of text
- simultaneous perception
- finding people in a group
- visual attention

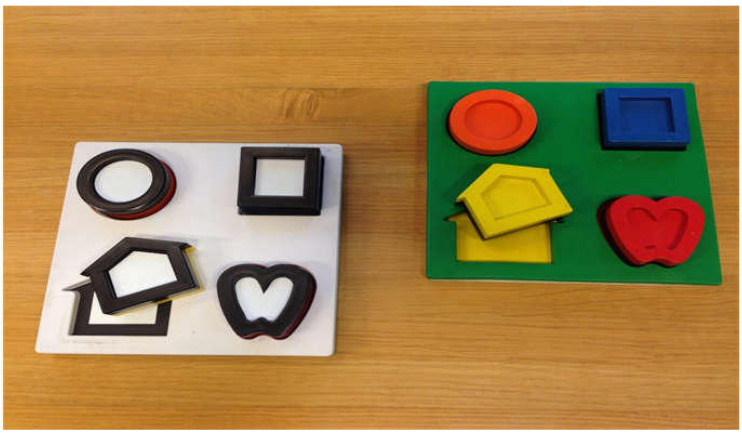
Ventral stream "What" – Temporal Lobe:
- details of objects
- recognition of shapes, objects, letters, numbers, words, landmarks
- recognition of human faces and facial expressions

Higher visual functions – Visual perception

- Screening tests
  - LEA Puzzle – Form perception
  - LEA Mailbox – Direction
  - Complex pictures – Recognition of details
  - LEA Faces – Recognition of facial expression
  - Coloured photos
  - Recognition of familiar faces

Higher visual functions – Visual perception

- Screening tests



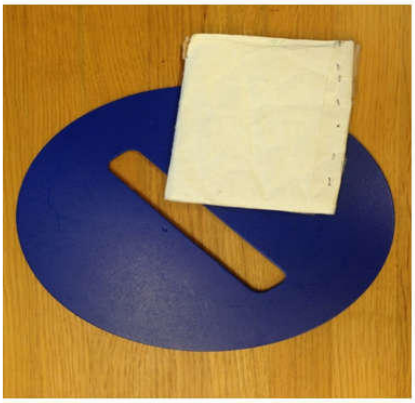
LEA Puzzle

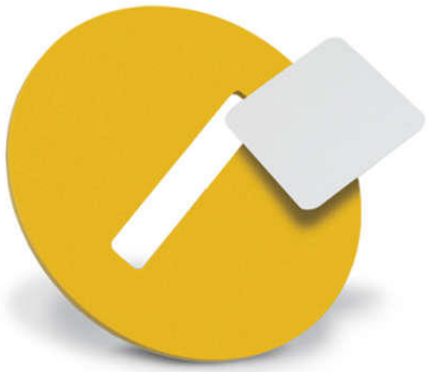
Higher visual functions – Visual perception

- Screening tests – **Lea Mailbox**
- Assess visual perception of line orientation. Tests two components:
  - Information for the hand movements in the parietal lobe
  - Picture perception in the inferior temporal lobe

Higher visual functions – Visual perception

- Screening tests





LEA Mailbox

Higher visual functions – Visual perception

- Screening tests

Pictures – Recognition of details

Higher visual functions – Visual perception

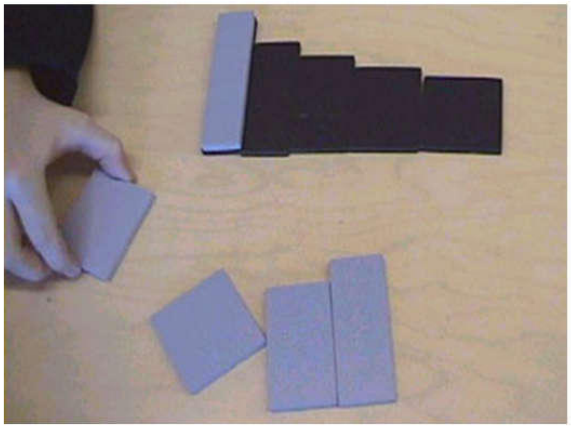
- Screening tests

Higher visual functions – Visual perception

- Screening tests - **LEA Rectangles Game**:
  - Interpretation of length
  - Assessment of eye-hand coordination
  - Capacity of grasping
  - Interpretation of comparing lengths of the model
  - Ability to handle, grasp and move the rectangles over the model

