Theories of Perception

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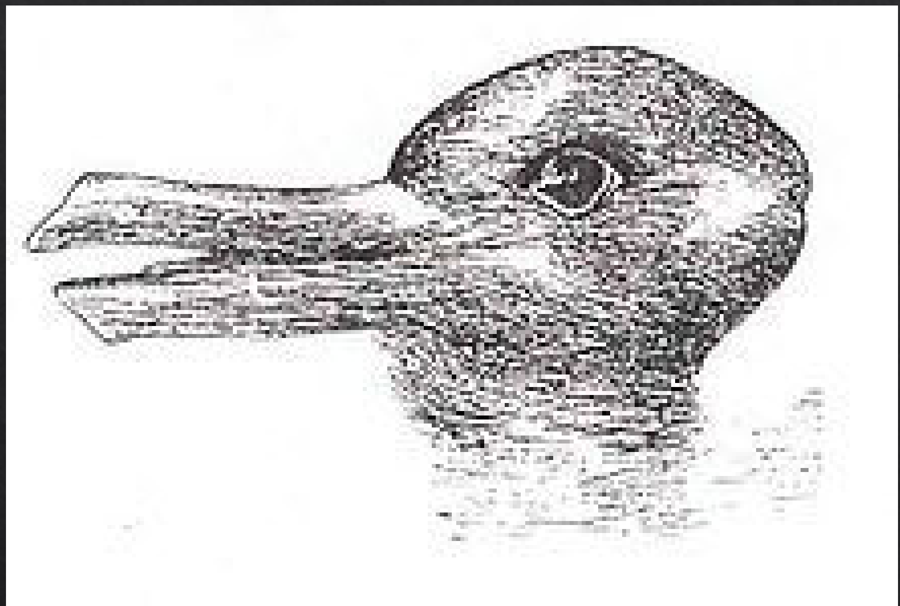
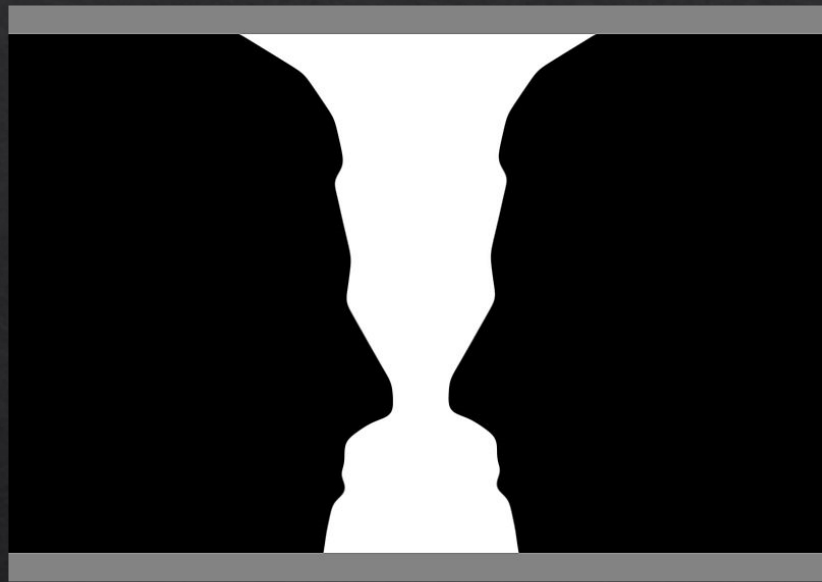
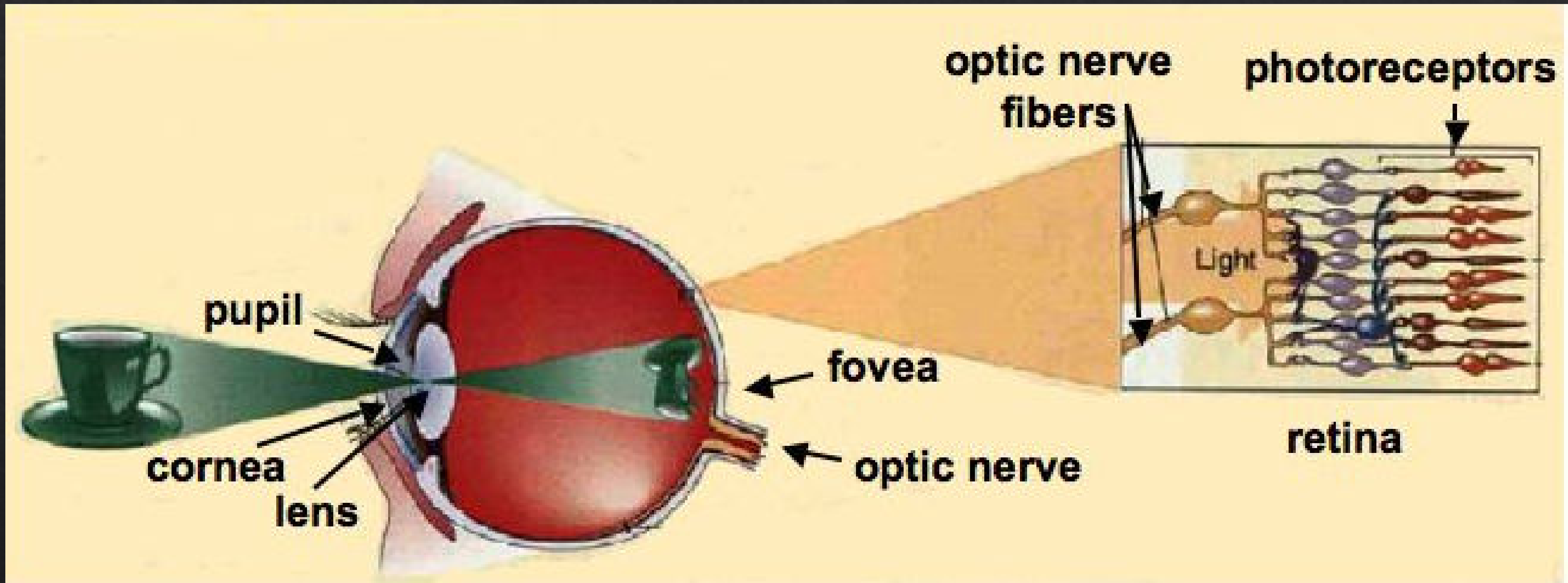
Vision

Same stimuli – Different Perception



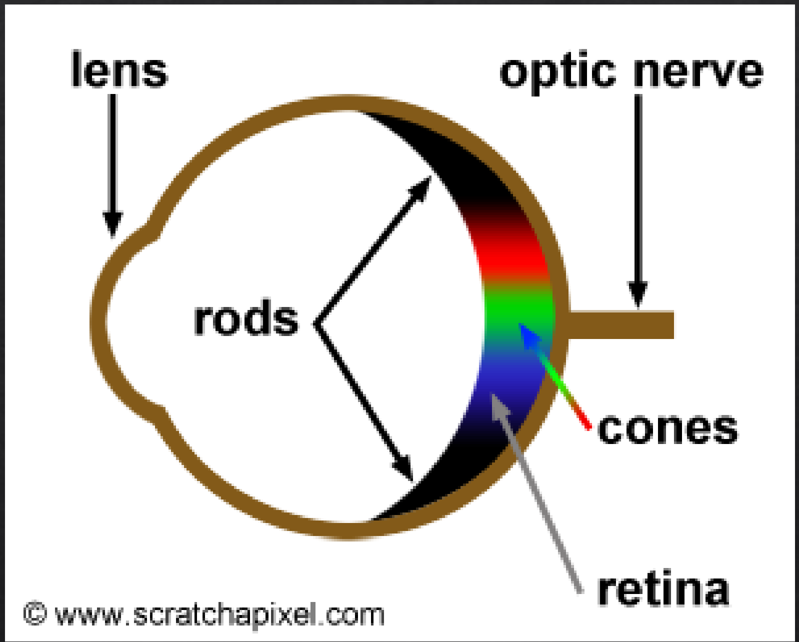


Eye


optic nerve
fibers
photoreceptors
Light
pupil
fovea
retina
cornea
optic nerve
lens

Human Eye

- FoV, both eyes combined 200-220^0
- Peak visual acuity 0.5-1^0
- Fovea 1-2^0
- Head movement range approximately 50^0
- Ratio of maximum to minimum perceivable light intensity is 10^{10}



