

Children and NIR: At particular risk? Biology and mechanisms

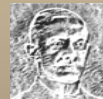
Optical Radiation and The Eyes

Per Söderberg

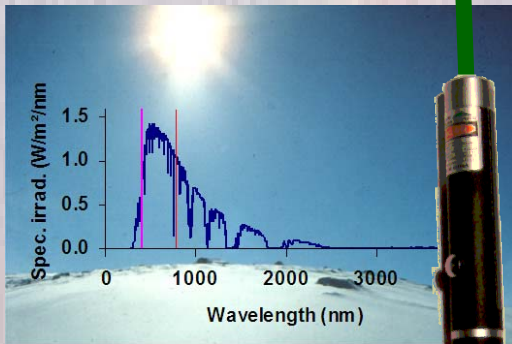


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**Gullstrand lab, Ophthalmology, Dept. of Neuroscience,
Uppsala university, Sweden**



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100

280

315

1400

3000

Far-UVR

UVR-C

UVR-B

UVR-A

IRR-A

IRR-B

IRR-C

1

400

760

1 000 000

Wavelength (nm)

Ultraviolet
radiation

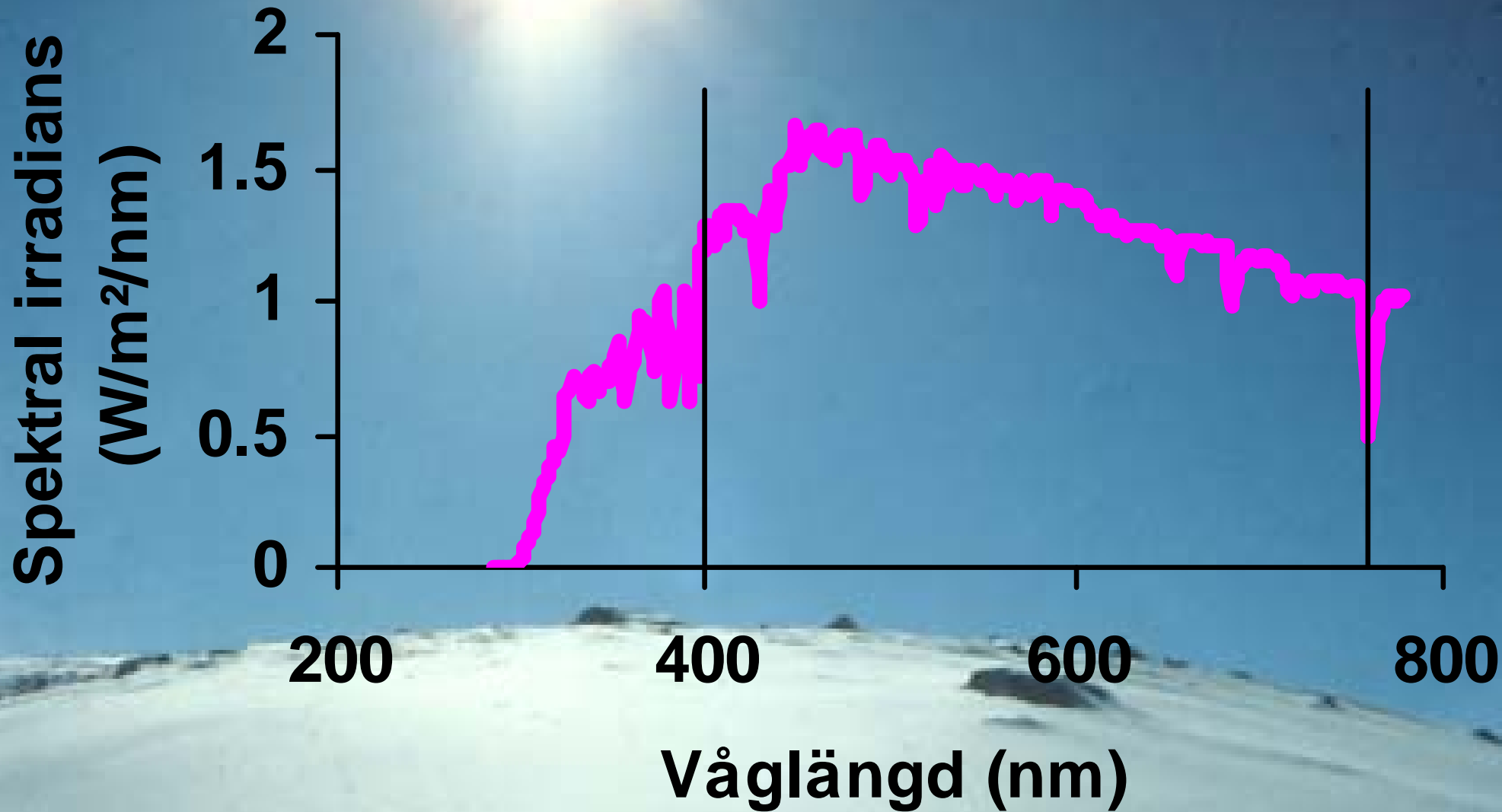
Visible
radiation

Infrared
radiation

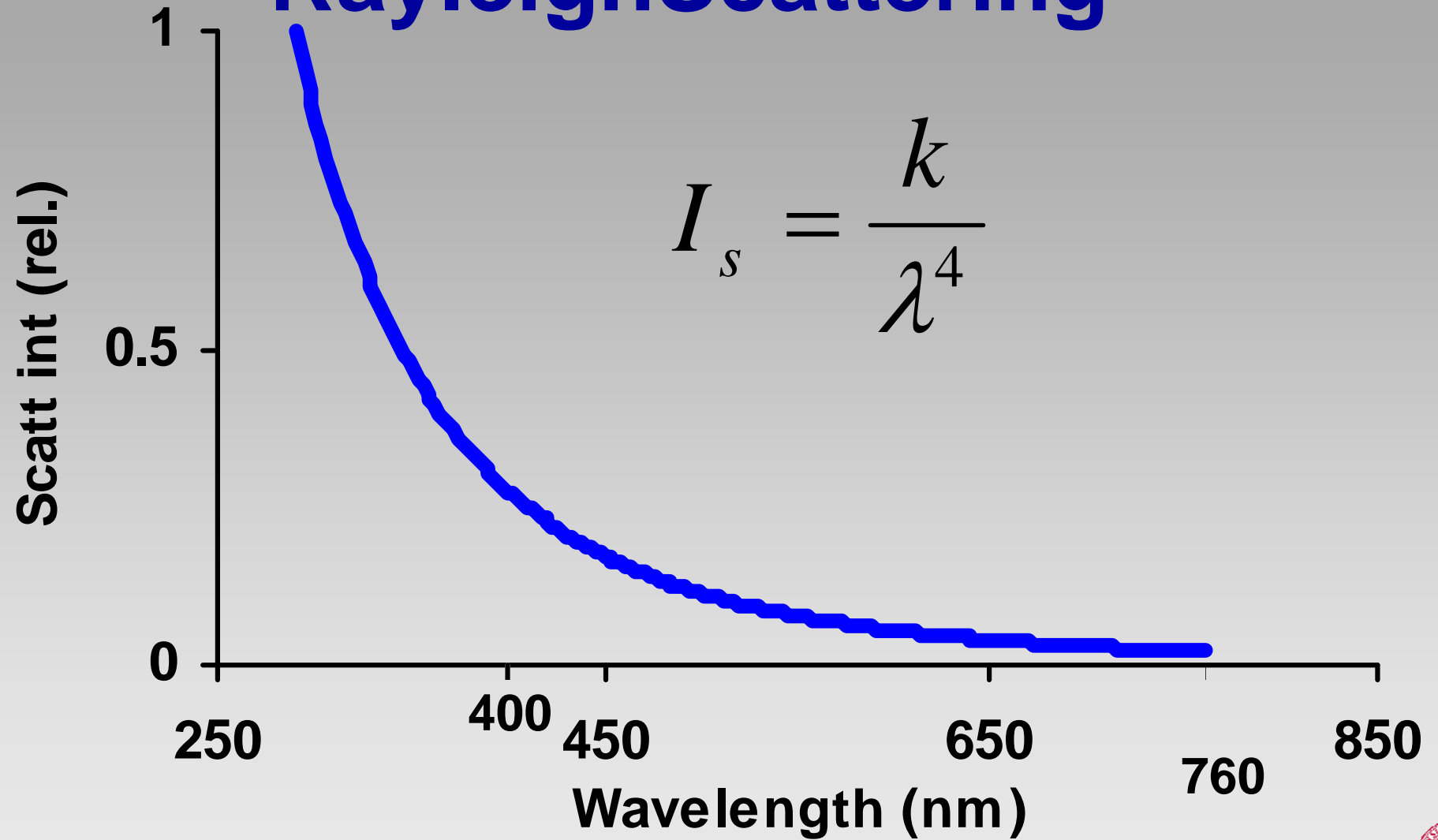
Ultraviolet
radiation

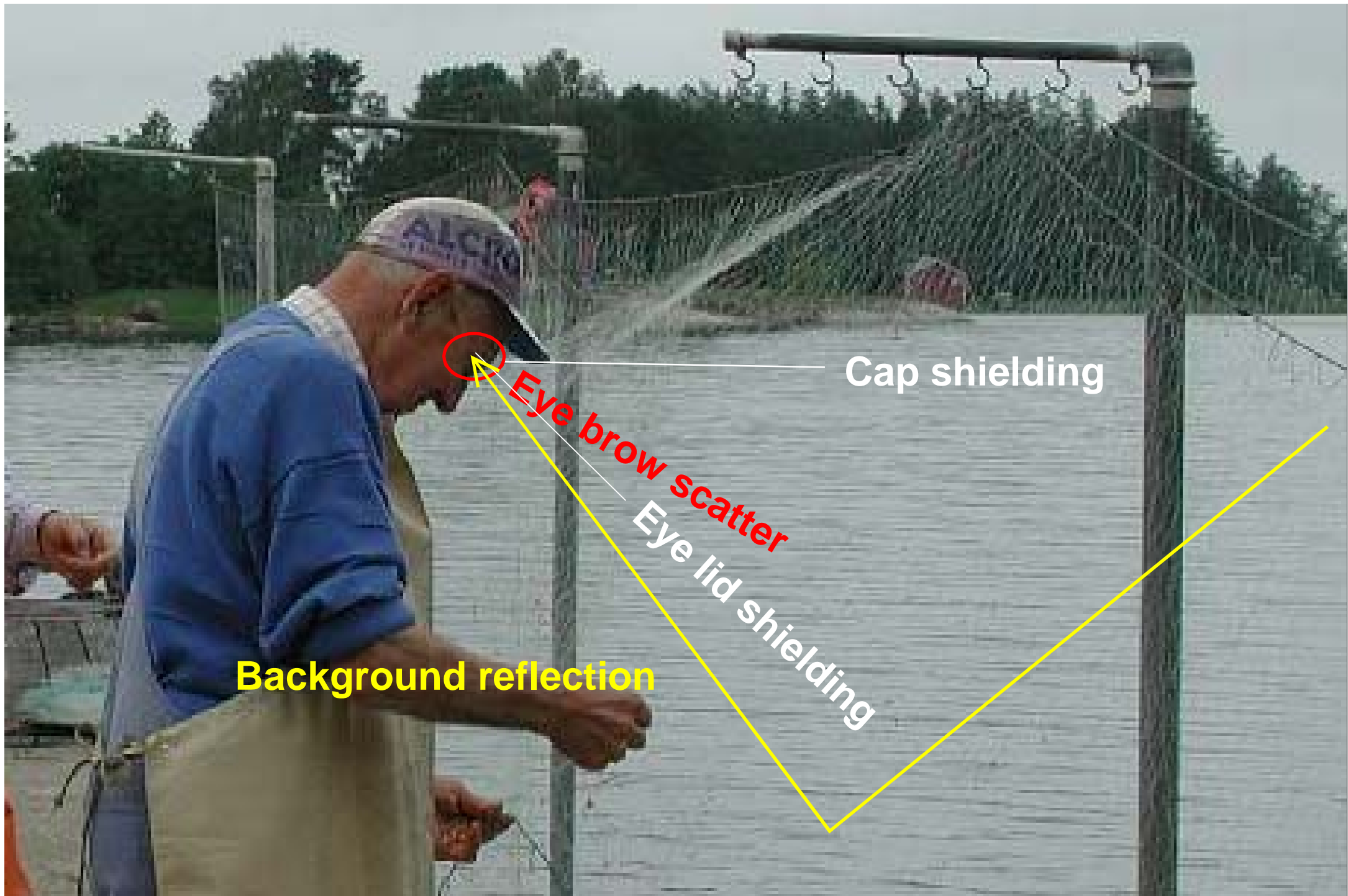
Visible
radiation

Infrared
radiation



Rayleigh Scattering





Cap shielding

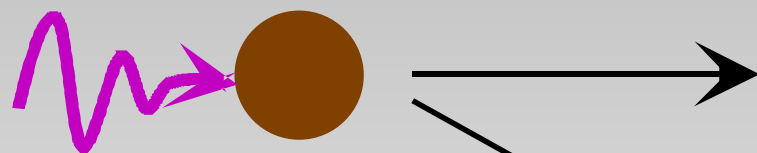
Eye brow scatter

Eye lid shielding

Background reflection

