Sensation -

Sensation is the first step in the process of allowing our brain to experience the features & characteristics of the env. around us. (or process of forming mental representations of the world)

Sensation detects - the presence of an objects or event in the environment.

function of our sensory apparatus — ~~Act~~ Q.

"Has there been a change in the envi - - - ?"

"Is there something out there?"

"How strong it doing?".

Perception forms - a mental representation of that ~~event~~ object or event. The function of our perceptual apparatus is to answer - such Q. -

"what is out there?"

"where is it?"

"what is it doing?"

In sensation —

① distal stimulus	② Proximal stimulus
is the object of perception itself ex. Tree, rock, ocean car etc. that exist in the ~~oo~~ world outside the mind.	consists of all physical energies emanating from distal stimulus. & which fall on sensory receptor organs associated with our eye, ear, etc. ex. Sound waves, light waves or other kind of physical energy

⇒ Aristotle - five - seeing, hearing, tasting, smelling touching & two addition skin senses - Temp & pain ⇒ Sherrington's - 2 - Kinesthesis & equilibrium.

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Sensation is the process that allows our brain to take information via our five senses (no. of human senses closes to ten more than five) — which can be then experienced & interpreted by our brain

1) Vision (visual), 2) hearing (Auditory)
3) taste (Gustatory) 4) Smell (olfactory)
5) touch (Somatosensory)
6) Cutaneous (sensation on the skin — sensation of pain, warmth, tickle, cold, hot soft, rough)
7) proprioception (sense of bodily position) a) Kinesthetic & b) vestibular)
8) Osmoreception (sensation of Thirst.)
9) sense of hunger

Many of senses are variations of two different mechanisms —
1) Chemical reaction (Photochemical) Vision, gustation, olfaction, (probably temp — the proximal stimulus)
2) Mechanical (innature) Audition, tactile sense, Kinesthesis & equilibrium the proximal stimulus.

Sensation is the process of receiving information from the environment through our sensory organs.

perception is the process of interpreting & organising the incoming information in order that we can understand it & react accordingly.

⇒ Sensation & perception work together in a fluid continuous process

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Sensation

- Exteroception (sensations arise from stimulation of sensory receptors located on or near the surface of the body)
  - Distance Senses — No direct contact b/w distal stimulus & sense organ
    1) Vision
    2) Audition (hearing)
  - Chemical senses — distal stimulus makes contact with a receptor organ, initiating chemical reaction which gives rise to sensory experience.
    1) gustation (taste)
    2) olfaction (smelling)
  - Skin senses OR (somesthesis) (Check it meaning) — distal stimulus makes contact (more or less) with the surface of skin, stimulating receptors buried underneath.
    1) tactile senses (mechanical pressure)
    2) thermal senses (temp)
    3) Pain
- Proprioception — refers to sensations concerning the position & motion of the body.
  - Kinesthesis — sensation of motion of body, stretching of muscles, contracting of Tendons, movement of joints,
  - Vestibular sense (or equilibrium) (Equilibrium some classified as form of Exteroception) Why?

=> Vestibular sense (equilibrium) OR Labyrinthine sense

As there is a strong connection between ear & our sense of balance) This involved in body position & movement of head. It comes from vestibular system in our ~~b. ear~~ inner ear and is activated when there is a change in gravity or when our head moves.

It helps us focus & feel centered.

Importance → ability to focus & attention span -
- Keep body upright 1) when jumping · 2) stand from seated position, or sit from standing position,
- responsible for our ability to focus on an object. like our eyes - even when our head nods up and down in agreement or shakes back and forth in disagreement.
- special significance in child development & childrens ability to maintain balance when learning how to walk, · Keep their TRUNK sturdy when learning how to sit up & develop various visual, fine & gross motor skills.

