Visual Science & Optometry

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School of Optometry

The Hong Kong Polytechnic University

眼科視光學院
SCHOOL OF OPTOMETRY

Students should learn:	Students should be able to:
a. Making sense of the eye and the ear	
physics of vision	• describe the basic structure of the eye including light sensitive cells (rods and cones) of retina, and their respective functions • interpret spectral response of light sensitive cells using receptor absorption curves • apply resolving power $\theta \approx \frac{1.22\lambda}{d}$ to solve problems • describe the process of accommodation of the eye
defects of vision and their corrections	• define power of a lens as the reciprocal of the focal length of a lens • use dioptre as a unit of power of a lens • state the near point and far point of the eye • describe the defects of vision including short sight (myopia), long sight (hypermetropia) and old sight (presbyopia) and their corrections

Two parts

Visual Science

- optics of the eye
- resolving power / visual acuity
- defects of vision and correction

What do optometrists do?

Primary eye care

Latest technology in eye surgery

Entrance requirement

HKALE

- Biology / Mathematics
- May not have A-Level Biology / Physics
- HKCEE Biology (Human Biology) + Physics (Engineering Science)

2012

- 2 elective subjects
- Single science subject + Combined Science covering the remaining two areas

Relevant subjects

Year 1

- Optics 1 (lens, aberration, instrument)
- Optics 2 (wave nature of light, photometry)
- Visual Science 1
- Visual Science 2

Year 2

- Visual Science 3
- Visual Science 4

NSS Physics

Atomic World (Elective)

- Diffraction patterns of 2 monochromatic pt sources demonstrate the limit of resolution
- Diffraction-limited vision of the human eye, Rayleigh criterion

Energy and Use of Energy (Elective)

- Lighting

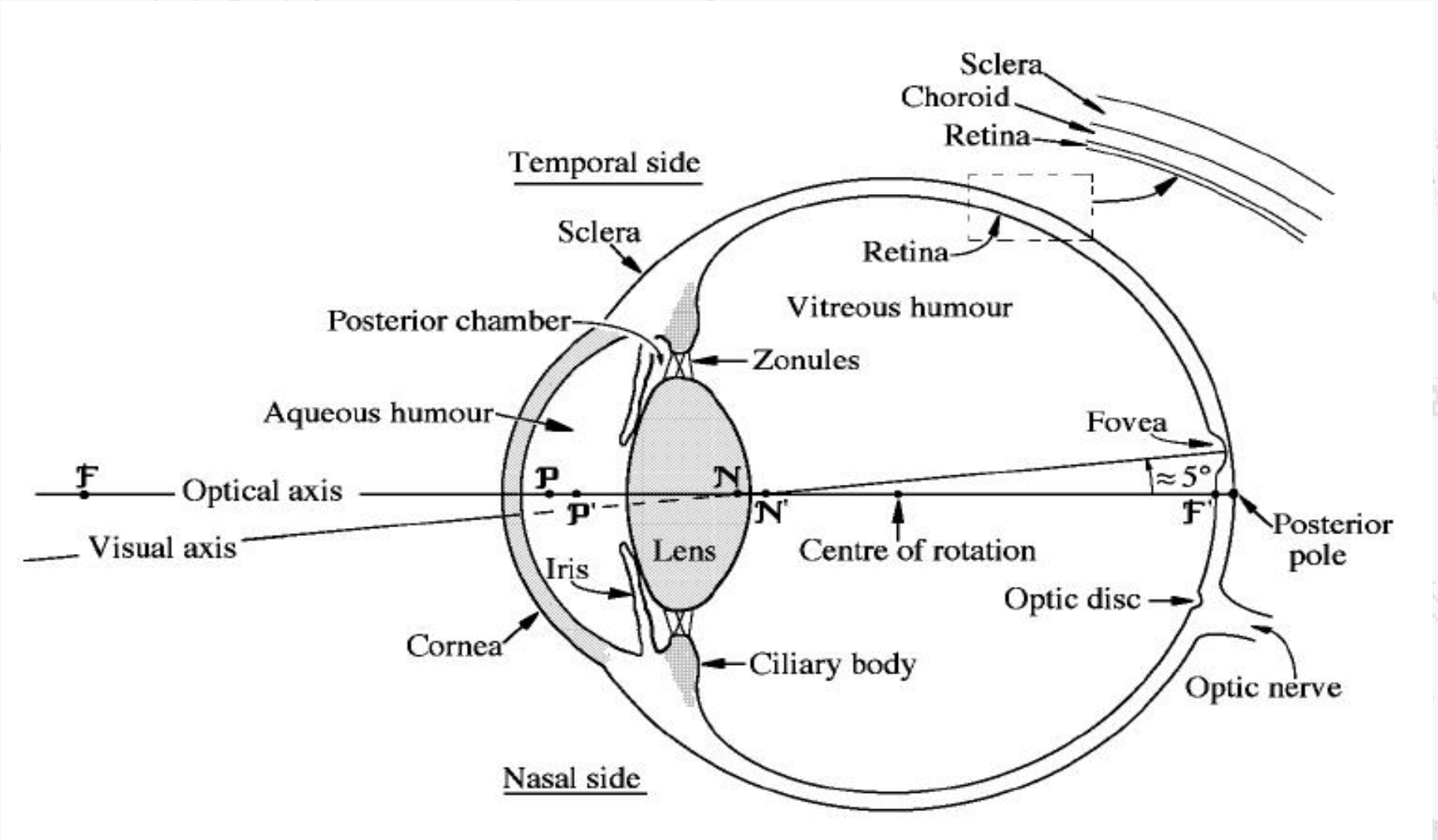
Medical Physics (Elective)

- Making sense of the eye

Visual Science

Optics of the eye

- The eye is just an optical device, +60D (diopter)
- Optical power is mainly from the cornea (+45D)
- It is mainly the big difference in refractive indices (air & cornea/aqueous), rather than a steep cornea

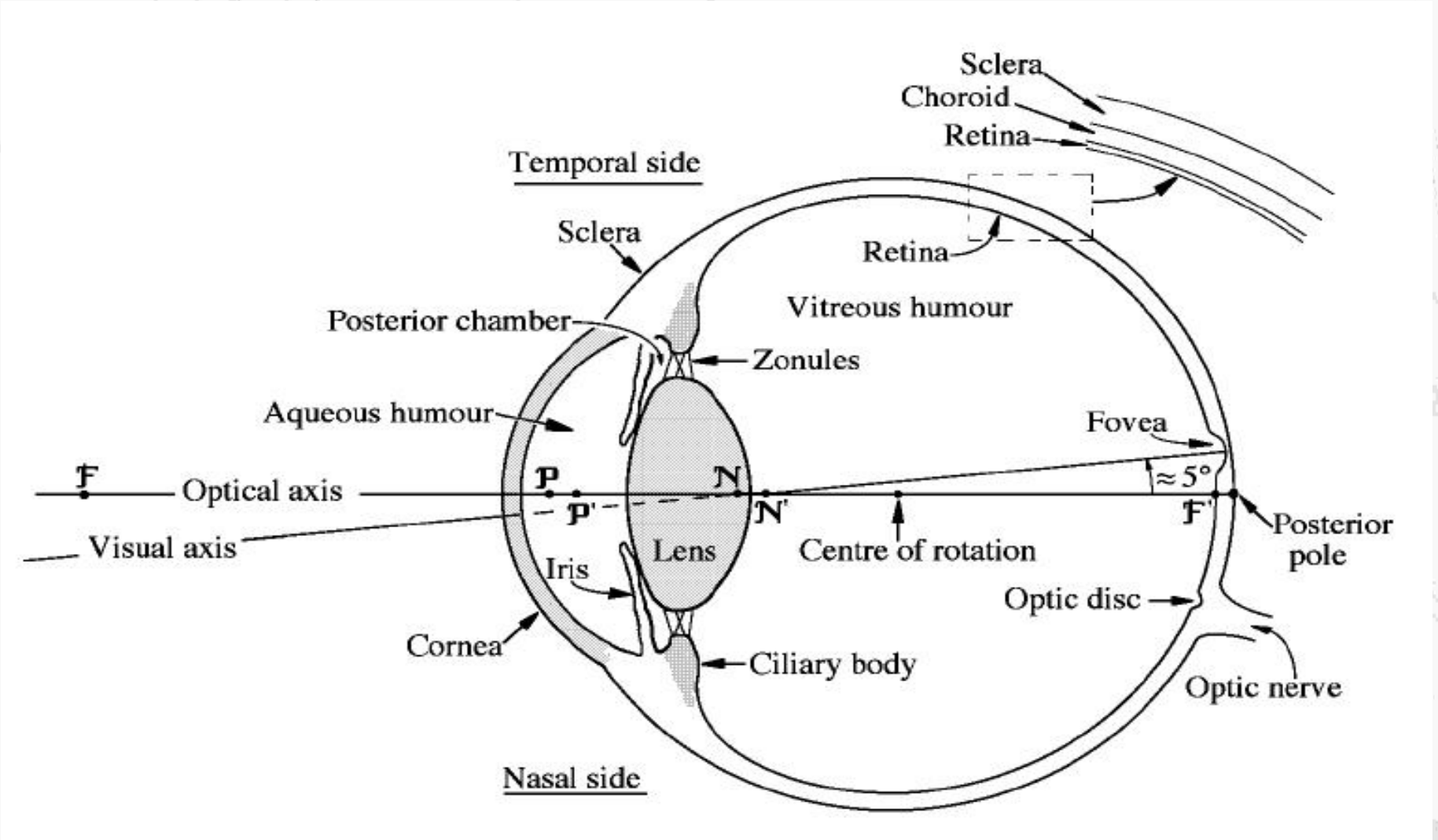


Atchison D, Smith G. Fig. 1.1 In: Optics of the human eye. 2000. Butterworths-Heinemann.