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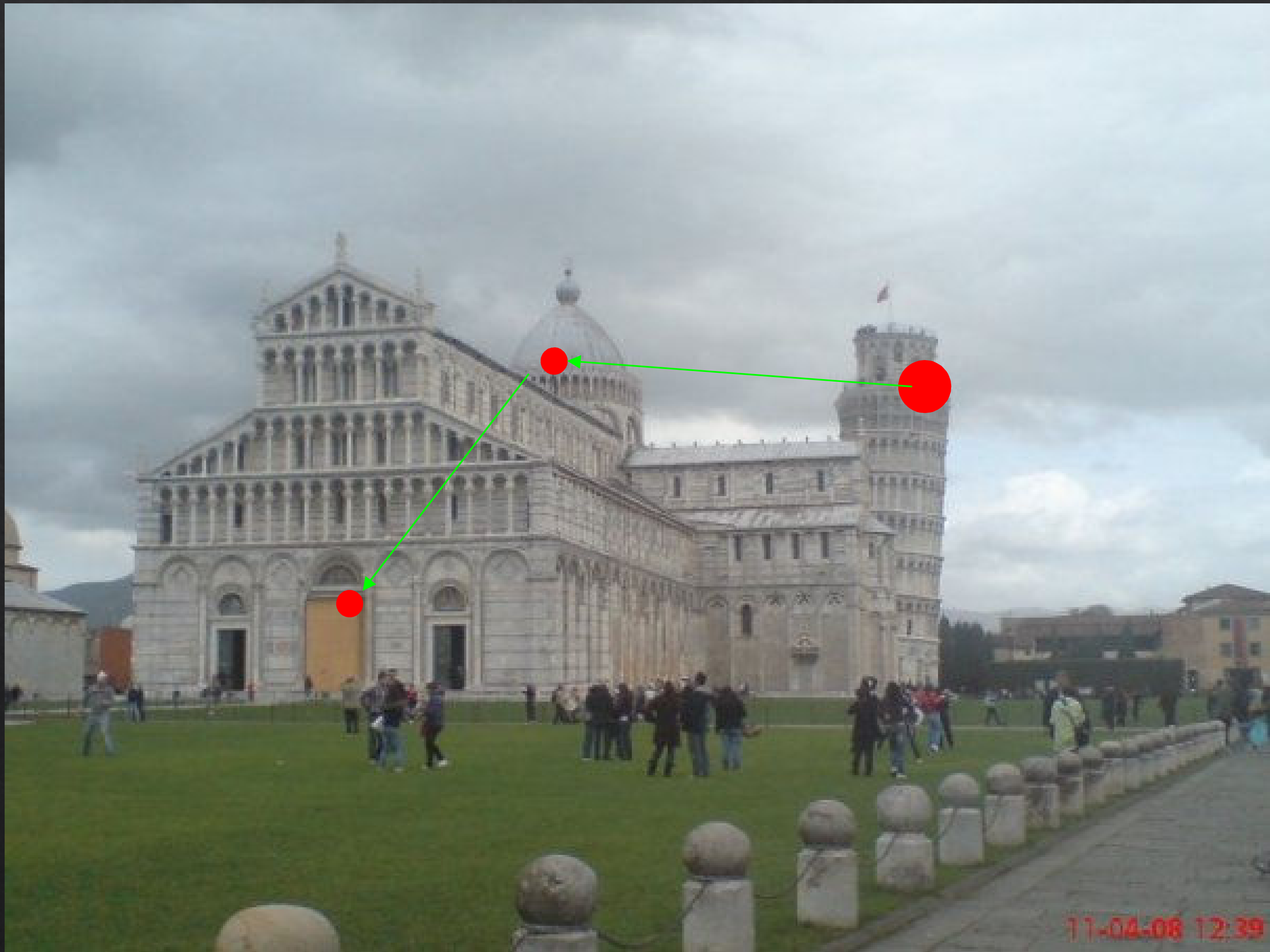
Principle of Vision

- Top down theory: You perceive what you want to
- Bottom up theory: You decompose & reconstruct
- Visual Search
  - Serial (search time ∞ number of items)

  - Parallel (pop out effect)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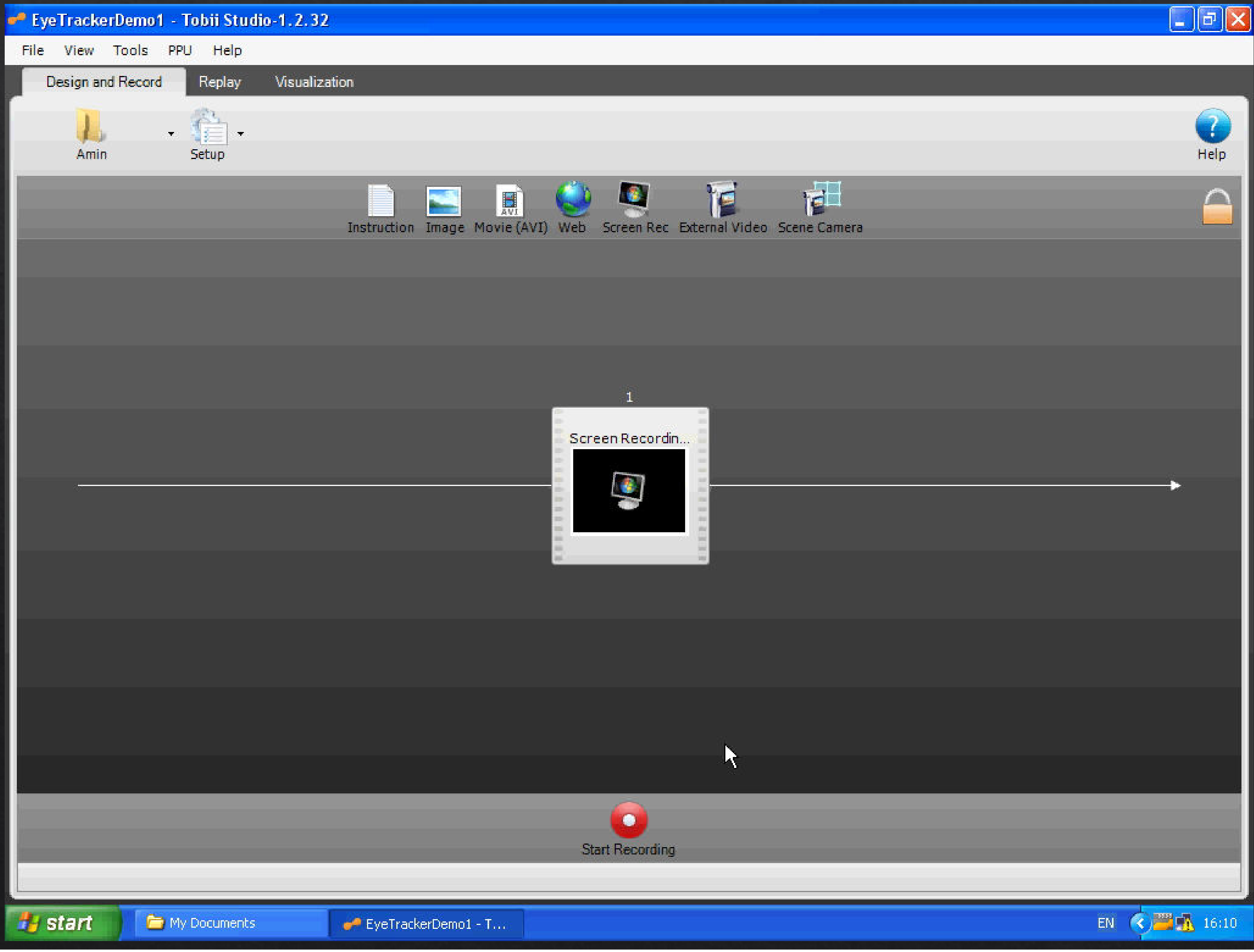
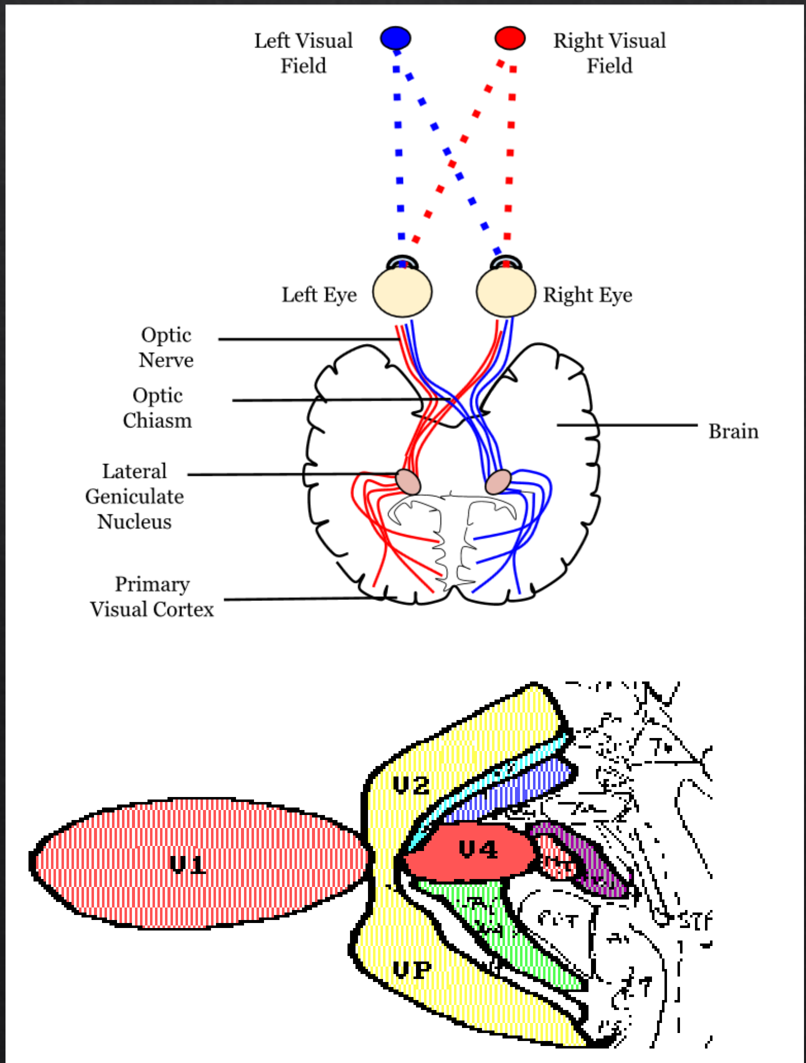
Recording from an eye tracker