Higher visual functions – Visual perception

- Screening tests



LEA Rectangles Game

Role of higher visual functions in daily life activities

The **higher visual functions** are important in:

- Recognize, identify and discriminate objects – orientation – recognize landmarks like buildings, trees, pathways; reading – recognizing letters and words
- Recognize and identify simultaneously multiple objects or people – finding a friend in a group of children in different spaces
- Build words from different letters and give a meaning (writing and understanding the written text)
- Copying pictures, drawings, letters, words, text under the visual control
- Recognizing people by their facial features and facial expressions – communication
- Moving freely in space in a very busy scene and objects / people in movement

References

1. *Report prepared for presentation at the World Ophthalmology Congress – Hong Kong, 2008 of the International Council of Ophthalmology.*
2. Zihl, J., & Dutton, G.N. (2015). *Cerebral visual impairment in children. Visuoperceptive and visuocognitive disorders.* Springer.
3. Hyvarinen, L., Jacob, N. (2011). *What and how does the child see?* Vistest Ltd.
4. Lueck A.H & Dutton G.N. (2015). *Vision and the brain. Understanding Cerebral Visual Impairment in Children. AFB Press.*
5. Clifford C.W.G, Webster M.A., Stanley G.B., Stocker A.A., Kohn A., Sharpee T.O. & Schwartz O. *Visual adaptation: Neural, psychological and computational aspects.* Vision Research, Volume 47, Issue 25, November 2007, Pages 3125–3131

Erasmus+

TEACH ERAVS MUSI+

Final thoughts

Final thoughts

TEACH ERAVS MUSI+

- Please note that provided information are not exhaustive
- This publication was supported by the Erasmus+ Programme of the European Commission
- This publication reflects the views of the authors, partners of the TeachCVI projects. Therefore, the Commission cannot be held responsible for any use of the information contained herein
- Find more information about the TeachCVI project on the website: http://www.teachcvi.net
-

Part 5: Terminology related to CVI

A

Accommodation

Automatic adjustment of the lens of the eye to maintain a clear image or focus on an object as the viewing distance varies.

Achromatopsia

Rare, inherited vision disorder in which a person has little or no ability to see colour. People with achromatopsia also commonly experience some vision loss, especially in bright light. The severity of achromatopsia varies. Although there is no cure or treatment for this disorder, people with achromatopsia can manage its symptoms. For example, they can wear sunglasses or tinted contact lenses to cope with bright light. They can use magnifiers and other devices for low vision to help them read, and telescopes to help them see distant objects.

Agnosia

A visual-cognitive disorder characterized by the inability to recognize and identify familiar visual stimuli (objects, faces, letters, places, etc.), despite sufficiently available visual and cognitive capacities. This term does not apply to difficulties with assigning labels/names to visual stimuli (Visual anomia).

Akinetopsia

A condition in which the individual can only see things when they are not moving.

Alexia

Difficulty in the naming of letters or words.

Amblyopia

A disorder of sight due to the eye and brain not working well together. Also known as a lazy eye. The impaired vision in one or both eyes, with no anatomical cause, is due to the impaired development of vision as a sequel to untreated optical (refractive) errors, impaired image formation due to an eye disorder such as cataract, or impaired eye alignment (strabismus).

Anisometropia

The condition in which the two eyes have an unequal refractive power.

Anomia

The inability to name objects or to recognize the written or spoken names of objects.

