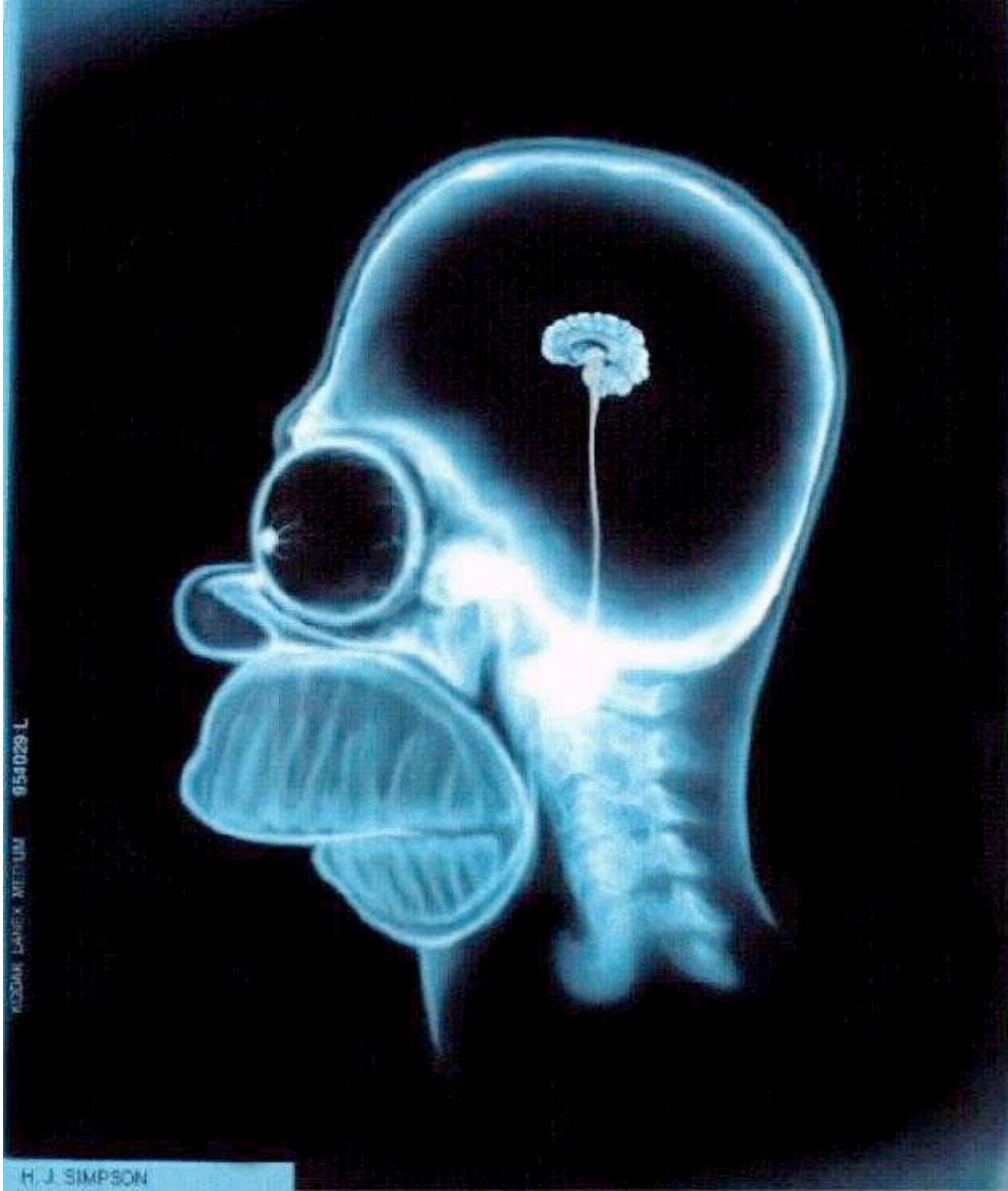
Color Blind

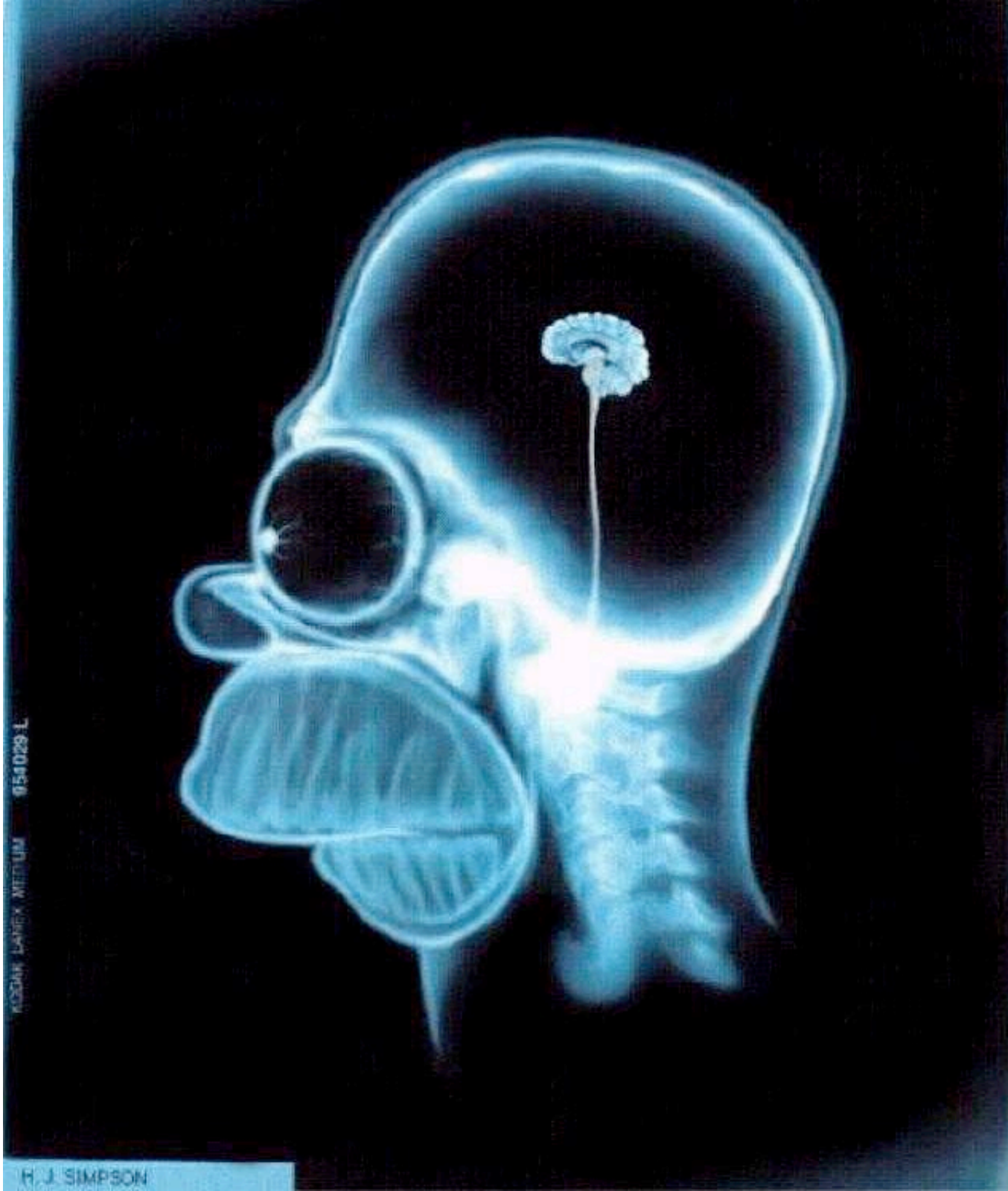
- David Bingham