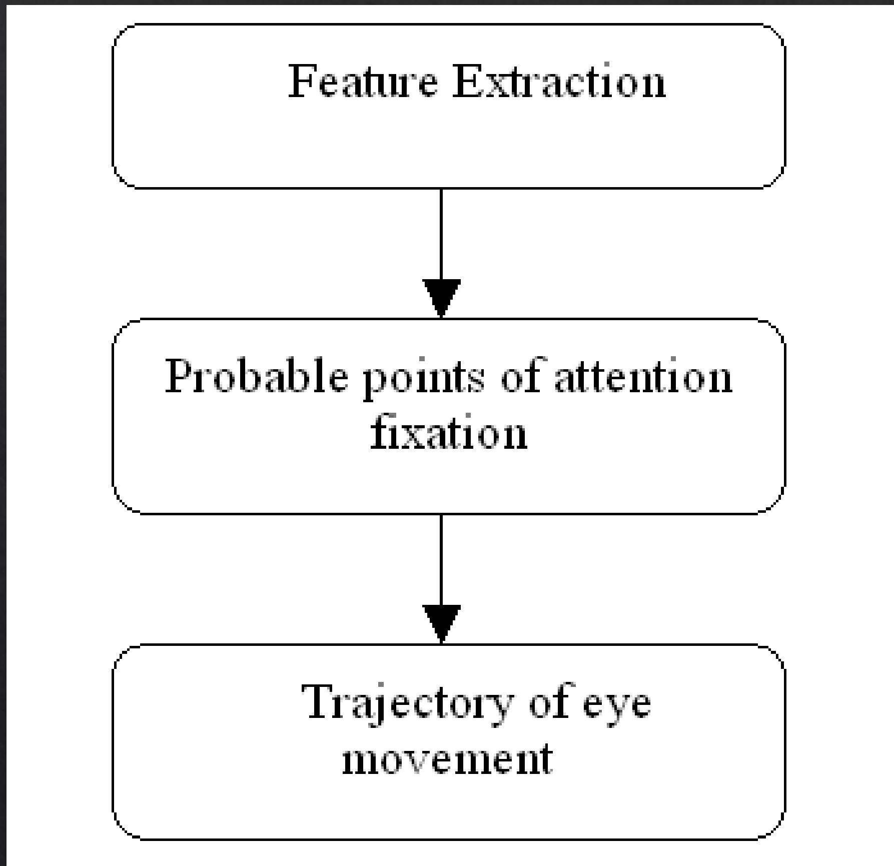


Visual Cortex



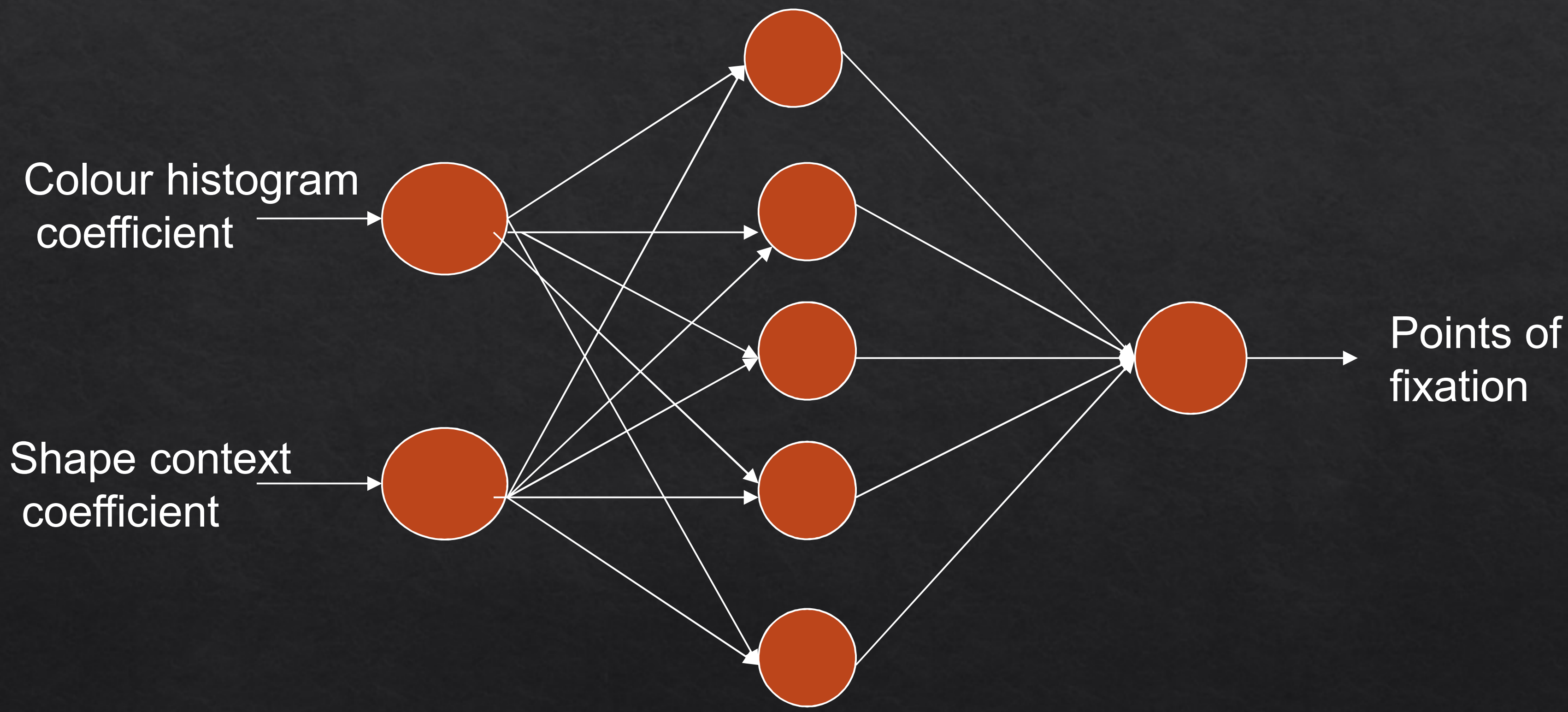
- Visual Pathway
  - Where and What Pathway
  - M and P pathway
- V1 – Primary visual cortex
  - Feature extraction
  - Colour and orientation feature
  - Mapping of retina on surface of cortex
- V2 region
  - Visual orientation map
  - Colour map
  - Disparity map
- V4 region
  - Colour recognition
  - Object discrimination
- V3 and V5 regions
- Motion
- Stereoscopic vision
- Visual guidance and scanning