Visual Science

Optics of the eye

- Cornea is not circular / spherical
- Cornea is elliptical / astigmatic
- Circular vs elliptical: spherical aberration
- Spherical vs astigmatic: compensated by the crystalline lens



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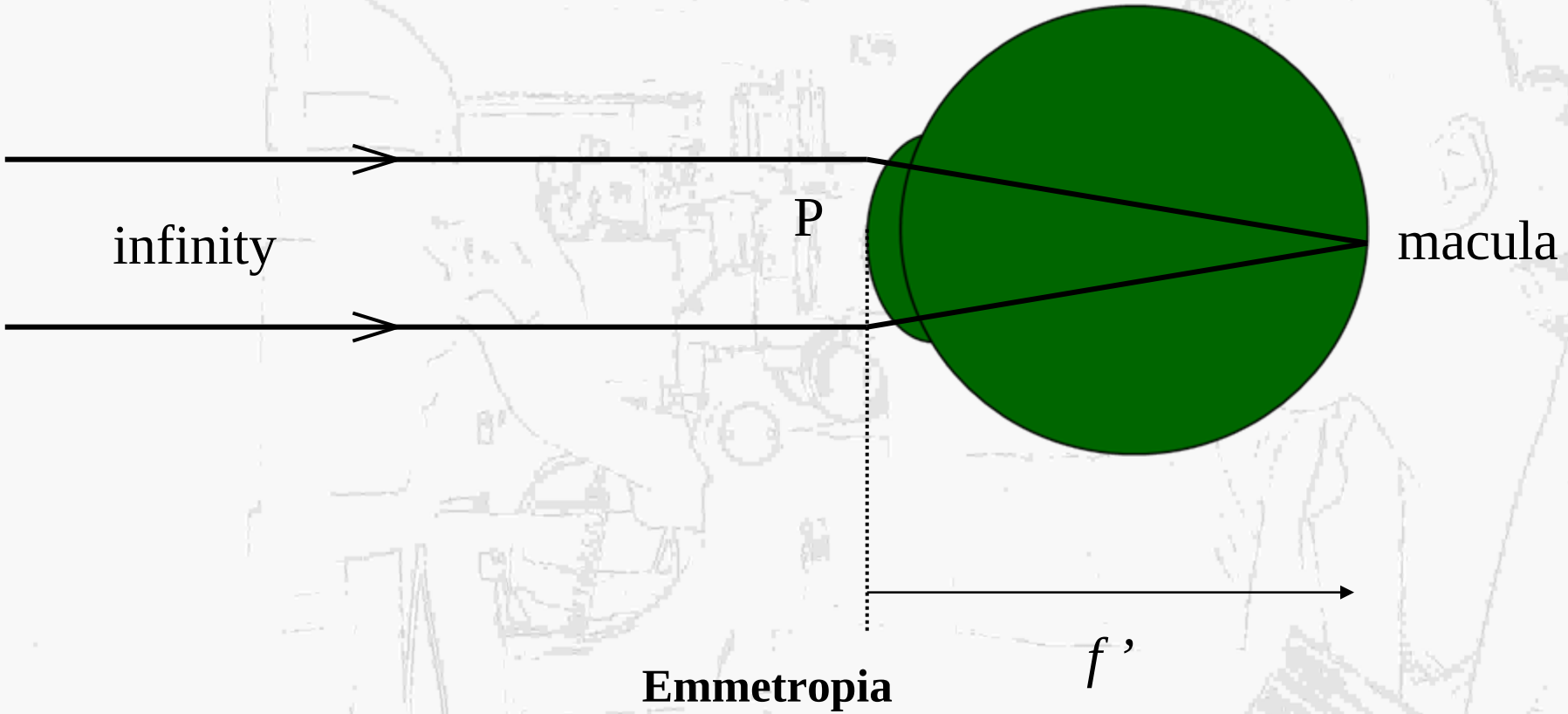
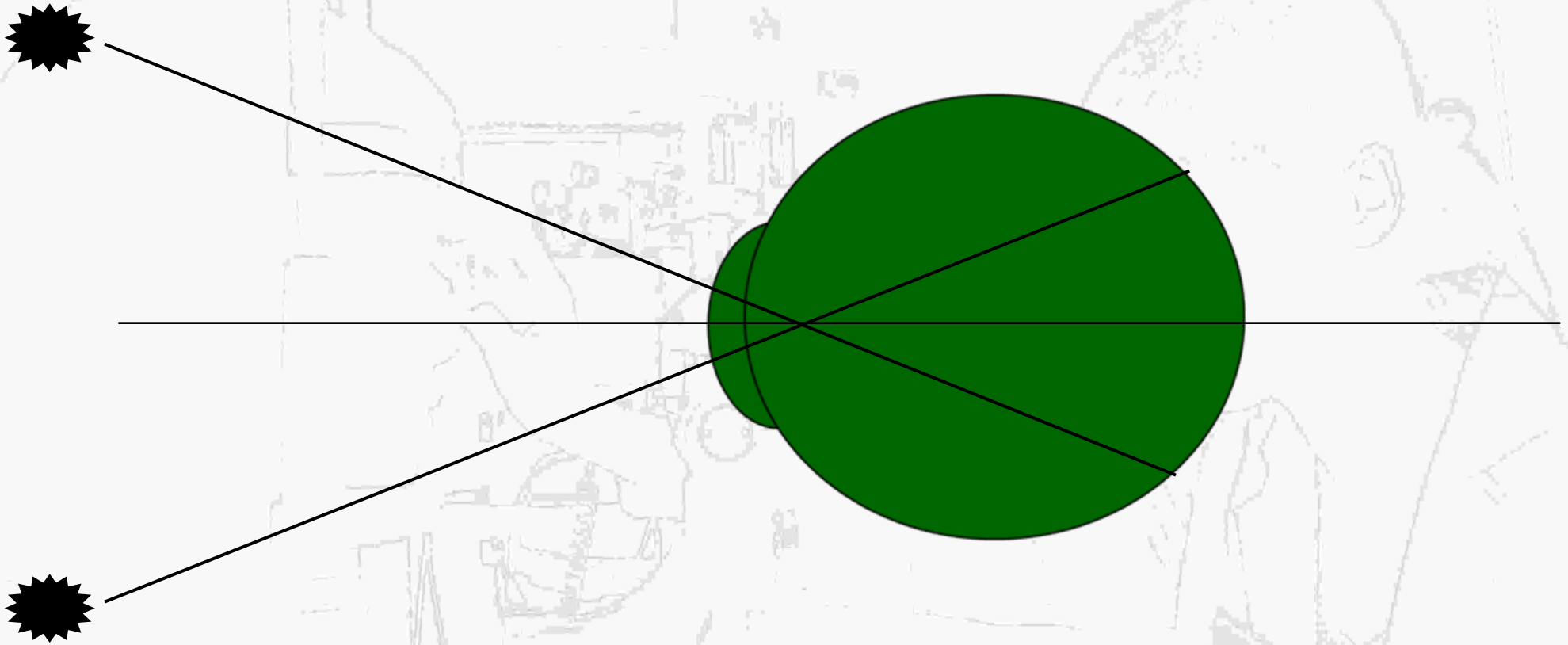


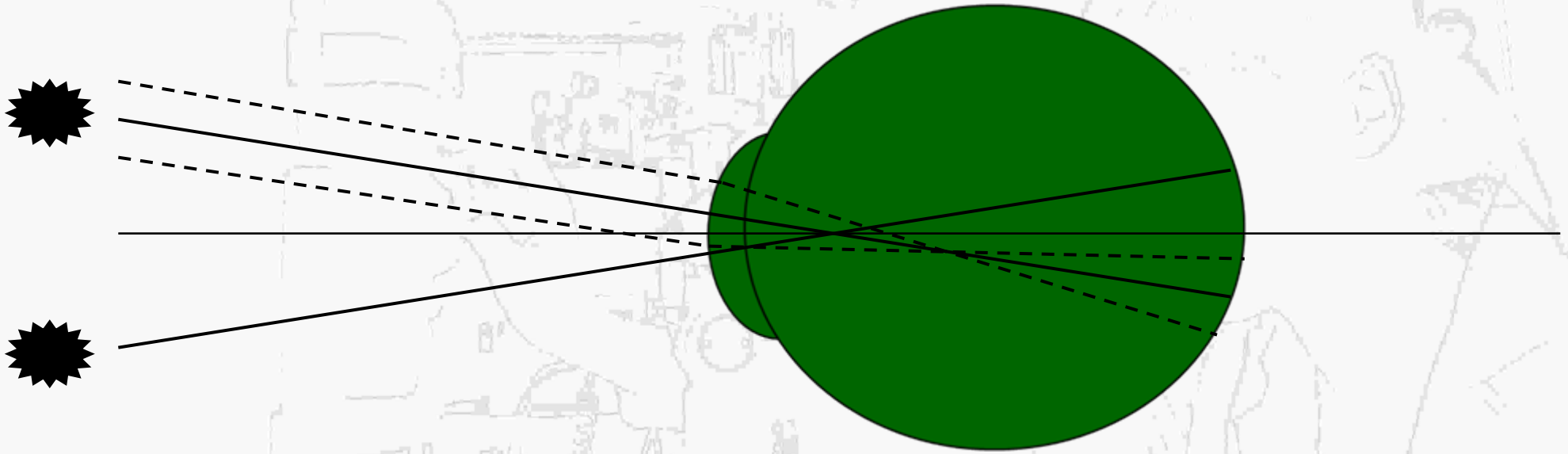
Visual Science

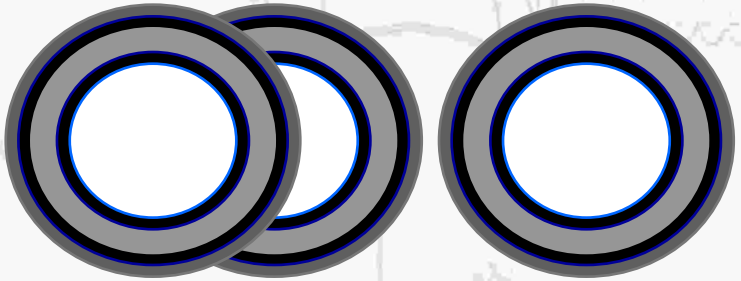
Resolving power / Visual acuity

- Distinguish there are two point sources, NOT one
- *Diffraction patterns of 2 monochromatic pt ...*
- Rayleigh criterion
- $\theta = (1.22 \times 555\ \text{nm}) / 3\ \text{mm pupil}$
- $\theta = 47''$

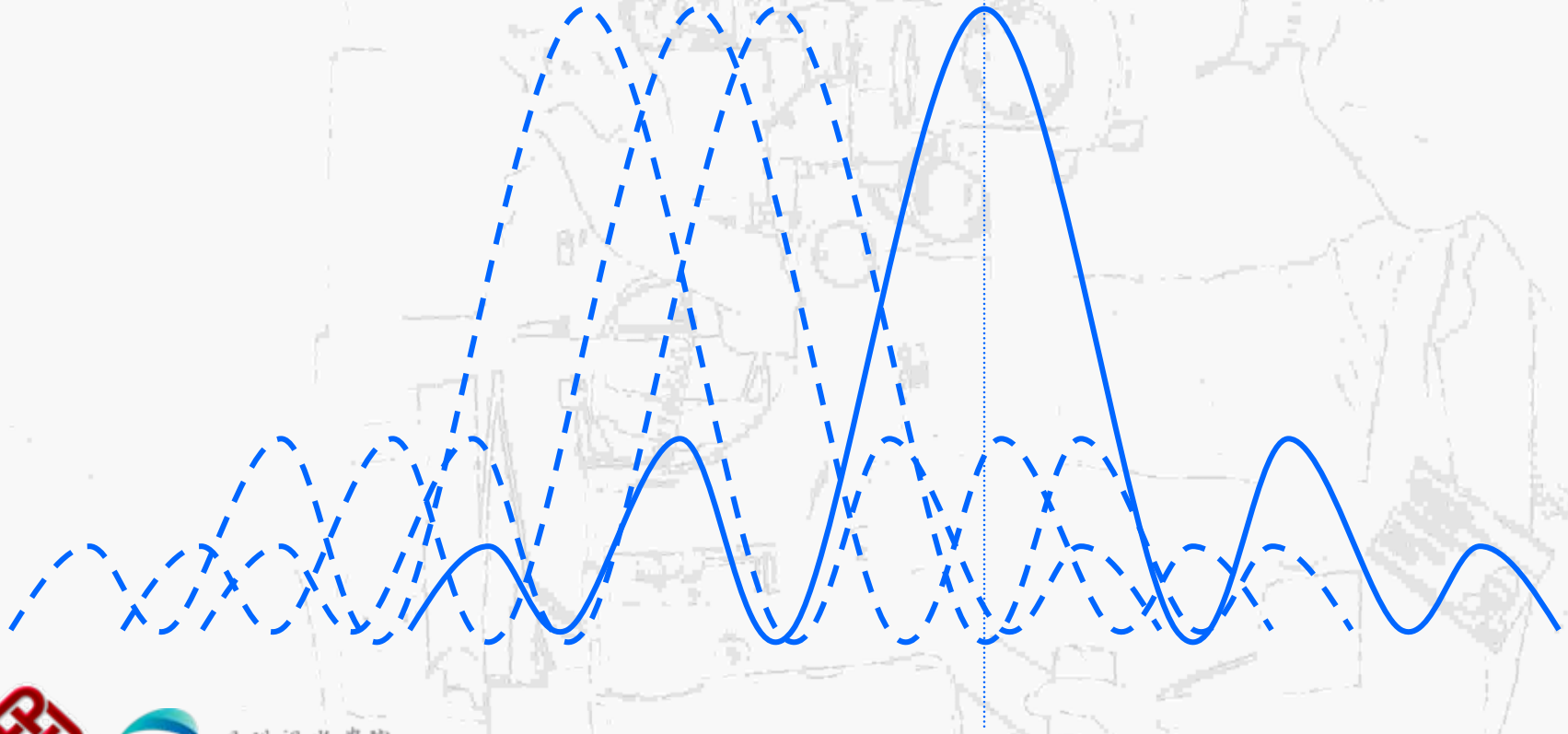
Resolving power of the eye







Lord Rayleigh suggested that two patterns were just resolved if the central peak of the 2nd Airy Disc fell on the extreme edge of the first Airy Disc



