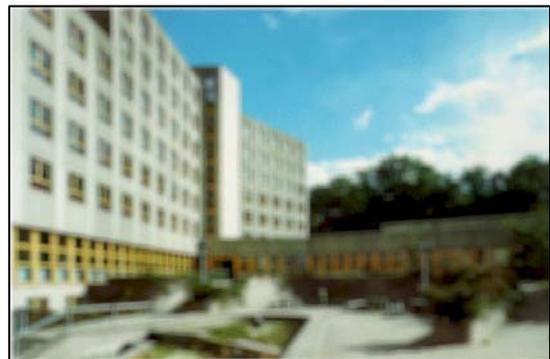




E-Learning **CO**ach for **V**isually **I**mpaired **P**eople

TUTORIAL S2 Visual and Hearing impairment



Official course tutorial for the E-COVIP examination

Published by the
E-COVIP project consortium

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Authors:

Halet, F.; Fédération nationale pour l’insertion des personnes Sourdes et des Personnes Aveugles

Hüllen, J.; Berufsförderungswerk Düren gGmbH

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The E-COVIP Project Consortium

Berufsförderungswerk Düren gGmbH
(Project coordination)
Karl-Arnold-Str. 132-134
D52349 Düren, Germany
<http://www.bfw-dueren.de>

Arla Instituutti
Puustellinmäki 5-6
02600 Espoo, Finland
<http://www.arlainst.fi>

Fédération nationale pour l'insertion des personnes Sourdes et des Personnes Aveugles
12, rue Alfred de Musset Carbon-blanc cedex, France
<http://www.fisaf.asso.fr>

Institut Montéclair
Rue du Vallon 51
4900 Angers, France
<http://www.monteclair.fr>

Visio
Waldeck-Pyrmonstraat 31
7315JH Apeldoorn, The Netherlands
<http://www.visio.org>

Specjalny Ośrodek Szkolno-Wychowawczy dla Dzieci Niewidomych i Słabowidzących
ul. Tyniecka 6
30-319 Krakow, Poland
<http://www.blind.krakow.pl>

Royal National College for the Blind
College Road
Hereford
HR1 1EB, United Kingdom
<http://www.rncb.ac.uk>

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2 Learning Aim

The reader should know after reading this tutorial the most frequent forms of visual and hearing handicaps and their consequences for the utilization of computers with GUI and the consequences how these handicaps influence the e-learning process.

Part A – Basic information

In Part A the reader will find a general overview about occurring problems of computer users with sensual handicaps. In a brief description about the problems and general recommendation, the reader should find general recommendations about the way how to provide information for sensual impaired e-learning students.

3 General

During this course we are using the term “impaired” for any visual and auditory disturbance because neither the terms “visually handicapped” or “blind”, nor the the declaration of symptoms of eye diseases defines exactly the visual restriction a person is suffering from. Furthermore the reader must also discriminate between the status of medical and legal blindness. During the medical term of blindness usually determines a total loss of visual capability, the legal status discriminates between visually handicapped and blind by the percentage of residual view. In comparison to the medical taxonomy it is possible that those persons, who are rated as blind, might have a very limited residual view. Within the countries of the EU the status of legal blindness is not uniquely regulated.

For example in Germany, the social legislation designates persons as visually impaired with a sight from a maximum of 1/3 to 1/20 of the normal sight. As a high-degree visual impaired person, the legal definition sees a visual restriction from a maximum of 1/20 to 1/50 of the normal sight In Italy for example the legislation designates people as blind with a residual acuity of up to 1/10.

The definition of the impairment varies also and differs from the status of light deafness, which includes a hearing restriction between 21db and 40db and the total deafness, which includes a hearing restriction over 120db.

4 Sensual impairments and e-learning

The sensory handicaps of the target group which is focussed in this project affects, technically spoken the interaction with computers via input and output technology, summarized as “Human Machine Interfaces (HMI)”. Unlike for the “regular” sighted computer users, computer screens and mouse or trackball might not be the appropriate HMI for these people. In these cases some additional or alternate assistive devices are required, to enable an adequate access to the computer. For computer user with hearing disabilities, some implemented Audio features might not be accessible and usable. In a period where multimedia files and even computer games gather increasing popularity and importance in e-learning, the e-learning coaches must think about strategies or alternatives to supplement those media for sensual impaired students. In general it is helpful, in terms of a “last chance strategy”, to provide the content of graphic and audio-visual learning media as a text-based document.



Picture 1 *Blind computer user with various assistive devices*

The recommendations considering required assistive devices and the computer configuration for a blind or visually handicapped user must be based on an individual assessment, and can't be deduced from the diagnosis of the eye-disease or the symptoms.

For user with hearing impairment it will be not in any case sufficient to increase the loudness of the audio files, due to individual restrictions of certain frequency levels or permanent noises. If we summarize the various symptoms of hearing and visual impaired computer users, it is possible to give only some generalized recommendations how to provide information in e-learning.