Disorder

~~Sensation~~

ex:- of vestibular sense in ~~play~~ psychology -

Child development is fascinating thing. It

is wondrous to see babies which did not have particular motor skills the day before all of a sudden be able to hold their head up, turn at the sound of a noise, sit up on their own & walk in a straight line, even if its wobbly at first.

The vestibular sense in psychology & child development helps kids with -

Gross motor skills — crawling, walking running Jumping hitting a ball with a bat etc

Fine motor skills - holding objects, Turning pages of a book, drawing etc.

Visual spatial motor skills - following moving objects etc.

The vestibular sense helps adults will all of the above as well; of course. It's what helps gymnast do somersaults & remain balanced & straight while doing them.

The vestibular sense makes riding a merry-go-round or roller coaster possible. It keeps you centered when your body is spinning. The spinning tea cup rides at a carnival or Disney is really Testing your vestibular sense's limits. You will likely be dizzy after the ride, but it's your vestibular sense that will reorient you back to normal soon afterwards.

5th path:

Proximal stimulus (Physical energy) → receptor organ → Sensory Tract (leading from Page Sensory surface to brain) → Sensory projection area in the cortex of brain

→ A Typical sensory channel —

Physical energy ⇝ Transduction at receptor → Receptor Potentials → Generator potentials → nerve impulses → Patterns of nerve activity in the nervous system (afferent code) → Sensation

Sensation involves 3 steps - -

1) sensory ~~receptors~~ detect environmental stimuli

2.) sensory stimuli is Transducted into electrical ~~stimuli~~ impulses (action potentials) to be decode by the brain

3) Electrical impulses (electrochemical neural impulses) move along to specific parts of the brain wherein the impulses are decoded into ~~useful~~ useful information (perception)

Each sensory system is a kind of channel, consisting of 1) sensitive elements (the receptor)
2) nerve fibres leading from this receptor to the brain or spinal cord, &
3) the various relay stations & processing areas within the brain.

Transduction – The process of converting physical Stimulus energy by receptor cells into a neural impulse (electrochemical neural impulse) within the nervous system (that are transported to the brain)
→ it occurs at the receptors – cells which are specialized for the most efficient conversion of one kind of energy.

During Transduction process → receptor cells converts physical energy into an electric voltage or potential called receptor potential.

1) In some sensory systems –
   the receptor potential itself directly Triggers the nerve impulses that Travel to brain or spinal cord.
2) In other sensory systems – The receptors potentials leads to further electrical events, which in turn trigger nerve impulses.

Whether it is receptor potential itself or some other voltage, the electrical event that triggers nerve impulses is known as generator potentials.

Transduction process at the receptor – physical energy results in a pattern of nerve impulses in the central Nervous system (CNS) - or physical energy is changed into a code made up of a pattern of nerve firings. The firing patterns that correspond to the events in the environment are known as afferent code.

Measurement of Sensation - 3

psychologists who specialize in psychophysics (relationship b/w physical events at the one end of sensory channels & sensation at the other end (psycho = mind or experience, physics = physical events) measure sensory sensitivity by identifying -

(Stimulus → experience relationship)

1. The Absolute Threshold - The minimum amt. of stimulation that a person can detect 50% of time.

2. The Differential threshold - (or just noticeable difference) - the minimum difference that must happen b/w two stimuli for the body to identify them as two separate sensations 50% of the time - ex- एक कप coffee में 1 T.S चीनी add करो - तो पता चलेगा लेकिन अगर पहले से 5 T.S है और Add करो तो पता नहीं चलेगा।

3. The Terminal Thresholds - The maximum amt. of stimulation that a person can sense.

Types of sensation

Visual (vision) → (wavelength, Intensity & complexity of light detected)

Vision starts with the electromagnetic radiation that objects emits or reflects.

All radiant energy - all wavelengths of the electromagnetic spectrum is very much the same physically only a small portion of it is visible

The visible spectrum — that part of the whole electromagnetic spectrum that receptors in the eye can detect (about 380 - 780 nanometers.

