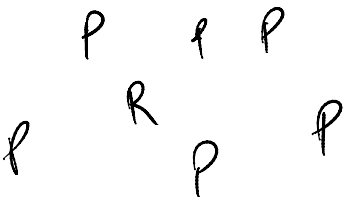
Last time: Treisman — ca. 1980, fairly dated by now
her model of visual attention has some limitations
e.g. based on conjunction of features —
something like a 'J' to be a
conjunction of '|' & '—' — two low-level
features



— more "recently" (1994) Kosslyn refined model of visual
attention proposing an attentional window
involves formation of
mental maps
applied to mental imagery: you form mental
maps when
navigating, for example
e.g. "picture internally a way to the post office"

are same neurons used to do this as for visual
perception?
— need to look at neuroscience.
— then do experiments that measure brain
activity e.g. MRI, CAT scans, etc
— can combine MRI + eye tracking

or, eye tracky + brain-implanted electrodes

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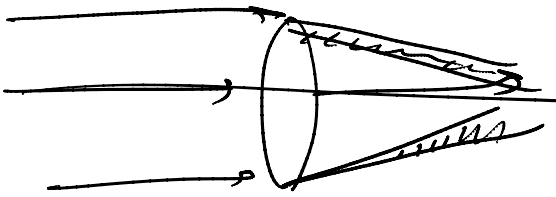
Neurophysiology of the HVS
Human Visual System

- In book, I start from outside in: eyes → brain
- The eye: "world's worst camera"

optical imperfections: 1. prismatic effect of peripheral parts of the lens

But: curvature of cornea is flatter topology



lens

But: eye is focused to produce sharp images of intermediate wavelengths

2. chromatic aberration
shorter wavelengths (blue) refracted more than longer (red)