4.1 Overview about sensual restrictions and consequences

To understand those generalized recommendations, it will be necessary to summarize the symptoms and restrictions of sensual impairments in a general overview. It is important to emphasize that those symptoms can occur also in combination and different degrees.

4.1.1 Symptoms and restrictions of visual impairment

1. Reduced visual field
2. Reduced acuity
3. Reduced contrast sensibility
4. Reduced capability of colour perception
5. Disorder in sensibility of light
6. Reduced capability of blind computer user to create virtual spatial mind maps about the Graphical User Interface (GUI)
7. Blind user can not use visual input devices like mouse or digitizer
8. No access to graphic information for blind computer user

4.1.2 Symptoms and restrictions of hearing impairment

1. Reduced sound perception in one or more frequency levels
2. Reduced sound perception under a certain loudness level
3. Reduced verbal communication capability of deaf or people with severe hearing disability, considering pronunciation
4. Deaf users can not use and setup voice recognition software and voice communication tools

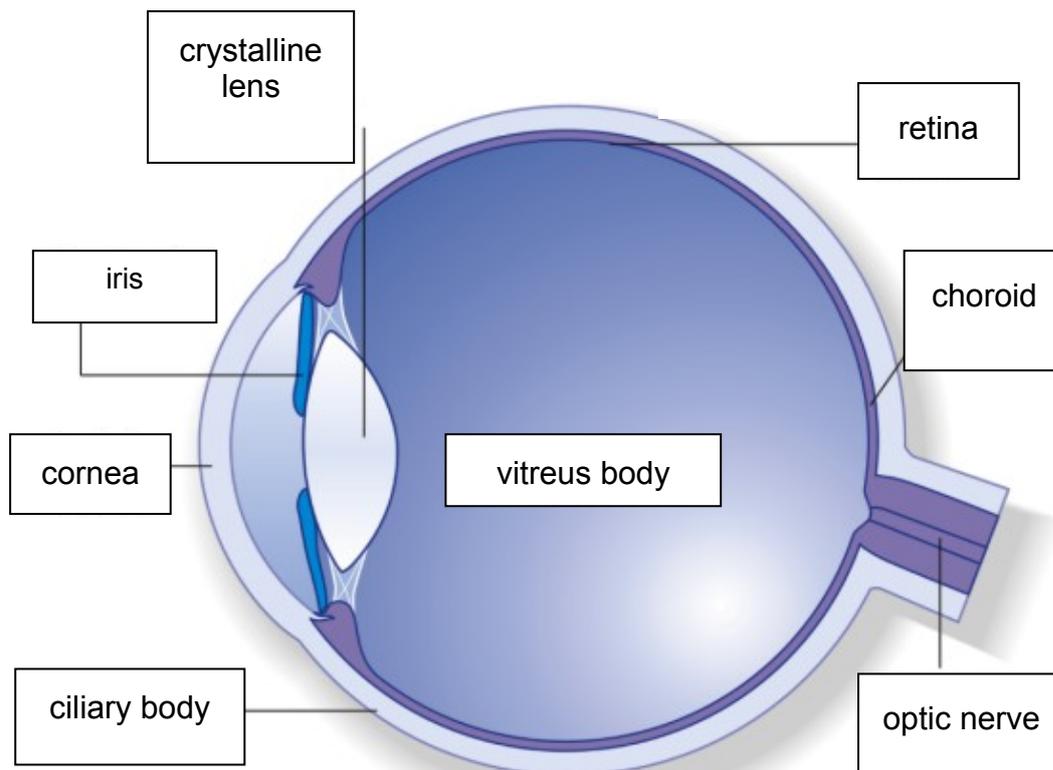
4.1.3 General recommendations

1. Provide a simple, reasonable and unique structure for navigation
2. Provide text in a high contrast (e.g. black font colour on white background), a non serif based font and a scalable font size (e.g. with the zoom feature of the text processor or the web browser)
3. Avoid information based only in graphics and media files. Provide for Graphics additional text descriptions and provide AV-media with textual and audio subtitles.
4. Make sure that all essential and necessary command- and navigation elements of the GUI can be accessed and activated with the computer keyboard.
5. If voice communication tools will be used for synchronous communication, provide simultaneously a text based communication tool like a chatbox
6. During synchronous communication provide more and longer breaks between the sequences of explanation. This will give the sensual impaired users the required time to access the written or transformed information.

Part B - Detailed information about Visual and hearing impairment

In this part of this tutorial, the interested reader will find closer information about visual and hearing disabilities. Several of the most common sensual disabilities and their symptoms will be explained.

5 The Anatomy of the human eye



Picture 2: Horizontal section through the human eye with the most important parts.