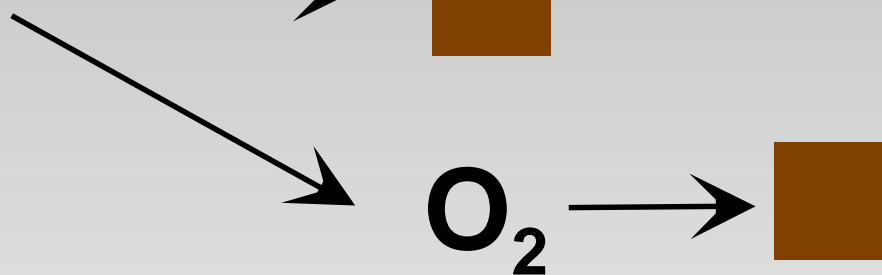


Phototoxic

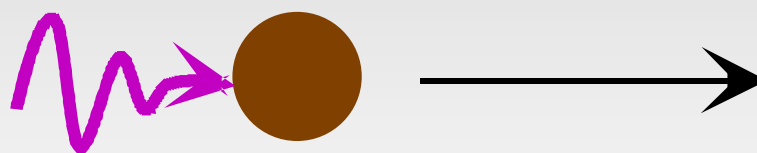


Photosensitized

Type I

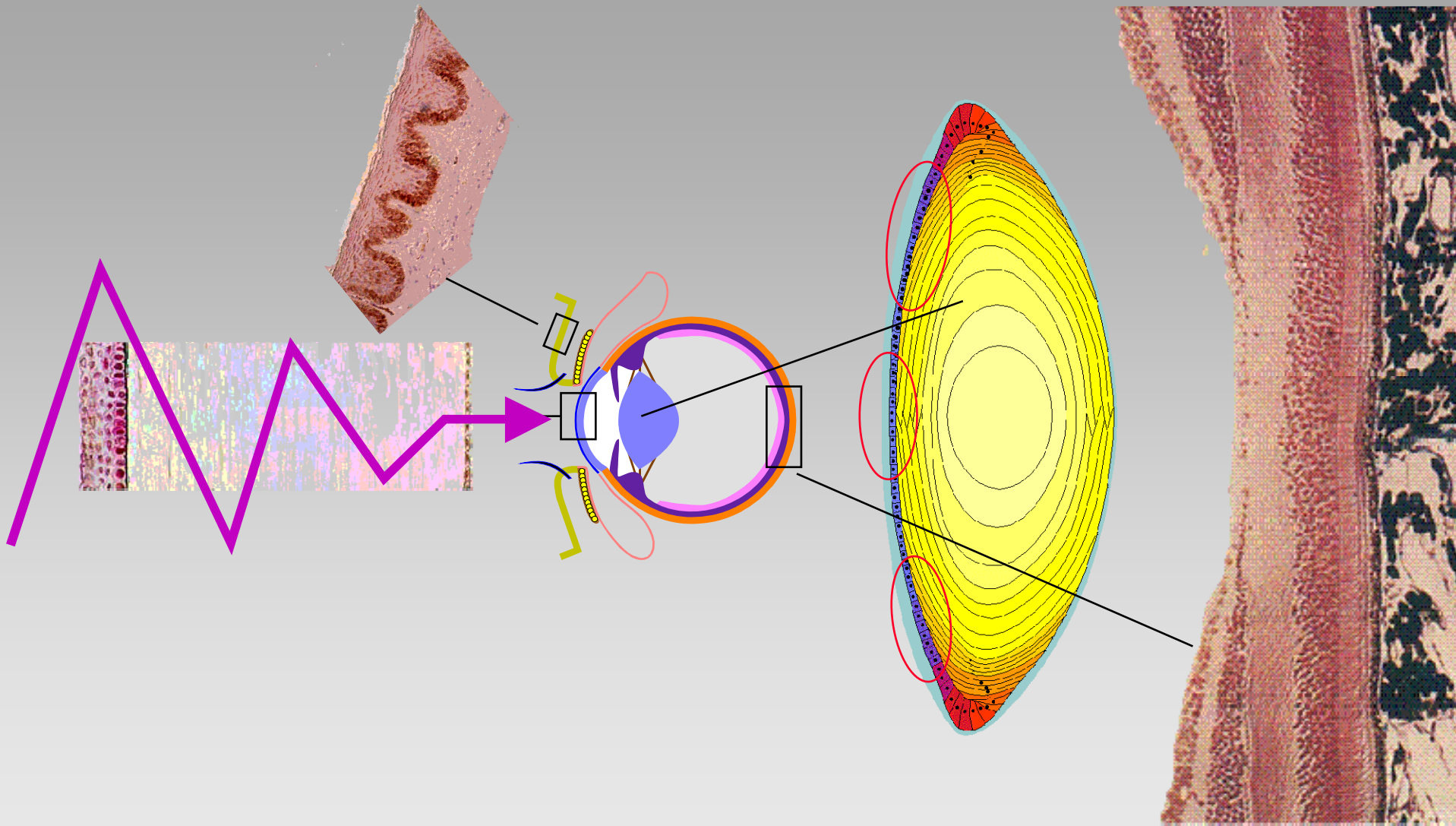


**Type II
(Photodynamic)**



Photoallergic

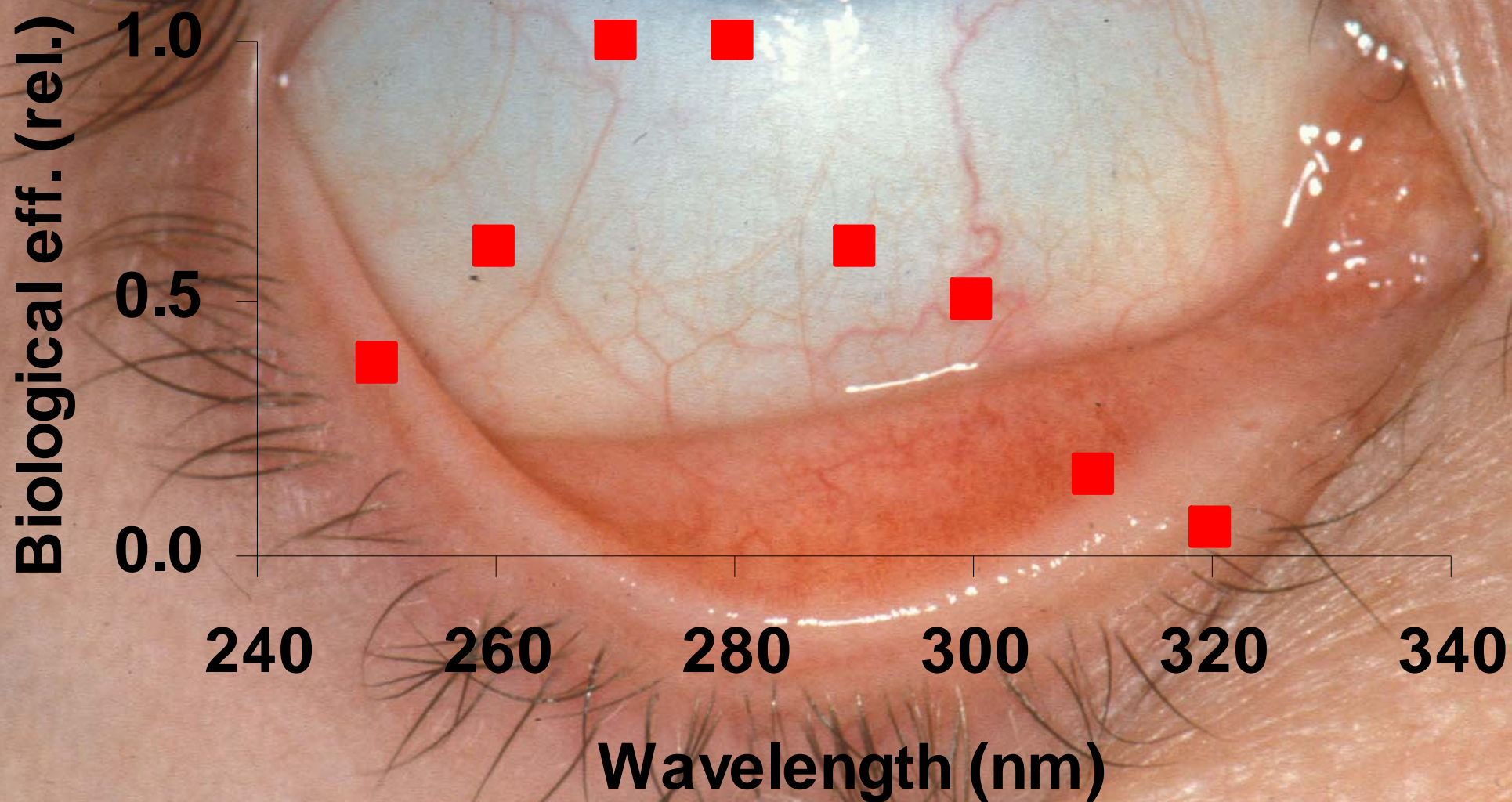
Critical ocular targets in children



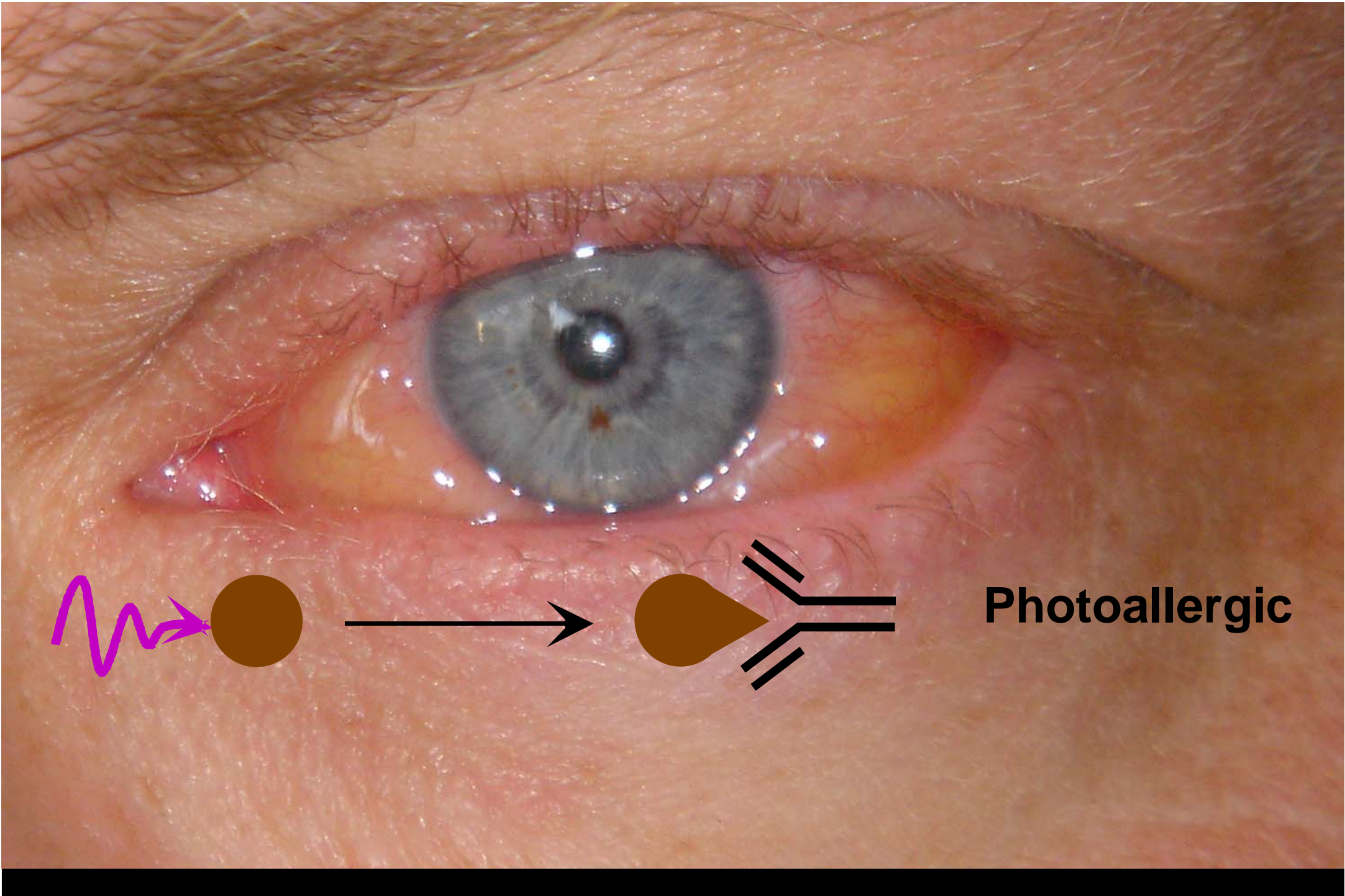




Cullen et al, 1994



Phototoxic



Photoallergic



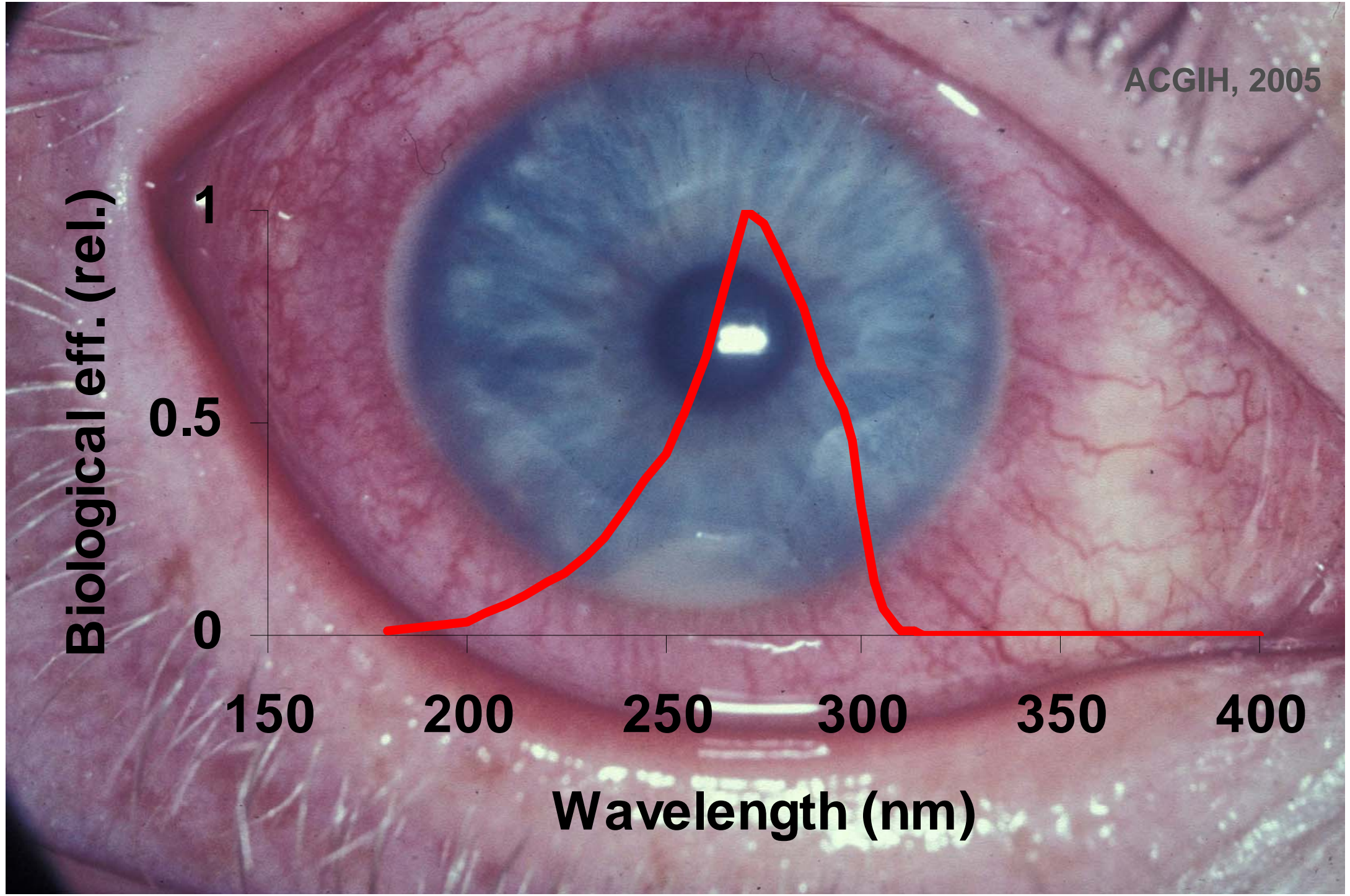
ACGIH, 2005

Biological eff. (rel.)