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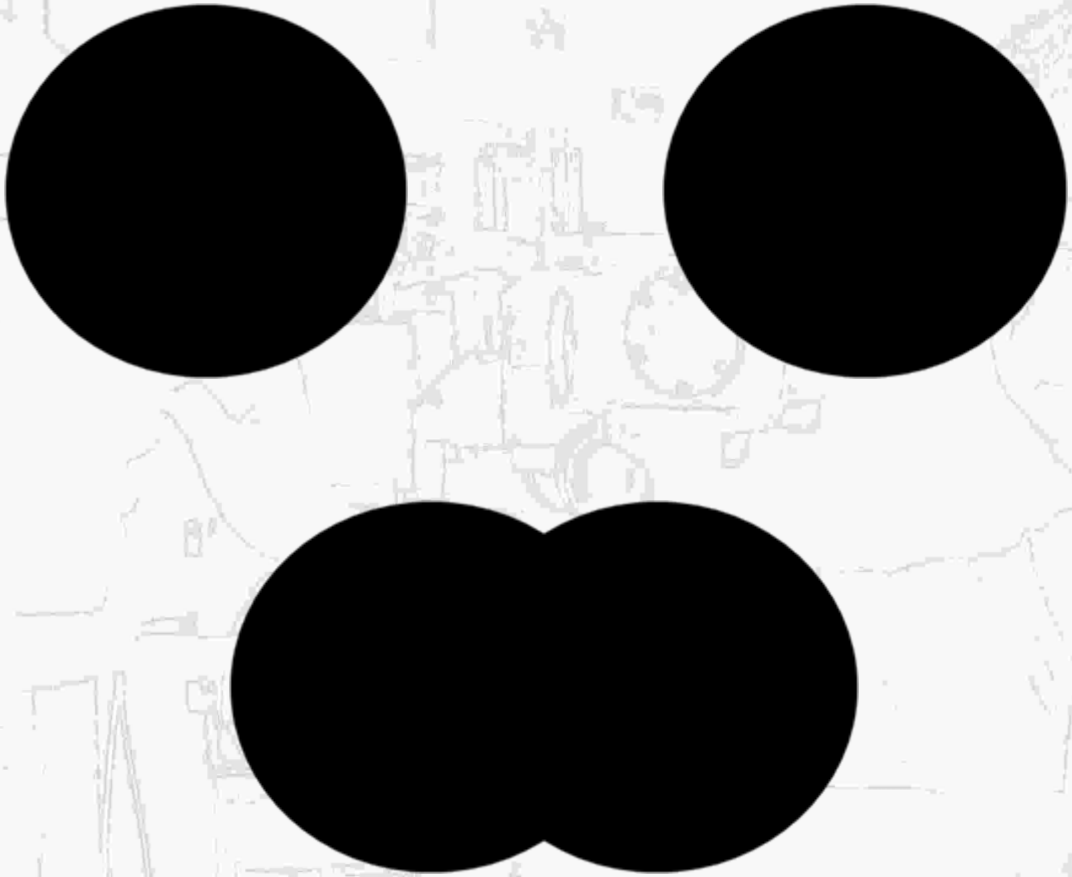
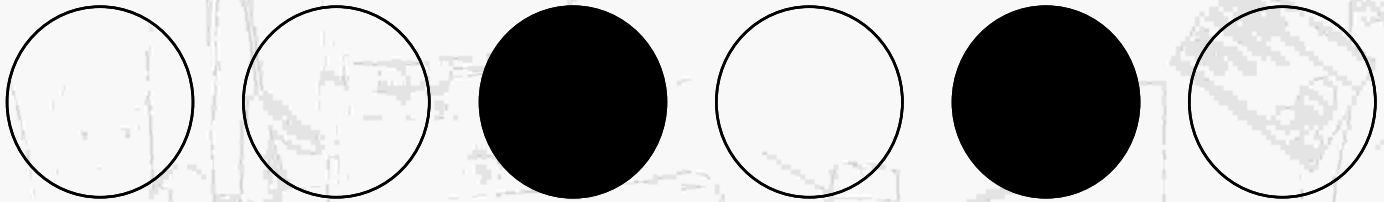
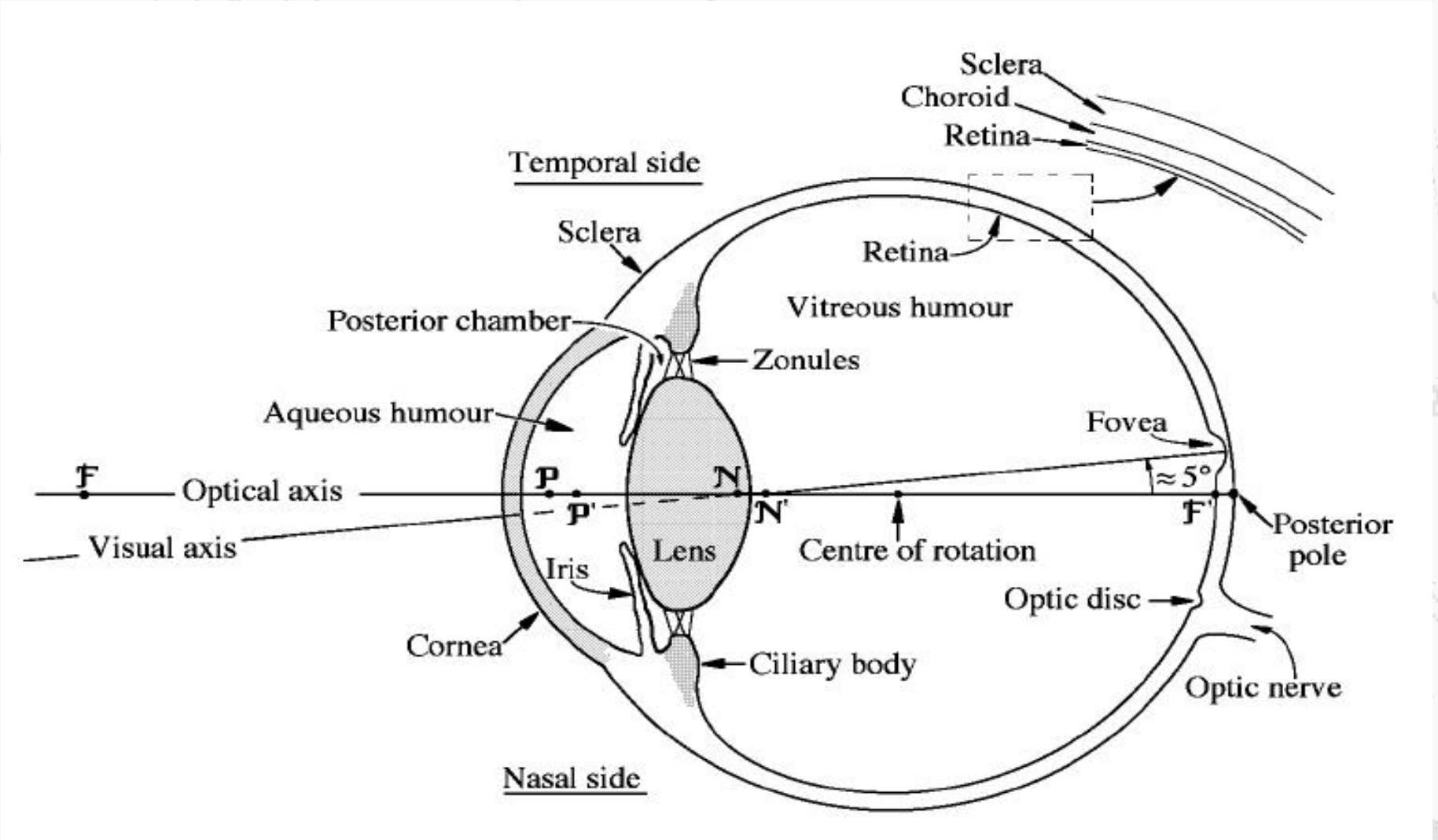


Visual Science

Resolving power / Visual acuity

- Anatomical approach
- Rod cells vs Cone cells
- Two stimulating cones with one un-stimulated cone in between
- θ = 50”





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Visual Science

Some anatomy

- Macula lutea: 5.5 mm
- Fovea: 1.5 mm
- Fovea has the highest concentration of cones, 200,000 to 300,000 cones per mm^2
- Long-wavelength cones (red), medium-wavelength cones (green), short-wavelength cones (blue)
- Red light: strong excitation of red cones, weak stimulation of green and blue cones
- Neural network: red vs green; blue vs yellow

Visual Science

Photometry

- Illuminance (lux)
- Luminance (candela/m²)
- Troland (retinal illuminance from surface of 1 cd/m² through 1mm² pupil)