6 Frequently visual restrictions

6.1 Reduced colour vision

6.1.1 anomalous trichromatism

	anomalous trichromatism
reason	<ul style="list-style-type: none">• malfunctioning of the cones• if hereditary - both eyes affected
consequence	<ul style="list-style-type: none">• disorder of the cones, but all of them are available• dependence on the type of cones which is disorder this colour is not seen completely• there are different types of abnormality:<ul style="list-style-type: none">- protanomaly = red- deuteranomaly = green- tritanomaly = blue
symptom	<ul style="list-style-type: none">• colour vision: decrease in comparison to a normal trichromatism person
visual aid	<ul style="list-style-type: none">• usually not necessary

6.1.2 dichromatism

	dichromatism
reason	<ul style="list-style-type: none">• malfunctioning or one type of cone is missing• if hereditary - both eyes affected
consequence	<ul style="list-style-type: none">• colour vision: decrease in comparison to a normal trichromatism person
symptoms	<ul style="list-style-type: none">• reduced colour vision• reduced visual acuity, depending on the disorder• dichromatic persons see a complete colour as the same (all shades)
visual aids	<ul style="list-style-type: none">• usually not necessary

6.1.3 Achromasia

	coloure blindness - achromasia
reason	<ul style="list-style-type: none">• the cones do not work or are not available• mostly hereditary
consequence	<ul style="list-style-type: none">• rod monochromatism
symptoms	<ul style="list-style-type: none">• central scotoma• high dazzle sensitivity• visual acuity is max. 0.1• no colour vision
visual aids	<ul style="list-style-type: none">• sun glasses• device to see colour

6.1.4 Red-green-anomaly

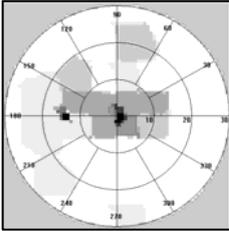
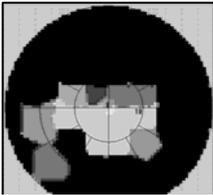
	example: red-green-anomaly
reason	<ul style="list-style-type: none">• genetic inheritance• sex-linked<ul style="list-style-type: none">- male: 8%- female: 0.4%
symptoms	<ul style="list-style-type: none">• reduced colour vision• compound colour – poorly perceptible
visual aids	<ul style="list-style-type: none">• usually not necessary

6.2 Visual field

6.2.1 General aspects

	visual field
explanation	<ul style="list-style-type: none">• the area visible to an eye in a given position (measured without head moving and eye moving))
general knowledge	<ul style="list-style-type: none">• restriction of the visual field:<ul style="list-style-type: none">- Deep-set eyes- Big eye-brows and a big nose- Tiredness and dark- glasses• papilla makes a scotoma → because of an absence of visual cells in this area• reading is only possible in the macula• Movement can be seen in the centre and the periphery.
Examination methods	<ul style="list-style-type: none">• perimeter• hand movements

6.2.2 Visual field defects

	visual field defects - scotoma
types of defects	<ul style="list-style-type: none"> • central scotoma <ul style="list-style-type: none"> - A scotoma involving the area of the visual field corresponding to the macula lutea. - local and (possible) connected areas with different shape and size - visual acuity $\ll 0.1$  <p style="text-align: center;">Picture 4: 30° visual field of a visually impaired person with macula degeneration - BFW Halle.</p>
	<ul style="list-style-type: none"> • peripheral scotoma <ul style="list-style-type: none"> - A scotoma which does not involve the central or fixation area. - Problematic → big scotoma e.g. retinopathia pigmentosa - defects have different reasons → Glaucoma - central vision survives - possibility of visual acuity = 1.0  <p style="text-align: center;">Picture 3a: 30° visual field of a visually impaired person with retinopathia pigmentosa - BFW Halle.</p>
	<ul style="list-style-type: none"> • hemianopia <ul style="list-style-type: none"> - Blindness in one half of the visual field of one or both eyes

visual aids	<ul style="list-style-type: none"> • depends on the scotoma • example: <ul style="list-style-type: none"> - magnifiers - guiding cane
-------------	--

6.3 *Visual acuity*

Visual acuity describes the ability to see small details of an object

6.3.1 Reduced visual acuity

reduced visual acuity	
reasons	possible reasons for reduction of the visual acuity are: <ul style="list-style-type: none"> • ametropia • turbidity of the eye media • eye diseases • dependence on age
symptom	<ul style="list-style-type: none"> • unclear vision
visual aids	<ul style="list-style-type: none"> • glasses • magnifiers • cut-off-filter-lenses

6.4 Dazzle and light

The term dazzle describes an abnormal, personal intolerance of irregular lighting conditions bright light which produces unpleasantness or discomfort.