Modelling Vision



Spotlight metaphor of attention

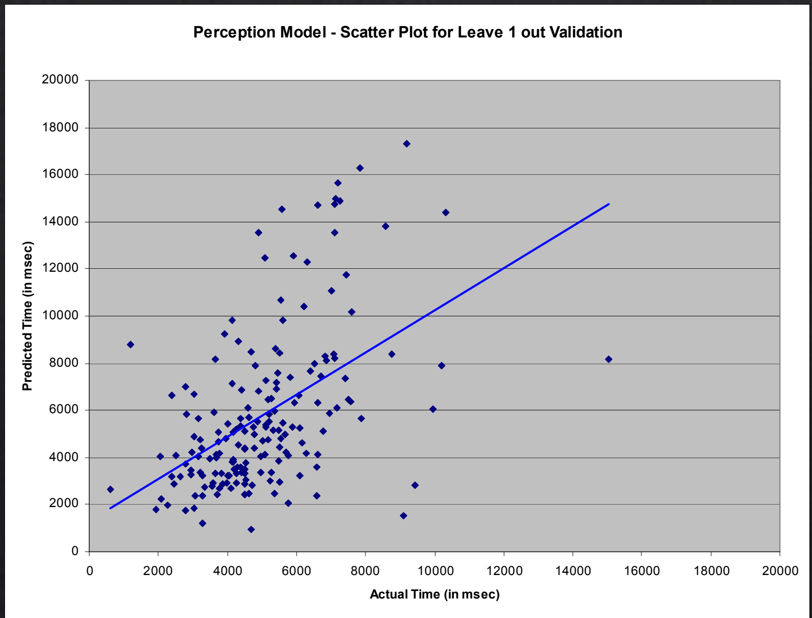
Points of fixation



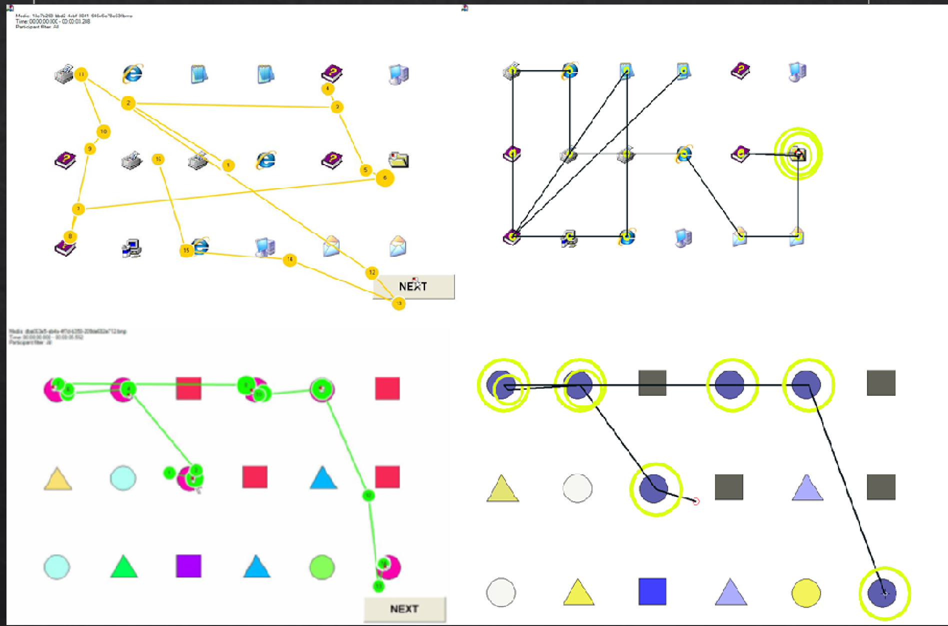
Neural Network

Simulation Result

Visual Search Time



Eye Gaze Movement



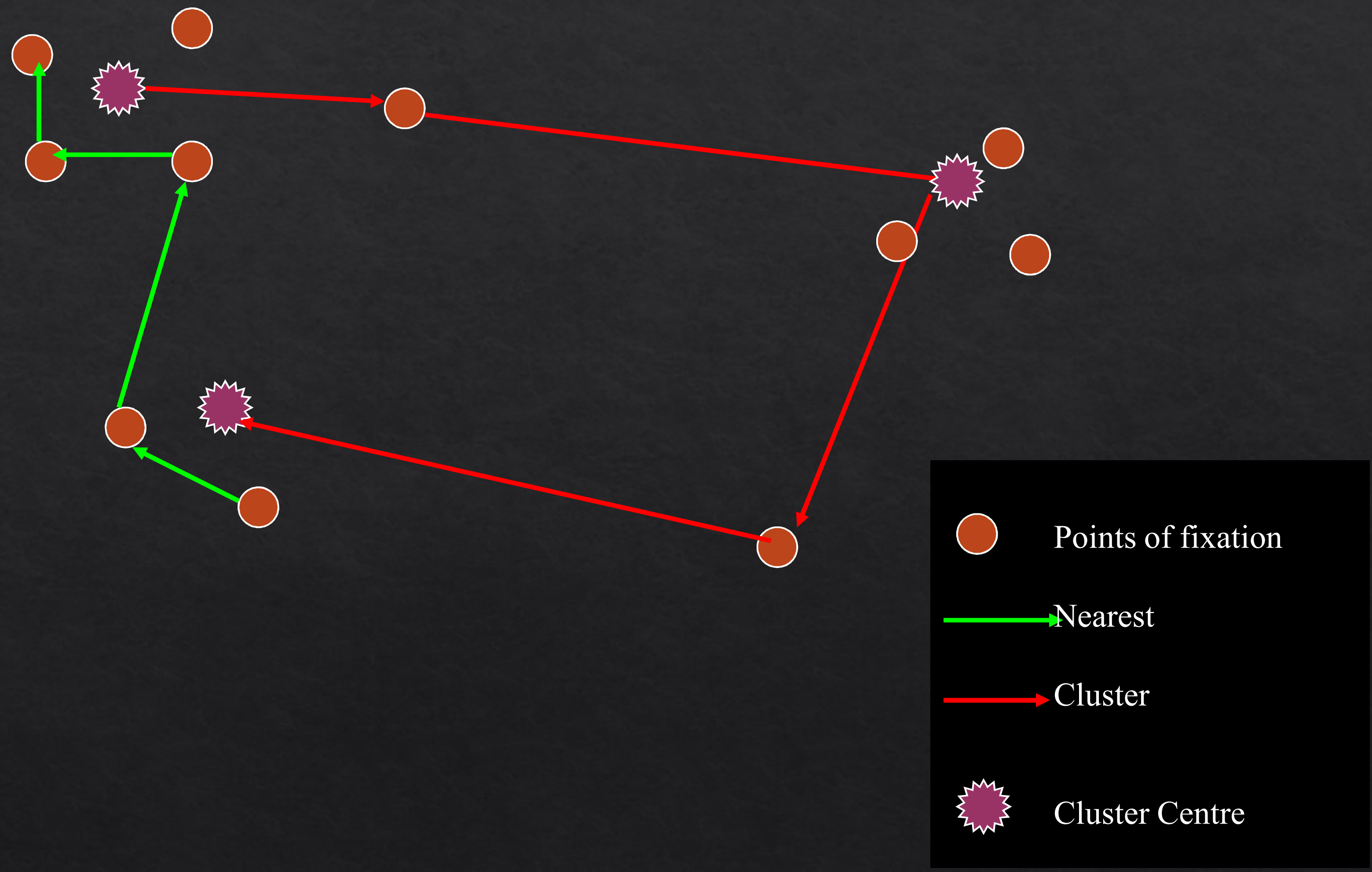
Icon design

Right hand side icons are more distinctive,
but not necessarily 'better'

