

Module III.6

Sensory impairments



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Sensory disturbances

1. Sensory systems

Sensory systems allow individuals to interact with the outside world, and this interaction defines the person, as it influences how they perform activities, interact with other individuals, and their alertness-wakefulness.

The CNS link between the outside and inside is through specialised neural structures called sensory receptors.

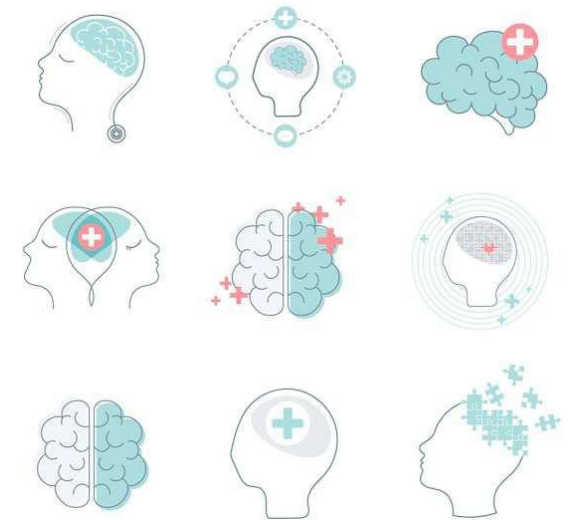


Image 1

Sensory disturbances

Sensory stimuli produce an excitation of afferent sensory fibres in the sensory receptors, which is integrated in the central sensory areas through the combination of the various synaptic circuits. This information is generally confronted with lived and learned experiences, producing a perception of the sensory stimulus in the individual. Therefore there are different levels of organisation that interact in the sensory physiology (objective and subjective).



Image 2



Sensory disturbances

Each stimulus has four basic dimensions (Cardinali, 2007):

-Spatiality and temporality describe the stimulus in time and space, e.g. when something touches the skin it can be located on an area of the body (spatiality) and the beginning and end of the stimulus identified (temporality).

-Modality defines the type of sensation: visual, auditory, tactile, gustatory, olfactory, proprioceptive or vestibular. The environment is experienced through isolated elements produced by interaction with appropriate stimuli with their receptors (visual, tactile...). Within each modality there are generally different distinguishable qualities such as the qualities of taste—bitter, salty, sweet, and sour.



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- Intensity is the quantitative expression of a sensation, it is related to the stimulation of the receptor by the sensory stimulus.

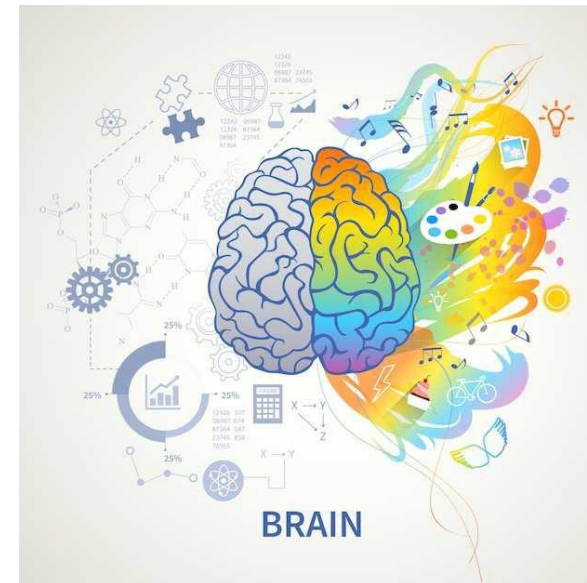


Image 3



Sensory disturbances

2. Main sensory systems

2.1 Touch system.

This allows us to appreciate the external sensations of cold, heat, pressure, texture, vibration, tingling, as well as the weight we are holding, the force our muscles exert, etc.

Touch is extremely important for every human being, it allows us to enjoy a caress, the warm rays of the sun, the cool wind, and an endless number of pleasant sensations; it also protects us against sensations that can cause us harm or pain.

The skin is innervated by a large number of sensory neurons: nociceptors, which perceive painful stimuli; pruriceptors, which transmit itching; thermoreceptors, which register temperature information; and low-threshold mechanoreceptors, which perceive non-painful mechanical stimuli or touch (Abraira, Ginty, 2013; Zimmerman et al., 2014).