Anopia

A defect into the visual field.

Anosognosia

Lack of awareness of and insight into an obvious functional impairment because the subject is unable to detect the mismatch between assumed/expected function and the real functional status. Anosognosia typically occurs in about 30% of subjects with hemiplegia and neglect.

Aphakia

Is the absence of the lens of the eye due to surgical removal, a perforating wound or ulcer, or congenital anomaly.

Apraxia

A motor disorder caused by damage to the brain, in which the individual has difficulty with the motor planning to perform tasks or movements when asked. This can affect simple movements (e.g. gestures) after a verbal instruction or by imitation (ideomotor apraxia) or complex movements (e.g. preparing a cup of tea, dressing: ideational apraxia).

Astigmatism

A type of refractive error that focuses light at different points in front of or behind the retina rather than a single point, and results in blurred vision at all distances, due to the subtle asymmetric, non-spherical shape of the cornea.

Atrophy

The partial or complete wasting away of a part of the body.

B

Balint´s syndrome

A neuropsychological condition characterized by severe limitations: inability to perceive the visual field as a whole (simultanagnosia), difficulty in fixating the eyes (oculomotor apraxia) and inability to move the hand to a specific object by using vision (optic ataxia).

Binocular coordination

Use of both eyes together so the separate images from each eye (which are slightly different) are interpreted by the brain as a single image. At its highest form - stereopsis - an impression of depth can be obtained by the brain superimposing two slightly dissimilar pictures of the same objects.

Blindness

Absence of vision. Total blindness is complete absence of vision and is rare.

Blindsight

Slight awareness of, or reflex reaction to, moving targets, lights and colours in an area of apparently absent visual field.

Brain plasticity

The capacity of the brain to adapt its functions to altered environmental (or task) conditions by experience (environment-dependent plasticity) and Learning (practice-dependent plasticity) and to compensate for functional alterations of the brain, e.g. after injury or in pathophysiological states (functional compensation).

Brain ventricles

Fluid filled cavities in the middle of the brain. The nerve fibers of the optic radiation run close to the wall of the lateral ventricle and are thus vulnerable if there are circulatory disturbances in the highly vascular ventricles walls.

Brain stem

The area at the base of the brain that, along with the midbrain above it, carries the nerves fibers running in both directions between the brain and the body and receives and processes input from the cranial nerves, including those that serve hearing and eye movements.

Brodmann area

A region of the Cerebral cortex, which is defined by its structure and organization of cells. The Brodmann areas were originally defined and numbered by the German neuroanatomist Korbinian Brodmann, who in 1909 described 47 different cortical areas.

C

Central acuity

The capacity of the visual system to see in the central visual field.

Central fixation target

A target placed in the centre of a visual field test.

Cerebellum

A brain structure that ensures the control of emotion by the frontal lobes, movement of the body processed by the parietal lobes, and vision processed by the occipital lobes.

Cerebral blindness

Profound impairment or absence of vision due to bilateral damage to the visual pathways posterior to the lateral geniculate bodies that may be accompanied by damage to other regions of the brain that serve vision. Also known as cortical blindness.

Cerebral cortex

The layer of grey matter that covers the outside of the brain and consists of six layers of neurons.

Cerebral hypoxia

Lack of oxygen supply to the brain, which can be caused by impaired blood flow or impaired oxygenation due to respiratory disorders.

Cerebral palsy

Loss or impairment of motor function caused by damage or abnormal development of the brain before, during or immediately after birth.

Cerebral visual impairment (CVI)

Visual impairment due to the damage of the visual pathways and visual centres in the brain, including pathways serving visual perception, cognition, and visual guidance of movement.

Chiasma

Crossing of the optic nerves.

Colour deficiency

Inherited non-progressive condition in which the person confuses colours (red-green or blue-yellow axis).