But: retina is curved to compensate

3. curvature of field
a planar object gives rise to a curved image

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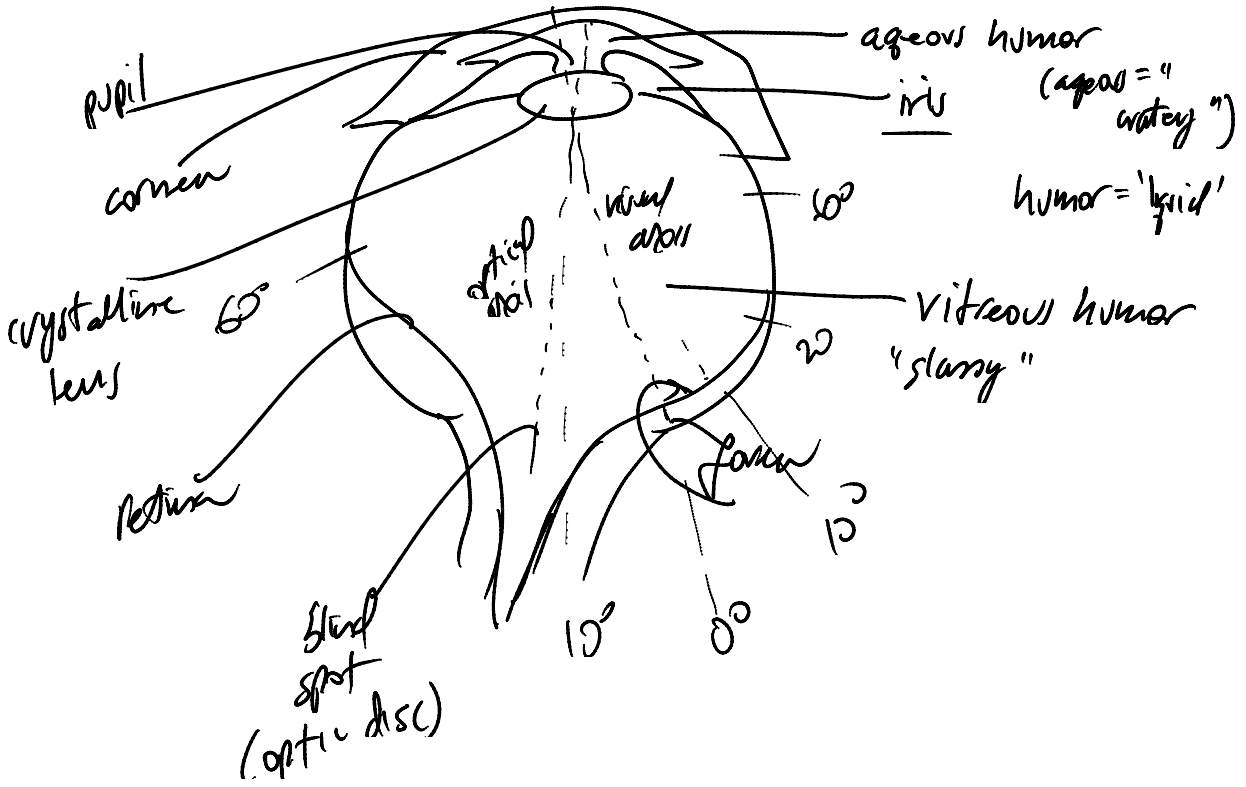
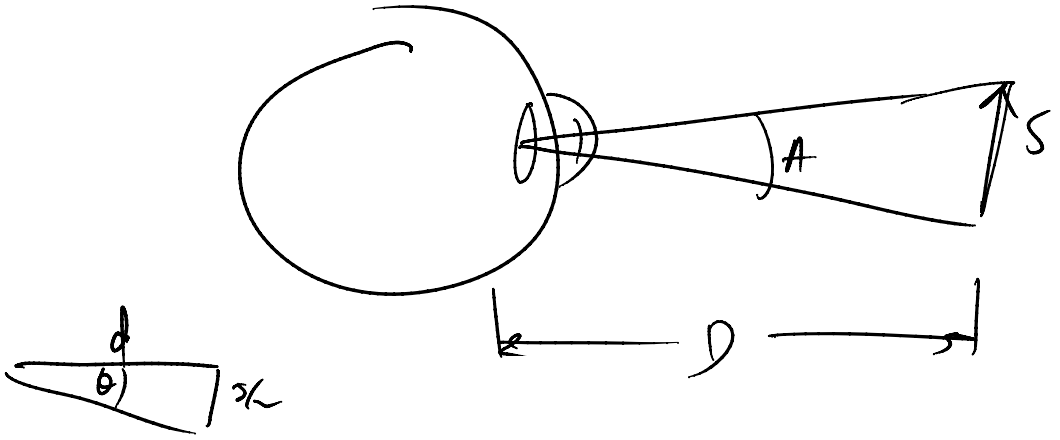


- dimension of retinal features: measured in deg. visual angle



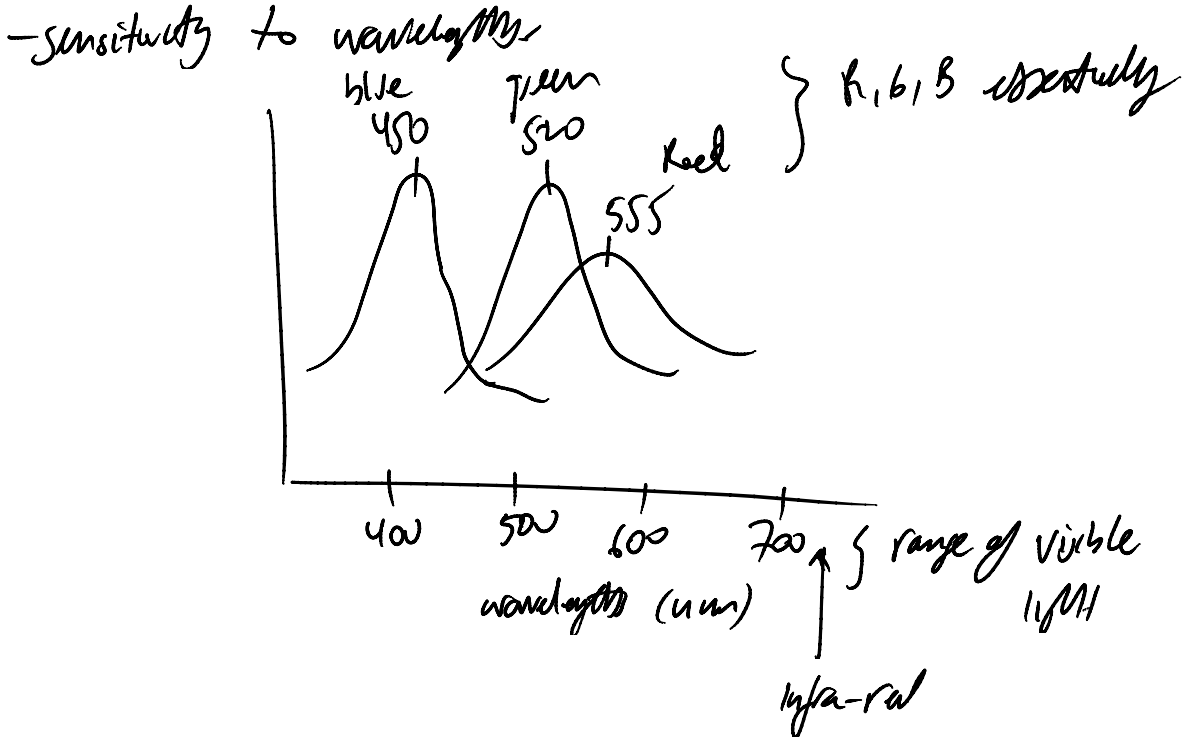
$\tan\theta = \frac{\frac{S}{2}}{D} = \frac{S}{2D}$ $\theta = \tan^{-1}\left(\frac{S}{2D}\right)$ ("half-angle")