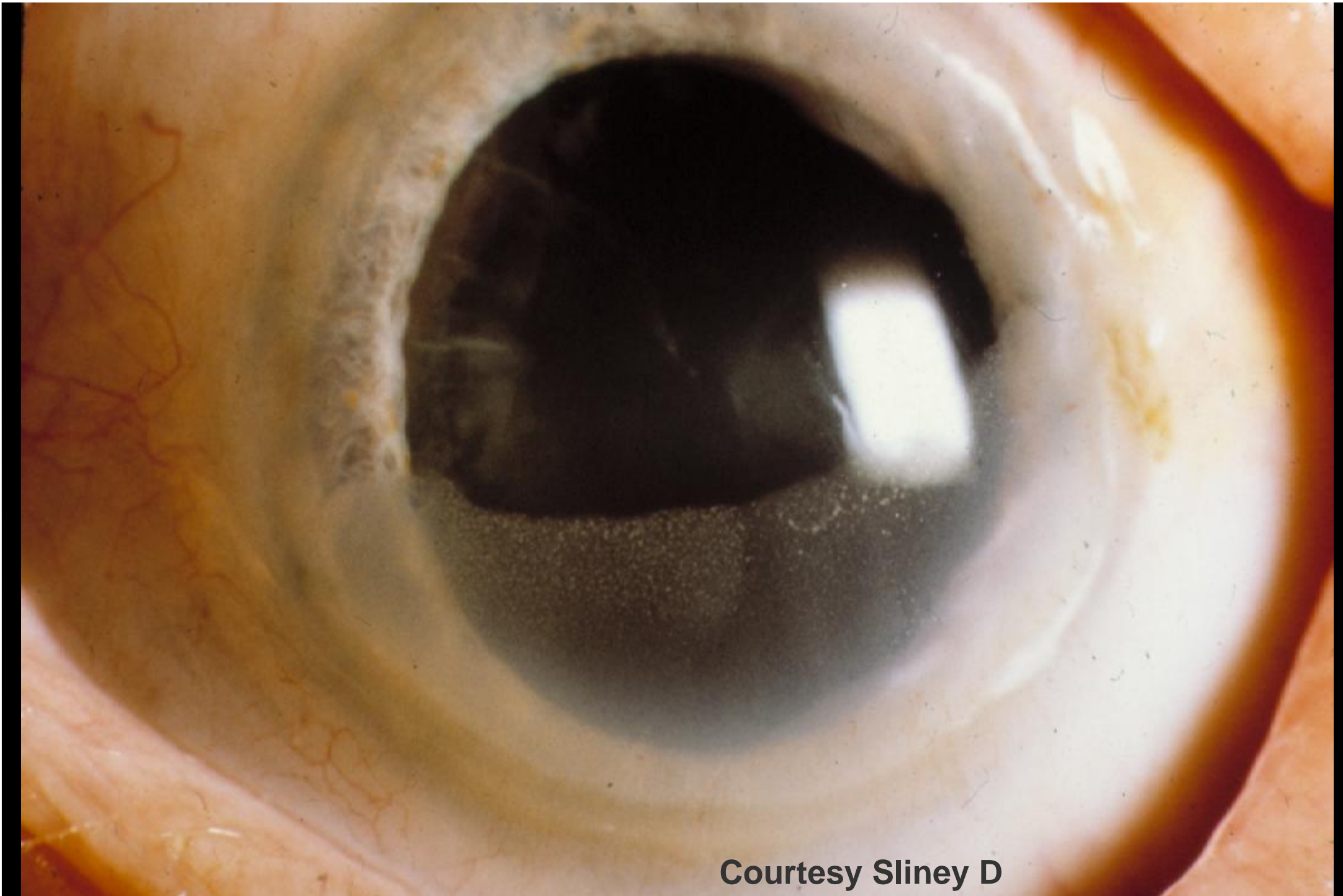
1
0.5
0

150 200 250 300 350 400

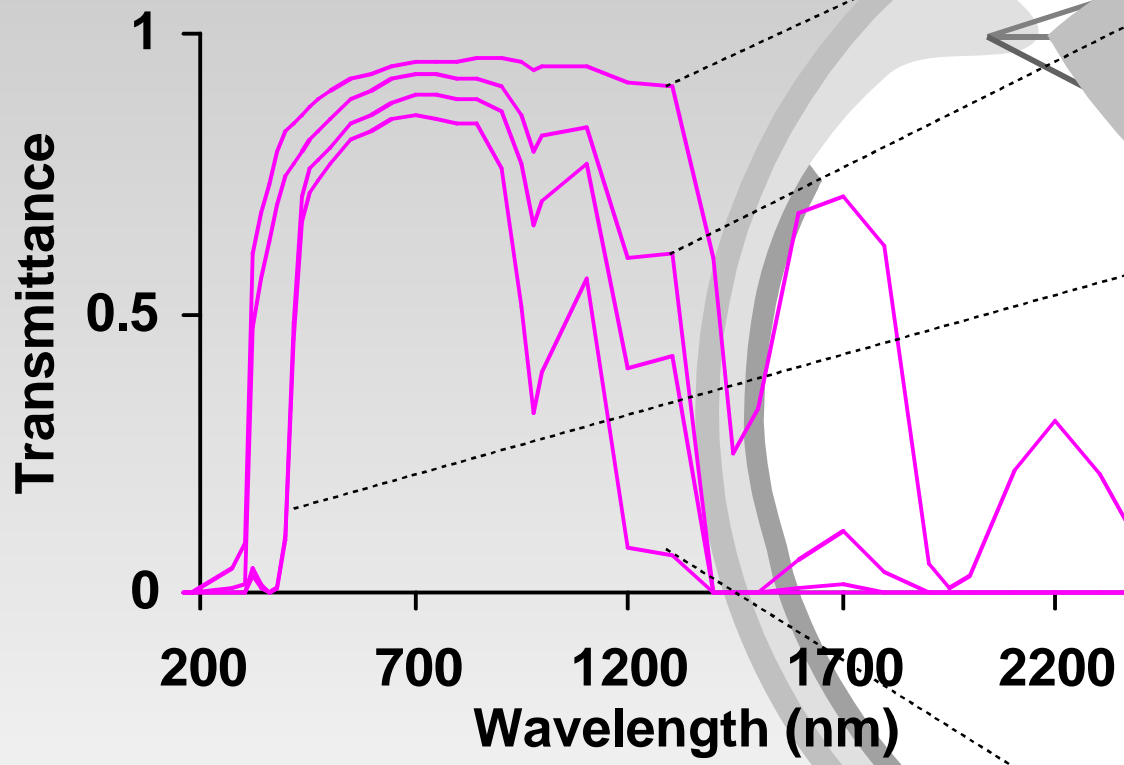
Wavelength (nm)

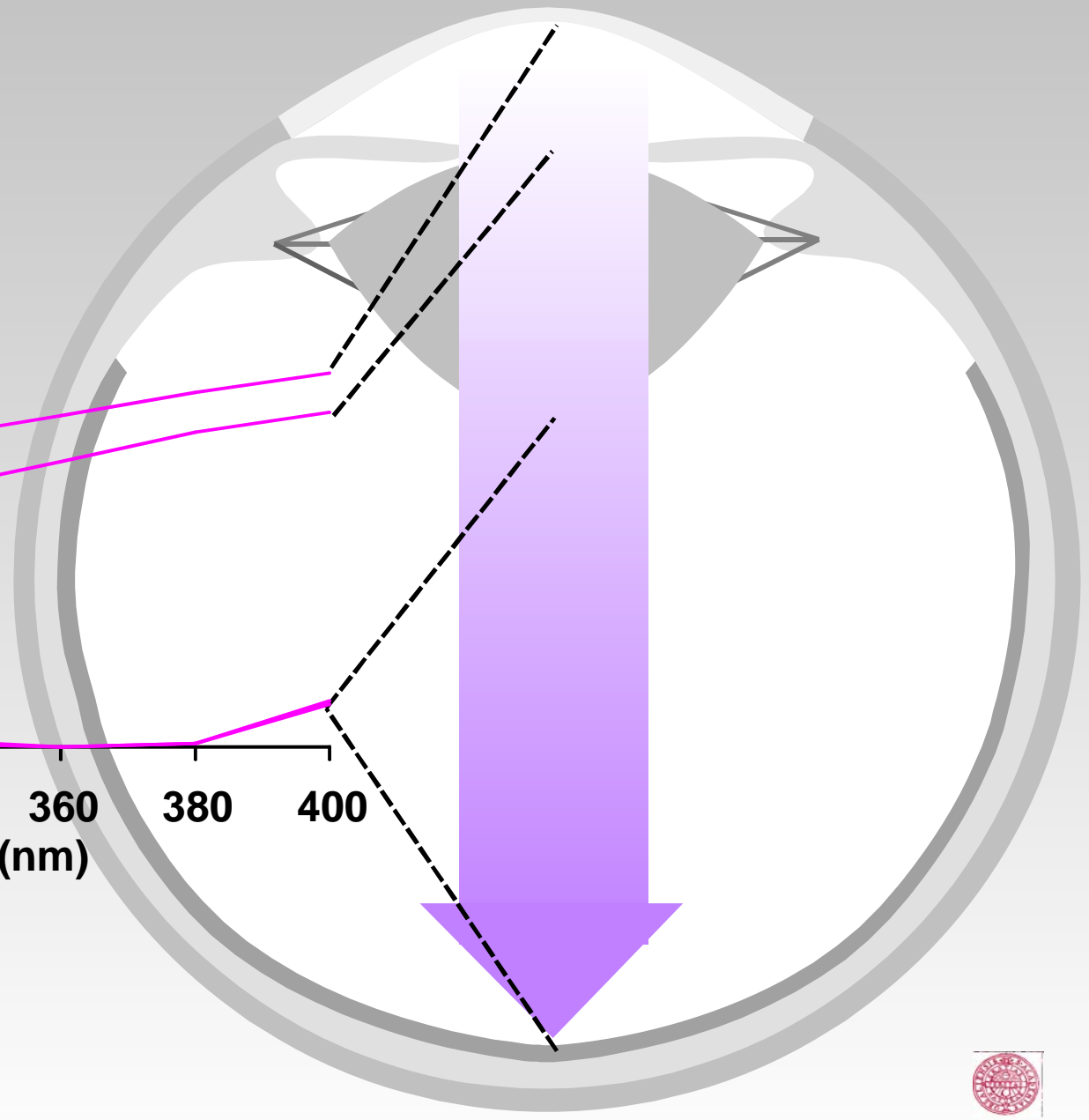
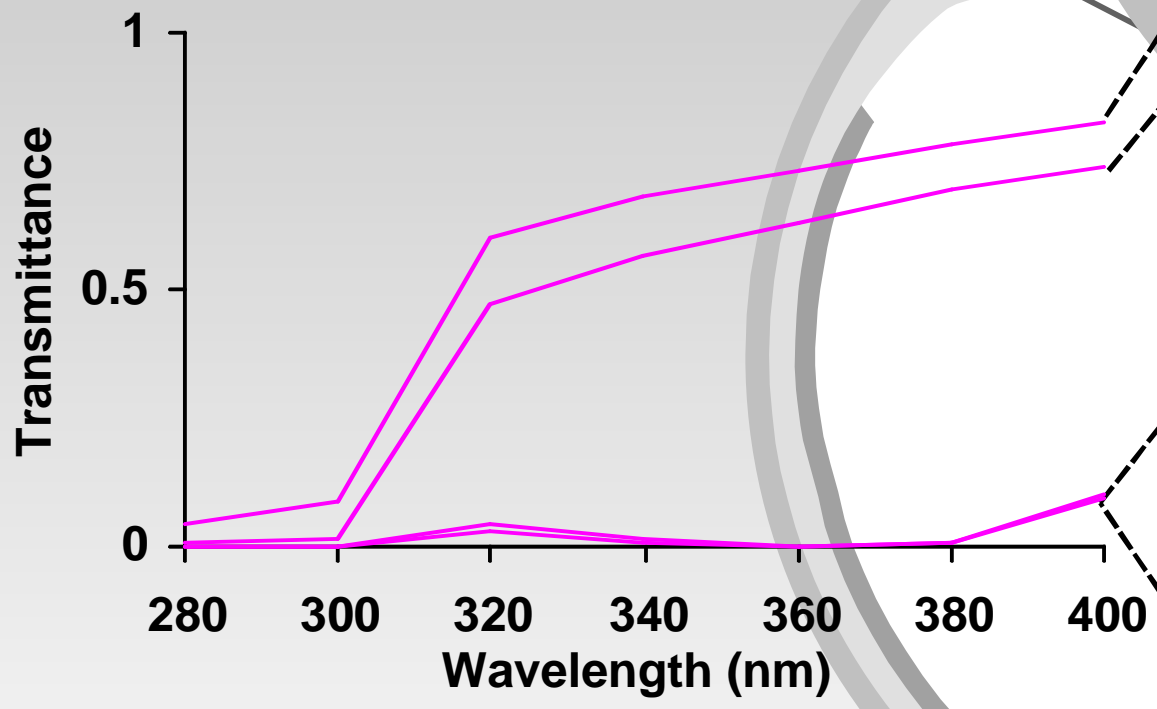