Cognitive visual dysfunction

Disordered function of the brain related to the damage of the visual-associative areas and/or their incoming pathways leading to misinterpretation of the visual world (where things are or what they are).

Colour anomia

Inability to name colours.

Congenital

Existing at or before birth.

Contrast

The way that a foreground stands out from its background. Contrast is not a property of visual edges on the retina but of visual edges in space.

Contrast sensitivity

The ability of the visual system to distinguish the difference in brightness between two adjacent surfaces.

Convergence

The ability to turn the eyes inward as an object approaches them.

Cortical

Pertaining to the cerebral cortex.

Crowding

Vision is sometimes worse when crowded by other information e.g. words on the page too close together or patterns behind an object.

D

Dark adaptation

Refers to the gain in sensitivity as the eye remains in the dark. It is a relatively slow process, taking around 40 minutes to complete.

Detection acuity

Measures what the smallest object that a child notices on a contrasting background is.

Developmental age

A measure of a child´s level of development according to social, emotional, intellectual and physical growth.

Developmental disability

Mental of physical disability arising as a consequence of a disorder of development.

Diplegia

Paralysis or weakness of the lower limbs.

Dorsal stream

The pathway between the occipital and posterior parietal lobes provides vision for action and is mostly automatic and unconscious.

Dorsal stream dysfunction

Condition in which the function of the dorsal stream is disrupted, causing impaired visual guidance of movement and limiting the number of entities that can be seen in crowed scenes.

E

Eccentric viewing

Looking slightly above, below or to one side of an object in order to place a visual image onto an optimum area of the visual field of viewing.

Electroencephalography (EEG)

Along with its magnetic counterpart, magnetoencephalography (MEG), this procedure noninvasively records brain activity from the surface of the scalp to provide an indirect evaluation of the brain function.

Emmetropia

Condition in which the light coming from a distant object to the eye is focused accurately on the retina to make a focused image without the need for refractive correction.

Encephalopathy

Disorder of the brain due to disease, causing damage and malfunction.

Epilepsy

A group of conditions in which disturbance of the electrical activity of the brain results in impairment and disorder in a range of brain functions, including consciousness, movement, sensation and vision.

Esotropia

A condition in which one eye is horizontally turned inward; also known as convergent strabismus (US) or convergent squint (UK). Results in a lack of stereopsis.

Executive functions

Higher-order mental skills that are used to control and coordinate cognitive abilities and behaviours to achieve a particular goal.

Exotropia

A condition in which one eye is horizontally turned outward; also known as divergent strabismus (US) or divergent squint (UK). Results in lack of stereopsis.

Extrastriate visual areas

Visual cortical areas outside the Striate (primary) visual cortex; also called prestriate cortex or visual association areas.

F

Face recognition

The identification of an individual's face on the basis of specific and characteristic facial features.

Figure-ground discrimination

The ability to discriminate an object from its surroundings; also called figure-ground perception.

Fixation

The ability to maintain the eyes focused on a target.

Form perception

The ability to judge the shape, size, texture, etc. of an object by vision or touch; also called form discrimination.

Fovea

The functional centre of the retina with the most numerous and tightly packed cone cells. This gives the sharpest vision.

Frontal lobes

Areas of the front of the brain, part of which serves the executive functions of thinking, planning and controlling behaviour.

Functional skills

Skills that students with multiple disabilities learn that provide them with the opportunity to work, play, socialize and take care of personal needs to the highest attainable level.

Functional vision

The way in which a person uses available visual skills and abilities in typical tasks of daily life. This it means how well an individual processes the visual information in his or her environment in order to go about daily tasks.

Functional visual impairment

Damage to the visual system that impedes the ability to learn or perform usual tasks of daily life.

G

Gaze apraxia

The impairment in using eye movements in a purposeful action, despite the intact capacity to carry out the eye movements.

Grating

A stimulus that consists of regular parallel light and dark elements.

Gross motor

Movement that involves the large muscles of the body such as the arms and legs (e.g. crawling, running, or jumping).