6.4.1 High dazzle susceptibility and need for bright conditions

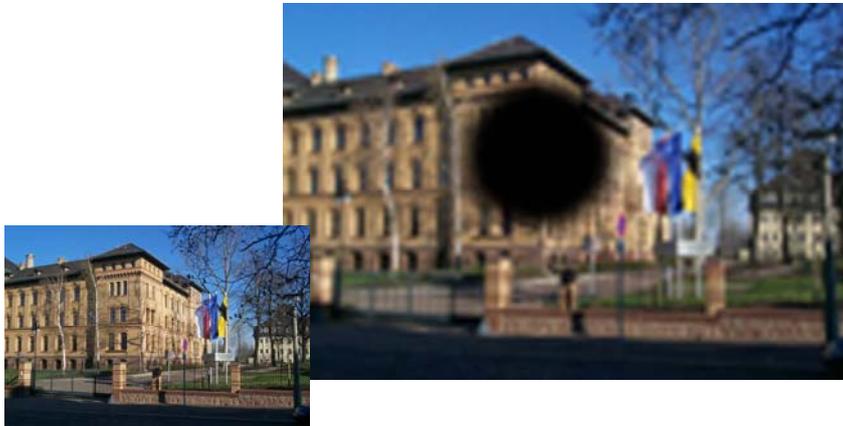
	high dazzle susceptibility
explanation	<ul style="list-style-type: none"> • dazzle susceptibility: <ul style="list-style-type: none"> - no clearly defined dimension for the reaction by coming up to the dazzle luminance • dazzle luminance: <ul style="list-style-type: none"> - luminance in the visual field → beyond this point personal dazzle - dependence on the adaptation
reasons for scattered light at the eye	<ul style="list-style-type: none"> • inflammation of the eye • turbidity of the eye medium • albinism • associated phoria • wrong lighting conditions
symptoms	<ul style="list-style-type: none"> • photophobia • high tear secretion • headache • poor contrast vision • eye irritation • high blink frequency
visual aids	<ul style="list-style-type: none"> • sunglasses • peaked cap • dazzle free light conditions • curtains

6.5 *Reduced contrast sensitivity*

	reduced contrast sensitivity
reasons	<ul style="list-style-type: none">• turbidity of the eye medium• old age• neurological disorder (glaucoma, optic atrophy)• poor lighting conditions
symptom	<ul style="list-style-type: none">• poor discern of objects
visual aids	<ul style="list-style-type: none">• electronical devices e.g. text rendering in black-white-contrast• cut-off-filter-glasses• using of colours e.g. household

7 Frequently occurring visual handicaps

7.1 *Macular degeneration*



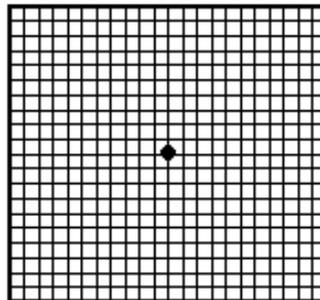
Picture 5: *Possible view of a person with an advanced macular degeneration at the BFW Halle; normal view (small picture)*

7.1.1 Age-related macular degeneration

	age-related macular degeneration
reason	<ul style="list-style-type: none"> • overcharge of the retina
consequences	<ul style="list-style-type: none"> • accumulation of metabolism products → no removal • sickness progresses over years • cones die
symptoms	<ul style="list-style-type: none"> • vision slowly drops down • reading becomes difficult • colour vision drops down • straight lines become distorted • scotoma at the centre of the visual field • reading with magnifiers is possible
treatments	<ul style="list-style-type: none"> • impaired blood vessels are removed • vitamine therapy

rules of
behaviour

- preventive examination with Amsler's chart – independent by the patient
 - fixation of the Amsler's chart in good light conditions and reading distance
 - glasses have to be worn if there is a need
 - It is a monocular examination (each eye for itself).
 - fixation of the point at the Amsler's chart with the open eyes
 - lines → have to be straight
 - if not → consult a doctor
 - preventive examination: once a week



Picture 6: Amsler's-chart; preventive examination for macular degeneration – for persons with poor vision

- regular examination by an ophthalmologist
 - preventive examination: Fluorescence angiography
 - A special photo of the retina is taken after an injection of a contrast fluid.
- Stop smoking.

7.2 Retinopathia pigmentosa



Picture 7: Possible view of a person with an advanced retinopathia pigmentosa at the BFW Halle; normal view (small picture)

	retinopathia pigmentosa
reason	<ul style="list-style-type: none"> • hereditary disease
consequences	<ul style="list-style-type: none"> • visual cells of the retina necrotize <ul style="list-style-type: none"> - firstly the rods (at dawn and at dusk) - lastly the cones (day and colour vision) • diseases progress over years • finishes in blindness
symptoms	<ul style="list-style-type: none"> • peripheral scotoma • poor contrast vision • reduced colour vision • high dazzle susceptibility • decreased scotopic vision and night blindness • the visual acuity drops down with the progressive disease - there is the possibility of blindness

retinopathia pigmentosa	
treatment	<ul style="list-style-type: none">• no possibility of causal treatment• different clinical experiments – only a slowing down of the process, but nothing can cure the disease
associate syndrome	<ul style="list-style-type: none">• Usher´s - syndrome<ul style="list-style-type: none">- heredity- in addition to retinopathia pigmentosa, an inner ear deafness- communication over tactile stimuli- communication over Lorm – alphabet