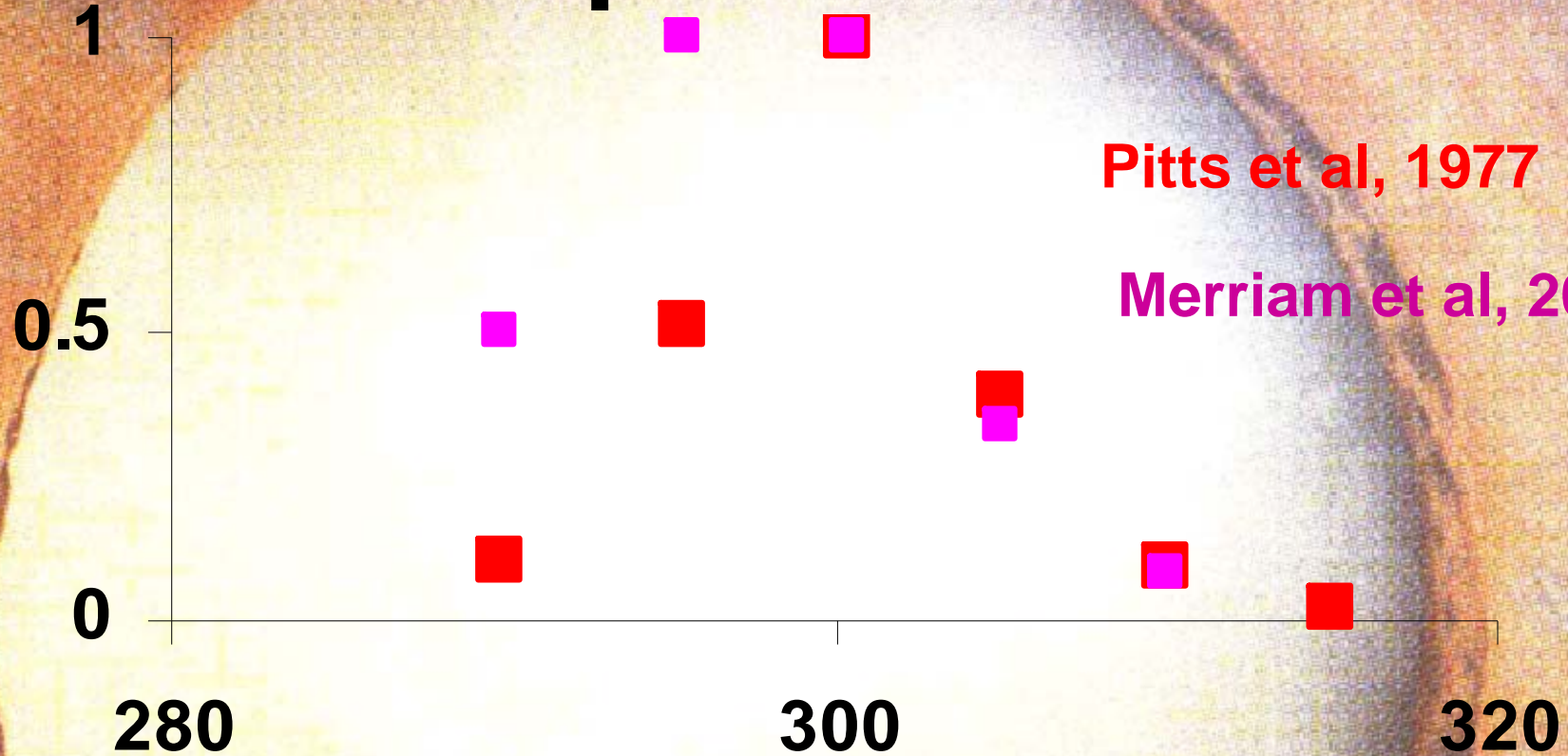
Courtesy Sliney D





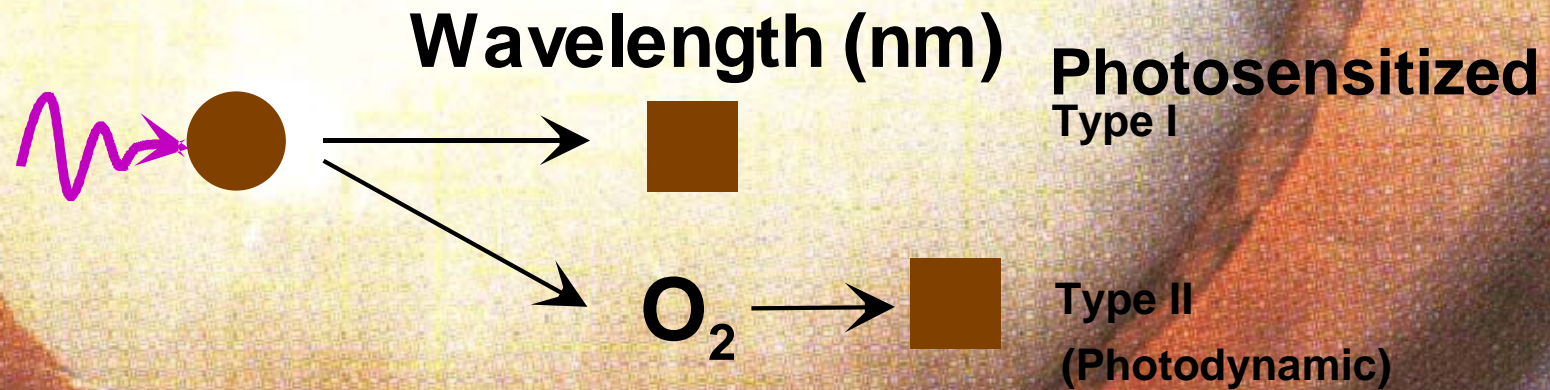
Action spectrum cataract

Biological eff. (rel.)