H

Hemianopia

Lack of perception of one half of the visual field.

Hemifield

One half of a sensory field.

Hemiparesis

Weakness on one side of the body.

Hemiplegic

Paralysis of one side of the body.

Higher visual functions

The combination of visual perception, visual cognition, guidance of movement and the capacity to choose to give visual attention.

Homonymous hemianopia

A visual field defect which the same half of the field of view is not seen by each eye.

Hydrocephalus

A condition in which there is an accumulation of cerebrospinal fluid (CSF) within the brain, causing increased intracranial pressure. With an increased CSF the ventricles of the brain will expand.

Hyperopia or hypermetropia

A condition of the eye in which light is focused behind, instead of on, the retina which results in blurred images. Also known as far-sightedness.

Hypertropia

An upward eye turn.

Hypoplasia

Underdevelopment of the body part.

Hypoxia

Lack of oxygen.

I

Impaired pursuit of movement

Disordered ability to pursue a moving target with the eyes.

Intermittent deviation

Turning of both eyes together in one direction for a variable duration, often with an accompanying head turn. Also paroxysmal deviation.

Ischemia

Insufficient supply of the blood.

J

Joint attention

An exchange that involves a child´s and a partner's awareness of the other´s mutual gaze, gesture or language.

L

Labyrinthine system

The subconscious automatic system in the inner ear and brain stem that is responsible for controlling and maintaining the balance.

Lateral geniculate nucleus (LGN)

A relay centre in the thalamus for the visual pathway. It receives a major sensory input from the retina. The LG is the main central connection for the optic nerve to the occipital lobe.

Letter agnosia

A selective type of visual agnosia, which is characterized by the loss of recognition of letters and/or the integration of letters into words.

Light adaptation

The capacity of the retina to adapt to increased levels of illumination.

Literal alexia

Inability to recognize certain individual letters due to damage to the brain.

Low vision

Visual impairment that is severe enough to impede the person´s ability to learn or perform usual tasks of daily life but still allows some functionally useful visual discrimination.

M

Magnetic resonance imagining (MRI)

A neuroimaging procedure that shows the anatomical features of the brain in great detail and can be used to study brain structure following injury.

Magnocellular pathway

A major pathway of the visual system that primarily transmits visual information in the peripheral visual field to the brain and serves movement perception, as well as facilitating visual guidance of movement.

Mirror neuron system (MNS)

A system in the brain that facilitate understanding and imitation of the actions of others.

Motion perception

The capacity to see movement.

Myopia

A type of refractive error that results in blurred images of the retina when viewing objects in the distance. Also known as near-sightedness.

N

Neglect

The inability to direct attention, which prevents a person of being aware of a part of space around or a part of herself. It may mean loss of attention in one half of the visual field.

Neuroplasticity

Refers to adaptation of neural pathways and structures due to changes in behaviour, environment and neural processes as well as changes resulting from injury due to learning processes.

Nystagmus

Unintentional or involuntary movement of the eyes.

O

Object permanence

The understanding that objects still exist when they cannot be seen, heard, touched, smelled or sensed.

Occipital lobes

Posterior parts of the cerebral cortex responsible for processing vision and sending visual information to other parts of the brain.

Occipitoparietal dysfunction

A disorder involving the occipital and parietal lobes of the brain, resulting in an impairment of the functions of both structures.

Ocular alignment

A description of the position of the eyes. If the eyes are out of alignment, strabismus is present.

Ocular visual impairment

Visual impairment caused by a disorder of the eye or optic nerve (but not the brain).

Oculomotor apraxia

Limited ability to move the eyes fast (saccadic eye movement) from one target to another.

Oculomotor scanning

Use of eye movements to scan the visual surrounding or a visual stimulus array (e.g. scene, object).

Oculomotor dysfunction

Impaired control of the eye movements leading to visual difficulties such as visual fixation or visual tracking problems, ocular alignment and impairment of accommodation.