Sensory disturbances

People have different types of skin that plays different role:

- Furry skin is associated with affective touch, which evokes an emotional response.
- Engraved skin found on the hands and feet

Touch has two main functions: protection against harmful stimuli, which is why this system is closely related to people's state of alertness to protect themselves, and discrimination of tactile stimuli, which allows us to recognise the objects we interact with.

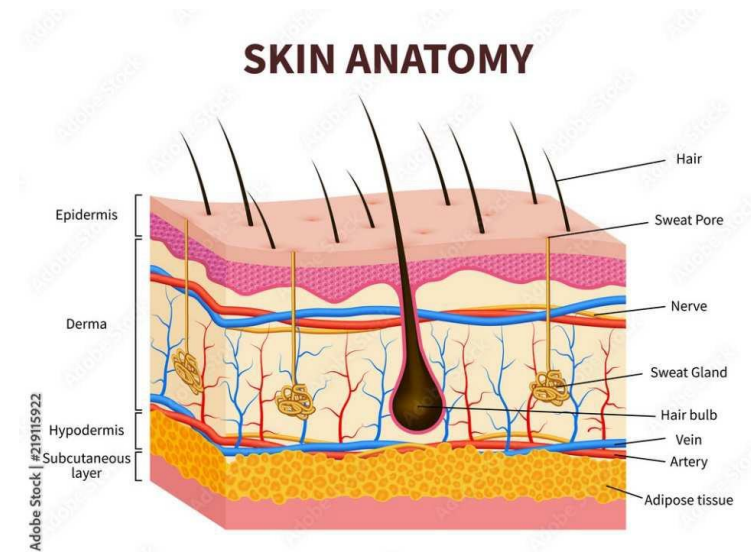


Image 4



Sensory disturbances

2.2 Auditory system.

The auditory system is the set of anatomical structures that enables sensory perception of sounds. The human ear can pick up sound frequencies ranging from 20 Hz (low frequency) to 15,000 Hz (high frequency) (García-Porrero, Hurlé, 201

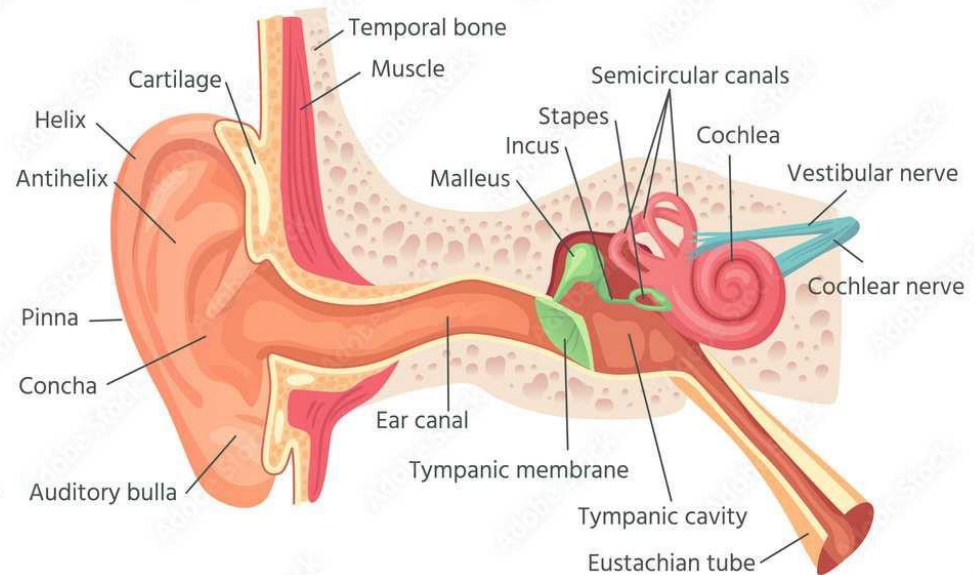


Image 5



Sensory disturbances

2.2 Auditory system.

The ear (or peripheral auditory system) is divided into three parts for study:

- The pinna picks up sound waves, sending them through the ear canal to the tympanic membrane (outer ear).
- The eardrum comes into contact with the vibration of air molecules, which transmits the vibration to the malleus, incus and stapes (middle ear).
- Activation of the stapes produces a liquid wave that generates an activation of the cochlea (inner ear).



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2.3 Visual system

The most important of the human sensory systems. It allows us to acquire a great deal of information from the outside world.