Cornea → pupil — iris → lens — retina → rods & cones

light enters the eye through pupils → Travels through the cornea → lens → interior of the eyeball

light wave pass through 1) cornea → Through 2) pupil, the size of which is controlled by 3) iris (under dim light the pupil widens to let more light in & in bright light, the pupil contracts.) The light is then focused by (4) lens of the eye so that it falls on the (5) retina on the inside back of the eye ball. This is retinal Image. There light wave impinge on 2 types of receptors (6) Rods & cones in the retina. (≈100 millions) (≈7 million)

Rods are responsible for black & white vision (during night)

Cones — colour vision — during day.

Transduction of the physical energy into receptor potentials occurs into the rods & cones cells when photosensitive pigments in Rods & cones are

changed in shape or configuration. by light energy. The receptor potentials or voltage of rods & cone cells are passed across the network of retina to the (7) ganglion cells where nerve impulses are triggered. → nerve impulses travel to (8) optic nerve &. The different fibres of the optic nerve meet & cross at the optic Chiasm (a division in the optic nerve which projects each half field to the opposite hemisphere of the brain.

These nerve impulses travel through optic nerves & the optic tracts to the (9) lateral geniculate body (nucleus) of the ~~Thalamus~~ Thalamus. From the Thalamus the visual pathway continues to the primary visual sensory area at the back of the brain

Afferent code in vision —

1) afferent code for colour
2) " " " Brightness & saturation
3) " " " form vision

⇒ Blindness is the complete or nearly complete inability to see

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⇒ Light waves → Pass (1) cornea → through (2) Pupil → Size controlled by (3) IRIS → focused → (4) lens → fall on → (5) retina (on the inside back of eyeball → forms Retinal Image → impinge on receptor organs → (6) Rods & cones → Neural Impulse → (7) Ganglion cells → carried over → (8) Optic Nerve → Visual impulse Pass through → (9) Lateral geniculate nucleus (LGN) of Thalamus → Visual image

(Transduction Takes place)

Myopia — (Nearsightedness) —
eye slightly elongated, causing the lens to focus the image on the interior of space of eyeball just before the retina — (in optics — refractory error) — Image of distant objects are blurry

Human — have high resolution vision. — which permits to distinguish among various kinds of objects such as

Auditory - Hearing.

Frequency, intensity & complexity of sound waves in the external world are detected by auditory receptors (cilia or hair cell receptors) in the ear.

The alternations in the air pressure moving in all directions from the source are called sound waves & such sound waves are the physical stimuli for everything we hear. (Sound waves - mechanical vibrations in the air)

Intensity refers to how great the pressure changes in the wave are & the degree of intensity are related to the sensation of loudness. (dB decibel - unit)

humans - audible — 20 — 20,000 cycle/second (Hz)

Most of the sound we hear in every day life are the result of complex waves. They are either periodic or aperiodic.

Noise is aperiodic in waveform.

Most musical instruments produce complex periodic tones & the sensed quality of sound called Timbre.

Ear three principal Part 1). external ear - collects the energy.

2) Middle ear — Transmits the energy

3) Inner ear — Transduction of energy into nerve impulses occurs.

Sound energy (20 – 20000 dB) (ie mechanical energy) → collects → Pinna of ext. ear → Travel through → auditory canal (air-filled duct) → ear drum (Thin membrane stretched tightly across the inner end of the canal)

Oscillation of the eardrum moves

→ ossicles (3 small bones) (hammer, anvil, stirrups (has)

→ vibration through middle ear to the entrance of cochlea in the inner ear (cochlea has 3 fluid filled canals)

→ ie. basilar membrane of cochlea

→ Vibrates hair cells (cilia) in the organ of corti

→ Bending of these hair cell fibres responsible for Transduction in the ear

→ When these hair like processes (hair cells) are bent receptor potentials are initiated. Thus starting the process by which nerve impulses are generated)

→ nerve impulse travel into brain

→ nerve fibre within brain (medial geniculate nucleus of Thalamus)

Different patterns of cilia hair cell receptors (in the ear) movement lead to different neural codes - which leads to hearing different loudness, pitch & timbre of sounds.