Optic ataxia

Impaired accuracy of movement of limbs and body through visual space because visual guidance of movement is impaired.

Optic chiasm

The X-shaped structure formed by the joining up of the optic nerves, which cross and then become the optic tracts just below and leading into the brain.

Optic nerves

Bundle of nerve fibers (axons) from the ganglion cells of the retina. Nerves that transmit visual information from the retina of each eye to the brain.

Optic nerve atrophy

Atrophy means loss of functioning cells. The reason for cell damage may be infection, trauma, tumour or increased intraocular pressure.

Optic radiations

A collection of nerve axons that carry information from the lateral geniculate bodies in the thalamus to the visual cortex in the occipital lobes.

Optic tract

Bundles of nerve fibres that emerge from the back of the optic chiasm on each side that carry visual information to the lateral geniculate body.

Optokinetic nystagmus (OKN)

Reflex to and from movement of the eyes in response to moving targets.

Optometrist

A health care provider who specializes in the measurement of refractive errors and other visual functions, prescribes eyeglasses or contact lenses and (in some countries) diagnoses and manages conditions of the eye.

Optotypes

Letters and symbols used to test visual acuity.

Orientation perception

The capacity to know where one is, has been and will be going, as well as the position and location of possession.

Orthoptist

A specialist in measurement and management of disorders of the eye movements and binocular vision.

P

Parallax

The perception of the relative alignment of objects in relation to the position of viewing. A phenomenon that helps compensate for lack of stereopsis.

Parallel processing

The ability to simultaneously process several stimuli.

Parietal lobes

The parts of the brain that integrate incoming sensory information with the execution of body movements and process language.

Parvocellular pathway

A pathway of the brain served by small retinal and brain cells that transmit fine, detailed visual information primarily in the central visual field.

Pattern perception

The discrimination and identification of a set of stimuli arranged in a certain regular form, e.g. contours, figures, objects, faces, words, melodies.

Perception

The ability to see, hear or become aware of something through senses.

Perceptual visual dysfunction

A condition in which the brain is unable to process visual information correctly.

Perinatal

Around the time of the birth.

Peripheral target

A target placed at the outer edge of a person´s visual field.

Peripheral visual field

The area of vision outside the centre of an individual´s gaze.

Periventricular leukomalacia (PVL)

Damage to the white matter adjacent to the lateral ventricles of the brain.

Periventricular white matter

The white matter near to the ventricles of the brain.

Photophobia

Increased sensitivity to light.

Preferential looking (PL)

An experimental method in developmental psychology. An infant is habituated to a particular stimulus; then a second, new stimulus is shown, which differs from the habituated stimulus with respect to a specific feature (e.g. size, colour, form). If the infant now looks for longer at the new stimulus, it is suggestive that the infant can discriminate between the two stimuli. Preferential looking is now used routinely to estimate visual acuities in young children and those who are otherwise unable to cooperate with the use of other methods.

Prefrontal cerebral cortex

The anterior part of the frontal lobes of the brain that contributes to initiation and coordination of thoughts and actions.

Prematurity

Birth before 37 weeks' gestation.

Prosopagnosia

Inability to recognize faces.

Pupil of an eye

The hole in the centre of the iris that allows light to enter the eye and, by its change in size, controls the amount of light passing through.

Pursuit eye movements

Smooth eye movements made while following an object. Also known as smooth pursuit movements.

Q

Ouadrantopia

A defect in the visual field that affects a quarter of the visual field.

R

Recognition acuity

Ability to recognize and distinguish a specific visual target from other similar stimuli. Often measured using letter charts.

Refractive errors

An inaccuracy within the eye where the light rays do not come into clear focus on the retina, resulting in a blurred image.

Rehabilitation

Training to improve skills or behaviours that have been lost or decreased due to disease or injury.