7.3 Diabetic retinopathy

diabetic retinopathy	
reason	<ul style="list-style-type: none"> • diabetes mellitus
consequences	<ul style="list-style-type: none"> • bleeding into the vitreous body • ablatio retinae • cataract • glaucoma • reduces cornea's sensitivity
symptoms	<ul style="list-style-type: none"> • at the beginning nothing • change of tear secretion • variation of daily visual acuity • lesion of the fundus of the eye • the visual acuity drops down with the progressive disease - there is the possibility of blindness
treatments	<ul style="list-style-type: none"> • treatment of diabetes mellitus • treatment of high blood pressure • removal of new blood vessels • control by a specialist and medical chiropody
rules of behaviour	<ul style="list-style-type: none"> • stick to a diet • sports and exercise • Stop smoking. • regularly examination by a specialist: ophthalmologist, family doctor

Survey your learn process

What are the similar symptoms between diabetic retinopathy and retinopathia pigmentosa?

7.4 Cataract



Picture 8: Possible view of a person with an advanced cataract at the BFW Halle; normal view (small picture)

	cataract
reasons	<ul style="list-style-type: none">• it is an old age blurring of the crystalline lens• metabolic disorders (diabetes, high - blood pressure, adiposity)• congenital (hereditary) cataract• lesion and inflammation of the eye• drugs (cortisone)
consequences	<ul style="list-style-type: none">• turbidity of the crystalline lens• hardening of the crystalline lens• crystalline lens growth up

	cataract
symptoms	<ul style="list-style-type: none">• visual acuity drops down• cloudy vision• double images• change of colour vision• high dazzle susceptibility• often changing of visual acuity → change of glasses• reading vision drops down• problems at night driving• reduced blue sensitivity
treatment	<ul style="list-style-type: none">• operation• insert a new lens
tips	<ul style="list-style-type: none">• after operation:<ul style="list-style-type: none">- there is the possibility of change in the visual acuity after the operation → new glasses a few months later- „blue vision“ after the operation → it disappears after some time• frequently complication → secondary cataract → secondary cataract is treated by laser treatment
rules of behaviour	<ul style="list-style-type: none">• high dazzle susceptibility after operation → sunglasses• separate glasses for near vision

7.5 Glaucoma



Picture 9: Possible view of a person with an advanced glaucoma at the BFW Halle; normal view (small picture)

7.5.1 Primary open angle glaucoma

	primary open angle glaucoma
reason	<ul style="list-style-type: none"> • high flowing off resistance at the chamber angle
consequences	<ul style="list-style-type: none"> • increase of the eye pressure • vascular disorder at the optic nerve
symptoms	<ul style="list-style-type: none"> • at the beginning: <ul style="list-style-type: none"> - small visual field defects – it is compensated with the other eye - blue-yellow- colour-anomaly • at the end: <ul style="list-style-type: none"> - bigger visual field defects, slow chronic progress → blindness
treatments	<ul style="list-style-type: none"> • drugs to improve the flowing off of the intraocular fluid or reduction to the intraocular fluid • dilation of the flowing off with laser treatment
rule of behaviour	regular control of the visual field, eye pressure and papilla

8 Hearing impairments

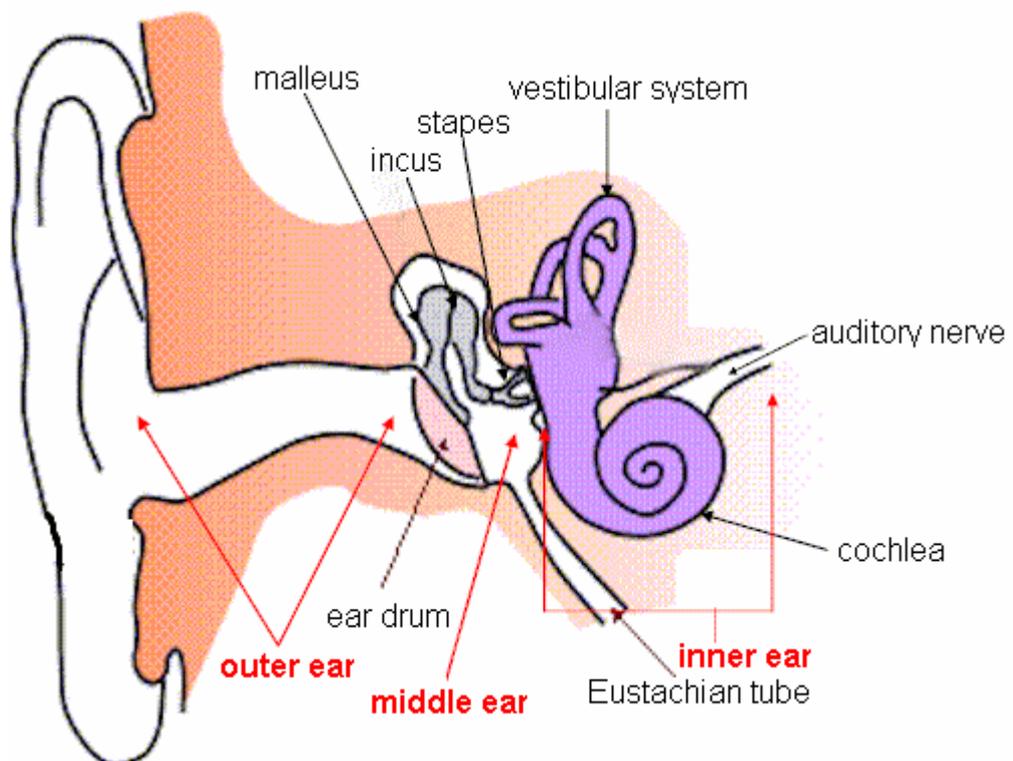
Hearing impairment is an unspecified term to describe a person's reduced capability in hearing in one or both ears. The World Health Organization categorizes different levels of hearing impairment:

1. partial or complete loss of the ability to hear from one or both ears
2. Deafness categorizes the complete loss of ability to hear from one or both ears.

The type of hearing impairment is also categorized according to the localization of the cause.

1. Conductive hearing impairments have their origin in the outer and middle ear.
2. Sensorineural hearing impairment have their origin in problems with the inner ear or hearing nerves

8.1 The anatomy of human ear



Picture 10 Anatomy of the human ear

Original Picture from: http://commons.wikimedia.org/wiki/Image:Anatomia_ucha.png

8.2 Frequently hearing restrictions

8.2.1 Different grades of deafness

8.2.1.1 Slight deafness

	Slight deafness
reason	<ul style="list-style-type: none">• earaches, punched ear drum• deformity of outer ear or middle ear (transmission deafness)
consequence	<ul style="list-style-type: none">• mean's loss between 21 and 40 dB• speech sensed with normal voice but difficulty with low voice• Families noises sensed
symptom	<ul style="list-style-type: none">• Possibility of light problem oral
hearing aid	<ul style="list-style-type: none">• usually not necessary

8.2.1.2 Moderate deafness

	Moderate deafness
reason	<ul style="list-style-type: none">• earaches, punched ear drum• deformity of outer ear or middle ear (transmission deafness)
consequence	<ul style="list-style-type: none">• mean's loss between 41 and 70 dB (2 degrees: first (41→55dB), second (56→70dB))• speech sensed with high voice and better understanding with looking mouse• discomfort with noises
symptom	<ul style="list-style-type: none">• substancial social handicap and problem
hearing aid	<ul style="list-style-type: none">• required equipment and help to learn language (1→6 years) + speech therapy re-education

8.2.1.3 Severe deafness

	Severe deafness
reason	<ul style="list-style-type: none">• earaches, punched ear drum• deformity of outer ear or middle ear (transmission deafness)
consequence	<ul style="list-style-type: none">• mean's loss between 71 and 90 dB (2 degrees: first (71→80dB), second (81→90dB))• speech sensed with very high voice near to ear• high noises sensed
symptom	<ul style="list-style-type: none">• language's problem• without equipment, socialization difficulty• emitted voice but problem with language's structure
hearing aid	<ul style="list-style-type: none">• required equipment• cued speech or sign language are vital• intense re-education

8.2.1.4 Profound deafness

	Profound deafness
reason	<ul style="list-style-type: none"> • problem with inner ear or nervous system (Sensorineural deafness) • problem genetic, illness during mother's gestation, prematurity, illness of child (meningitis, virals earaches, brain-injured, ...)
consequence	<ul style="list-style-type: none"> • mean's loss between 91 and 120 dB (3 degrees: first (91→100dB), second (101→110dB), third (110→120dB)) • only bass noises sensed but rarely described • nothing language sensed
symptom	<ul style="list-style-type: none"> • language's problem • without equipment, socialization difficulty
hearing aid	<ul style="list-style-type: none"> • required equipment (cochlear implantation) • cued speech or sign language are necessary • intense reeducation

8.2.1.5 Total deafness (cophose)

	Total deafness (cophose)
reason	<ul style="list-style-type: none">• problem with inner ear or nervous system (Sensorineural deafness)• problem genetic, illness during mother's gestation, prematurity, illness of child (meningitis, virals earaches, brain-injured, ...)
consequence	<ul style="list-style-type: none">• mean's loss upper 120dB• nothing senses
symptom	<ul style="list-style-type: none">• language's problem• socialization difficulty
hearing aid	<ul style="list-style-type: none">• required equipment : cochlear implantation is the only source to use auditory source• it's possible to use vibrotactile message

8.2.2 Communication

	Communication
Hearing impaired persons	<ul style="list-style-type: none">• problem is the discomfort, in the daily life, the persons are independent but they are embarrassed with exact condition• required equipment limits or wipes out this problem
Severe and profound deafness	<ul style="list-style-type: none">• it's not discomfort, it's handicap: communication is limited• help with required equipment, technical or lip-reading
Total deafness	<ul style="list-style-type: none">• disappearing of sound, so communication, feedback impossible• replacement technical: lip-reading, cued speech, Sign Language, ...