For teaching Visual ergonomics and lighting

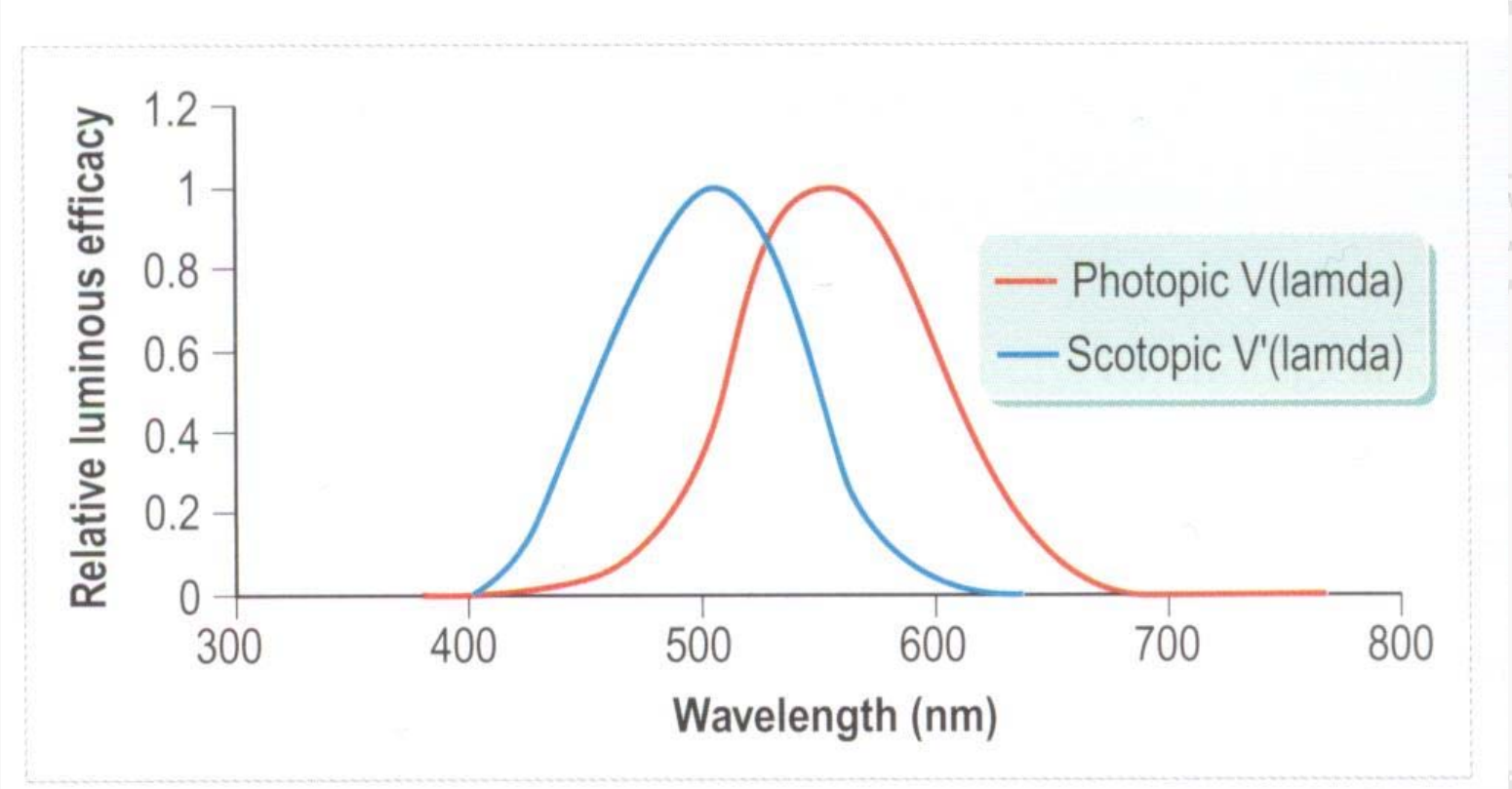
- Visual requirements for various occupations
- e.g. 500 lux for office
- e.g. Lighting design
- e.g. 120 cd/m² for visual acuity chart

Visual Science

Relative luminous efficiency curve

- Photopic condition: 555 nm
- Scotopic condition: 509 nm
- Purkinje shift
- “... eye response depends on wavelengths”

Visual Science



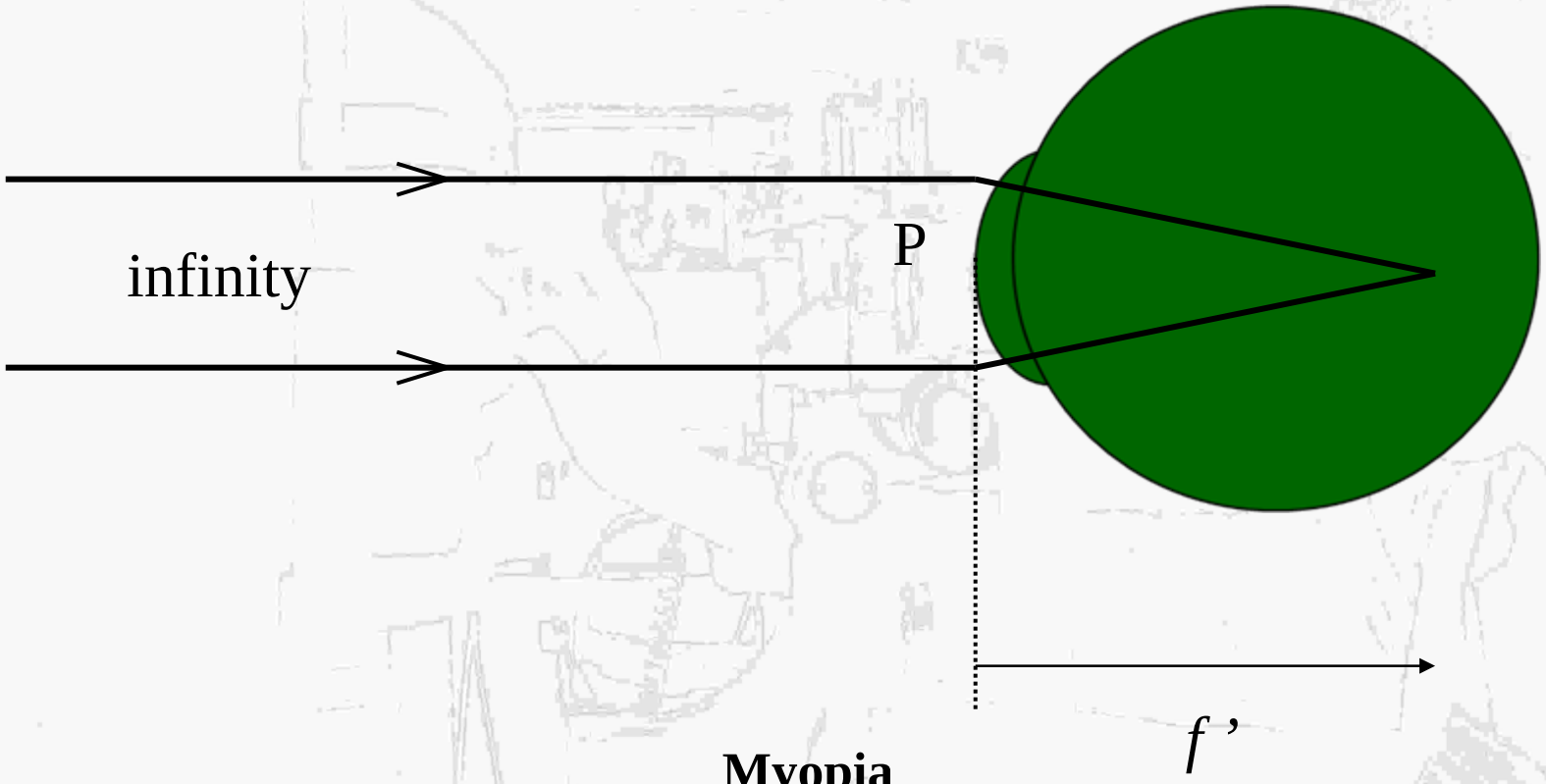
Rosenfield M, Logan N. (Ed.) Optometry: Science, Techniques and Clinical Management. 2nd ed. 2009. Butterworth Heinemann. Page 70.

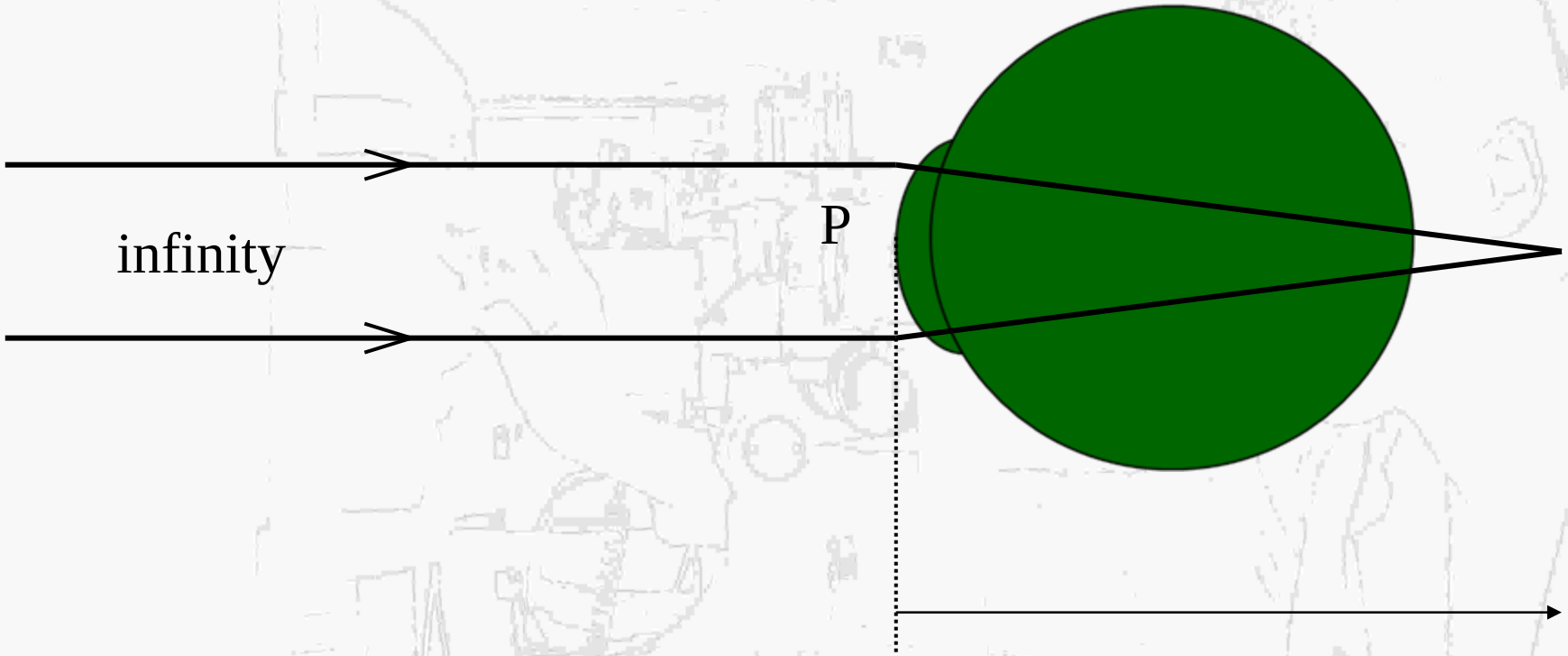
Visual Science

Defects of vision

- Myopia: distant object forms image in front of retina
- Hyperopia: distant object forms image behind retina
- Astigmatism: powers differ along different meridians
- Presbyopia: lack of accommodation power for near vision