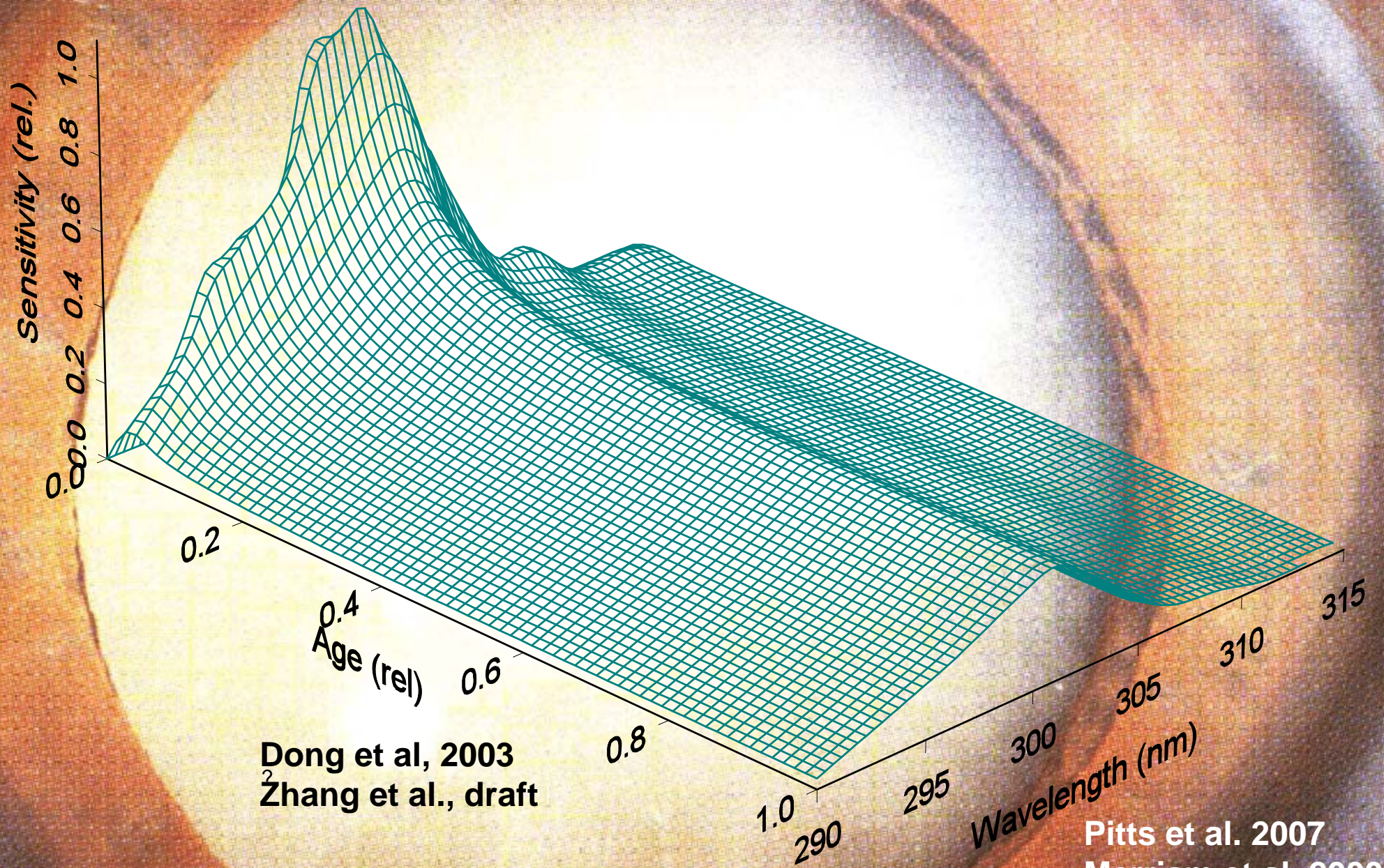
Pitts et al, 1977

Merriam et al, 2000



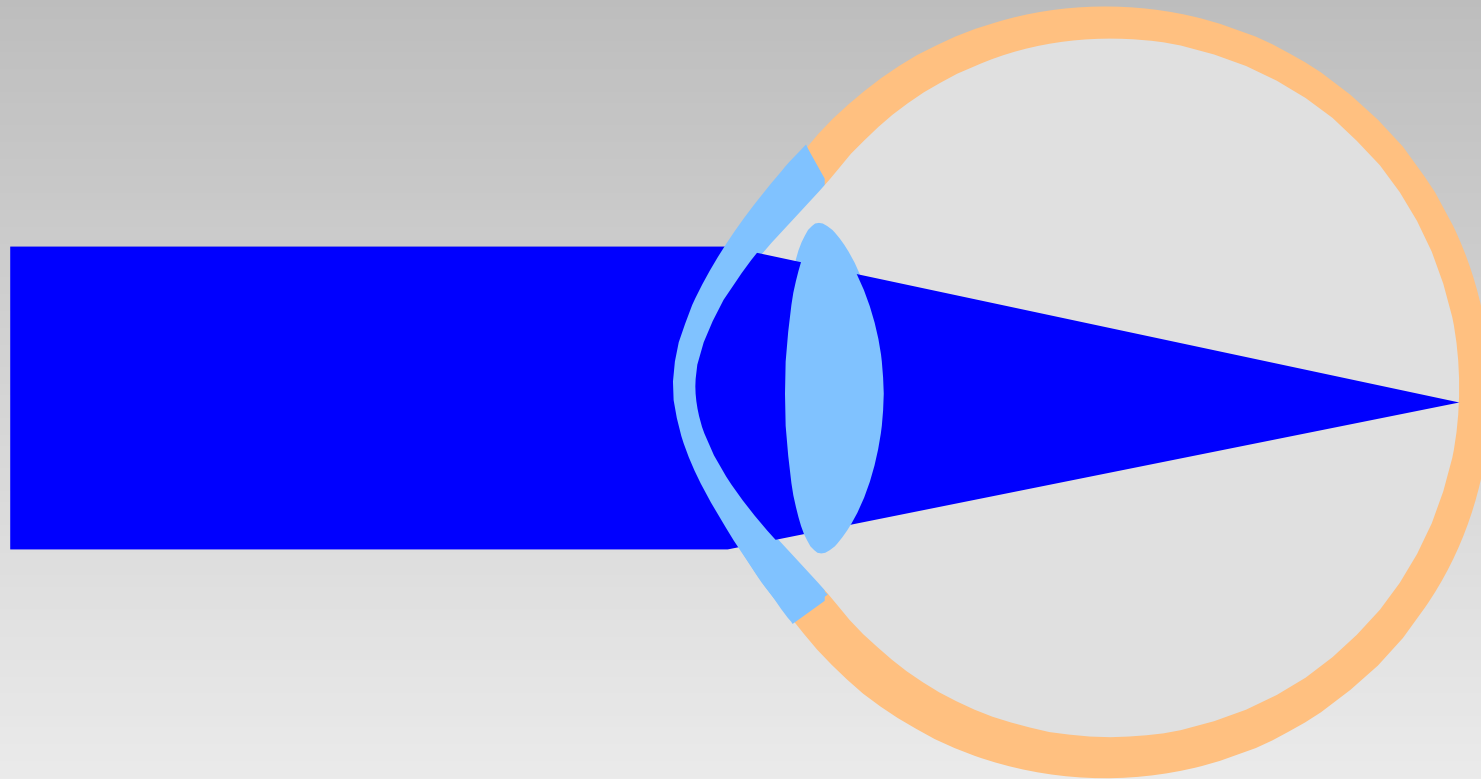
Rel. sensitivity as a function of age





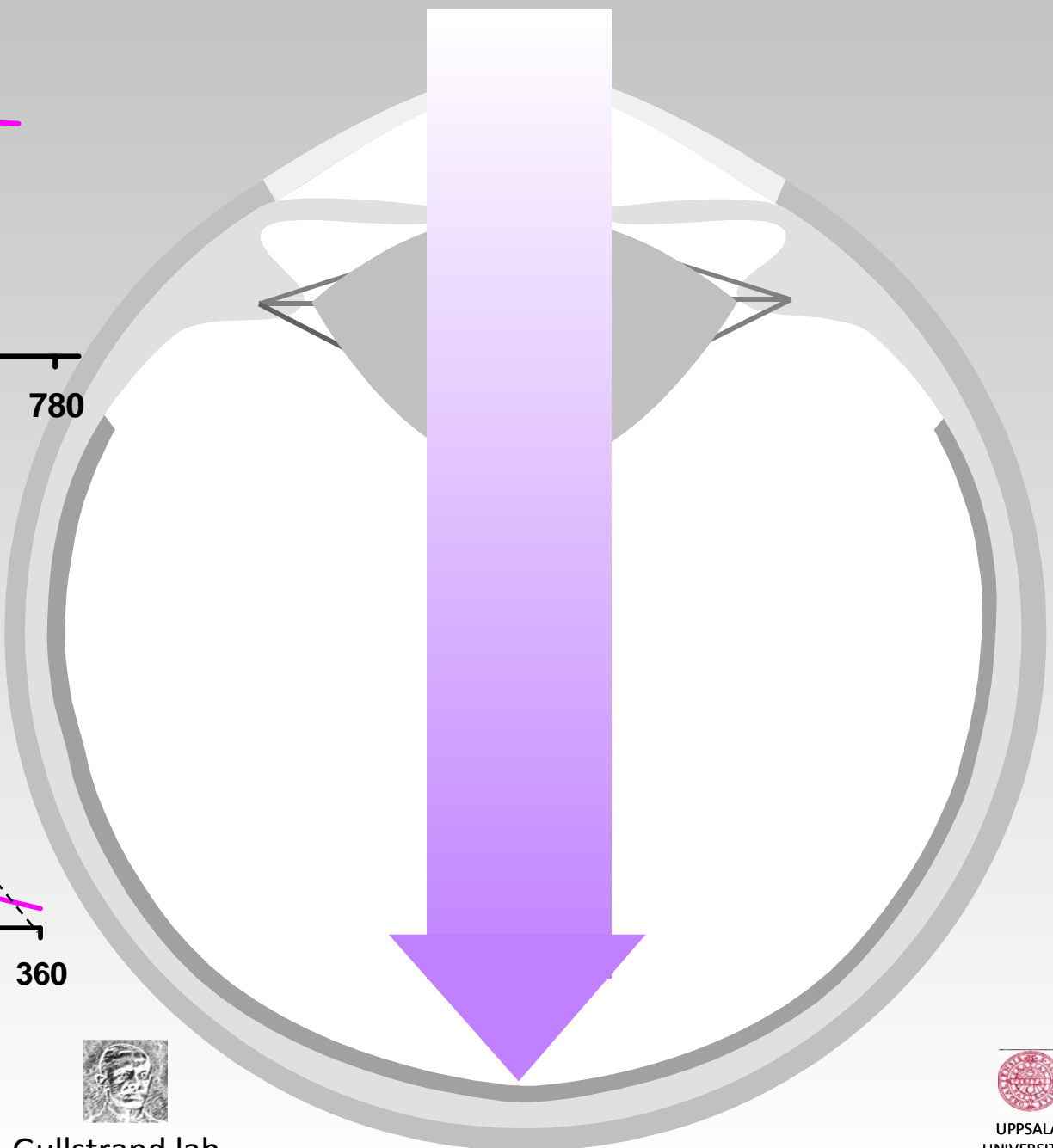
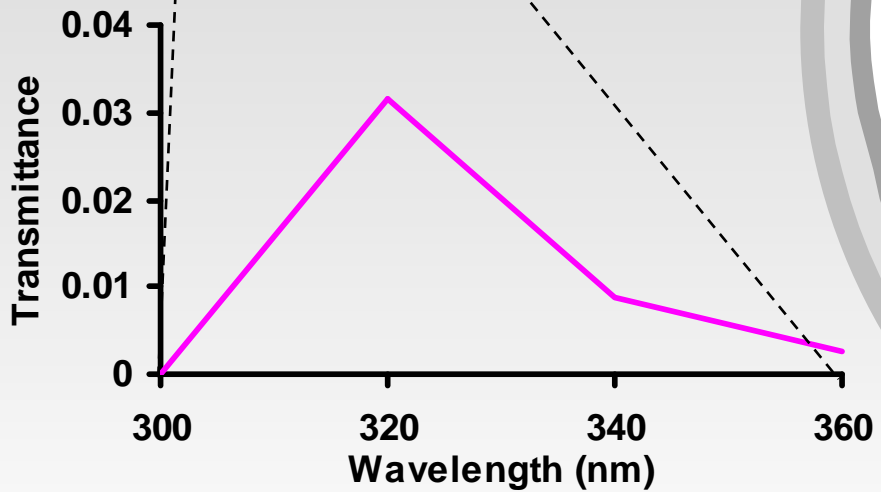
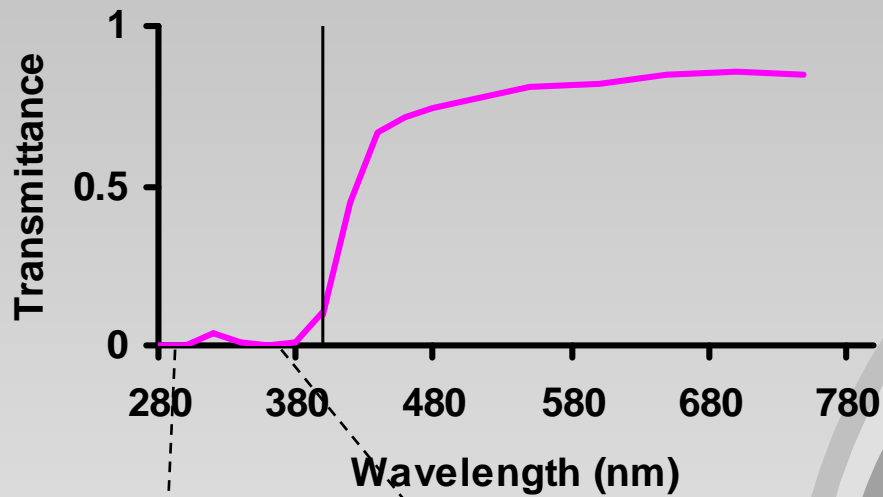
Dong et al, 2003
Zhang et al., draft

Pitts et al. 2007
Merriam et al, 2000



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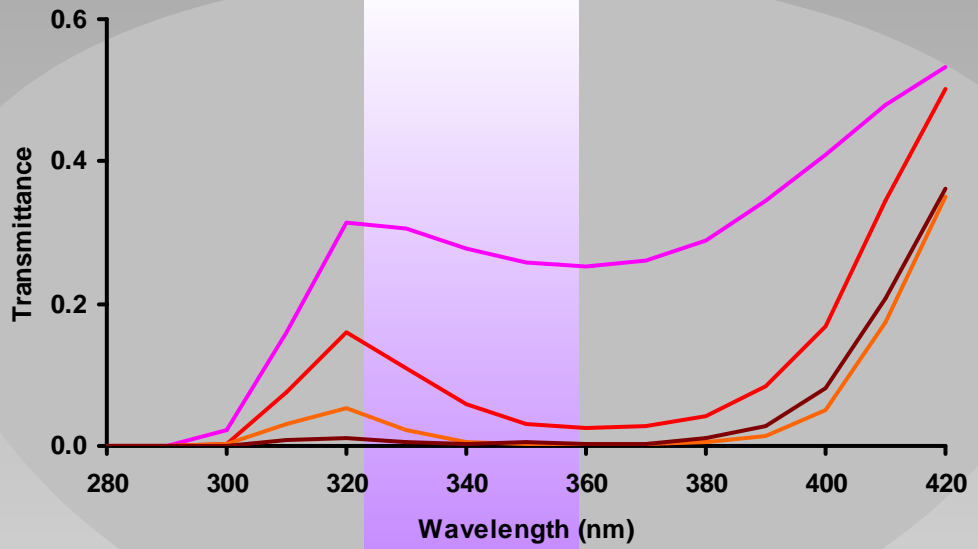
Boettner et al, 1962



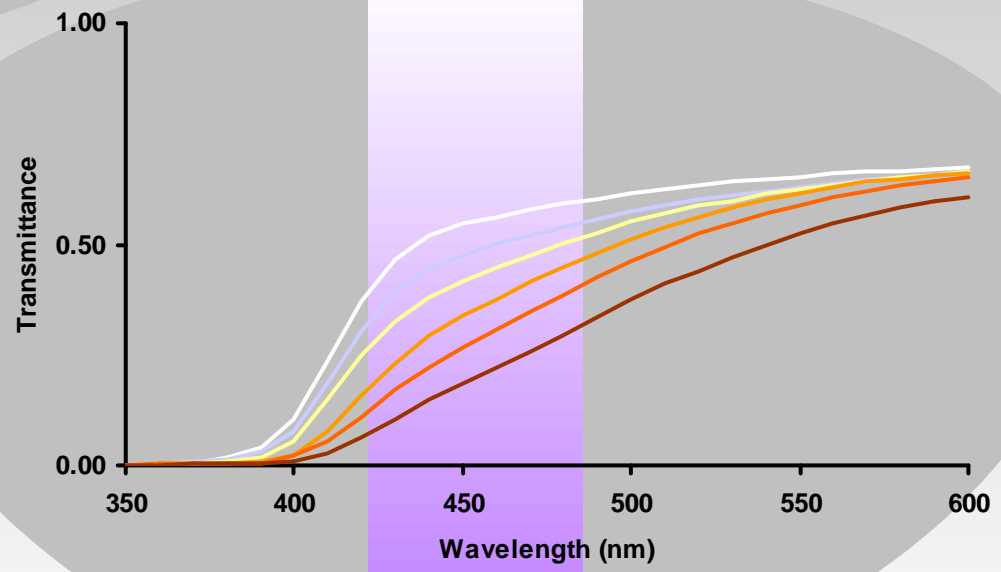
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Prenatal
 Birth
 0-2 yrs
 10-19 yrs



20-29 yrs
 30-39 yrs
 40-49 yrs
 50-59 yrs
 60-69 yrs
 70-79 yrs

WHO, 1994



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Photochemical retinal hazard

Type II Type I

Biological eff. (rel.)