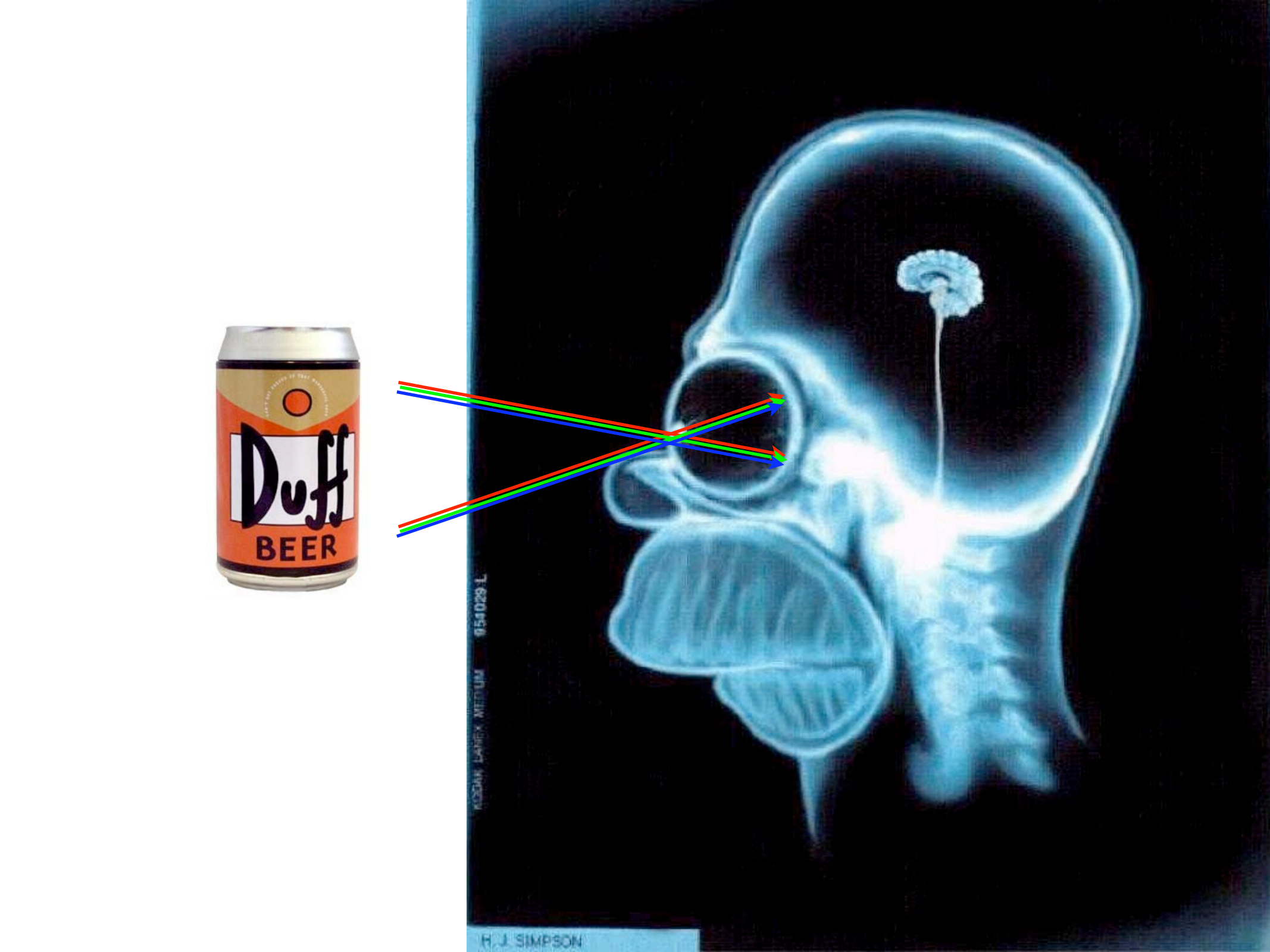
Being Color Blind

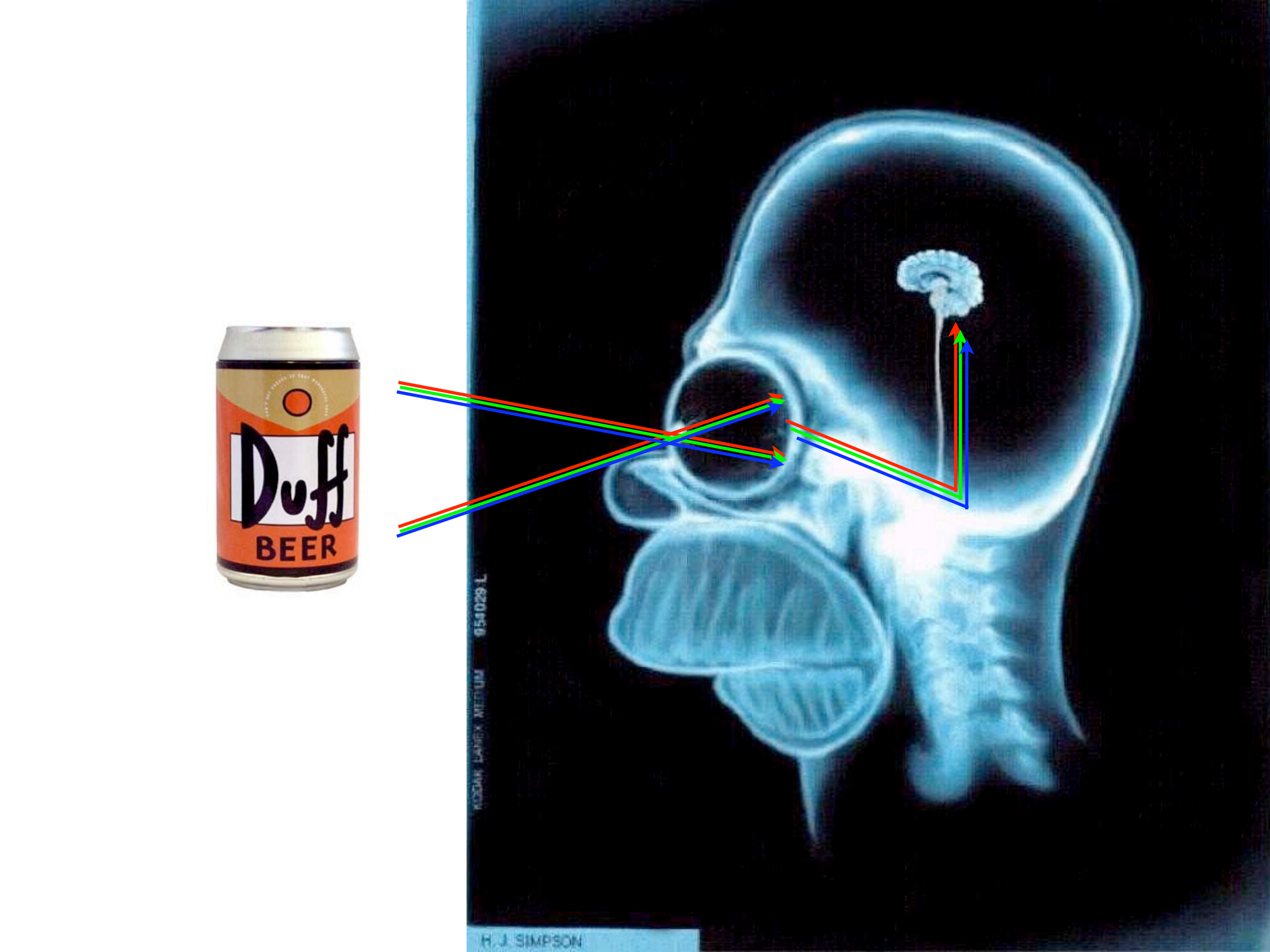
- Degrees of severity
- No treatment, surgery, or cure
- Very few assistive products
- Numerous design considerations


