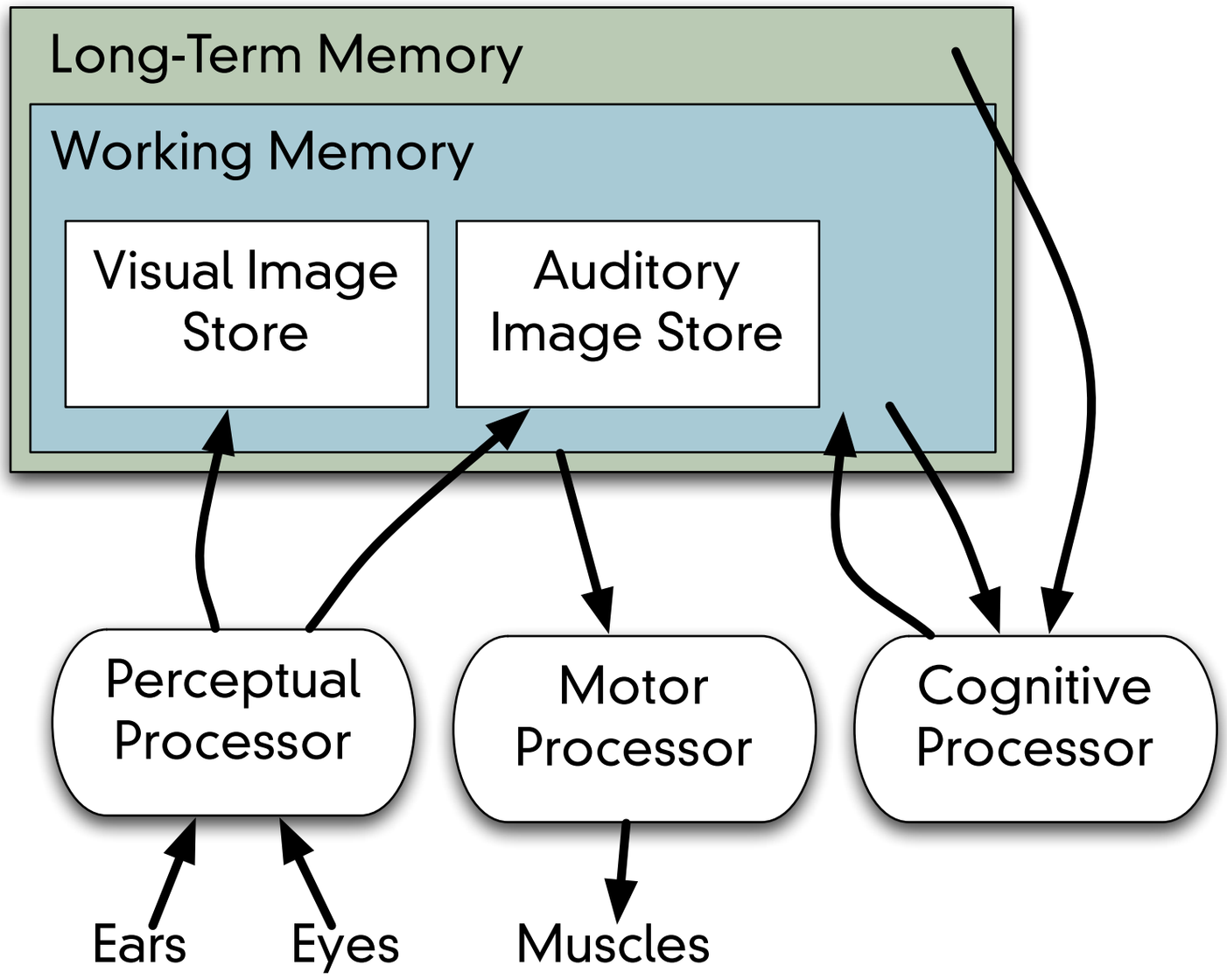
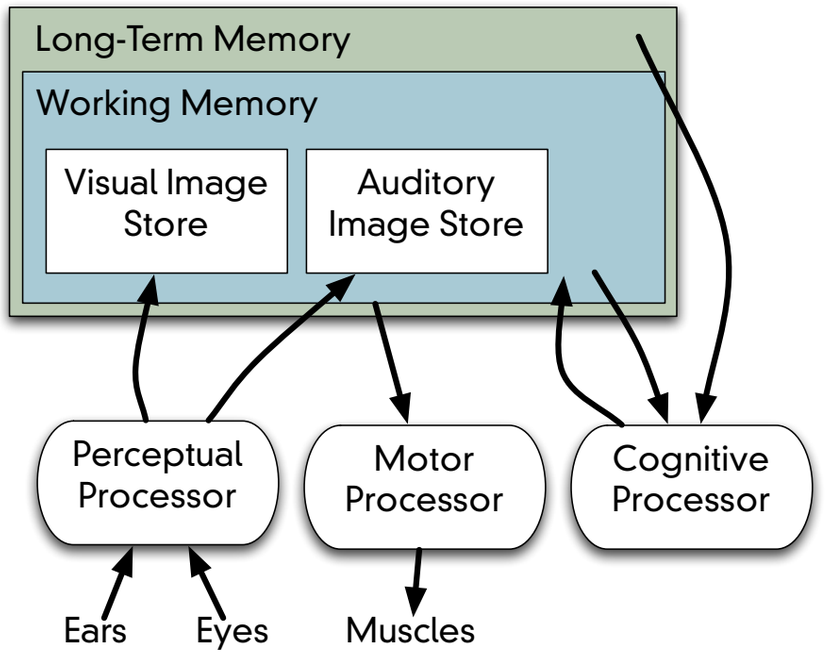
User Interaction: The Human