1

0.5

0

300

400

435

500

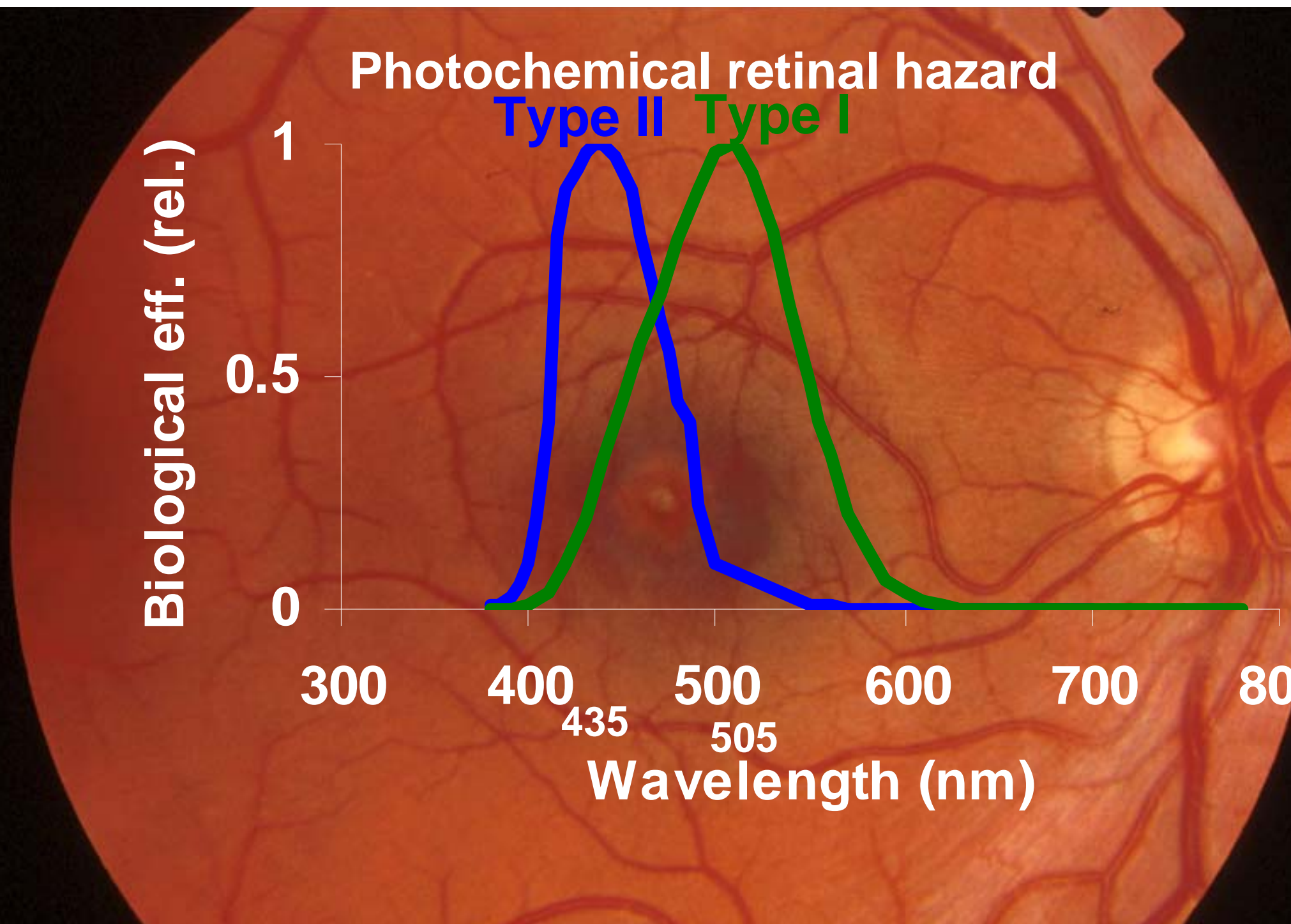
505

600

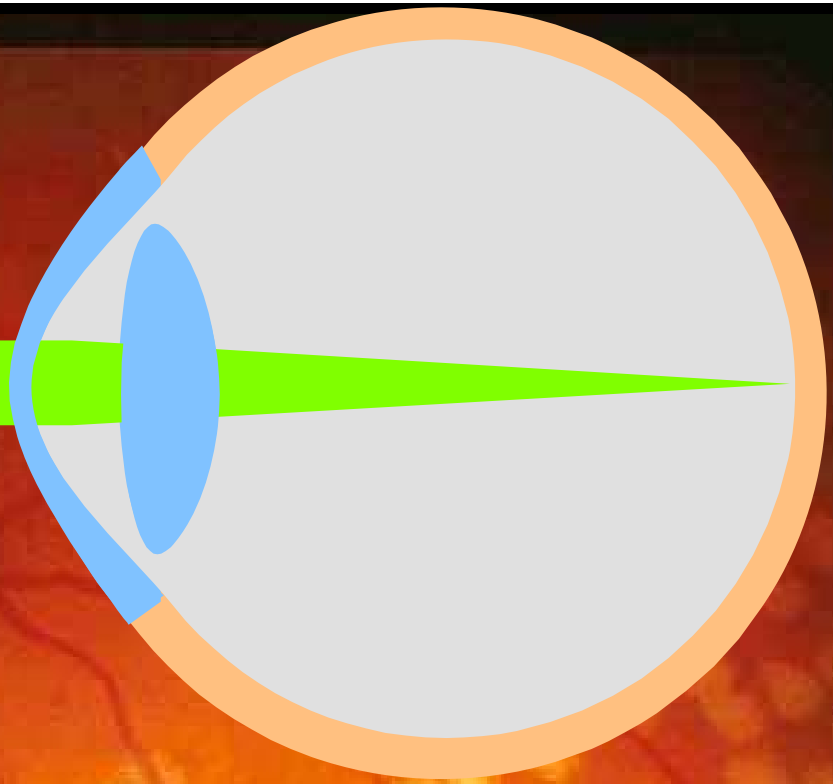
700

800

Wavelength (nm)



≈ 150 mW



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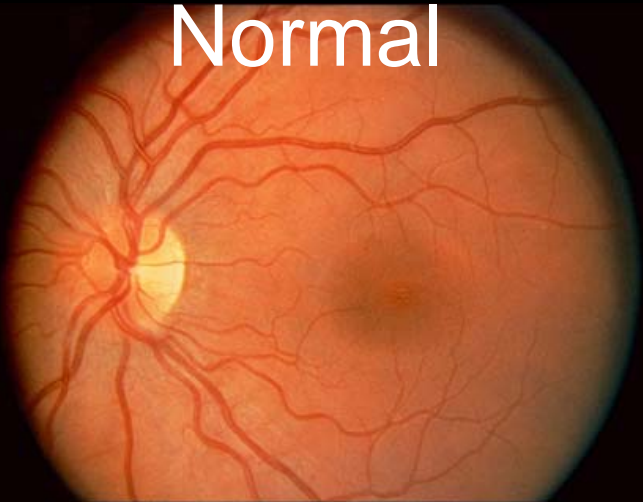
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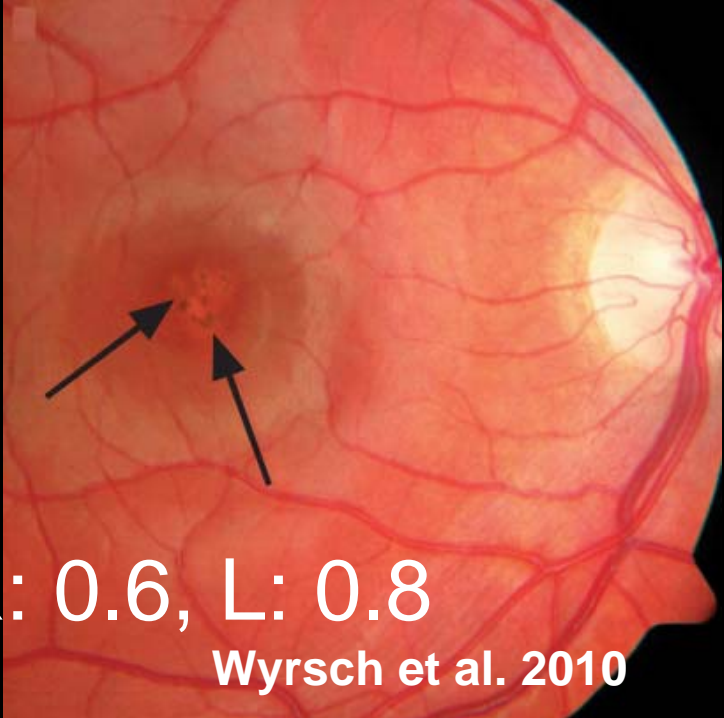
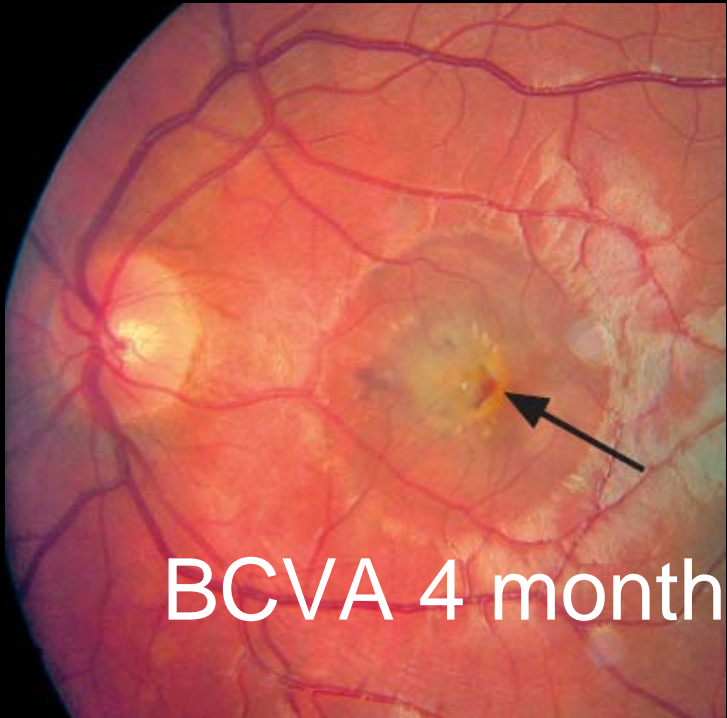
\$54.99
Free Shipping