KODAK LANEX MEDIUM 054029-L
H. J. SIMPSON


Duff
BEER

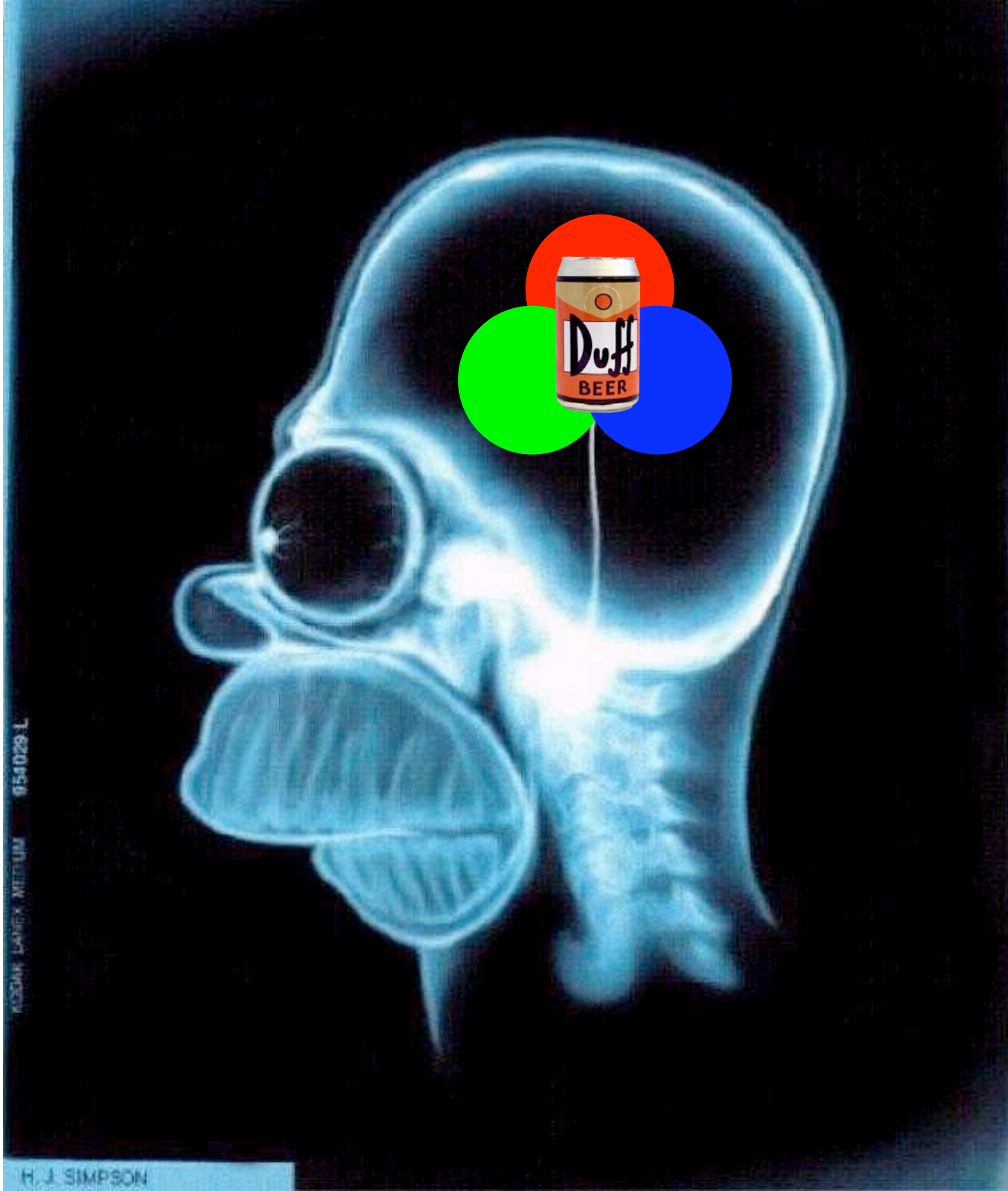

H. J. SIMPSON


Duff
BEER
H. J. SIMPSON


Duff
BEER
H. J. SIMPSON

Brain interprets:

- Color
- Luminosity
- Motion



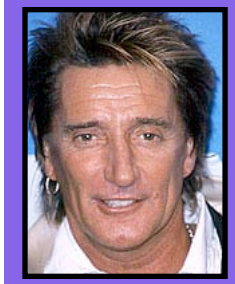
Rods v Cones

20 rods



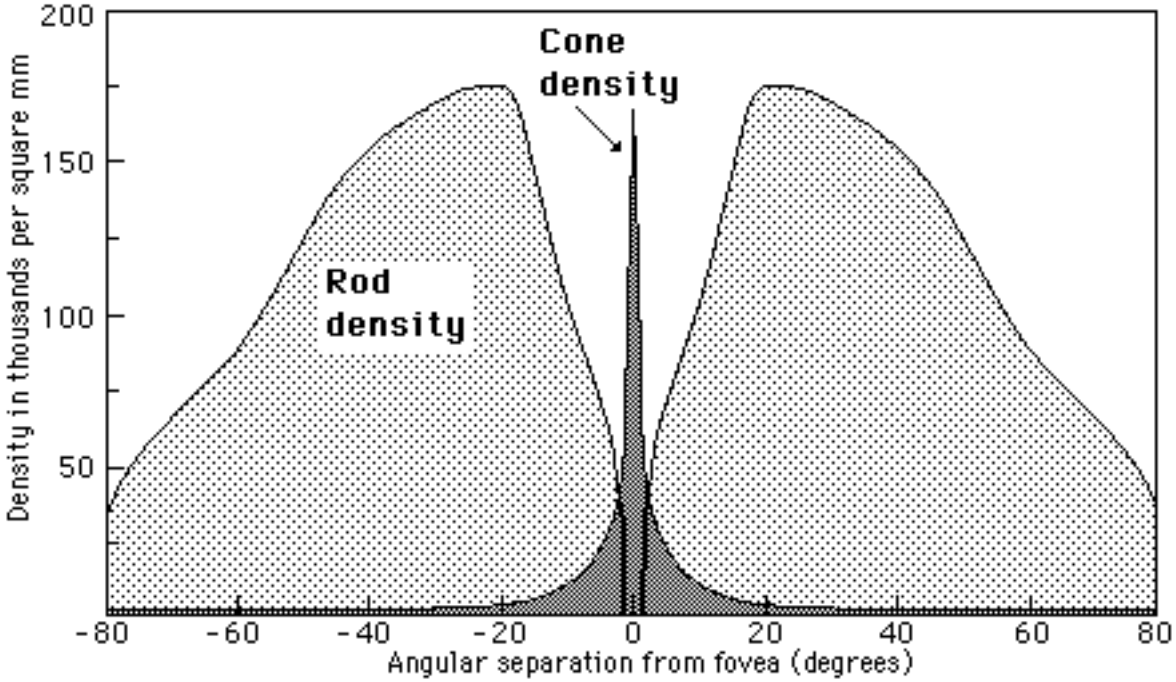
1 cone





Rods v Cones




200
150
100
50
Density in thousands per square mm
Cone density
Rod density
-80
-60
-40
-20
0
20
40
60
80
Angular separation from fovea (degrees)