Deafness or hearing loss — may occur in one or both the ears.

⇒ Thus bending of cilia (hair cell fibres) is responsible in the auditory system for the Transduction of mechanical energy into nerve impulses

⇒ (1) Conduction deafness - (wax, problem with bones)
corrected by medically, surgically, or alleviated by hearing aid.

(2) Sensory neural hearing losses → cochlear (hair cell damage implants हो जाती)

cochlear implant → consists of microphone & miniature radio transmitter.

⇒ Afferent code in Hearing -

Afferent code for loudness may be based on the fact that sense organs usually generate more & more impulses as the intensity of the stimulus increases

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The no. of ~~impulses~~ impulses is not usually directly proportional to the intensity of the stimulus. but a relationship does exist between the two.

Two afferent codes (1)

For frequency above 1500 hertz pitch depends upon the fact that different portions of organ of corti on the basilar membrane are maximally stimulated by different frequencies. The somehow the brain uses a place code that is nerve impulses arising from a given region of the organ of corti are sensed as a particular pitch. Called "pitch is which" theory.

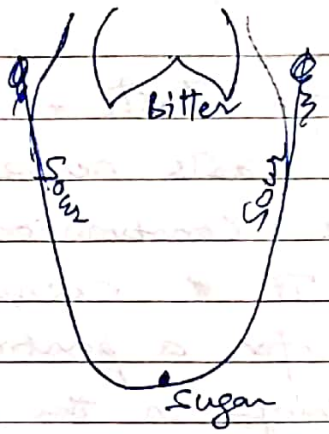
— The experience of pitch depends upon the place at which the organ of corti is most stimulated.

Thus the afferent code for the pitch of higher frequencies is largely a spatial one.

(2) → For lower frequencies 20 – 1500 ~~Hz~~ – pitch is represented by fibre in the auditory pathway that fire in step with the frequency of the physical stimulus.

Taste (Gustatory)

Taste receptors - (Taste buds or papillae) most located on the top & sides of the tongue but a few of them are at back of the mouth & in the throat



location of different types of taste bud

There are primary 4 basic taste qualities - salty, sour, sweet & bitter — tongue is not uniformly sensitive to all stimuli.

alkaloids — bitter (quinine, nicotine)

→ Sense of taste begins with certain chemical molecules carried on food & drink dissolved in saliva (Pavlov's Noble Prize winning research on the salivary reflex)

→ dissolved molecules then fall on taste buds in the papillae (bumps) on the tongue. as well as palate & the throat.
each papilla can contain upto 700 taste buds & there are about 10,000 taste buds in all

→ These dissolved molecules then bind to Chemical receptors on the taste buds just like lock & key mechanism.

→ Neural impulses generated by the taste buds

are carried over an afferent portion of the glossopharyngeal nerve as well as other cranial nerve as facial nerve & Vagus nerve.

⇒ afferent code for Taste - — The firing of a no. of taste nerve fibres can make up a unique combination for a given stimulus. It seems that the afferent code for a particular taste consists of pattern of firing in the nerve fibres from the taste buds

Thus one taste might be represented by high rates of firing in a certain group of nerve fibres, intermediate rates in another group & low rates in others Another taste would have a different pattern. & so on..

Smell (Olfactory)

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Smell may have a special role to play in behaviour

4 basic odor systems —
fragrant (musk), acid (vinegar), burnt (roast coffee), caprylic (goaty or sweaty)

Chemical molecules in air → dissolve in → mucous membrane of nasal cavity → Contact with → receptor cells embedded in the olfactory epithelium

Smell receptors are located high up in the nasal passages leading from nostrils to the throats. They lie in two small patches. one on the left & one on the right in the roofs of the passage.

resulting neural impulse carried over the olfactory nerve buried underneath the frontal lobe of the cerebral cortex (base of brain) which begins in the olfactory bulb.