8.2.3 Speech and writing

	Oral and written language
Hearing impaired persons	<ul style="list-style-type: none">• phonetics references are incomplete• example : the person doesn't see the difference between acute accent and grave accent, the grammatical links between the word, ...
Deaf people	<ul style="list-style-type: none">• no phonetics references when deaf people practices Sign Languages (which has no writting form and there is difference between Sign Language grammar and Country Language)• linguistic doubt : so problem with scholastic learning• learning organization functions of Sign Language

8.2.4 Social handicap

	Social handicap
reason	<ul style="list-style-type: none">• problem with scholastic, vocational and social integration for deaf born people• problem with social exclusion for people with declining hearing ability
consequence	<ul style="list-style-type: none">• initial training is low's level• retraining is difficult• unemployment rate is high• social advancement is low
solutions	<ul style="list-style-type: none">• it is necessary to meet, to act and to learn with hearing people• it is necessary to do deafness information and its consequences

8.3 Frequently occurring hearing handicaps

8.3.1 Transmission deafness

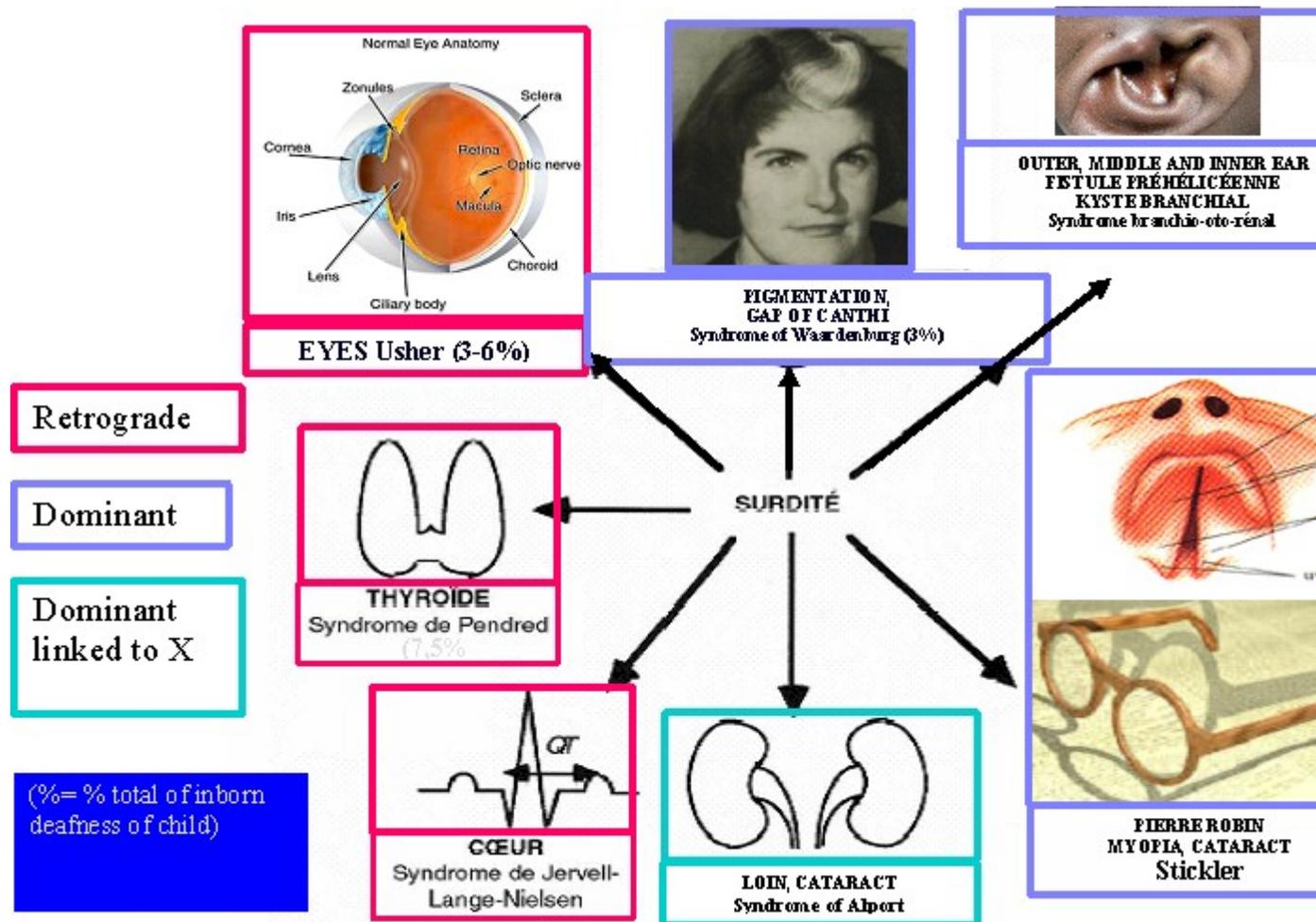
	Transmission deafness
reason	<ul style="list-style-type: none"> • earaches (otitis media, otitis acute, chronic) • punched ear drum • deformity of outer ear or middle ear (deformity of extern ear canal, malleus, incus, stapes) • otospongiose (hereditary illness) : problem of stapes which can't send the sound • cholesteatome • tympanosclerose
consequences	<ul style="list-style-type: none"> • problem with bass frequency • break of the acoustic wave's transmission in outer auditory conduit or in middle ear • acrian line is touched but no bony line
symptoms	<ul style="list-style-type: none"> • possibility difficulty in development speech
treatments	<ul style="list-style-type: none"> • surgery (repairing eardrum, reconstruction malleus, incus and stapes) • medical treatment • required equipment • hydrotherapeutic