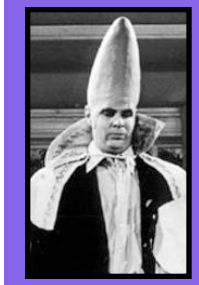

Fovea



Rods



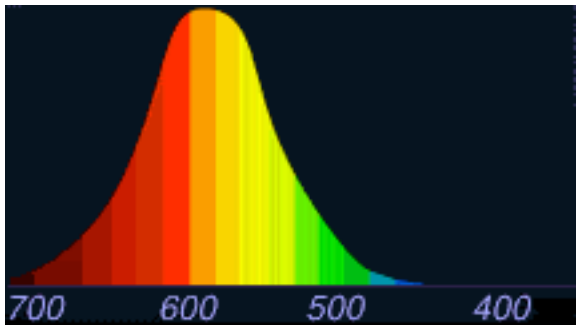
- 1000x light sensitivity
- Do not perceive color
- Periphery of the field of view
- Attuned to motion detection
- Night vision
- More sensitive to shorter wavelengths



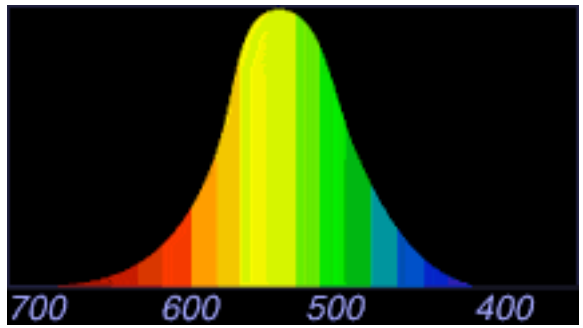
Cones



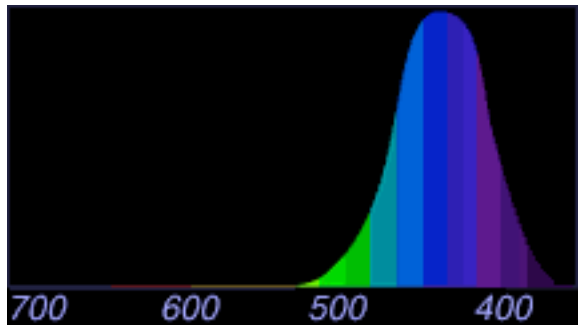
- Visual acuity
- Resolution
- 7 million cones in each eye
- 3 types of cones



Red-sensitive or, L-cones
70%



Green-sensitive or, M-cones
30%



Blue-sensitive or, S-cones
10%

What Color?

- “Monochromacy”
- Only 0.0025% are truly “color-blind”
- Black, white, and grays

Red - 1st color

- 1 in 100 males
- “Protanomaly” - reduced sensitivity
- “Protanopia” - complete loss
- Large % of eye is red cones:
  - Overall light reception is reduced
  - Images with red will seem darker

Green - 2nd color

- 1 in 100 males
- “Deuteranomaly” - reduced sensitivity
- “Deuteranopia” - complete loss
- Most common type in women

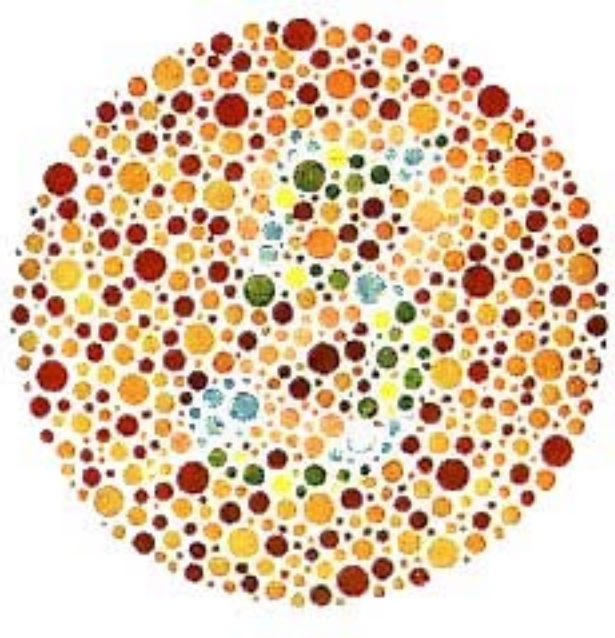
Blue - 3rd color

- 1 in 50,000
- “Tritanomaly” - reduced sensitivity
- “Tritanopia” - complete loss
- Usually caused by eye disease

