

PUPILS AND NEAR VISION

Akilesh Gokul

PhD Research Fellow

Department of Ophthalmology



nz national eye centre

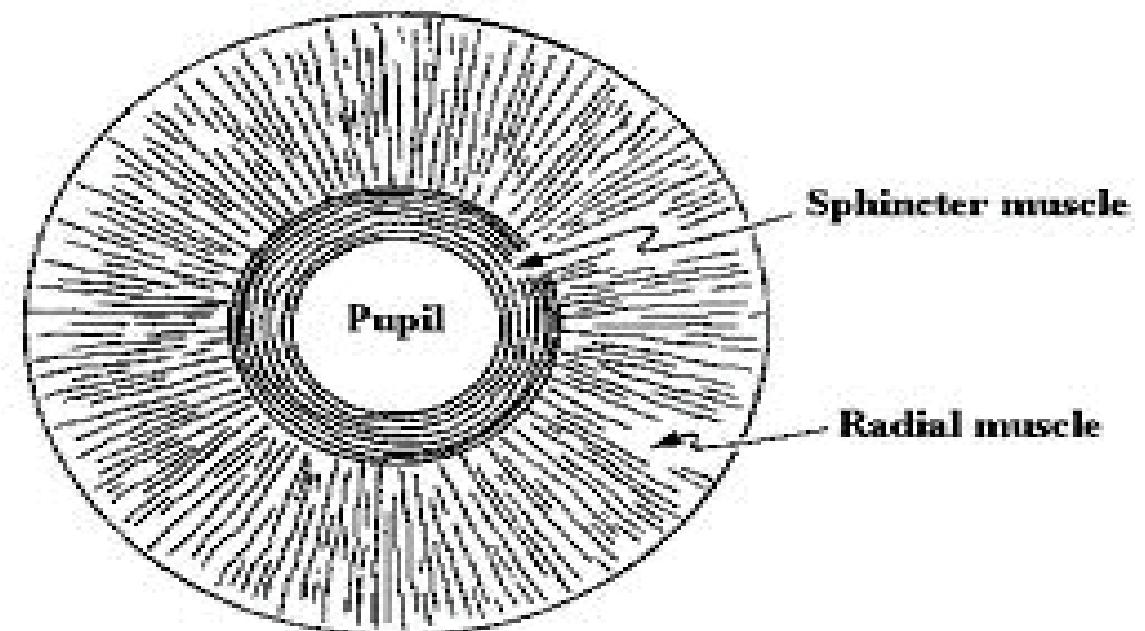


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Iris Anatomy

Two muscles:

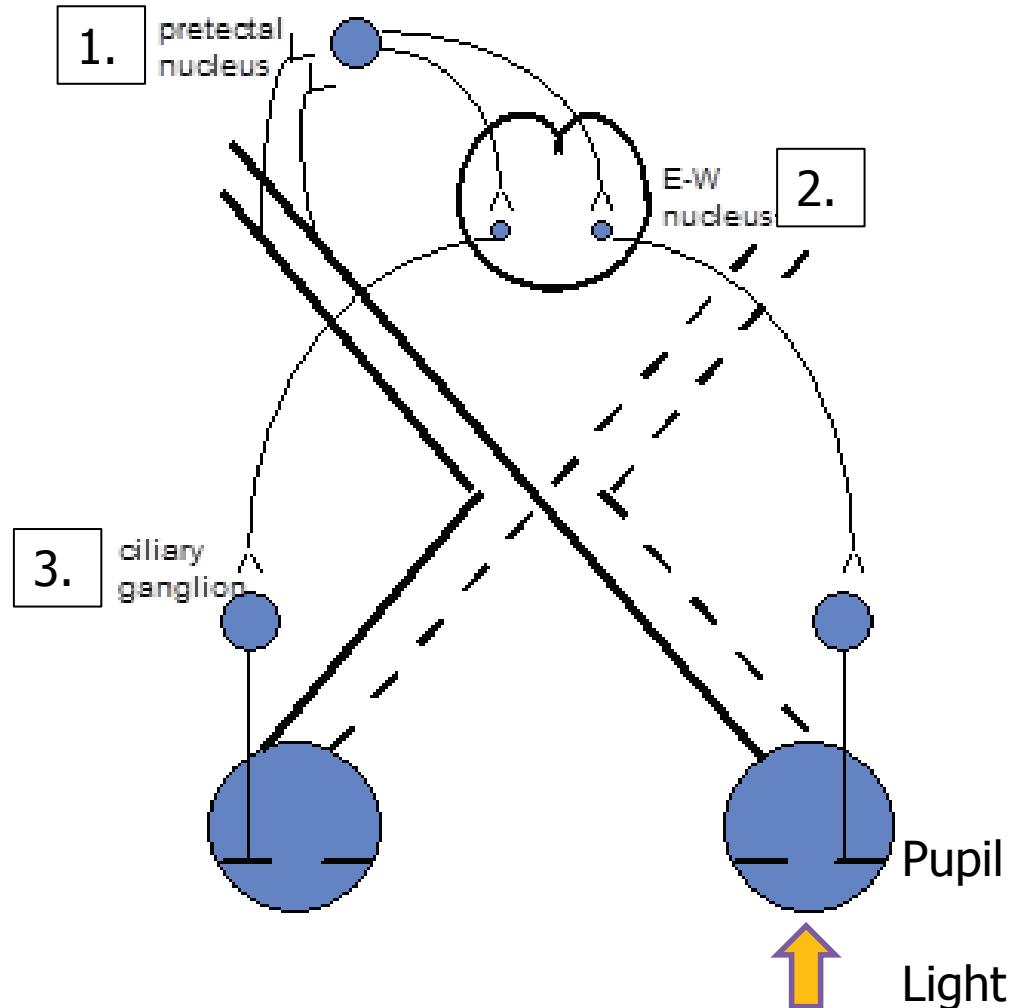
- Radially oriented dilator (actually a myo-epithelium) - like the spokes of a wagon wheel
- Sphincter/constrictor