full angle $2\theta = 2\tan^{-1}\left(\frac{S}{2D}\right)$

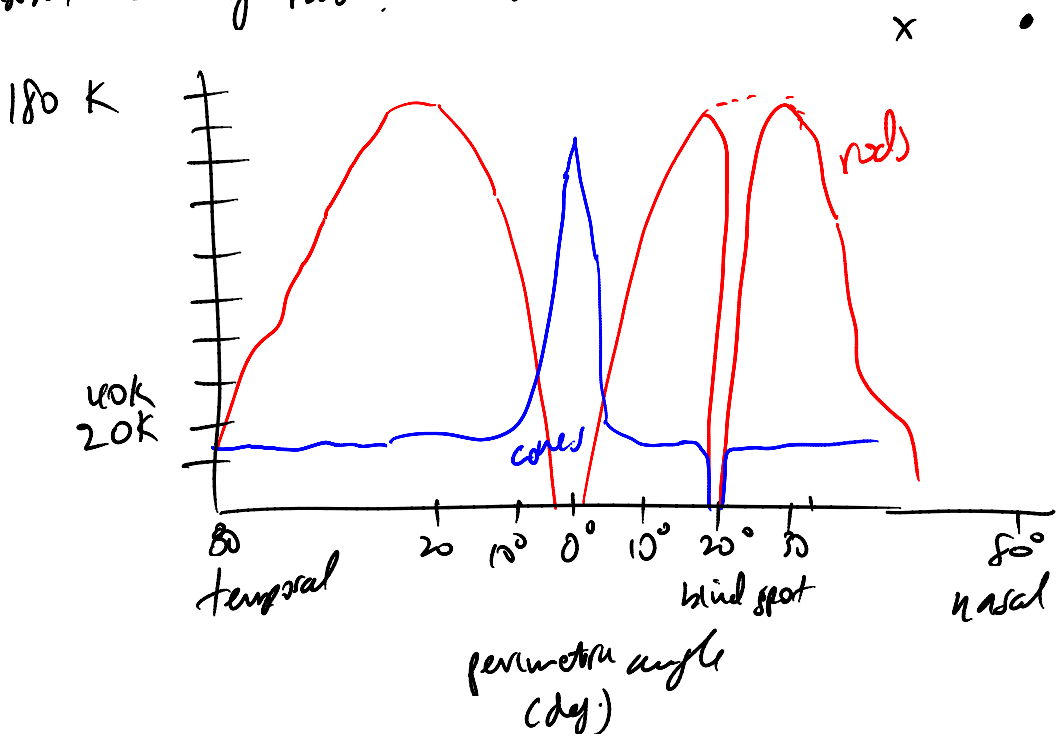
- Common visual angles:
  - thumbnail at arm's length: subtends 1.5–2°
    V.c
  - sun & moon: .5°
    or 30' of arc
    (dia. of fovea
    ↑
    inner part of fovea)
  - US quarter (25¢ piece):
    at arm's length 2°
    at 85 m, 1' (1 min of arc)
    at 5 km, 1" (1 second of arc