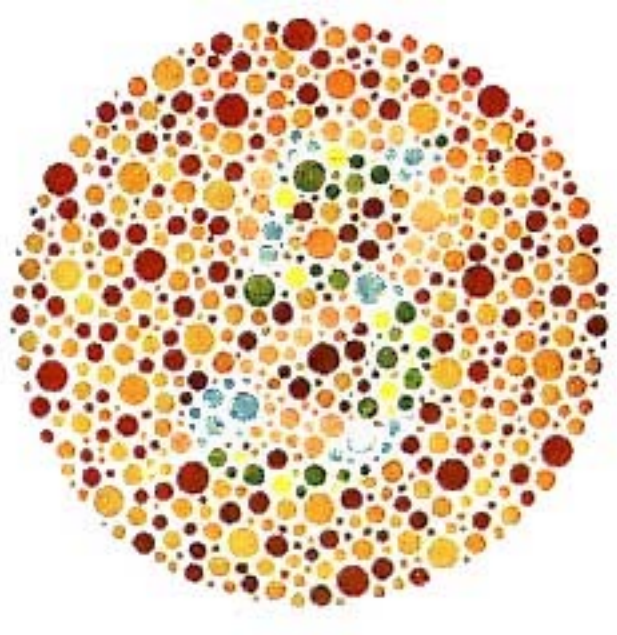
Girl-power

- Carried on the X-chromosome
  - Women = carriers
  - Men = afflicted

Are you?



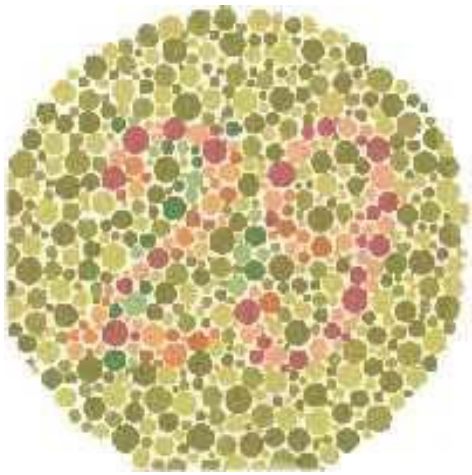
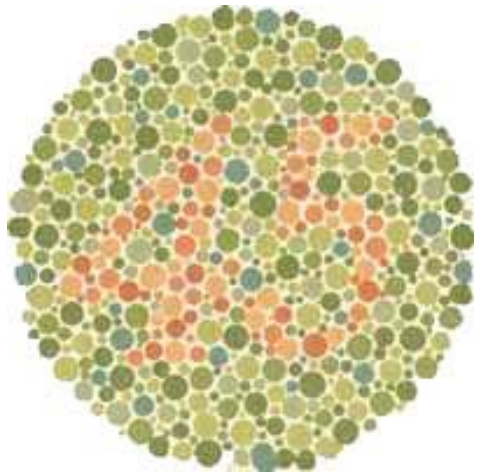
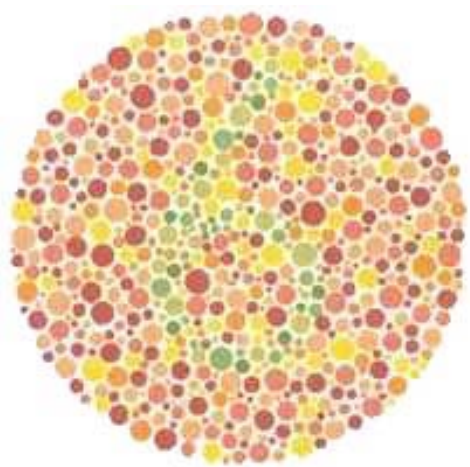
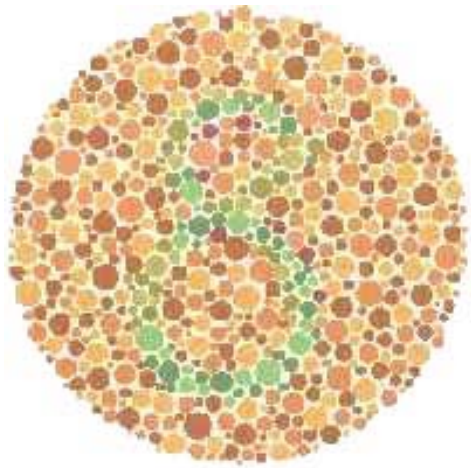
Are you?



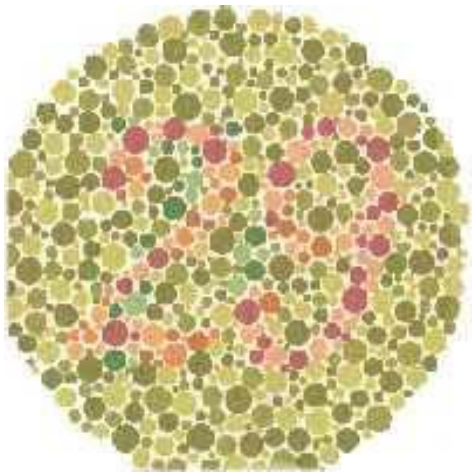
Normal: 5

Red/Green Deficient: 2

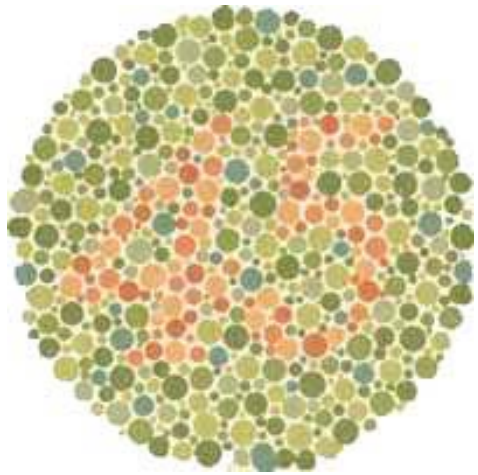
What do you see?