Pupillary Reflex

- Size of pupil determined by balance between parasympathetic and sympathetic input
- Parasympathetic constricts the pupil via sphincter muscle
- Sympathetic dilates the pupil via dilator muscle
- Response to light mediated by parasympathetic;
 - Increased innervation = pupil constriction
 - Decreased innervation = pupil dilation

Parasympathetic Pathway



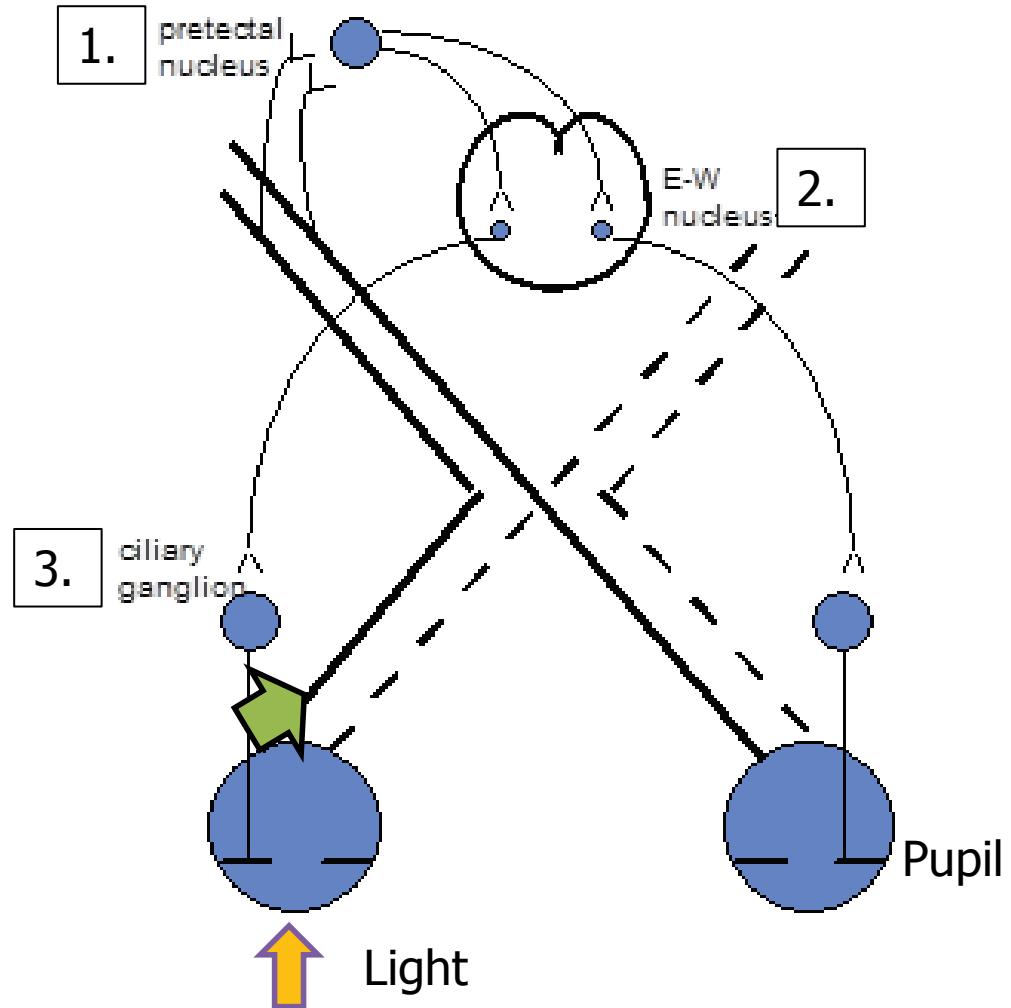
Three major divisions of neurons:

- Afferent division
- Interneuron division
- Efferent division

Near response:

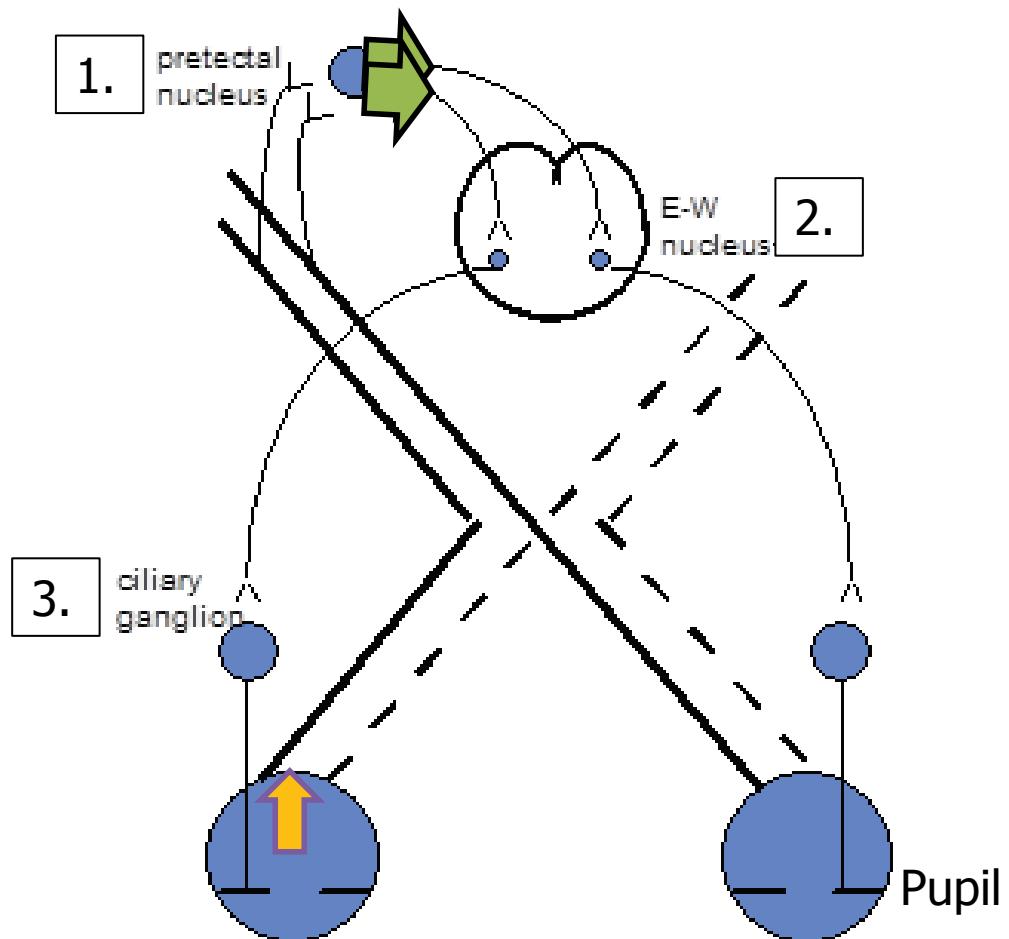
- Convergence
- Accommodation
- Pupillary constriction

Parasympathetic – Afferent Pathway



- Retinal ganglion cells travel via the optic nerve leaving the optic tracts before the LGB, and synapse in the pre-tectal nucleus.