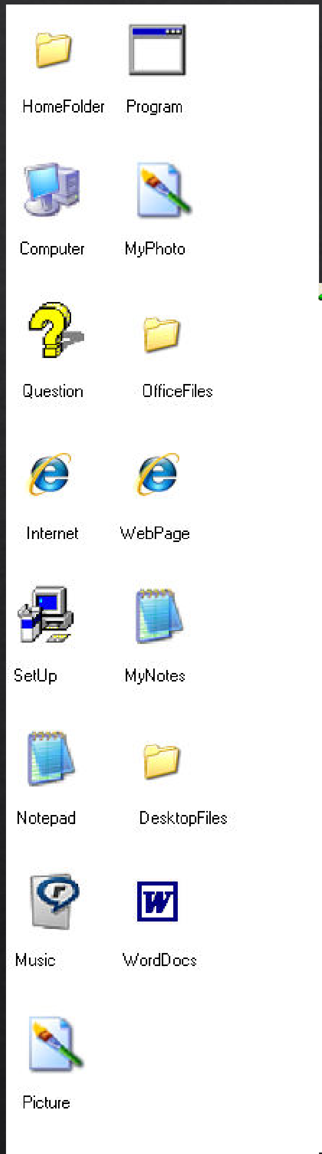
Types of Eye Gaze Movement

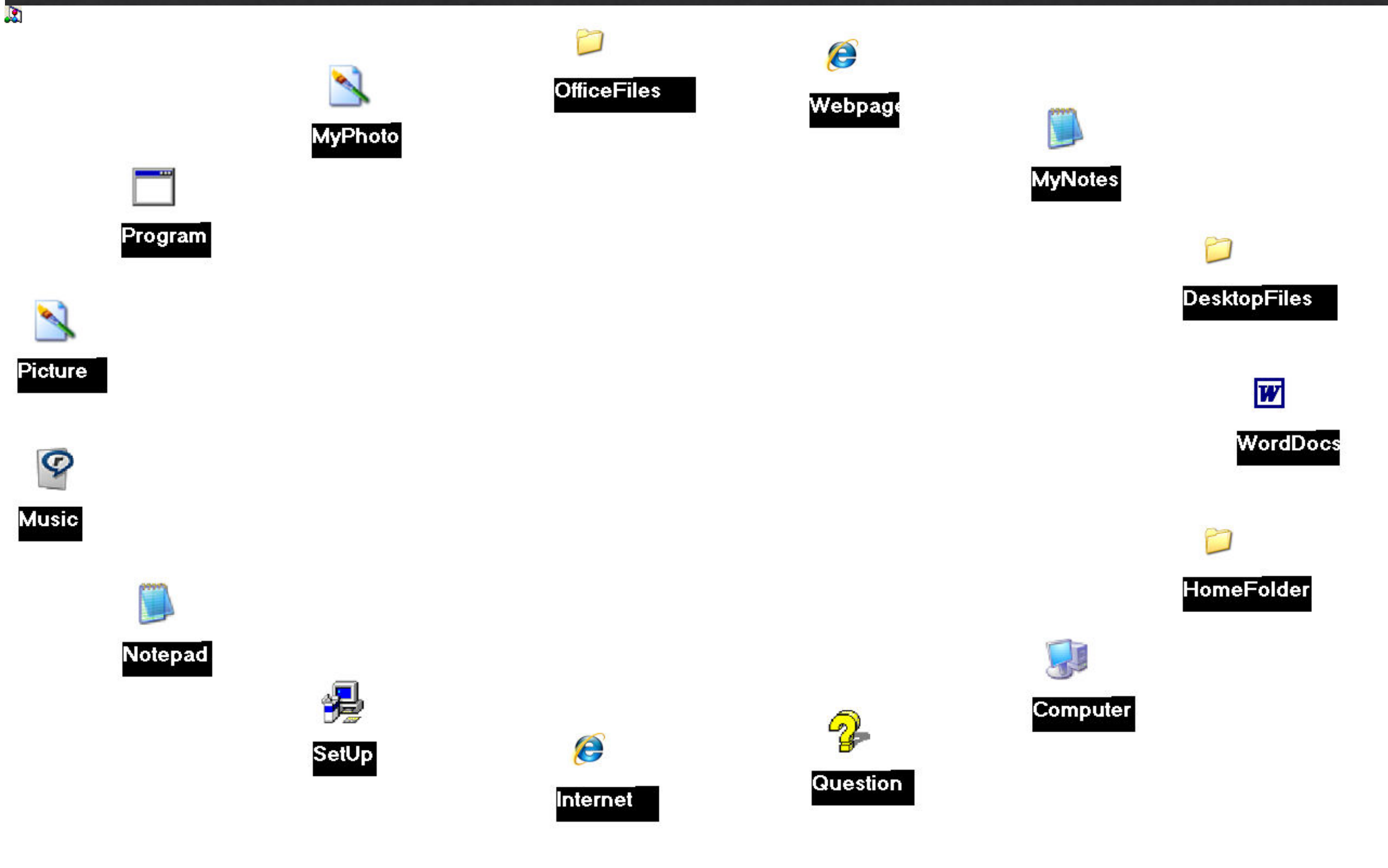
- Saccades
- Smooth Pursuits
- Vergance

Eye Movement Strategies



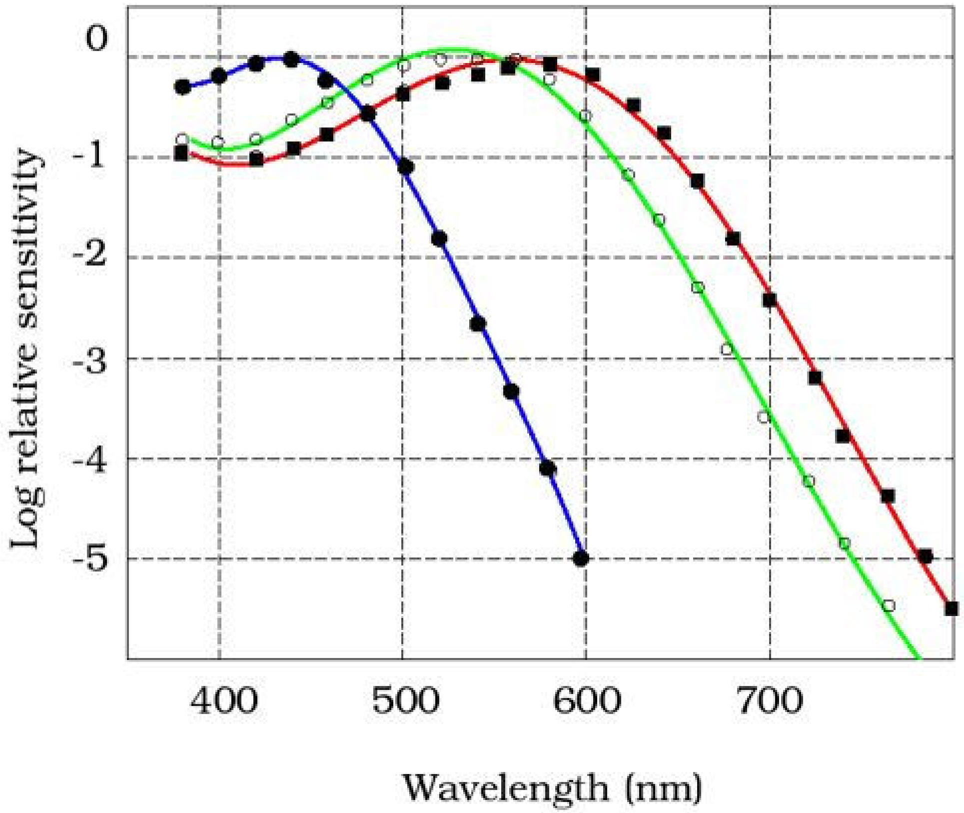
Eye movement in interfaces



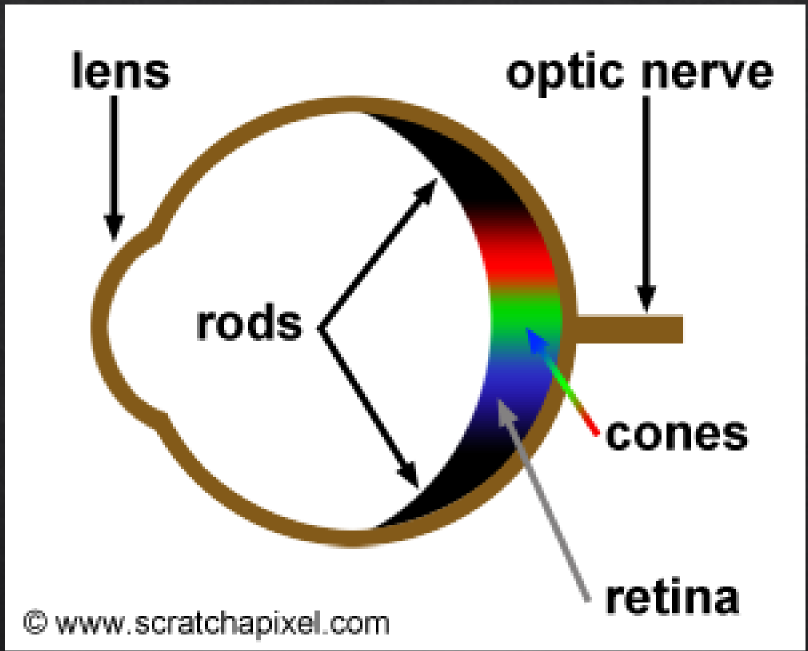


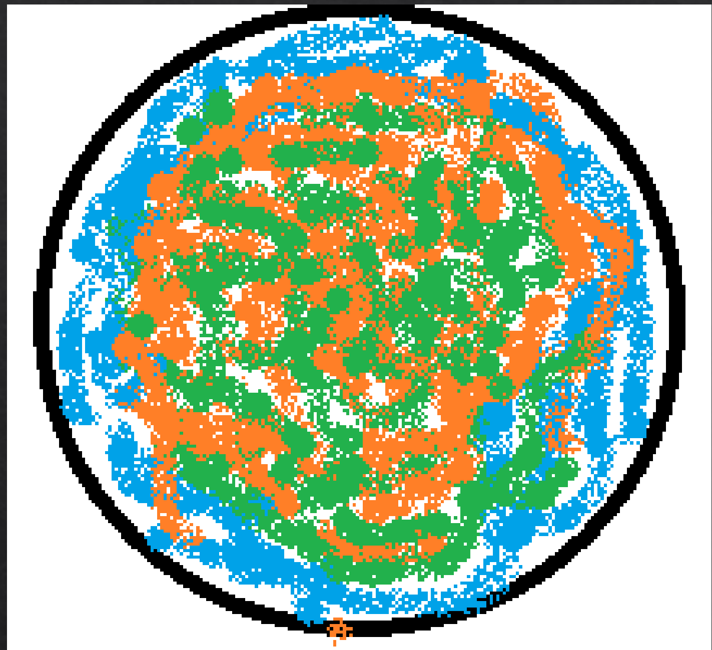