Visual information is provided by light radiation of varying frequencies and intensity that penetrates the eyeball through the pupil. The pupil dilates or contracts depending on the light conditions through the action of the iris. The light signal then passes through the cornea, the lens and the aqueous inner chamber to the retina.

In the retina, photoreceptors (cones and rods) convert light into electrochemical energy that is transmitted to the brain via the optic nerve.



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2.4 Olfactory and gustatory

The senses of smell and taste are similar in their ability to detect chemical signals in air or saliva. These signals are transmitted to the CNS as nerve activity, where they are interpreted as smell or taste. The sensation of smell is extremely diverse, as it can distinguish thousands of different chemical compounds. Taste, however, is more limited and can distinguish about five different modalities (Champney, 2017).

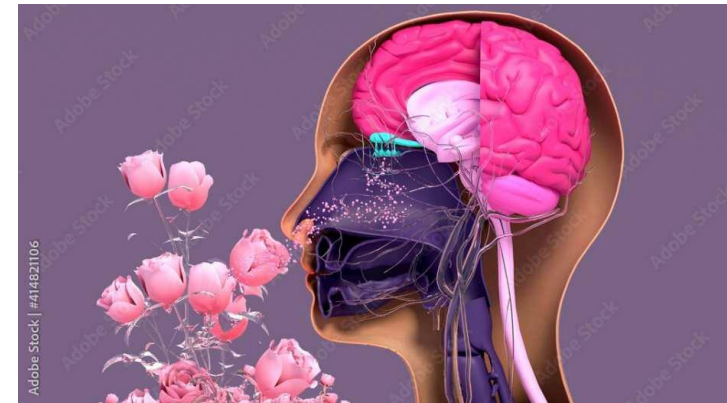


Image 7



Sensory disturbances

The sense of taste is very important in food; certain tastes are perceived as pleasant and play a hedonic role; others, such as bitter tastes, are perceived as unpleasant and are associated with toxic substances.

Taste is the set of sensations that originate in the taste receptors; however, the perception of flavours is also influenced by olfactory sensations and proprioceptive sensations originated in the mouth by the texture of the food (García-Porrero, Hurlé, 2014).

Taste receptors respond to a wide variety of molecular components of food that give rise to five modalities: sweet, salty, bitter and umami.



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The organ of taste is made up of taste buds, which are distributed throughout the lingual papillae, the mucosa of the palate and pharynx.

Each taste bud contains different cells that are sensitive to the five taste modalities, at the base of the bud is linked to the afferent nerve branch that transmits the nerve impulse to the CNS.



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The olfactory system can recognise more than 10,000 odours and very low concentrations.

Smells evoke our memories and influence our mood and enjoyment of food.

The olfactory system is stimulated by airborne substances called odour molecules which are volatile substances. These substances enter the nose with inspired air and can dissolve in the nasal mucus to reach the receptor.



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The olfactory system has three peculiarities (Champney, 2017, García-Porrero, Hurlé, 2014):

- The receptor cell is also the first neuron of the olfactory pathway.
- The information reaches the cerebral cortex directly through other structures.
- It is a system with a very low threshold of stimulation, but with a great capacity for adaptation, so that the perception of the odour stimulus lasts for a very limited time.



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2.5 Proprioceptive system.

The subconscious and conscious awareness of the spatial and mechanical state of the body; including joint position, total or body part position in space, movement and force exerted on objects (Ager et al., 2017).

Receivers:

- The muscle spindle which specialises in detecting changes in muscle length and speed of contraction.
- There are endings in the joints that report mechanical changes in the joints or severe inflammatory changes in the joints (Chu, 2017).
- Golgi tendon organs, found in ligaments and menisci, inform joint boundaries (Hillier et al., 2015).



Sensory disturbances

Proprioception plays an important role in motor planning, coordination and adaptation for rapid changes during task execution (feedback) (Hillier et al., 2015).

It plays an important role in motor learning of new learning, when a child first learns a new motor skill it requires all available information (visual, proprioceptive and tactile). As the skill improves, movements are refined and the process becomes more subconscious, at this point, proprioceptive information is used as a feedback signal to confirm correct execution of the task (Chu, 2017).



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2.6 Vestibular system

It encodes self-motion information by detecting head movements in space. In turn, it provides subjective information on movement and orientation and plays an important role in gaze stability, balance control and posture (Cullen, 2012).

Two types of sensors:

The semicircular canals, which detect angular acceleration in all three dimensions,

The two otolithic organs (sacculle and utricle), which sense linear acceleration, i.e. gravity and translational movements (Cullen, 2012).