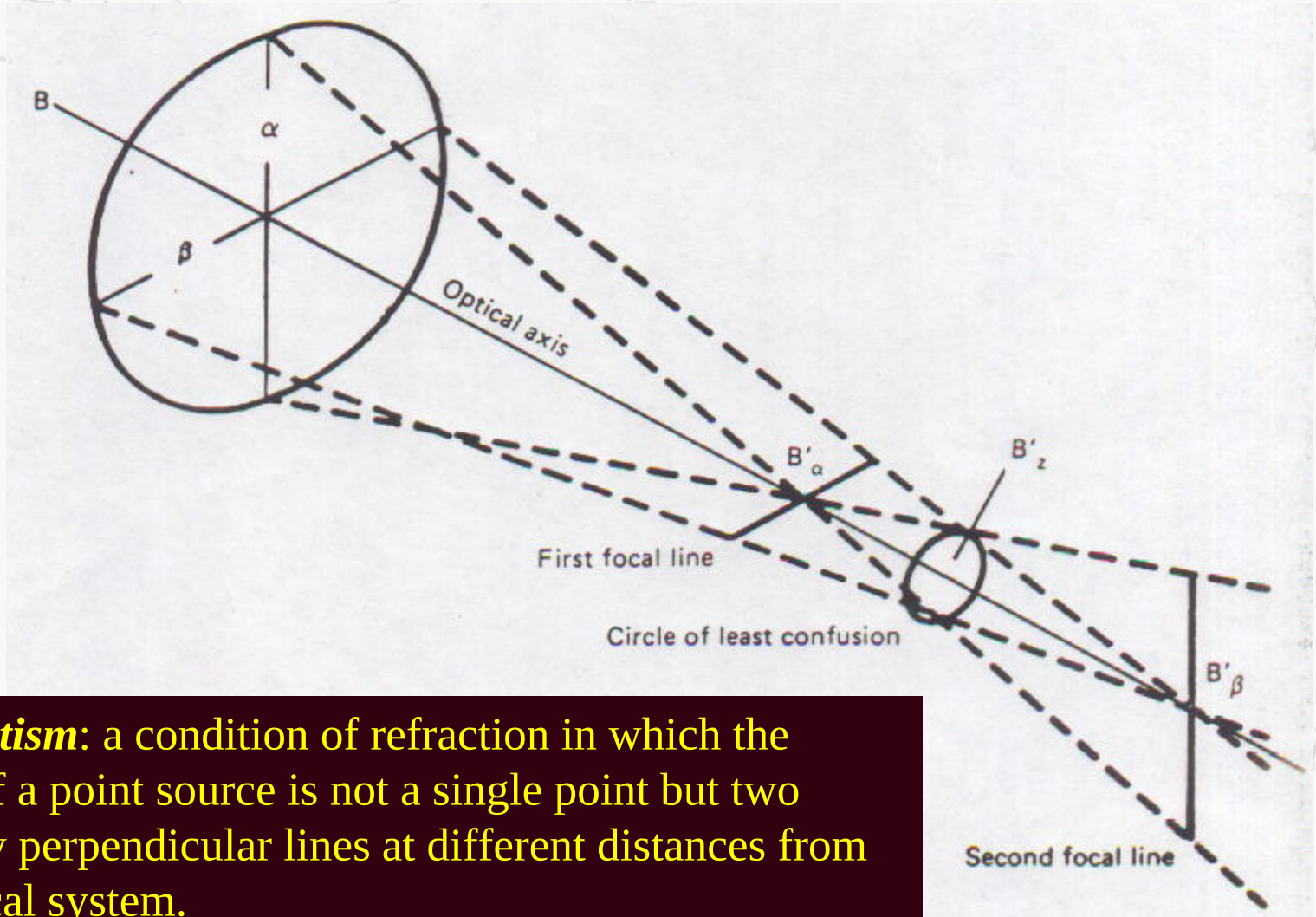
What could be the likely causes?





Hyperopia

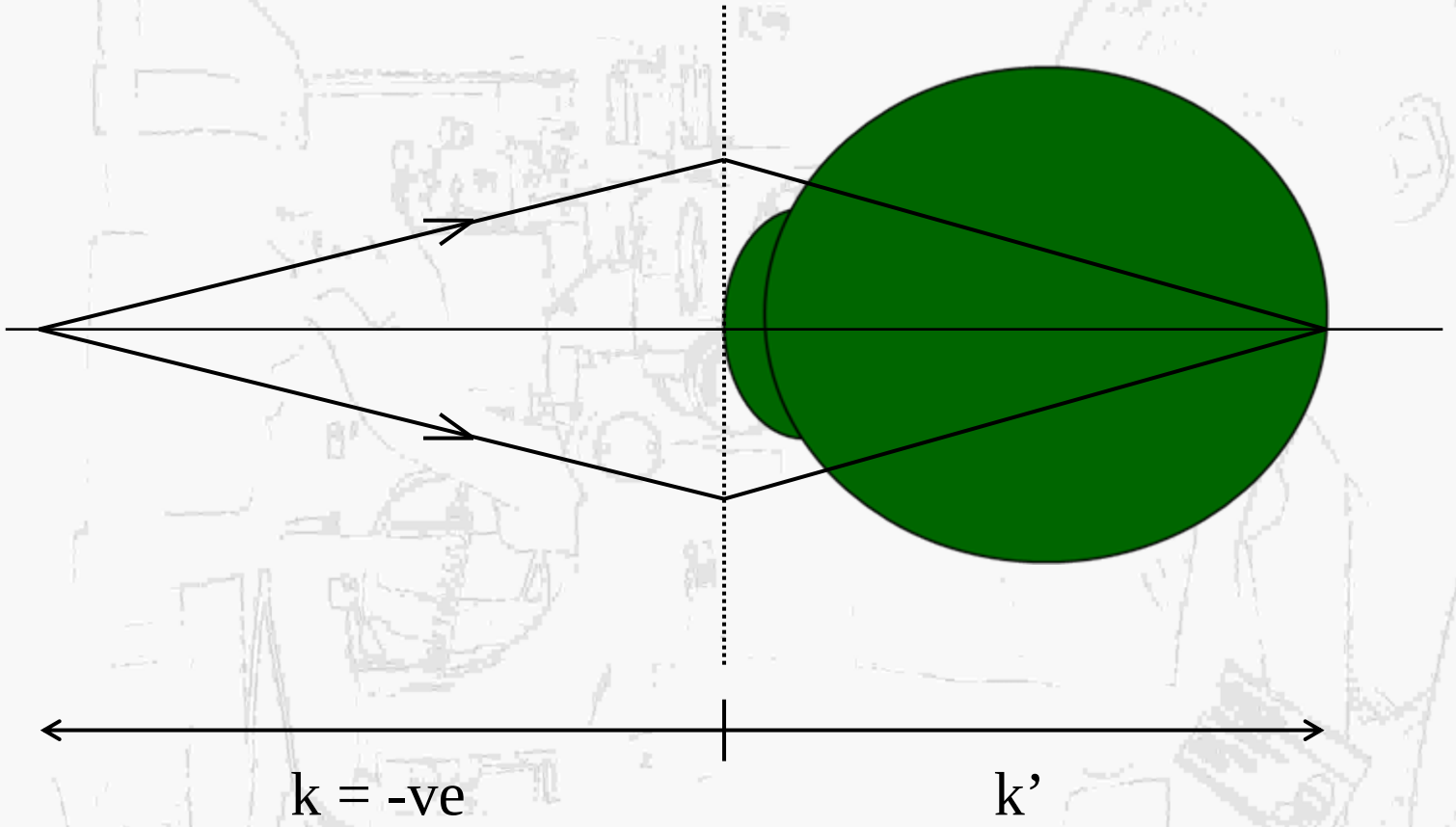
* accommodation: the ability to change focusing power of the eye

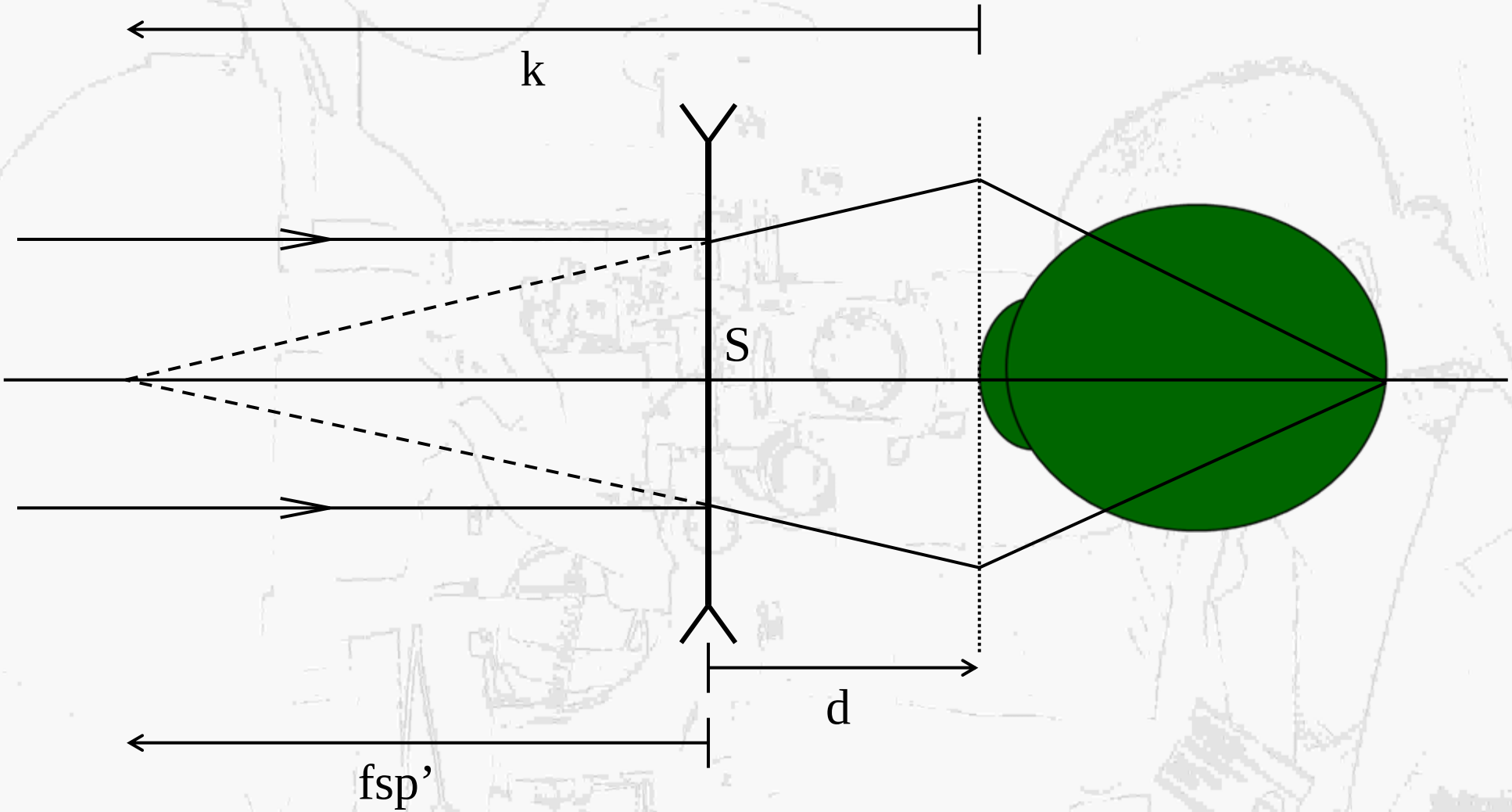


Astigmatism: a condition of refraction in which the image of a point source is not a single point but two mutually perpendicular lines at different distances from the optical system.