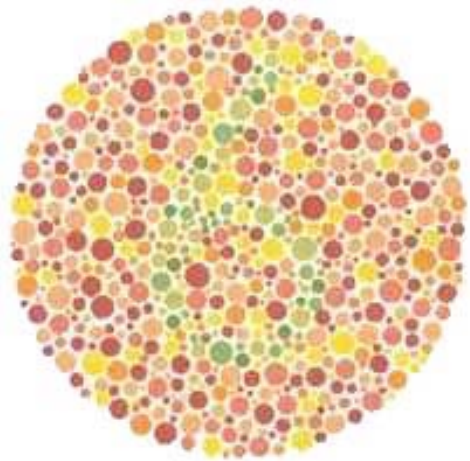
Lucky Lotto Numbers



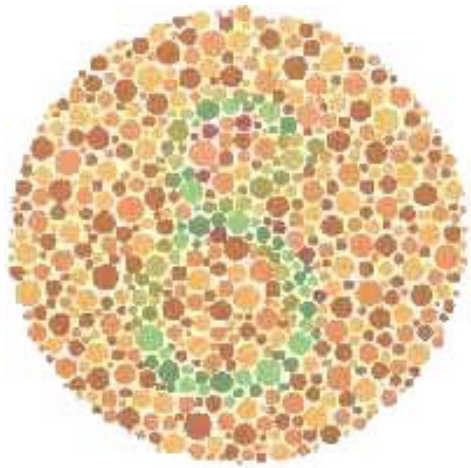
29



45



6

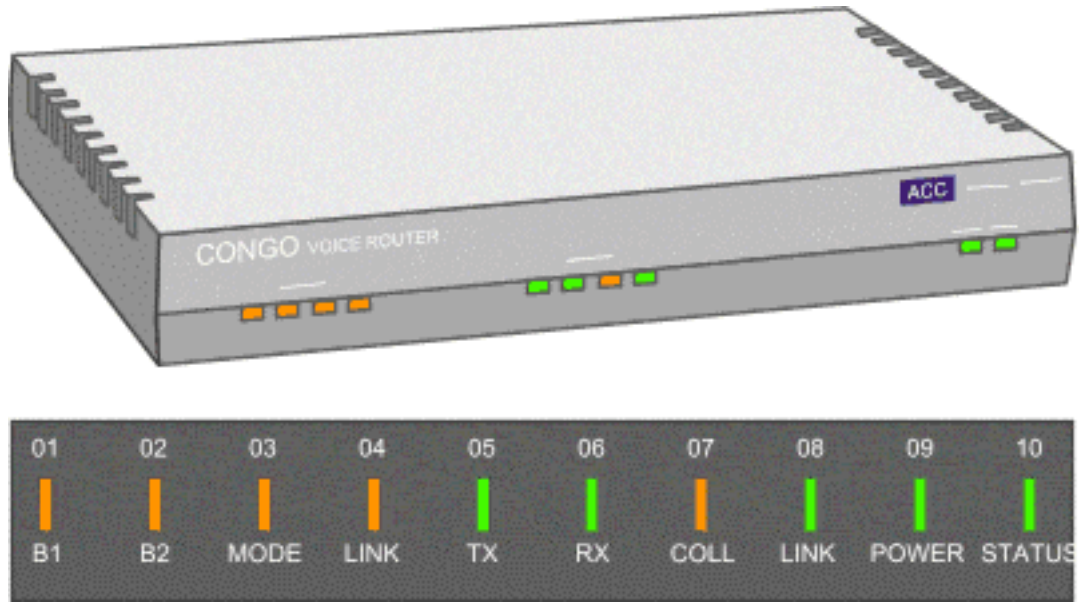


8

Product Problems

LED status indicators



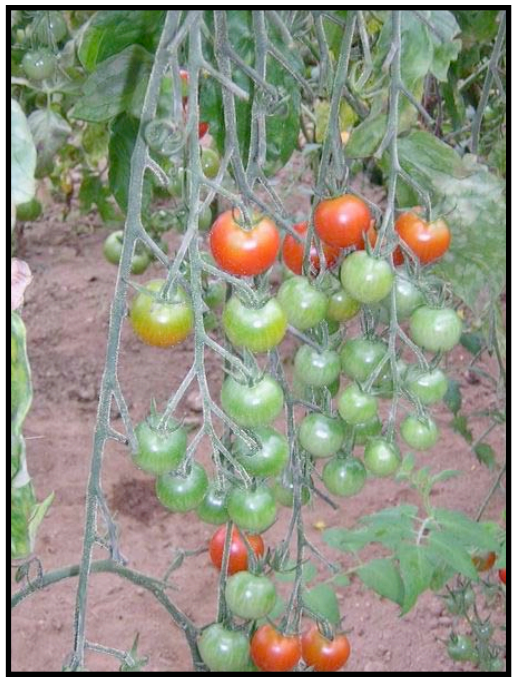


Product Problems

Food Industry







Product Problems

Clothing









Digital Color Identifiers







Existing Products

- "ColorMax", Color Vision Technologies
  - Tinting process, like anti-glare & shading
  - Helps with red-green deficiency
  - Adds dark and bright variance to colors
  - Prescription eyewear, clip-ons, sunglasses

Existing Products

- "New Pigment" PC application
  - Adjusts color, brightness, & saturation
  - Can't convert to full color equivalent
  - Adjusts tones to differentiate

Existing Products





- Exit Signs, Gilbert Industries
  - Red is lower wavelength
  - Green is middle of spectrum
  - Extra bright light

Product Redux



Quantity



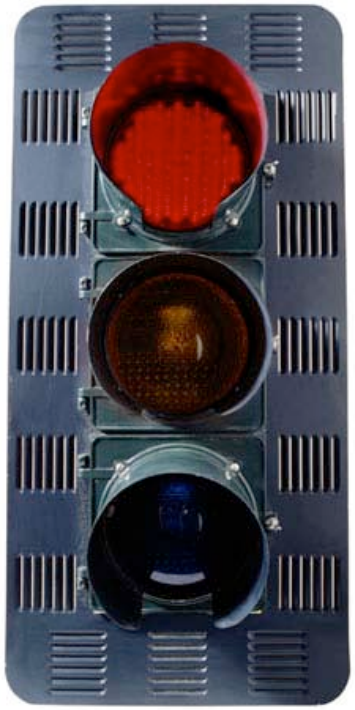


Orientation & Number





Red - Stop!