Eye gaze needs to move more distance on right hand side interface but again it does not mean the LHS interface is better

Cone spectral sensitivities



Distribution of Colour Sensitive Cells

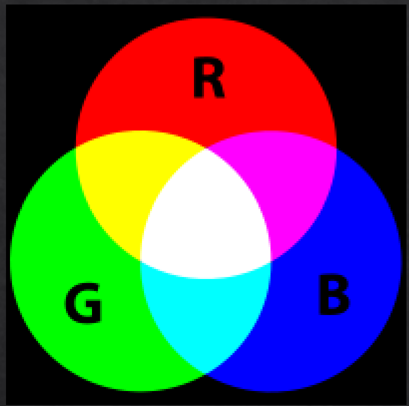


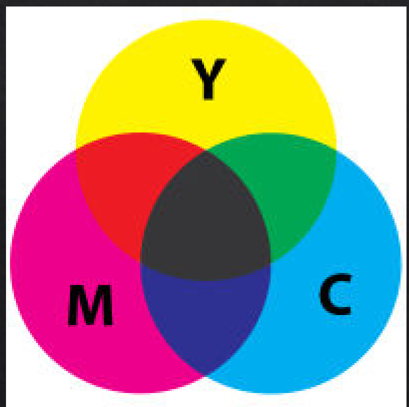


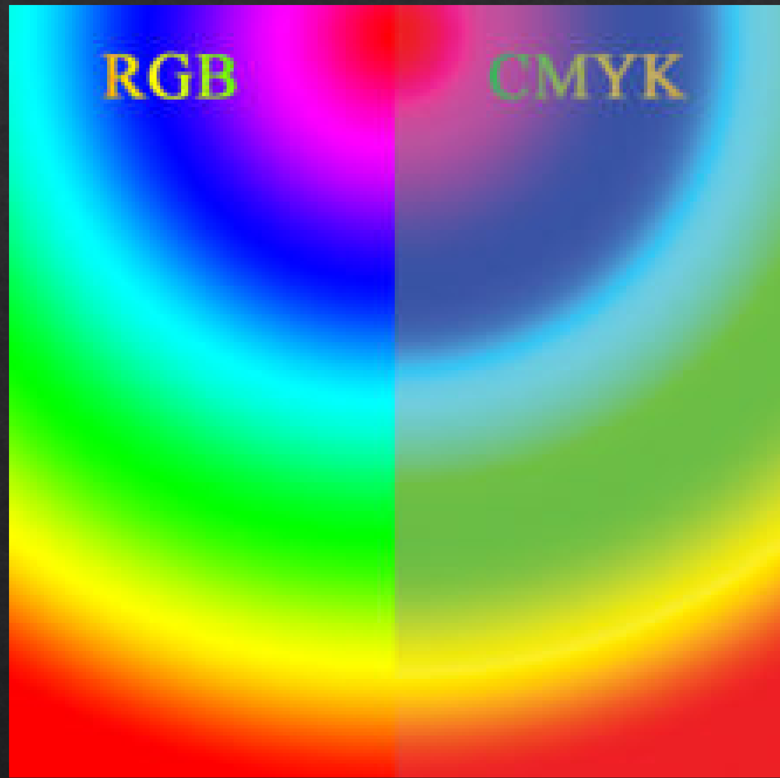
We have less Blue photoreceptors than Red or Green ones