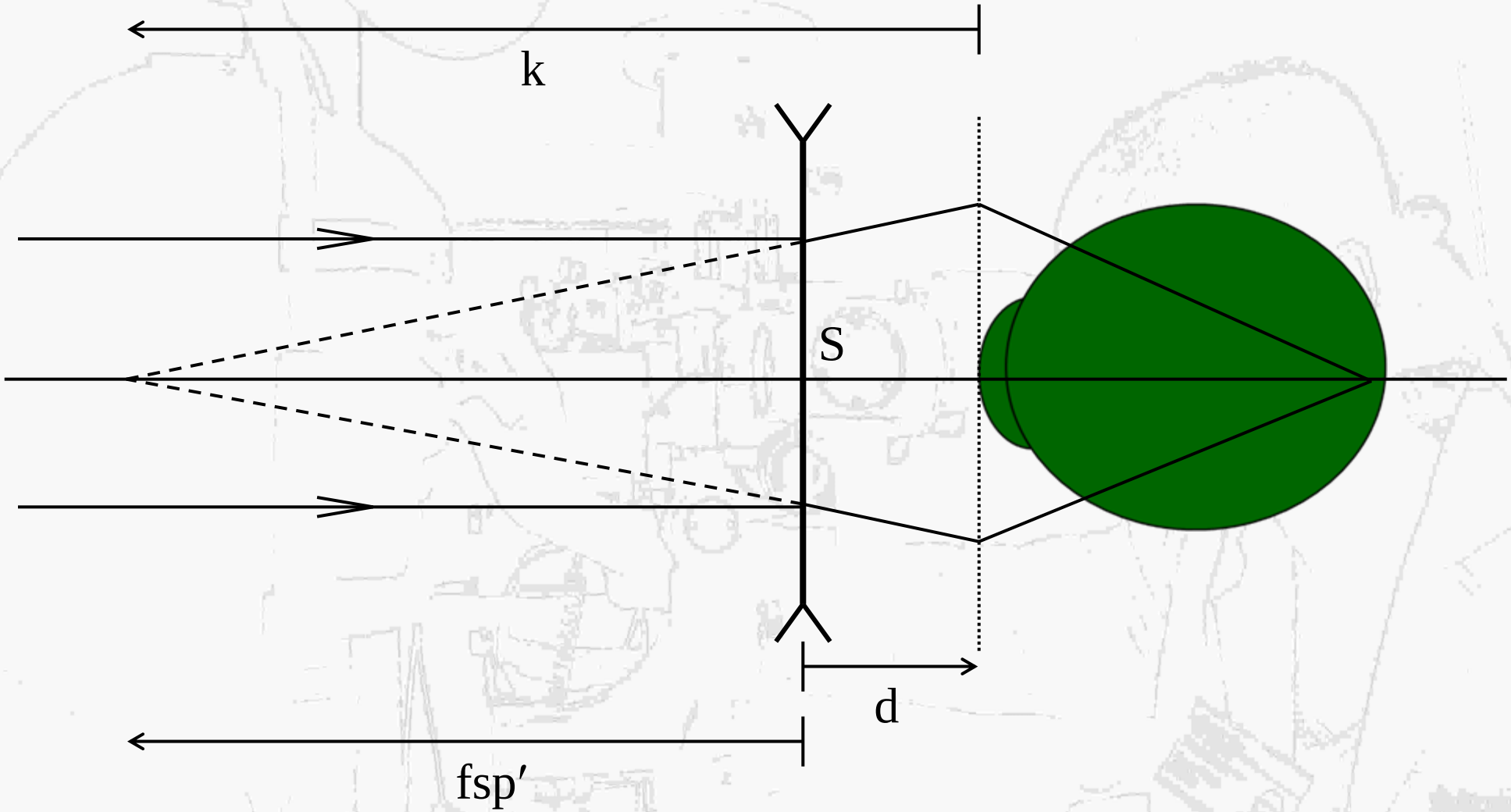
Rabbetts RB. Clinical Visual Optics. 3rd ed. 1998. Butterworth-Heinemann. P.81.

Myopia: far point in front of the eye

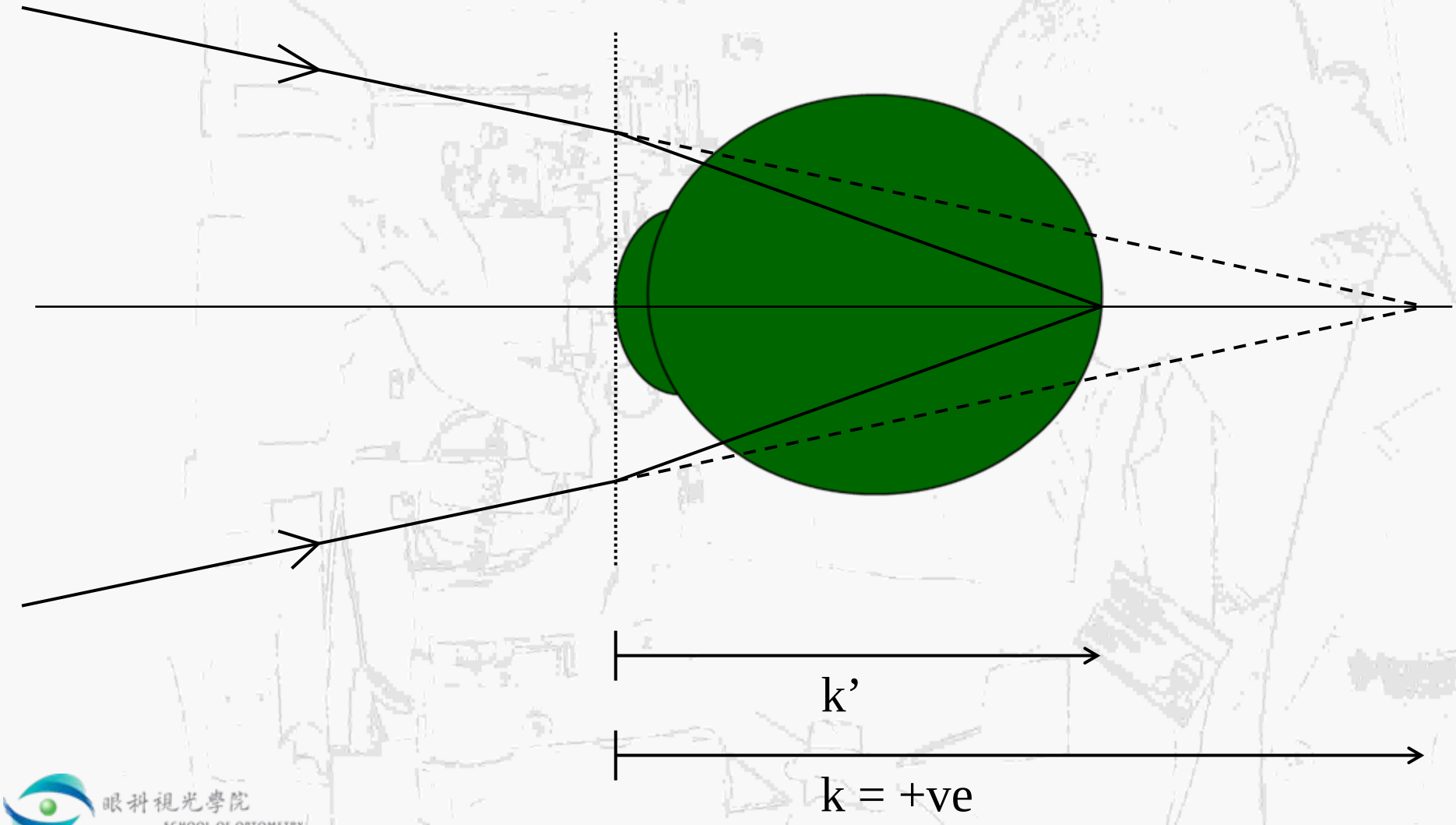


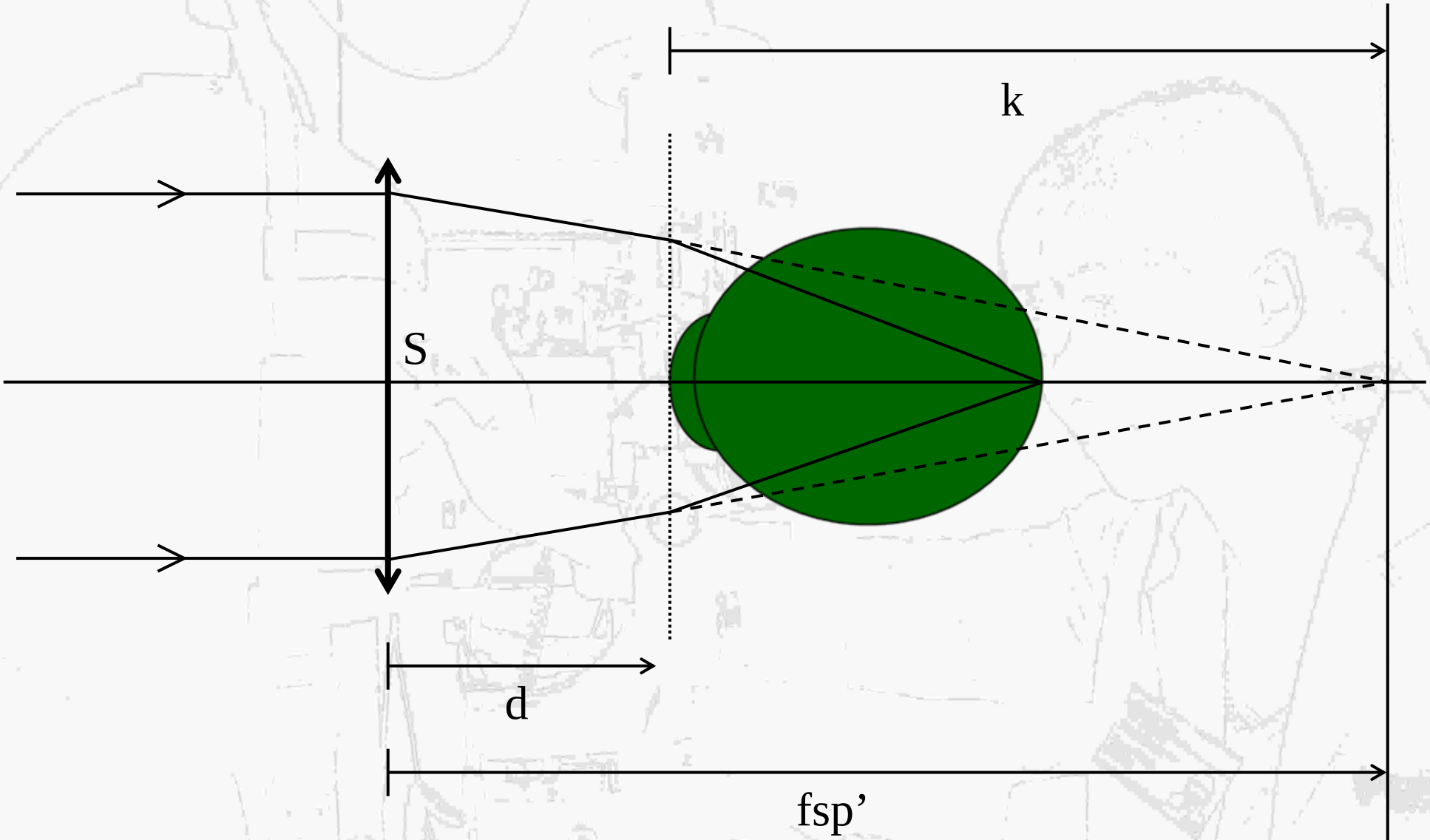


Spectacles: for distant vision, provide virtual object at far pt.