Imp Of all sensory systems only the olfactory system does not use the thalamus as a sensory relay station.

Anosmia — is the inability to smell.

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Brain distinguishes between ordinary odors entering the nose through nostrils in what is known as Orthonasal olfaction & those which enter the nose from behind in what is known as ~~test~~ retronasal olfaction. — . Same receptors are involved in both kinds of olfaction.

Taste is the sensory experience that arise from stimulation of our taste buds

Smell is the sensory experience that arise from orthonasal stimulation through the nostrils.

flavor is the sensory experience that arise from retronasal stimulation through the retronasal pathway.

Skin (cutaneous) (Touch)

Four skin senses are usually distinguished

1) pressure or touch 2) Tickle
2) ~~Warmth~~ 3) cold 4) Pain

Skin is not uniformly hot sensitive.
Sensation on the skin are detected by cutaneous receptors.

Proximal Stimulus for touch is mechanical pressure which causes deformation of the skin or hair shafts. The Tactile Sense is also sensitive to vibration & electrical stimulation.

This stimulus stimulates a no. of receptors embedded in the skin
Some touch receptors in the skin —

1) free nerve ending buried in the epidermis of the skin
2) basket nerve ending around hair follicles
3) Meissner corpuscles
4) Pacinian corpuscles.

receptors of pressure —

1) Mechanoreceptors - detect light pressure (caress), vibration & texture

2) nocicreceptors (Check spell) detect strong pressure (nociceptors.)

~~Astereo~~

Astereognosis – inability to identify an object by Touch

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neural impulses arising from these receptor organs are then carried over the afferent Tracts of the spinal nerves & up the afferent Tract of the spinal cord – finally these impulses arrive at the somatosensory projection area of the parietal lobe.

Skin has punctuate sensitivity – ie it is sensitive at some points and not so sensitive at others.

If we explore the same patch of skin with touch stimuli, warm stimuli, cold stimuli & stimuli for pain & we find that sensitive spots for these 4 types of stimuli are distributed differently over the patch of skin.

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Thermal (Temperature) sense:

experience of cold or warmth are elicited by changes in the normal gradient of skin Temp. Ie - by changes in the diff. b/w the Temp of the skin surface & the temp of the blood circulating beneath it.

→ cold and warm are not the effective proximal stimuli - a stimulus is felt to be cold only if its Temp is lower than that of the skin with which it makes contact.

In the case of forearm ~~&~~ - this gradient is about 5°C. The Temp of the skin surface is usually 32 or 33°C & that of the blood beneath it is about 37°C. A stimulus of 28 to 30°C which is definitely felt as cold. Increases this gradient a little.

A stimulus of 34°C felt as warmth

Thus it taken a change of 1° or 2° of skin Temp. to be experience as cold or warmth

- Positive & negative differentials stimulate neural activity in the Krause end-bulbs (for relatively cold stimuli) and Ruffini end-organs (for relatively warm Stimuli)

~~Stimuli~~ Simultaneous stimulation of both receptors generates the sensation of hot as opposed to warmth.

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⇒ The free nerve endings fibres are also sensitive to temp differentials — called cold fibres — ~~vice versa warm fibres.~~

Increasing the temp gradient by cooling the skin causes certain free nerve ending fibres to increase their rate of firing — These fibre - cold fibre.

And up to a point decreasing the temp gradient by warming the skin cause an increase in the firing of certain fibres — warm fibre.

Thus afferent code for the experiences of cold & ~~hot~~ warmth appears to be the rates of firing in the cold & warm fibres.