Parasympathetic – Efferent Pathway

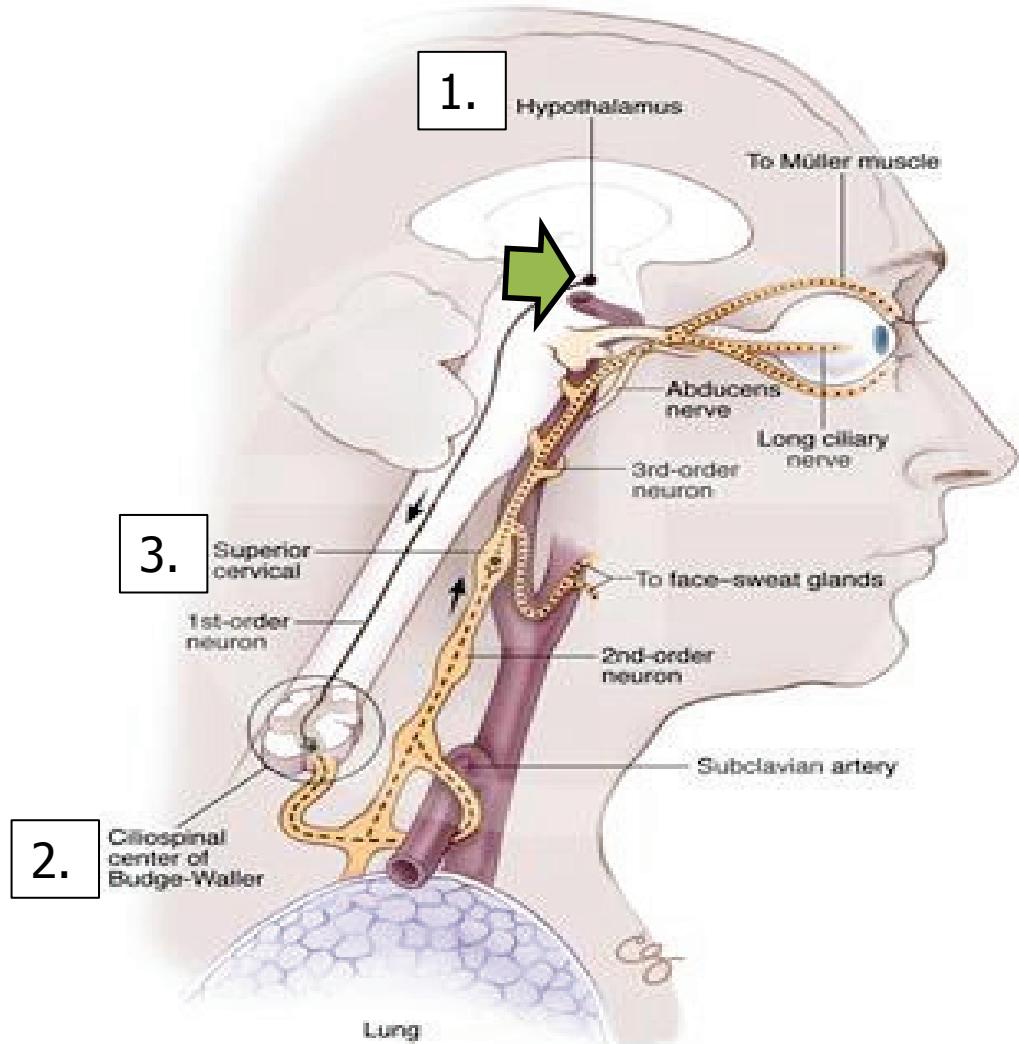


- Pre-tectal nucleus nerve fibres partially decussate to innervate both Edinger-Westphal (EW) nuclei.
- E-W nucleus to ipsilateral ciliary ganglion. Fibres travel via inferior division of III cranial nerve to ciliary ganglion via nerve to inferior oblique muscle.
- Ciliary ganglion via short ciliary nerves to innervate sphincter pupillae muscle.

Near response:

1. Increased accommodation
2. Convergence
3. Pupillary constriction

Sympathetic pathway



- From hypothalamus uncrossed fibres down brainstem to terminate in cilioospinal centre of Budge.
- Cilioospinal centre of Budge to superior cervical ganglion in neck.
- Superior cervical ganglion along internal carotid artery, enter skull, to cavernous sinus where join nasociliary branch of ophthalmic division of Vth CN to reach the ciliary body and dilator pupillae muscle.

Pupillary responses

- Direct response – response of the eye that light is shined into it
- Consensual response – response of the eye when light is shined into contralateral eye
- Total Afferent Pupillary Defect (Amaurotic pupil)
- Relative Afferent Pupillary Defect (RAPD) (Marcus Gunn pupil)
- Efferent Pupillary Defect



Relative Afferent Pupillary Defect

- Pupils are equal in size.
- Affected eye has consensual response but no direct response.
- Near reflex is normal in both eyes.