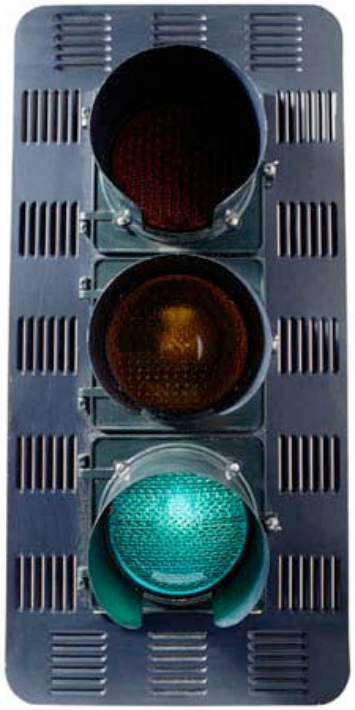


Yellow - Yield!





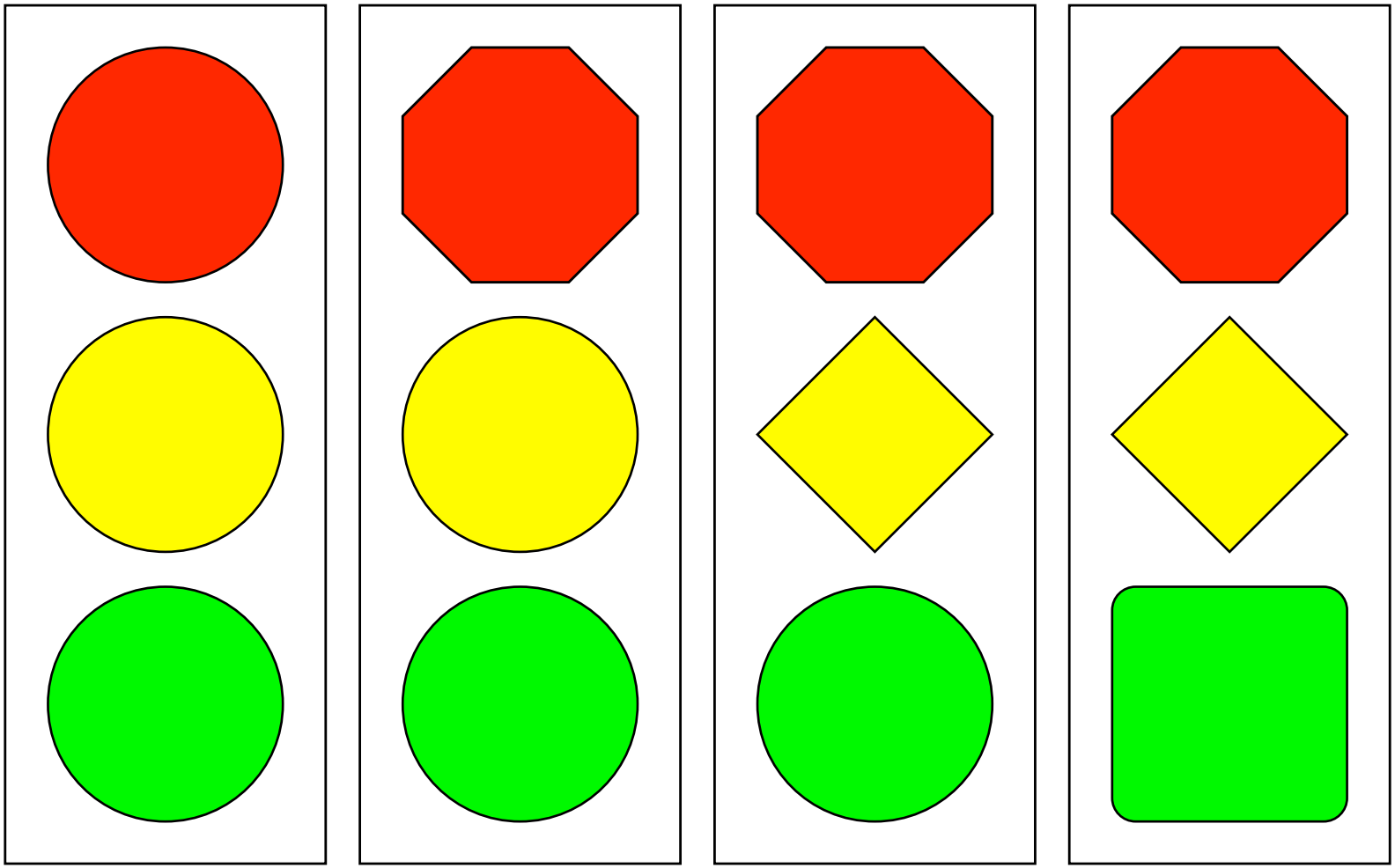
Green - Go!







Visual Redundancy



Thanks