Retina

The retina reacts to light and transmits visual information by means of nerve impulses to the brain.

Retinopathy of prematurity (ROP)

A disorder of the retina related to abnormal vascular development that occurs as a sequel to premature birth.

Rod cells

Sensory cells in the outer layer of the retina. They are highly sensitive to light and thus function best in twilight and scotopic conditions. In daylight their activity is not transmitted through the retina because the function of the cone cells inhibits it. The highest concentration of rod cells is in the peripheral parts of the retina.

S

Saccades

Fast voluntary eye movements, usually quick movements of both eyes simultaneously, used for tasks such as reading or scanning a scene.

Scanning

Making a series of visual fixations in order to visually inspect a large area.

Scotoma

A non-seeing area in the visual field.

Simultagnosia

Inability to see more than one item within the visual scene at the same time.

Spastic diplegia

A form of cerebral palsy resulting in weakness and stiffness of the lower limbs.

Spatial orientation

The perception of one's own location in space and its adjustment with reference to objects in the same space.

Spatial vision

Perception of spatial properties of visual stimuli, e.g. position, orientation of contours, spatial configuration of figures, objects and scenes.

Stereopsis

Depth perception that results from the interpretation of the slight difference between pictures of the same visual scene provided by the two eyes.

Strabismus

Misalignment of the eyes. The eyes do not look in the same direction.

Striate (primary) visual cortex

The discrete region in the posterior occipital lobes of the brain that receives input directly from the eyes via the optic radiations, which serves primary visual functions, e.g. light detection. Also labelled Brodmann area 17 or V1 (visual area 1).

T

Temporal lobes

The areas of the brain under the temples that analyse the input from the senses. They provide the memory banks that underpin knowledge and recognition.

Text processing

The act of processing text material (letters, numbers). Essential prerequisites are an intact central visual field, a sufficiently high visual acuity and contrast sensitivity, accurate form discrimination, ability to integrate letters/numbers to larger elements and regular shifting of fixation. Text processing is the main basis for understanding of text material.

Thalamus

A structure situated between the cerebral cortex and the midbrain involved in processing and relaying sensory and motor signals to the cerebral cortex.

Threshold acuity

The lower limit of visual acuity measured with each eye separately for the purpose of diagnosis and follow-up of visual disorders.

Topographic agnosia

Disorientation in one´s surrounding. Impairments results from ventral stream damage and problem forming a mental map of the environment. Also known as topographic disorientation.

Tracking

Maintaining fixation on a moving object of interest using pursuit eye movements.

V

Ventral stream

Visual pathway between the occipital and temporal lobes, sometimes known as the “what” pathway, which supports the process of visual recognition. Dysfunction can cause impaired recognition of objects and persons, and impaired orientation in surrounding and extended space.

Ventricles

Fluid-filled cavities in the brain.

Vision loss

Lack of vision due to acquired damage to a previously intact visual system.

Visual acuity

A measure of the ability of the visual system to see or resolve the parts of an image as being separate from one another.

Visual attention

The ability to focus on specific elements in a visual scene by selecting and filtering out less salient information.

Visual blurring

It is observed when discrete boundaries between images are not seen as distinct, but instead merge into one another. This can be caused by refractive error and disorders of the eyes or visual pathways.

Visual brain

The totality of brain elements serving or supporting vision that serve to map, search, give attention to, recognize and interpret visual input.

Visual cognition

The capacity to process what is seen, to think about its significance, and to manipulate and use both incoming image data and remembered imagery in the context of creative thought.

Visual dysfunction

Disorder of the visual perception, visual guidance of movement, and/or visual attention.

Visual evoked potential (VEP)

Computerized recording of electrical activity at the back of the brain.

Visual field

Area of space visible to the eyes when looking straight ahead.

Visual functions

Measurable components of vision including visual acuity, contrast sensitivity, colour perception, visual field and the perception of movement.