Sensory disturbances

The most important functions of the vestibular system are balance, righting reactions, eye control, bilateral hemibody coordination and alertness control (Shayman et al., 2018).



Image 8



Sensory disturbances

3. Sensory disturbances

3.1 Hearing impairment

By 2021, more than 5% of the world's population will suffer from disabling hearing loss.

By 2050, almost 2.5 billion people are expected to have some degree of hearing loss and at least 700 million will require rehabilitation.

A person with hearing impairment has an alteration in the auditory pathway, in the organ of hearing or in the brain, which produces a loss in the quantity and quality of information coming from the environment via the auditory pathway that prevents them from being autonomous in daily life (Cañizares. 2015).



Sensory disturbances

Hearing is the main route through which language and speech develop, so any impairment at a very early age affects linguistic and communicative development (FIAPAS, 2010).

- Ranking
 - a) hearing loss, people with hearing impairment who can acquire spoken language through hearing and use it in a functional way, although in most cases they use a hearing aid.
 - b) deafness, a profound hearing loss that prevents the acquisition of spoken language through hearing (Aguilar et al. 2008).



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The site of injury:

- Conductive or conductive hearing loss:
- Sensorineural or perceptual deafness
- Mixed deafness

Central deafness Age of emergence:

- Prelocution hearing loss
- Postlocution hearing loss



Image 9

Sensory disturbances

3.1.2 Causes of hearing loss and deafness

Prenatal period

- Genetic factors: including those that cause hereditary and non-hereditary hearing loss.
- Intrauterine infections: such as rubella and cytomegalovirus infection
- Perinatal period
- Perinatal asphyxia (lack of oxygen at birth)
- Hyperbilirubinaemia (severe jaundice in the neonatal period)
- Low birth weight
- Other perinatal morbidities and their management



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Childhood and adolescence

- Chronic otitis (chronic suppurative otitis media)
- Presence of fluid in the ear (chronic non-suppurative otitis media)
- Meningitis and other infections

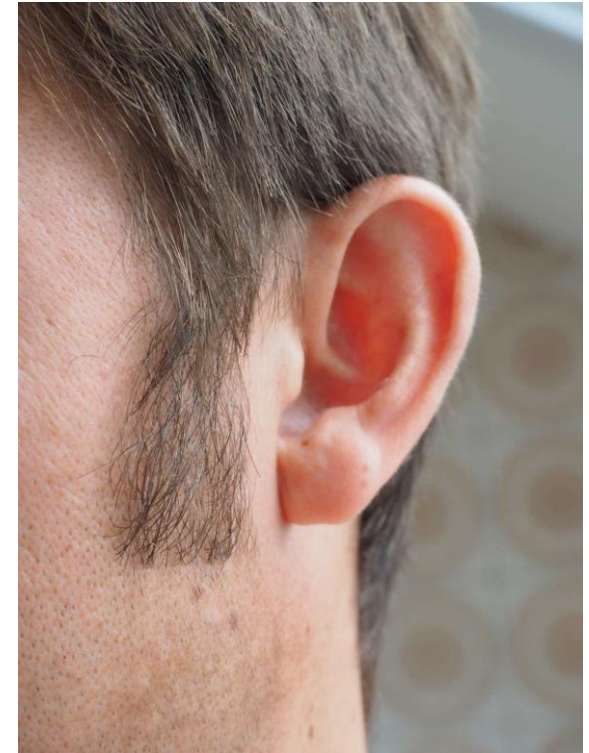


Image 10

Sensory disturbances

3.1.3 Implications for child development

Consequences for cognitive development:

- Cognitive development is impaired due to an information deficit and a lack of use of their experiences, resulting in a lack of motivation for learning.
- They have difficulties in planning their actions and reflecting, acting impulsively and immediately, often without calculating the consequences of their actions.
- They have great difficulty in performing tasks of abstraction or reasoning, as well as in formulating hypotheses or proposing various alternatives.
- The poverty or absence of an inner language greatly hinders the development and structuring of thought and language.



Sensory disturbances

Development of sensory functions:

- Hearing loss means that a fundamental sense is missing, so vision takes on a central role.
- There is an imbalance in spatial-temporal structuring, as lack of hearing does not allow proper development of orientation in space.
- The loss of the sense of hearing makes it difficult to structure time and appreciate rhythm.
- Lesions of the inner ear sometimes lead to alterations of the vestibular apparatus, causing balance problems in some people with deafness.