Blue cones are organized away from the fovea

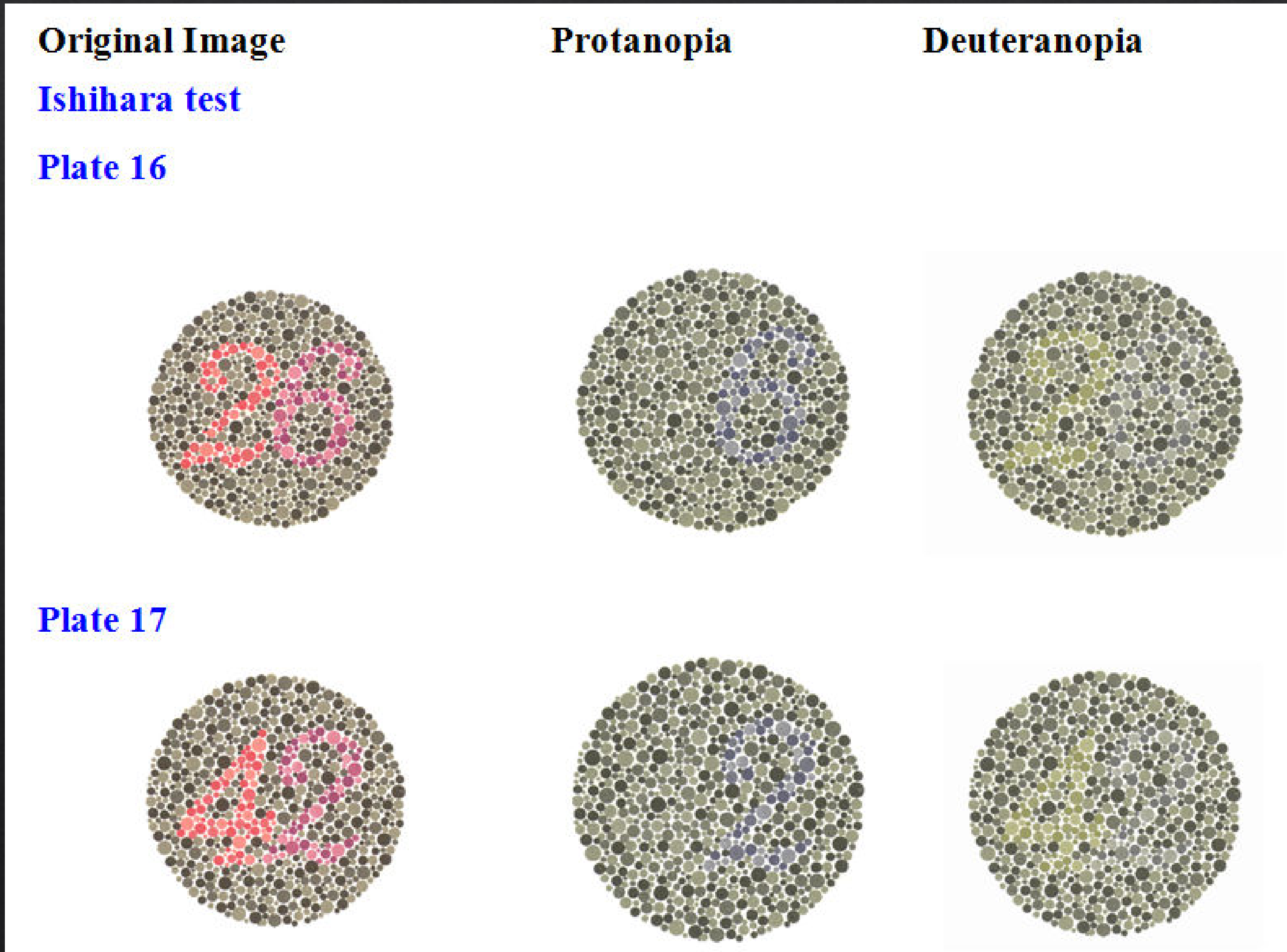
Colour in computers and printers







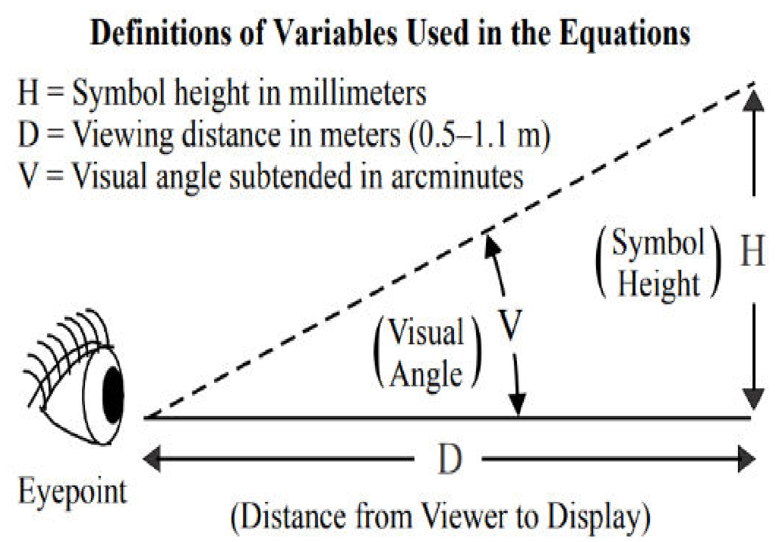
Colour blindness



Main challenges in modelling vision

- Modelling for complex scenes
- Developing eye-movement strategy
- Modelling prior knowledge