Hyperopia: far point behind the eye





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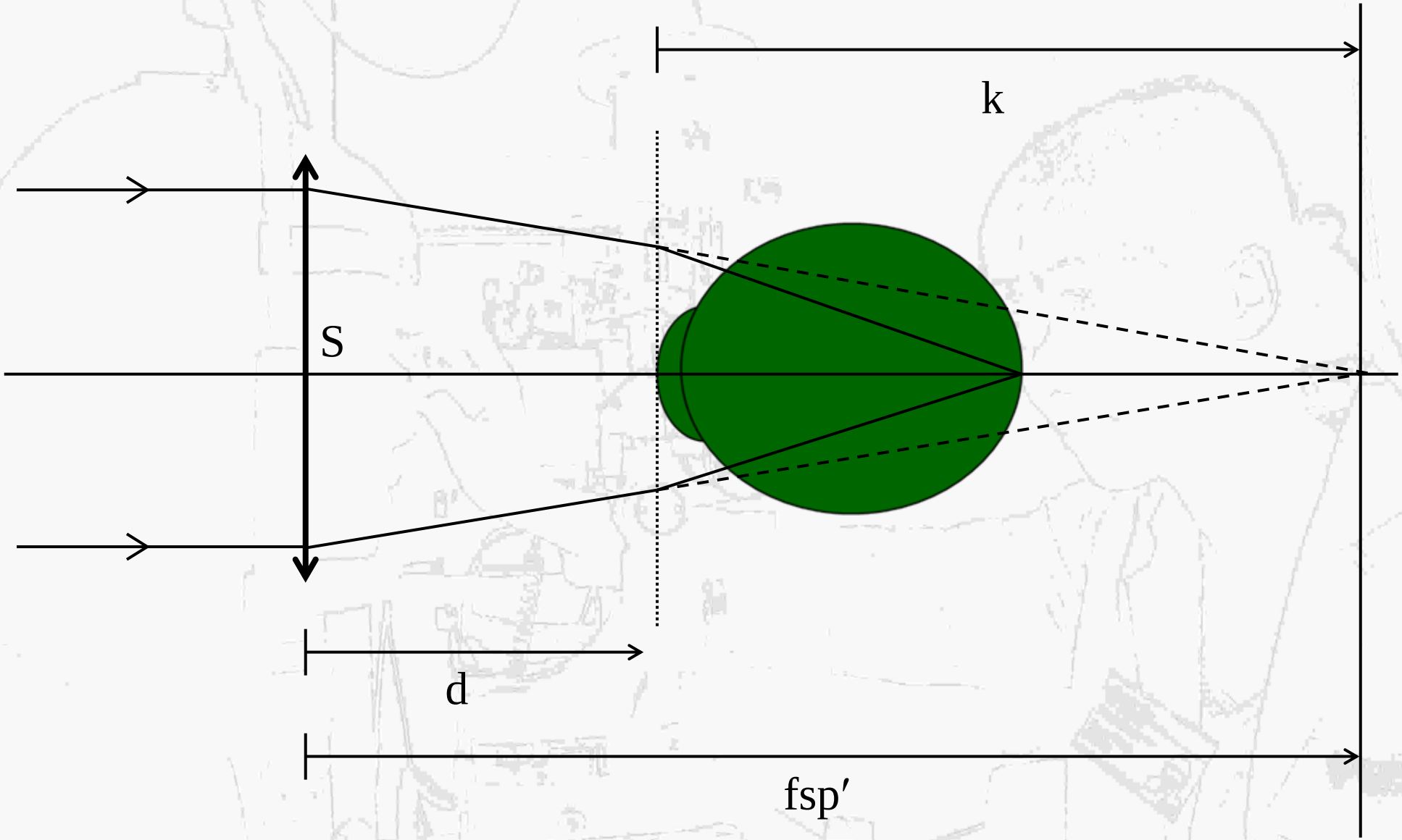
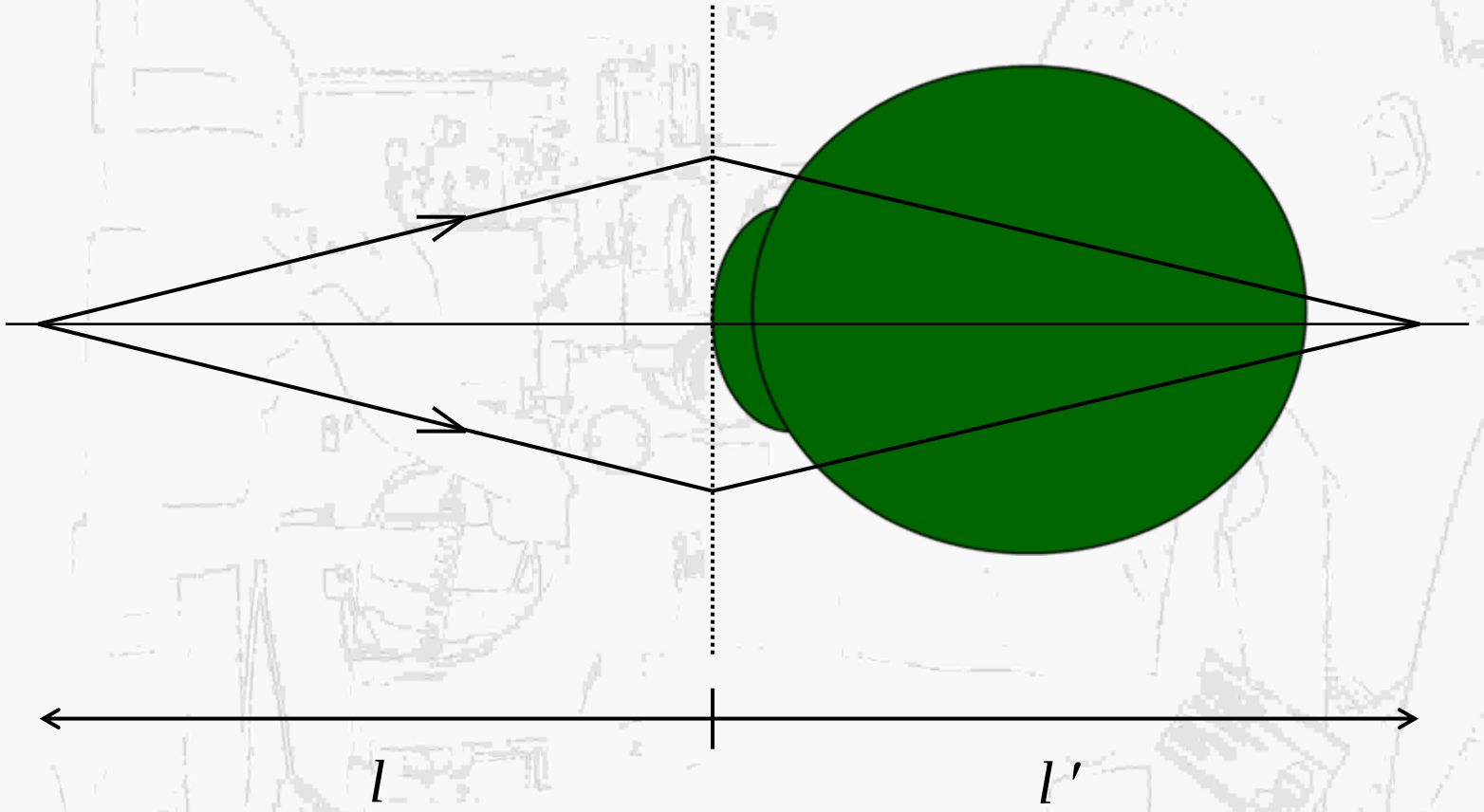
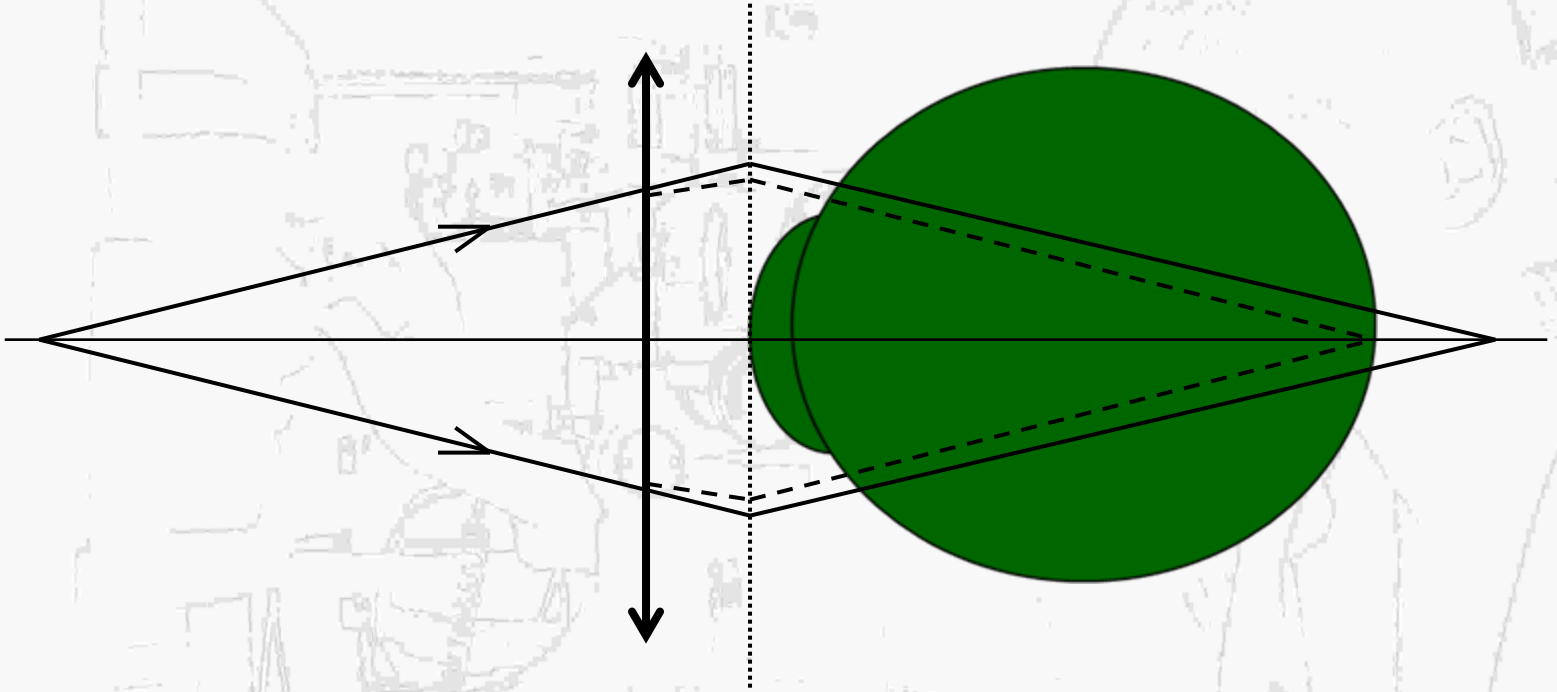


Presbyopia: near object!



Presbyopia: near reading glasses is needed




Have a break!

What do optometrists do?

- Optometrist
- Ophthalmologist
- Optician

Optometrist

- A person licensed to practise optometry
- Professional provides the “primary eye care” service
- Independent professional
- Member of Health Care Professions

What do optometrists do?