Efferent Pupillary Defect



- Pupils are of unequal size – anisocoria.
- Affected eye is stimulated ONLY normal eye reacts – affected eye no direct response.
- Normal eye is stimulated ONLY normal eye reacts – affected eye no consensual response.
- Near reflex present in normal eye only.
- Sympathetic innervation is affected, pupil is constricted – anisocoria more apparent under low light.
- Parasympathetic is affected, pupil is dilated – anisocoria more apparent under bright light.

Third cranial nerve palsy

- Clinical features
 - Eye facing “Down and Out”
 - Pupil may be affected (involved) or not (spared)
 - Ptosis
 - Etiology
- Pupil involving i.e. efferent defect:
 - Compressive lesion e.g. aneurysm (posterior communicating artery)
- Pupil sparing:
 - Ischaemic microvascular disease



Cases

Ambient light			
Penlight Right eye			
Penlight Left eye			
Diagnosis	Normal Reactions The Right eye has: <input checked="" type="checkbox"/> Direct response <input checked="" type="checkbox"/> Consensual response The Left eye has: <input checked="" type="checkbox"/> Direct response <input checked="" type="checkbox"/> Consensual response	Left Efferent Defect The Right eye has: <input checked="" type="checkbox"/> Direct response <input checked="" type="checkbox"/> Consensual response The Left eye has: <input checked="" type="checkbox"/> Direct response <input checked="" type="checkbox"/> Consensual response	Right Afferent Defect The Right eye has: <input checked="" type="checkbox"/> Direct response <input checked="" type="checkbox"/> Consensual response The Left eye has: <input checked="" type="checkbox"/> Direct response <input checked="" type="checkbox"/> Consensual response
	Common causes: Adie's pupil, Horner's syndrome, Pupil involved III nerve palsy	Common causes: Retinal vascular occlusion, retinal detachment, optic neuritis (MS)	

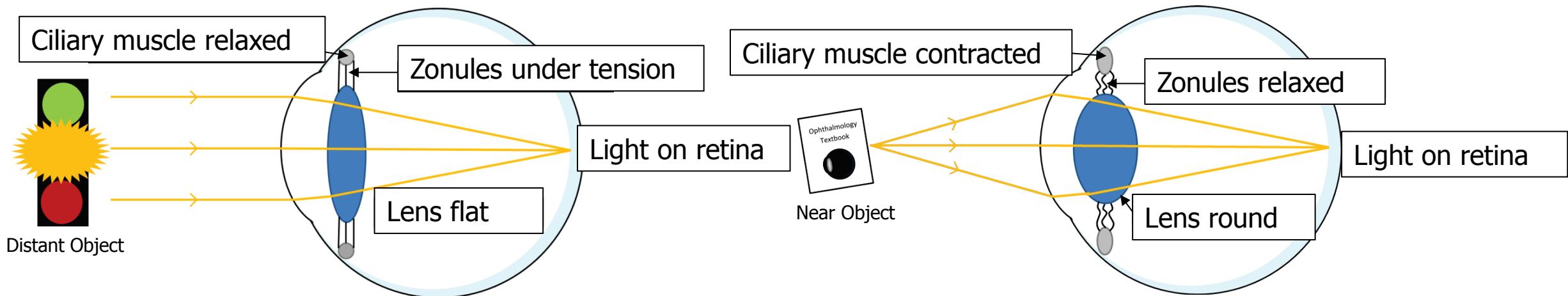
Pharmacology

- Mydriasis – pupillary dilatation
- Anticholinergic (Parasympatholytic)
 - Competitive inhibitors of cholinergic receptors of iris sphincter muscle
 - Also causes cycloplegia (loss of accommodation)
- Sympathomimetic
 - Direct stimulation of alpha adrenergic receptors of iris dilator muscle
- Miosis – pupillary constriction
- Parasympathomimetic (Cholinergic)
 - Direct stimulation of cholinergic receptors of iris sphincter muscle
- Sympatholytic
- Competitive inhibitors of adrenergic receptors or iris dilator muscle