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Pain - Cutaneous pain (Nociception)

arises from inflammation arisig from injury to or destruction of cutaneous tissue (skin)
There are free nerve endings (receptors) in the epidermis of the skin that are sensitive to pain - & also to touch & movement.
Many different stimuli produce pain — a needle prick, scalding steam, a cut & a hard blow to the skin, inflammation, swelling or strong ~~sensation~~ chemical stimulation of the skin. This pain called noxious stimulation.
The pain stimuli are stimuli that damage bodily tissues in some way.

The nerve fibres that carry information about pain into spinal cord & brain are the smaller - diameter fibres in the senory nerves from ~~organs~~ to skin & body organs.

Fast pain — Sharp or prickling, with a rapid onset & rapid offset — appears to be mediated by A - delta fibers in the spinal nerves (& some cranial nerves)

Slow pain - aching, throbbing or burning with slow onset & slow offset — appears to be mediated by C - ~~fibers~~ fibers in the same nerves.

Afferent code of pain –

The nerve fibre that carries information about pain into spinal cord & brain.

⇒ Rate of firing in these small nerve fibers constitute much of the afferent code for pain

As the pain inputs enter the spinal cord or brain their transmission for further processing may be blocked. It is as if there as "gates" for pain inputs which can be closed.

Some pain killing drugs (analgesics) are able to close these pain gates.

⇒ Melzack & Wall — Gate control theory of pain

→ A Placebo (pharmacologically inactive substance) provide genuine relief of pain

Hypnosis – also use to relieve pain.

Accupuncture anesthesia –

"Pain gates" in the central N. system (CNS) seem to block the Transmission of pain signals & thus reduce the amt. of pain perceived.

Placebos & Accupuncture Anesthesia → activate these gates. & reduce pain

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Kinesthesis – sense of movement & position –

– is generated by activity in the skeletal musculature – 1) the contraction of Tendons
2) stretching of muscles (& of the skin
3) the movement of joints

These activities stimulate nerve endings that are embedded in these body parts including –

1) neuromuscular spindles embedded in muscles
2) neuroTendious organs also known as Golgi Tendon organs embedded naturally enough in the Tendons
3) free nerve endings in the joints between bones.

These impulses are carried over the afferent Tracts of the spinal nerves & up the afferent Tracts of the spinal cord as well as over some of the cranial nerves. & finally to the somatosensory projection area of the parietal lobe of brain.

Equilibrium — Sense of balance

- begins with gravitational force which pulls on otoliths, tiny crystals suspended in the semicircular canals & the saccule & utricle of the vestibular sac, both structures located in the inner ear.

→ The semicircular canals are arranged at approximate right angles to each other & detect the rotation of the head. The saccule & utricule detect the position of the head with respect to gravity.

→ These structures contain hair cells which are stimulated by the crystals generating neural impulses in much the same manner as the cochlea does for audition.

- Rotatory motion of head will cause the otoliths to fall on different hair cells in the semicircular canals ; thus signaling a change in the organism's orientation with respect to gravity.

→ Linear motion of the head in a forward direction causes the otoliths to fall on hair cells in the postirior portion of the Vestibular Sac, while motion in a backward direction stimulates hair cells in the antirior portion

The neural impulses are then carried ~~out~~ over Vestibular branch of Vestibulocochlear nerve. ⟶ cerebellum of brain

Osmoreception. (Sense of thirst/hunger)

→ Sensation of thirst

Osmoreception is the body's sensation of thirst. When the amt. of water in one's body falls below a certain threshold, the concentration of osmolytes (salt) increase in one's blood.

Osmoreceptors, or sensory receptors in the hypothalamus, detect these changes in osmotic concentration. These signals are then transferred to neural signals of thirst.

Loss of sensation - Many types of sensory loss occur due to dysfunctional sensation process - whether it be -

1) ineffective receptors
2) nerve damage or
3) cerebral impairment

Unlike Agnosia these impairments are due to damages prior to the perception process.

Conditions do exist where the patients experiences sensory loss, but experimental evidence shows that the effect is perception based