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Socio-affective development:

- The communicative processes of adult-child interaction are poorer and their content is substantially reduced.
- Understanding of these situations is limited to visual perceptions, which sometimes lead to errors.
- Deaf pupils are distrustful, self-centred, touchy and sometimes impulsive.
- Deaf pupils often have difficulty in accepting frustration.



Sensory disturbances

3.2 Visual impairment

Visual impairment is total or partial loss of sight.

According to the WHO there are 45 million blind people in 2020, of whom 1.4 million are blind children.

The prevalence of childhood blindness is higher in developing countries due to (Gilbert, Awan, 2003):

- Increased prevalence of conditions that cause blindness, e.g. vitamin A deficiency, harmful traditional ophthalmic treatments.
- Inadequate preventive measures for pathologies affecting vision such as measles, congenital rubella or ophthalmia neonatorum.
- A lack of facilities and qualified staff to handle conditions requiring surgery.



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There are two types of blindness:

- Total blindness: Blind or partially sighted people who see nothing at all or have only a slight perception of light (they may be able to distinguish between light and dark, but not the shape of objects).
- Partial blindness: people with visual impairment who, with the best possible correction, could see, or distinguish, some objects at very close range. Under the best conditions, some of them can read print at large size and clarity, but usually more slowly, with considerable effort and with the use of special aids.



Sensory disturbances

3.2.1 Causes of visual disturbances:

- Corneal disorders: responsible for less than 2% of blindness in children, caused by vitamin A deficiency.
- Cataracts and glaucoma: congenitally acquired rubella is a potential cause of childhood cataracts.
- Successful treatment of cataracts and glaucoma requires: training of health care personnel caring for newborns, mechanisms to ensure that children with cataracts and glaucoma are seen by specialists; training of ophthalmologists
- Retinopathy of prematurity: screening, detection and treatment of infants in all units of premature infants weighing less than 1,500 g.



Sensory disturbances

3.2.2 Implications for child development

According to Pérez (2015), there are a wide variety of constraints, the most important of which are:

- Visual difficulties reduce the globalising aspect of vision.
- Difficulties in imitating visually observed behaviour, gestures and games.
- Self-image may be affected due to frustration when realising they do not react like others.
- Fatigue when doing activities due to the greater effort they need to make faced with any visual task.
- Hyperactivity

Image 11



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3.3 Sensory integration impairments

Each child has some sensory peculiarities, these peculiarities are not of great importance, as adequate sensory processing occurs. The problem arises when the child manifests a problem in their activities of daily living, school and leisure caused by inadequate sensory processing.



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Sensory reactivity impairment: includes inappropriate responses, either hyper-reactive or hypo-reactive, to everyday sensory stimulation to which most people readily adapt.

It is a problem that occurs in approximately 5% of the normotypical population and in 40-80% of children with developmental disabilities.

There are different types of sensory reactivity difficulties:

- hyper-reactivity
- under-reactivity



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Sensory discrimination: is the result of:

- Slow and inaccurate processing of one or more types of sensory information; inadequate response to sensations
- Inadequate formation of perceptions and impaired sensory associations (Lane et al., 2016).



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Difficulties in different sensory systems have been reported:

- 1) At the tactile level, there are difficulties in differentiating between dangerous stimuli, identifying objects, recognising drawings on the skin, identifying where they have been touched (all of these processes without vision); in addition, there is an excessive dependence on vision when performing fine motor tasks.
- 2) At the proprioceptive level, there are difficulties in graduating pressure when grasping objects, difficulty in maintaining an appropriate posture and imitating it, lack of fluidity in movements, individuals tire easily when carrying out movements.
- 3) At the vestibular level, difficulty in maintaining balance, poor head-eye and hand-eye coordination, confusion between right and left and individuals fall easily.



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Dyspraxia: is the sensory processing disorder for programming actions in environments with a diversity of possibilities (Mailloux et al., 2011). There may be difficulties in one or more components of praxis. In individuals with dyspraxia, poor motor skills, slowness in the execution of movements, difficulty in playing (they do not seem to know what to do, they always do the same thing), alterations at the emotional level and in participation are observed.



Psychomotor development

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Web

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<https://www.who.int/es/news-room/fact-sheets/detail/deafness-and-hearing-loss>

<https://www.once.es/>

<https://research.aota.org/ajot>



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