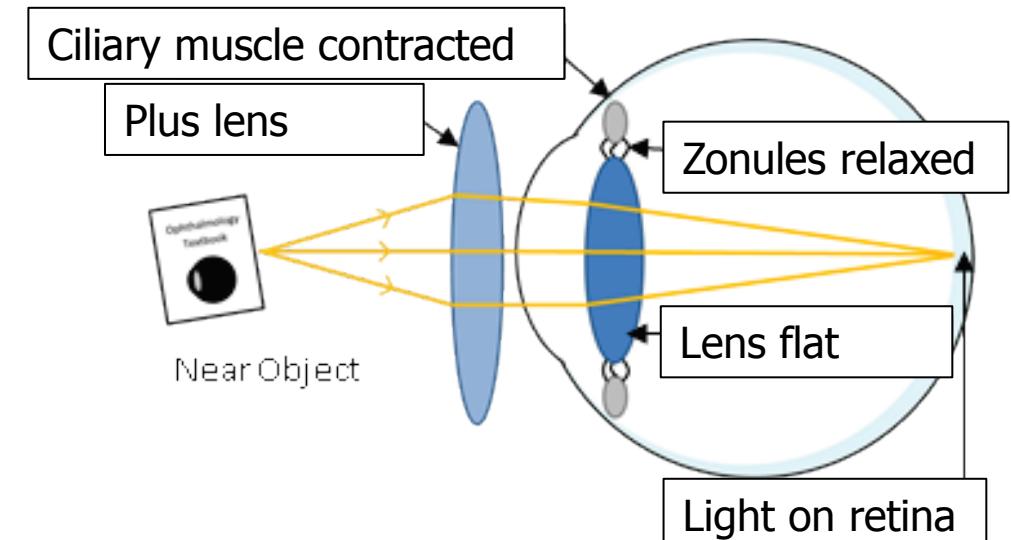
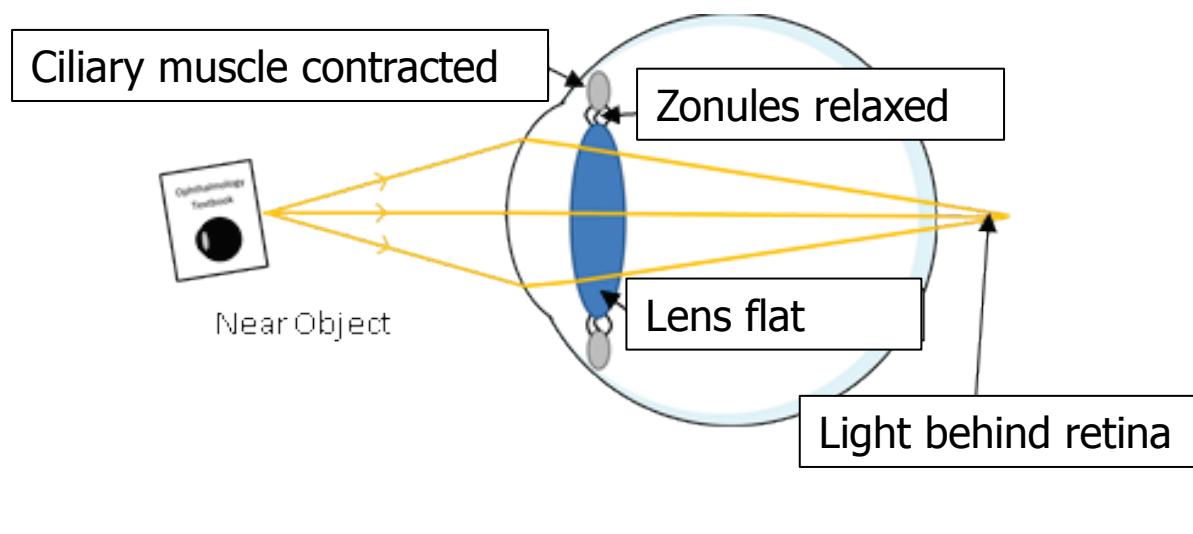
Accommodation

- Accommodation = ability to focus at near
- Light from distant object has zero vergence -> cornea and crystalline lens refract light -> focusing it on the retina
- Light from a near object is divergent -> eye requires more refractive power to focus light retina -> power is provided by crystalline lens



Presbyopia

- Presbyopia = Loss of the ability to accommodate
- Most likely due to loss of the elastic properties of the crystalline lens
- Happens to everyone - symptoms around age of 45 (process starts much earlier loss of about $\frac{1}{2}$ of accommodation by age 25)
- Reading glasses or progressive lenses most common treatment option



Examination

- Size, shape, symmetry
- Assess pupil under light and dark conditions
- Light reflex
- Near reflex
- RAPD
- Look for ptosis
- Evaluate ocular motility



