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- The **fovea centralis, or fovea**, is a small depression within the neurosensory retina where visual acuity is the highest.
- Movements of eye - horizontal, torsional , vertical
- **Donder's law** - If the head is upright and stationary, and the visual environment is stable, the torsion, or twist of the eye about the line of sight, is invariant for any one direction of the line of sight.
- **Listing's Law** - Listing's law states that the eye does not achieve all possible 3D orientations and that, instead, all achieved eye orientations can be reached by starting from one specific "primary" reference orientation and then rotating about an axis that lies within the plane orthogonal to the primary orientation's gaze direction (line of sight / visual axis). This plane is called Listing's plane.
- **Strabismus** is a disorder in which both eyes do not line up in the same direction.

Types of eye movement

- **Saccade**- Rapid eye movement to bring the object of interest to fovea
 - **Smooth Pursuit**-Continuous smooth eye movement to track a moving object
 - **Vergence**-Convergence or divergence of the eyes in order to focus on objects that are closer or further away from the individual.
 - **Optokinetic nystagmus** — Involuntary fixation on objects that are moving relative to the head.
 - **Vestibular Ocular reflex**— Accurate reflex that allows the eyes to remain focused on a target when the head moves.
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- Saccade velocity > 30 degree/sec
 - Smooth pursuit velocity >15-20 degree/sec
 - Small eye movements - We begin with miniature eye movements or small eye movements. These are only observable through special recording techniques such as the photodiode recording system discussed above or through careful perceptual experiments.
 - **Drift** - Another class of miniature eye movement is drift. Drifts are slow, covering about 1/60th of a degree of arc per second. Drifts can cover as much as 5/60th of a degree of arc before being terminated
 - **Microsaccades** - Microsaccades are very small saccades are conjugate (parallel in the two eyes) and may serve a corrective function, bringing the fovea back toward a fixation target from which the eye has drifted, though on occasion they may also take the eye away from the target.
 - The miniature movements of the image on the retina serve a useful perceptual function. They keep photoreceptors from fatiguing
 - **Retinal stabilization**-Retinal stabilization also occurs outside vision laboratories. For example, it also occurs in severe snow storms. Arctic explorers have reported cases of

snow blindness, where they can see nothing, though, ironically, they are surrounded by light. The homogeneity of the visual field produces this effect.

- **Covert** - We do not directly see the stimulus to perceive it.
- **Attention** - Attention is the cognitive process of selectively concentrating on one aspect of the environment while ignoring others.
- There are two main types of visual orientations, covert (exogenous) which occurs when a salient environmental change causes a shift in attention and overt (endogenous) which occurs when the individual makes a conscious decision to orient attention to a stimuli[1] During a **covert** orientation of attention, the individual does not physically move, and during an **overt** orientation of attention the individual's eyes and head physically move in the direction of the stimulus.
- **Rapid eye movement sleep(REM sleep or REMS)** is a unique phase of sleep in mammals and birds, characterized by random rapid movement of the eyes, accompanied by low muscle tone throughout the body.

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- **Glissadic overshoot** can be simulated by assuming that the holding position for the eye is set correctly, but the signal that propels the eye toward the target is set incorrectly.
- **Types of attention** - spatial attention and selective attention
- **Spatial attention** allows humans to selectively process visual information through prioritization of an area within the visual field. A region of space within the visual field is selected for attention and the information within this region then receives further processing.
- **Cue facilitates selective attention.**
- **Spatial attention is often directed before saccade initiation.**
- Saccadic latencies can be reduced if initial fixation target is extinguished before another saccadic target is presented.
- When location and time of stimuli is known before hand then saccade can be initiated before target onset.
- It is possible to process visual information while saccade is being planned but contradiction to this point is saccadic suppression.
- Unlike saccades **smooth pursuit (SP)** eye movement usually cannot be initiated spontaneously without target.
- REM sleep sometimes have smooth pursuit eye movements.
- Saccades and smooth pursuit uses same set of muscles but mode of operation is different.
- Saccades and smooth pursuits are controlled by different neural circuitry.
- **Optokinetic Nystagmus** - Coordination between saccades and smooth pursuit eye movement . Slow phase - smooth pursuit , fast phase - saccade.

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- **There are two kinds of vergence movements.** Convergence brings the eyes inward toward the nose as the observer looks at nearer or approaching targets. Divergence brings the eyes out toward the temples as the observer looks at farther or receding targets. When the visual target is very far away, the lines of sight become parallel or nearly parallel.
- **Retinal disparity** - This is the difference (often very slight) in the retinal projections of a given stimulus on the retinas of the two eyes.

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- **Type of grasps - Power and Precision.**
- Power - spherical , hook
- Precision - Pinch , tripod
- **Attentional control is handled by posterior parietal cortex.**
- **Saccade control is handled by superior colliculus.**
- **Visual processing is handled by striate cortex.**
- **Hemispatial neglect** - Hemispatial neglect is a [neuropsychological](#) condition in which, after damage to one hemisphere of the brain (e.g. after a [stroke](#)), a deficit in attention and awareness towards the side of space opposite brain damage (contralesional space) is observed.
- Vision affects other senses - **Ventriloquist effect**
- **Ventriloquist effect** - Refers to perception of speech sounds as coming from a direction other than their true direction, due to the influence of visual stimuli from an apparent speaker.
- **McGurk Effect** - The McGurk Effect is an auditory-visual illusion that illustrates how perceivers merge information for speech sounds across the senses. For example, when we hear the sound "ba" while seeing the face of a person articulate "ga," many adults perceive the sound "da," a third sound which is a blend of the two.
- **Pain Perception** - For painful stimulation, knowing where it will be provided, increases its aversiveness
- **Phantom limb** - Painful sensations that seems to be coming from the part of the limb that is no longer there.
- Visual information to an extent helps other type of perceptions like auditory , tactile etc.
- Visual system - Dorsal stream , Ventral stream
- **Dorsal stream** - The dorsal stream, or where pathway, describes a hierarchy of areas that support visually-guided behaviors and localizing objects in space.
- **Ventral stream** - The ventral stream (also known as the "what pathway") leads to the temporal lobe, which is involved with object and visual identification and recognition.

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- Size contrast illusions deceive eye but not the hand

Paper - Hand-eye coordination for rapid pointing movements Arm movement direction and distance are specified prior to saccade onset

- Visually guided arm movements such as reaching or pointing are accompanied by saccadic eye movements that typically begin prior to motion of the arm.
- The goal of the present study was thus to assess the relative timing of rapid eye and arm movements made to visual targets by examining electromyographic (EMG) activity of limb muscles in conjunction with eye and arm position measures.
- Result - Pectoralis->Eye->Deltoid->Hand
- Eye and hand movements had same RT.
- Muscle movements generated before eye movement.
- **Mirror neurons** - A mirror neuron is a neuron that fires both when an animal acts and when the animal observes the same action performed by another.
- the neurons fired vigorously whether the same action was performed by the monkey or witnessed by the monkey.
- **Use of mirror neurons** - 1)our mirror neurons fire when we experience an emotion and similarly when we see others experiencing an emotion, 2)The idea is that thanks to mirror neurons, we are able to first observe an action ("What is being done?"), then understand the intention of that action ("Why is it happening?") .
- **Aiming**
- **The endpoint distributions were elliptical:** The endpoints were more widely spread along the line connecting the start point to the target point than along the line perpendicular to the line connecting the start point to the target point. This result implies that participants were better at getting the direction of movement right than at getting the amplitude.
- Participants paid more attention to getting direction right before movements begin than to getting amplitudes right before movements begin because direction errors are harder to correct than are amplitude errors.