8.3.2 Sensorineural deafness

	Sensorineural deafness (endocochlear = affected Corti's organ; or retrocochlear = affected auditory nerve)
reason	<ul style="list-style-type: none"> • inborn deafness (genetic) • deformity • presbycusis (old people) • progressive bilateral deafness • labyrinthitis (otitis inner) • Menière illness (acouphène) • 50% environmental (prematurity, rubella, meningitis,...) • 50% genetic (30% syndrom ; 70% separated → 80% retrograde e, 20% dominant gene) • otospongiose • meningo-neuritis of herpes zoster (retrocochlear) • mumps (retrocochlear) • syphilis (retrocochlear)
endocochlear	
consequences	<ul style="list-style-type: none"> • oscillation sonorous transformation in nerve impulse isn't possible
symptoms	<ul style="list-style-type: none"> • disorder of poise • vertigo • no reaction with sound when the person is in group
treatments	<ul style="list-style-type: none"> • surgery • required equipment (by acrian line) • cochlear implantation • cochlear implantation for middle ear • vibrotactile message (by bony line) • intense reeducation

Mixed deafness is a transmission deafness and Sensorineural deafness.

8.3.3 Syndromes



8.3.4 USHER Syndrome

- heredity
- in addition to retinopathia pigmentosa, an inner ear deafness
- type I
 - audition
 - profound deafness by birth
 - equilibrium
 - lateness walk
 - vision
 - night vision difficulty as soon as childhood (7-8 years ago)
 - gradual reduction field of vision
 - special education
- type II
 - audition
 - average (mean) deafness scalable (birth)
 - auditory equipment
 - equilibrium (normal)
 - vision
 - night vision difficulty at the beginning of adolescence
 - gradual spoiling of field of vision
 - normal schooling
- type III
 - audition
 - gradual deafness
 - equilibrium (normal)
 - vision (problem with “cône” and “bâtonnets”)
 - night vision difficulty
 - normal schooling at the beginning

8.3.5 PENDRED Syndrome

- bilateral inborn deafness, thyroid goitre, cochlear deformity, vestibular dysfunction
- average, heavy or profound deafness
- thyroid goitre before adolescence
- broken cochlear
- auditory equipment
- hormonal thyroid treatment

8.3.6 JERVELL-LANGE-NIELSEN Syndrome

- deafness and dumb (10%)
- syncope (faint) during effort
- situs inversus (partial or overall inversion of organ position in body)
- anaemia (infrequent)
- death risk during childhood
- surgical operation
- medicine

8.3.7 ALPORT Syndrome

- Sensorineural deafness
- glomerular hereditary gradual nephropathy
- lenticular anomaly
- renal deficiency and high blood pressure
- beginning before 5 years ago
- diagnostics during adult period
- macular injury
- no treatment
- renal dialysis or transplant

8.3.8 STICKLER Syndrome

- hereditary vitreo retinopathie which associate ocular problem, wasted affected and neurosensory deafness (10%)
- ocular anomaly : young cataract, myopia, strabismus, retinal detachment,
...
- premature arthrosis
- unforeseeable progression
- one patient = one different treatment

8.3.9 WAARDENBURG Syndrome type I

- major principle : Canthi dystopia, pigmentation anomaly (white frontal lock, eyelash, eyebrow and hairiness are white, hirsutism heterochromia, two-coloured iris), neurosensory deafness
- minor principle : cutaneous pigmentation anomaly, synophris, prominent nose, hypoplasia of nose
- auditory equipment and help

8.3.10 BRANCHIO-OTO-RENAL Syndrome

- branchial anomaly : leak, branchial cyst
- auditory anomaly : deformity of outer ear, transmission or neurosensory deafness
- renal anomaly : deformity of urinary organ, renal hypoplasia, renal dysplasia, renal cyst
- difficulty with genetic advice
- surgical operation : excision of cyst
- auditory equipment
- special education
- renal dialysis or transplant sometimes necessary

9 Bibliography

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