The retina:

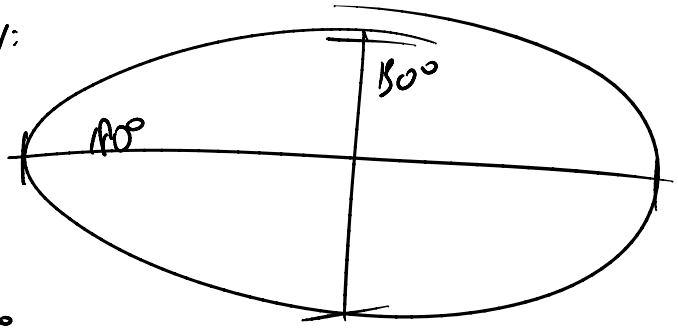
- contains photoreceptors
  - 1st stage of visual perception
  - transducers converting light energy to elec. impulses
  - neural signals leading to cortex start here
- 2 types of photoreceptors:
  - rods
    - sensitive to dim and achromatic light (night vision)
    - 120 M of them, hardly any in fovea
  - cones:
    - respond to bright, chromatic light (day vision)
    - 6-7 M of them — most of them in fovea


-sensitivity to wavelength-
blue
450
green
520
Red
555
} R, G, B respectively
400
500
600
700
wavelength (nm)
} range of visible light
infra-red

- distribution of rods & cones

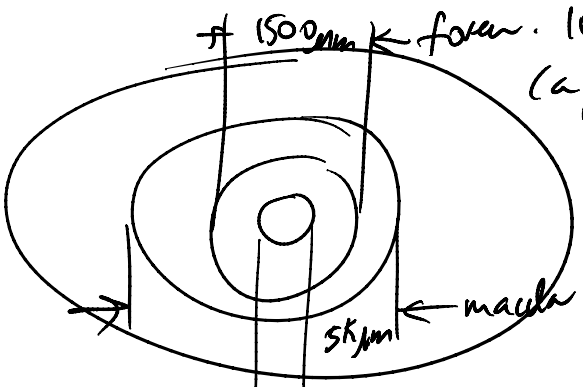


field of view:



highest acuity region: 2°-5° of

at 5° acuity (resolvability) drops off sharply



1500 μm ← fovea: 100K-120K cones (a few rods) 5°

macula (central retina) 16.7° 650K cones

5K/mm

400 μm fovea: 25K cones, 1.3° v.a.

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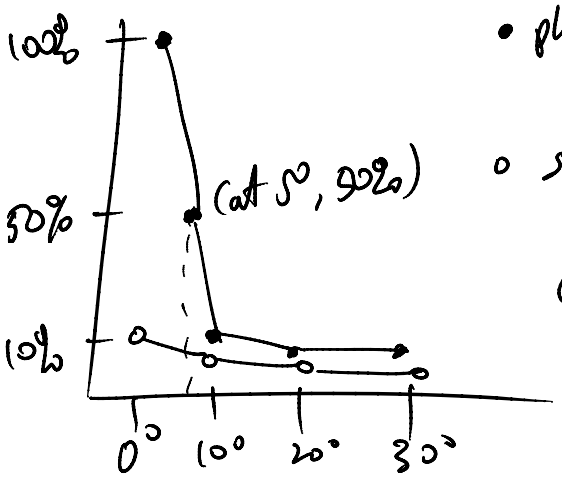
Visual acuity (spatial)
↳ how well can one resolve spatial detail



- photopic (day) light level
- scotopic (night) light level
  (acuity is poor at all eccentricities)

How is this measured? psychophysics — subjective perception
psychophysical variables: brightness
↓
perception of intensity.

tests of acuity:
E
A B
C D E Z

C Landolt ring
| vernier → hyperacuity

— 4 other types of cells:
- amacrine cells
- horizontal
- bipolar cells
- ganglion cells

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- what's important about retinal neurons & their connections