Visual Angle Calculation

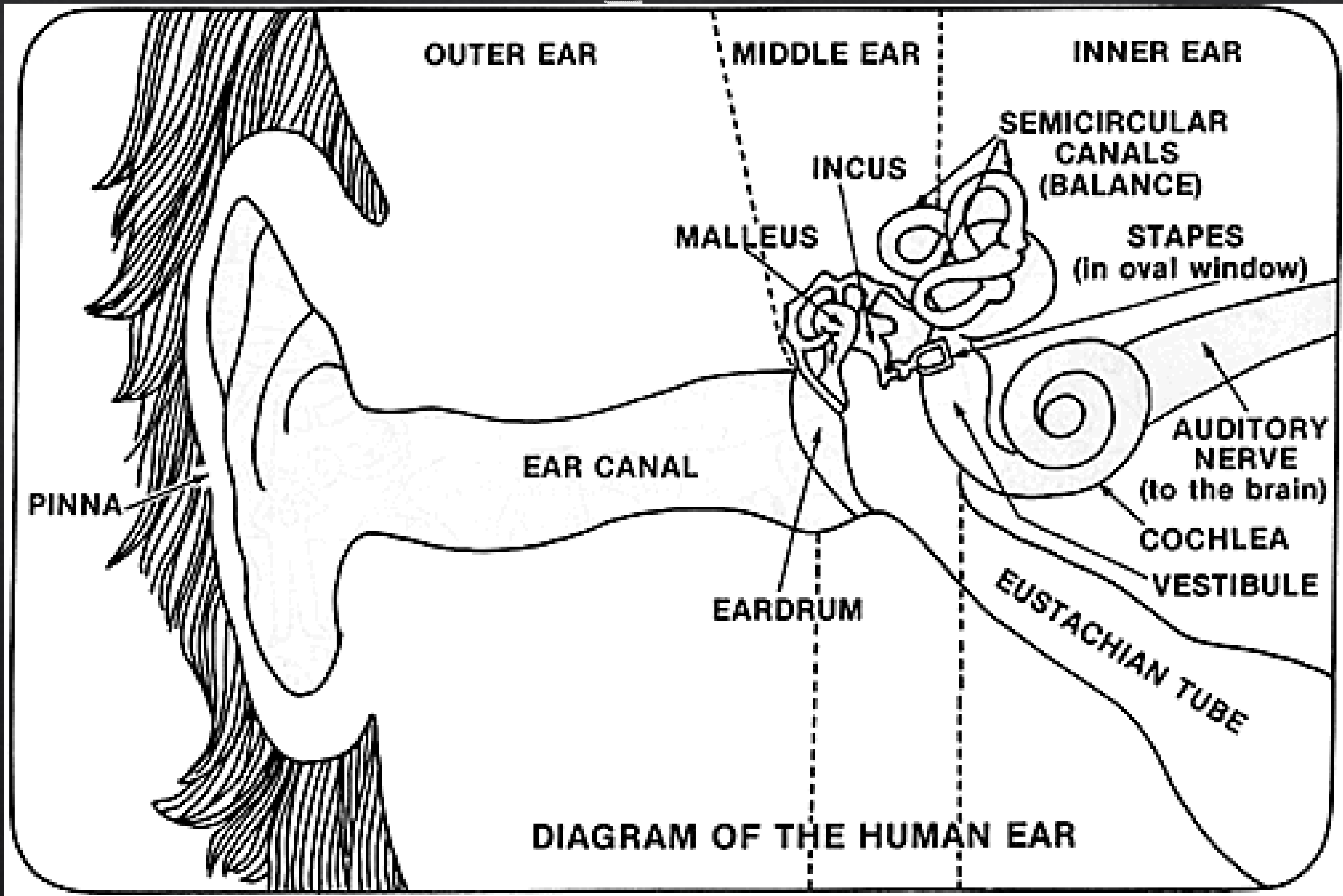


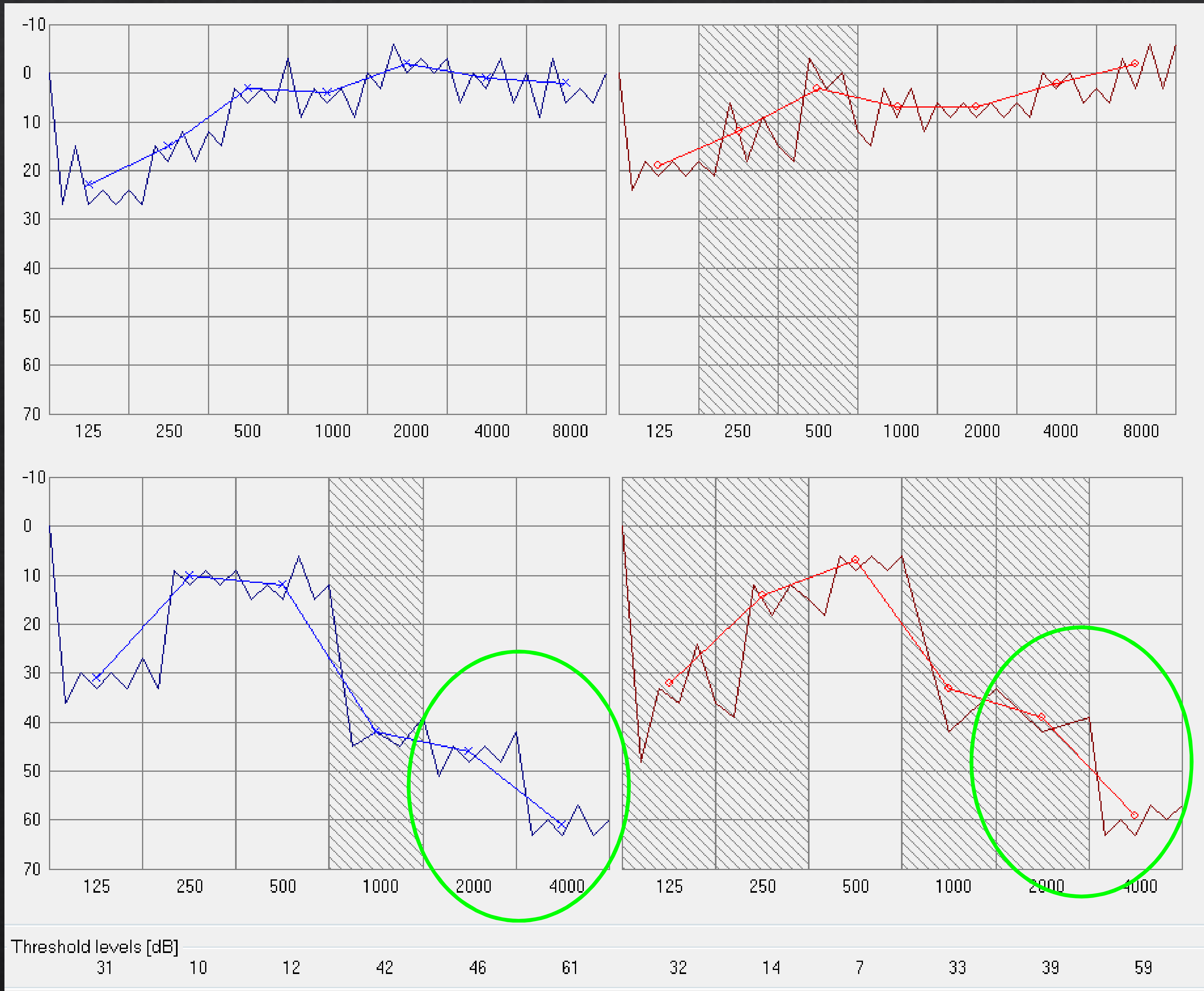
Parameter	Icon	Text
Optimal visual angle (x)	1.433 degrees	0.333 degrees
Tan(x)	0.025	0.0058
Symbol Height (H)	D × tan(x)=120 × 0.025 =3 cm = 1.18 in	D × tan(x)=120 × 0.0058 =0.7 cm = 0.275 in
Symbol height (H)	320.4 px	72.09 px

Designers' points

- Keep similar interface items together
- Use distinctive symbols but keeping in mind consistency
- Remember how a colour will be rendered, considering colour blind users
- Remember top down theory, means users' expectation from an interface

Hearing


OUTER EAR
MIDDLE EAR
INNER EAR
SEMICIRCULAR
CANALS
(BALANCE)
INCUS
MALLEUS
STAPES
(in oval window)
EAR CANAL
AUDITORY
NERVE
(to the brain)
PINNA
COCHLEA
VESTIBULE
EARDRUM
EUSTACHIAN TUBE
DIAGRAM OF THE HUMAN EAR

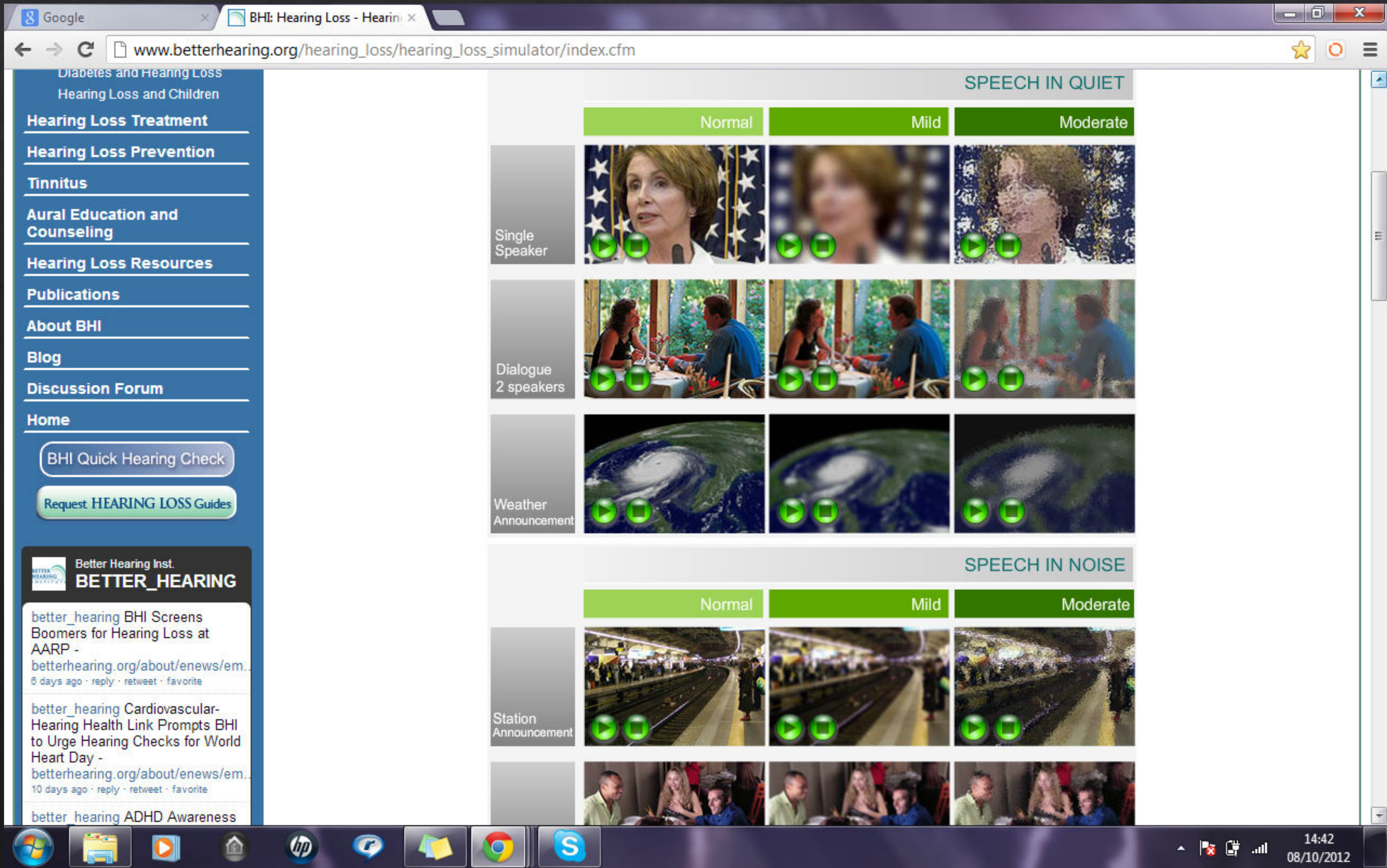


-10
0
10
20
30
40
50
60
70
125 250 500 1000 2000 4000 8000
125 250 500 1000 2000 4000 8000
125 250 500 1000 2000 4000
125 250 500 1000 2000 4000
Threshold levels [dB]
31 10 12 42 46 61 32 14 7 33 39 59

Hearing impaired users

- Difficult to listen soft sound
- Loud sound may seem louder (Loudness recruitment)
- Reduced response to spectral contrast (like blurring of an image)

Hearing impairment examples



Designers' points

- Increasing volume cannot solve the problem
- Background noise and music may reduce audibility
- Certain words or syllabi have higher chances to be confused, which should be taken care of during designing audio based dialog system

Take away points

- Principles of vision and hearing
- Modelling visual perception
  - Visual search → Icon design
  - Eye movement strategies → Screen layout
  - Colour vision → Colour contrast of interface
- Auditory perception
  - Issues with loudness recruitment