Visual guidance of movement

Mapping of incoming visual information in the mind that is used to guide movement of the limbs and body.

Visual impairment

Damage to the visual system that impedes the ability to learn or perform usual tasks of daily life, given a child´s level of maturity and cultural environment. Includes both low vision and blindness.

Visual latency

The time taken to receive and process incoming visual information in the brain.

Visual guided motor behaviours

Behaviours with a major visual-motor component, including reaching for, turning toward, and moving among obstacles toward visual targets.

Visual memory

The ability to remember a visual image or form after viewing.

Visual-motor processing

Coordination of goal-directed motor actions in relation to a visual target.

Visual neglect

Inattention to one side of the visual space and/or to one side of the body.

Visual pathways

Bundles of nerve fibres that carry visual information to different location of the brain.

Visual perception

Ability to interpret the immediate environment by processing incoming information that is sent from the eyes to the brain.

Visual processing

The brain´s recognition and interpretation of information.

Visual recognition

The ability to recognize and identify objects, faces, geometric shapes and colours as well as pictures and images.

Visual search

The process of detecting a target stimulus among distractor stimuli.

Visual space perception

The sum of abilities to process and comprehend spatial properties of the environment and of objects, i.e. position, distance, direction, spatial relationships between stimuli.

Visual stimulation

An approach that places a child as a passive observer, in an environment in which selected visual stimuli are presented with the intention of bringing about attention and enhancement of visual development.

Visual system

Network that produces sight, including both the eyes and the brain.

Visuospatial perception

The capacity to appreciate, understand and map the three-dimensional characteristics of the surroundings, both for subjective appreciation and to facilitate movement through space.

W

WHAT pathway

Occipito-temporal route that is specialized for the processing of visual object properties (ventral pathway).

WHERE pathway

Occipito-parietal route that is specialized for the processing of visuospatial information (dorsal pathway).

Working memory

The ability to actively process information in temporary storage, with a phonological loop for the manipulation of verbal content and a visuospatial scratch pad for retaining of visual information.

References

1. Colenbrander, A. (2010). What's in a name? Appropriate terminology for CVI. Journal of Visual Impairment & Blindness, 104(10), 583-585.
2. Dutton, G. N. (2003). Cognitive vision, its disorders and differential diagnosis in adults and children: knowing where and what things are. Eye, 17(3), 289-304. doi: 10.1038/sj.eye.6700344
3. Hyvarinen, L., & Jacob, N. (2011). *What and how does this child see?* Helsinki: VISTEST Ltd.
4. Lueck, A. H. (2010). Cortical or cerebral visual impairment in Children: A brief overview. Journal of Visual Impairment and Blindness, 104(10), 585-592.
5. Lueck, A. H., & Dutton, G. N. (2015). *Vision and the brain: Understanding cerebral visual impairment in children*. New York: AFB Press.
6. Ortibus, E., Lagae, L., Casteels, I., Demaerel, P., & Stiers, P. (2009). Assessment of cerebral visual impairment with the "L94" visual perceptual battery: clinical value and correlation with MRI findings. Dev Med Child Neurol., 51(3), 209-2017.

7. Ortibus, E., Verhoeven, J., et al. (2011). Screening for Cerebral Visual Impairment: validation of a CVI questionnaire. Neuropediatrics, 42, 138-147.
8. Swift, S. H., Davidson, R. C., & Weems, L. J. (2008). Cortical visual impairment in children: presentation intervention, and prognosis in educational settings. TEACHNG exceptional children plus, 4(5), 1-14.
9. Wagemans, J., Wichmann, F. A., & Op de Beeck, H. (2005). Visual perception I: Basic principles. In K. Lamberts & R. Goldstone (Eds.), Handbook of Cognition (pp. 3-47). London: Sage Publications.
10. Zihl, J., & Dutton G.N. (2015). *Cerebral visual impairment in children. Visuoperceptive and visuocognitive disorders*. Wien: Springer.