Comprehensive eye examination

- History and preliminary examination
- Refraction and binocular assessment
- Anterior and posterior examinations
- Intraocular pressure measurement
- Treatment and advice

Case Scenario – Amblyopia (弱視)

- A 3 year-old child came to the clinic for a regular eye examination
- Findings:
  - Right Eye: normal vision with minimal refractive errors
  - Left Eye: poor vision with +5.00D (五百度遠視) & moderate esotropia (中度內斜視)

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Case Scenario – Diabetic retinopathy (糖尿病視網膜病變)

- Haemorrhages (血液滲漏)
- Retinal edema (視網膜水腫)
- Exudates (黃色滲出物)
- New blood vessels (血管增生)

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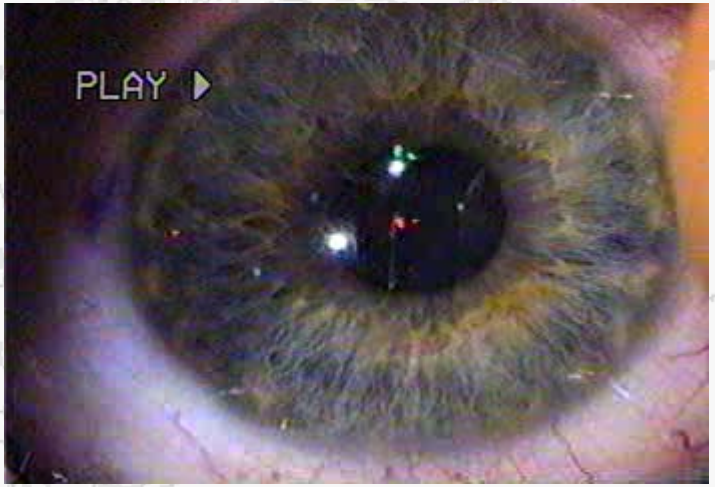
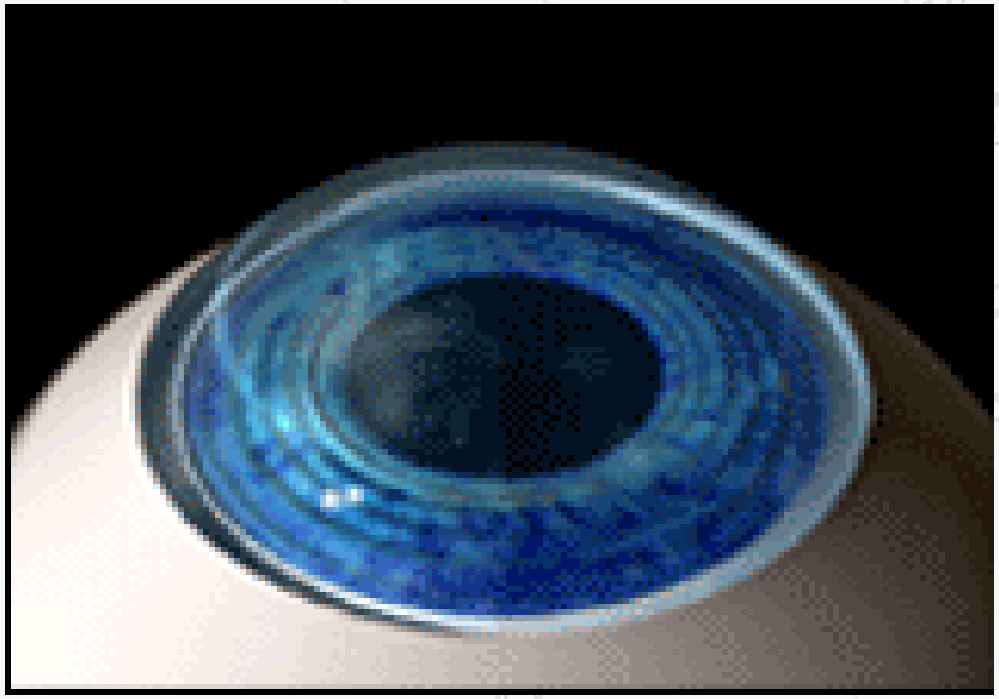
Working partners

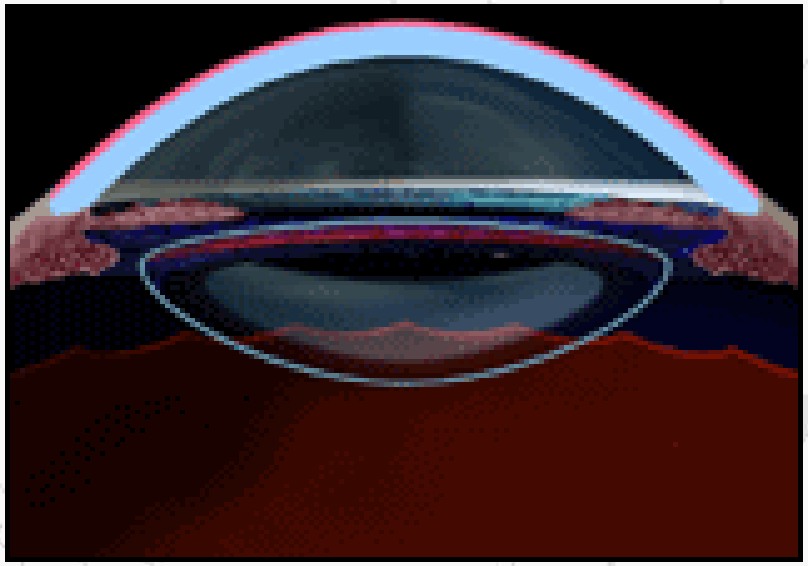
- Ophthalmologists
- Family doctors
- Endocrinologists
- Nurses
- Occupational therapists

Photorefractive keratectomy

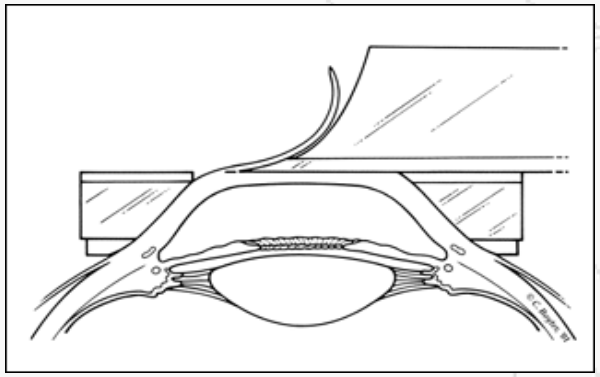


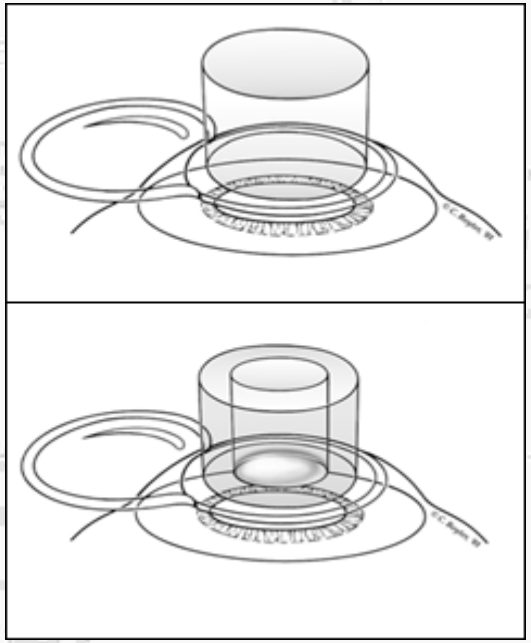
Photorefractive keratectomy

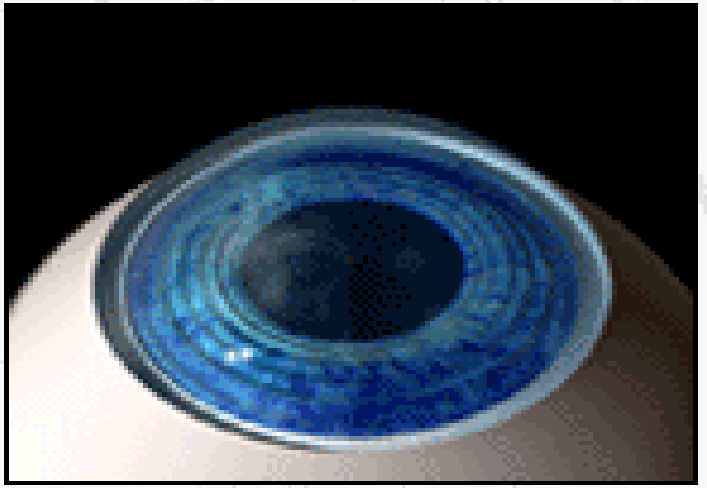




Laser assisted *in-situ* keratomileusis







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IntraLase

Status of Optometrist in Hong Kong

- Independent professionals providing "primary" eye care service
- Good reputation around the world
- Recognized by the HKSAR
- Under the Optometrists Regulation, all optometrists must be registered and follow the Code of Practice

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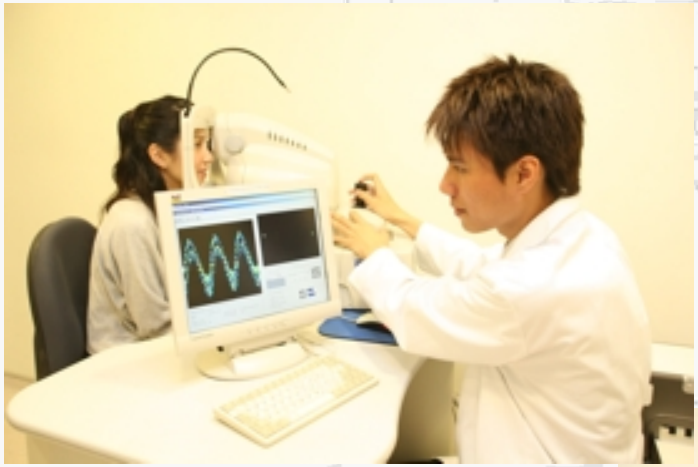
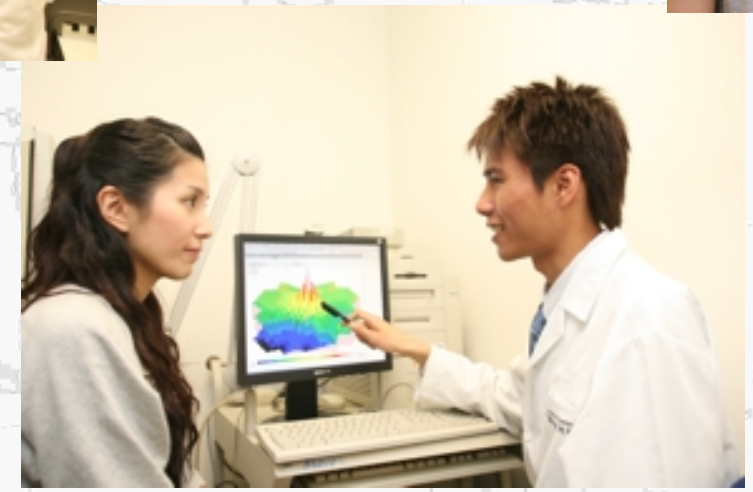
Programme in PolyU

- B.Sc. (Hons) Degree
- 4-year credit-base programme
- 4 main subject areas:
  - Basic Sciences (基本科學知識)
  - Optometric Sciences (眼科視光學及視覺科學)
  - Clinical Sciences (臨床眼科視光學)
  - Clinical and Professional Training (眼科視光學臨床實習)

Unique facility - Optometry Clinic

- Students will have their clinical placement for 1.5 yrs





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Unique facility - Satellite Clinics

聖母醫院
眼科視光學

荔景社區結合
保健中心

嗇色園—香港理工大學
合辦眼科視光學中心

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Career Prospects

- **private practice** as a salaried employee
- **private practice as a partner or sole owner**
- a career in **hospital** as a primary health care provider
- a career with a multinational company specialising in ophthalmic products
- a career in vision science research

http://www.polyu.edu.hk/so/QuizOptometrist_chn.swf

眼科視光學院

你適合當眼科視光師嗎?

8. 我關心香港市民的健康護理問題。

- 非常同意
- 同意
- 沒意見
- 不同意
- 非常不同意

Thank You

Q & A

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