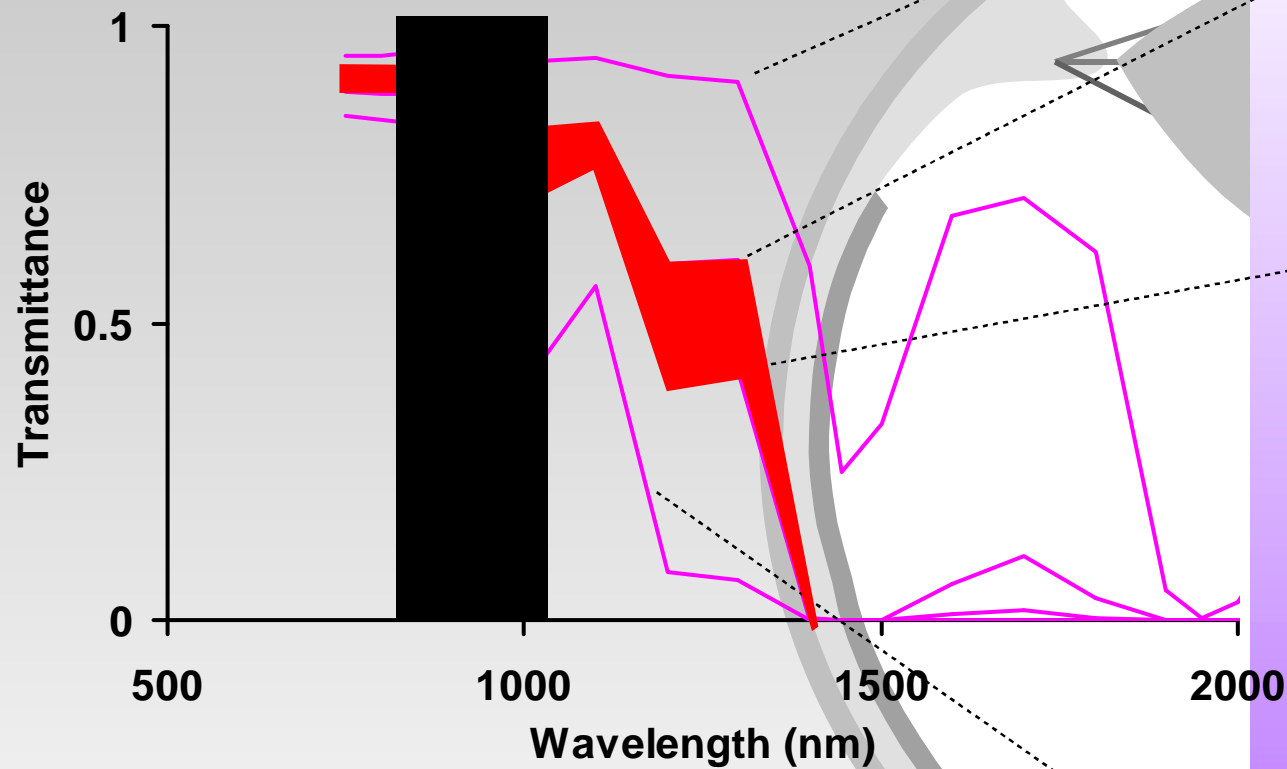
Normal

2 weeks after playing with laser pointer in front of a mirror



BCVA 4 months: R: 0.6, L: 0.8

Wyrsch et al. 2010



Boettner et al, 1962

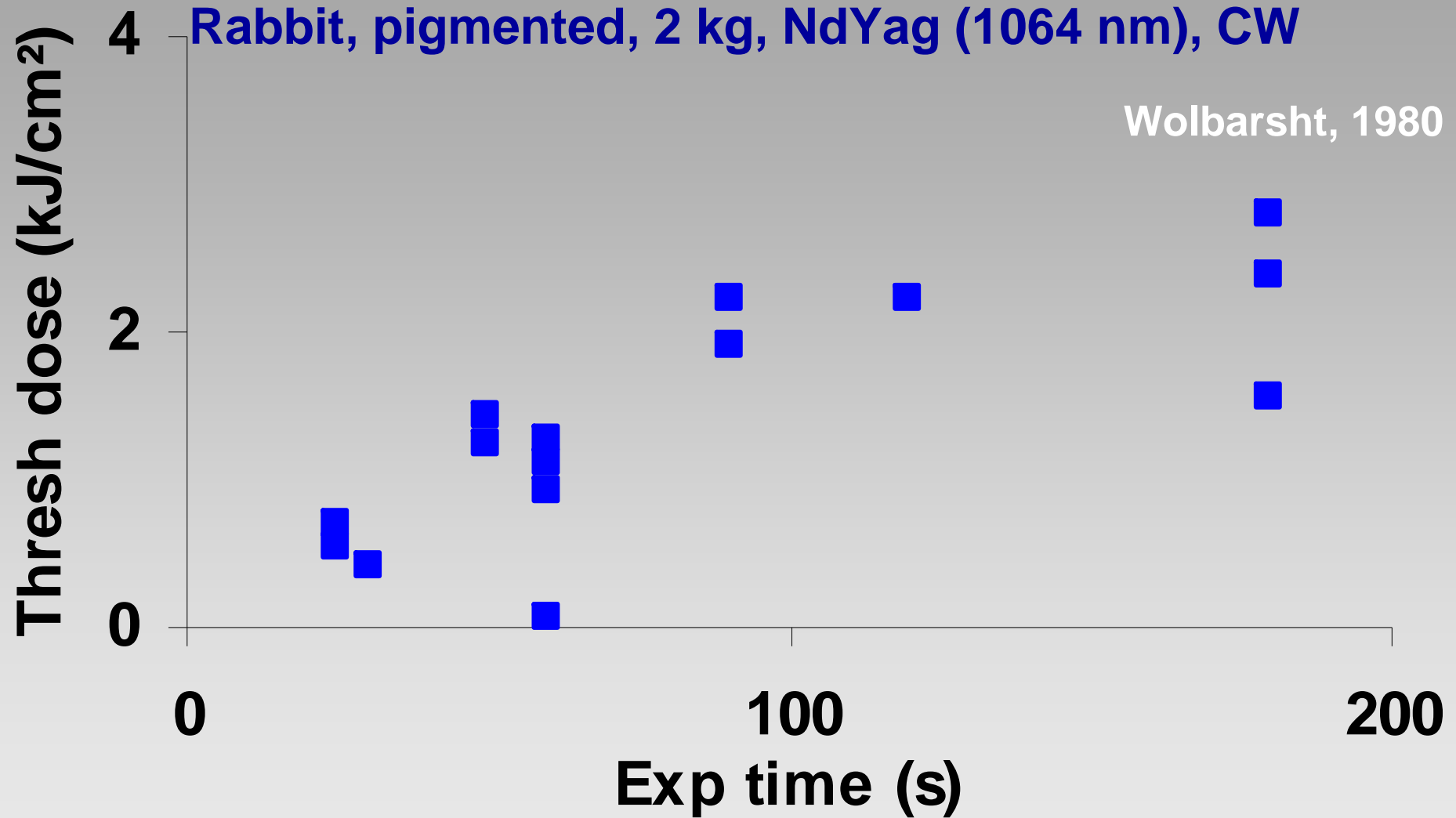


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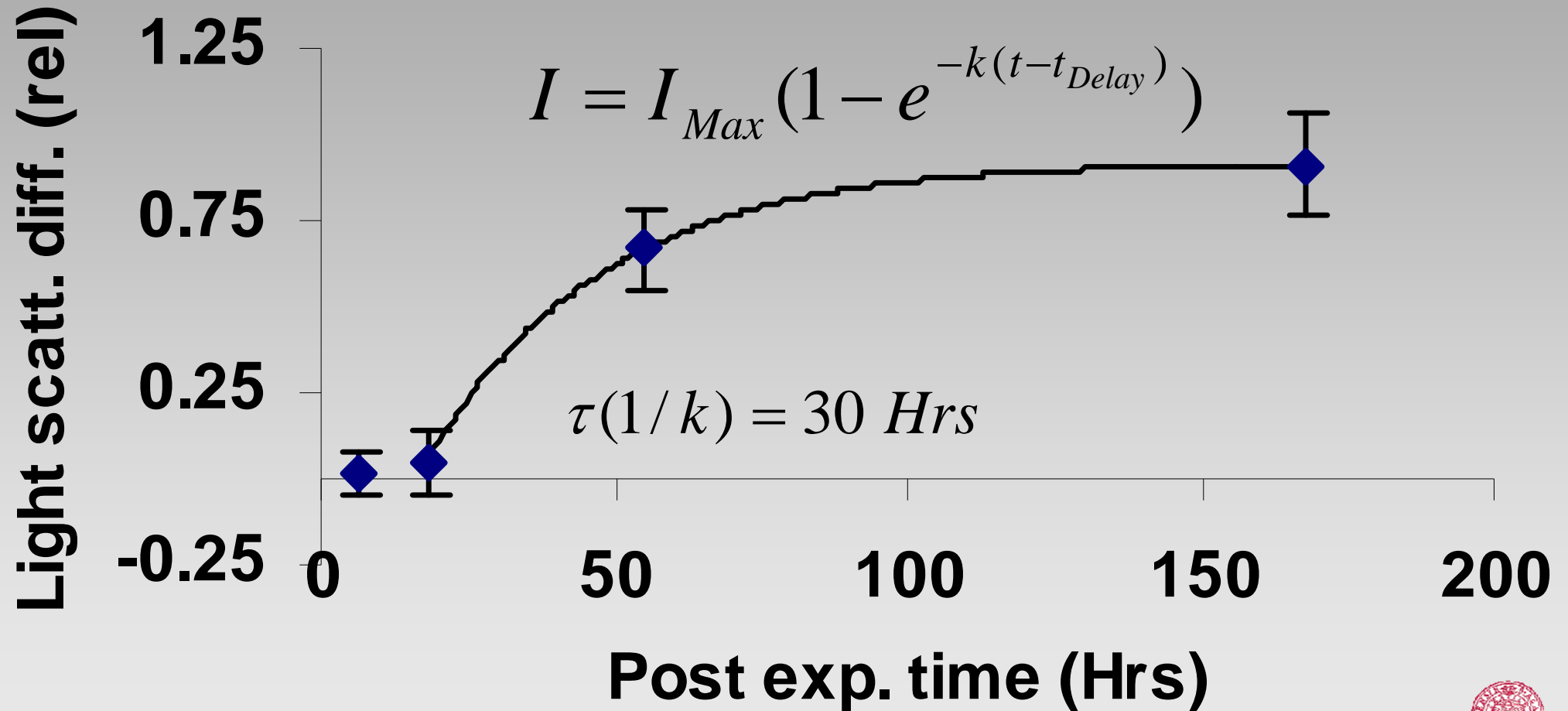
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Threshold dose vs Exp time



Evolution of IRR-cataract

Albino SD rat, 1090 nm, 6.2 W within (3 mm), exp time 8 s (0.7 kJ/cm²)



Summary



UVR: Acute damage is related to radiant dose. Several ocular pathologies have been epidemiologically associated with exposure to UVR from the sun.

Children show:

- Inverse age dependent sensitivity to UVR induced cataract.



- Inverse age dependent lens transmittance to UVR

High power handheld visible lasers, although illegal in many countries, are easily available on the internet and are a serious threat against vision for young adult children



If near infrared radiation causes a photochemical effect in the lens, remote controls and remote sensing may be a long term threat for the lens in children and thus their vision