Asst. Professor Donald J. Patterson
INF 133 Fall 2011

The Model Human Processor



Card, Moran, Newell (1983)



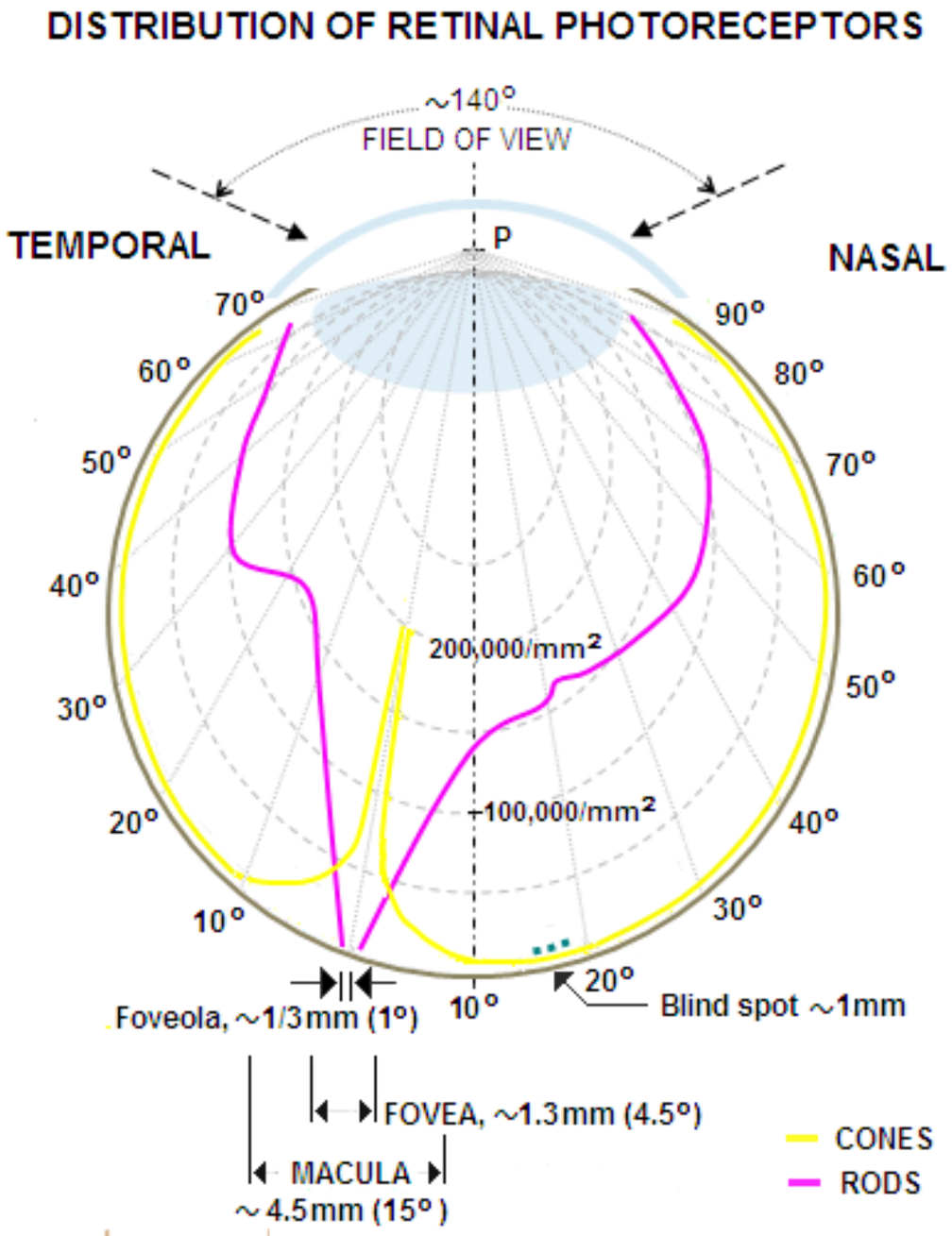
- Information Input/Output
  - visual, auditory, haptic, movement
- Information stored in memory
  - sensory, short-term, long-term
- Information processed and applied
  - reasoning, problem solving, skill, error
- Emotion influences human capabilities
- Each person is different

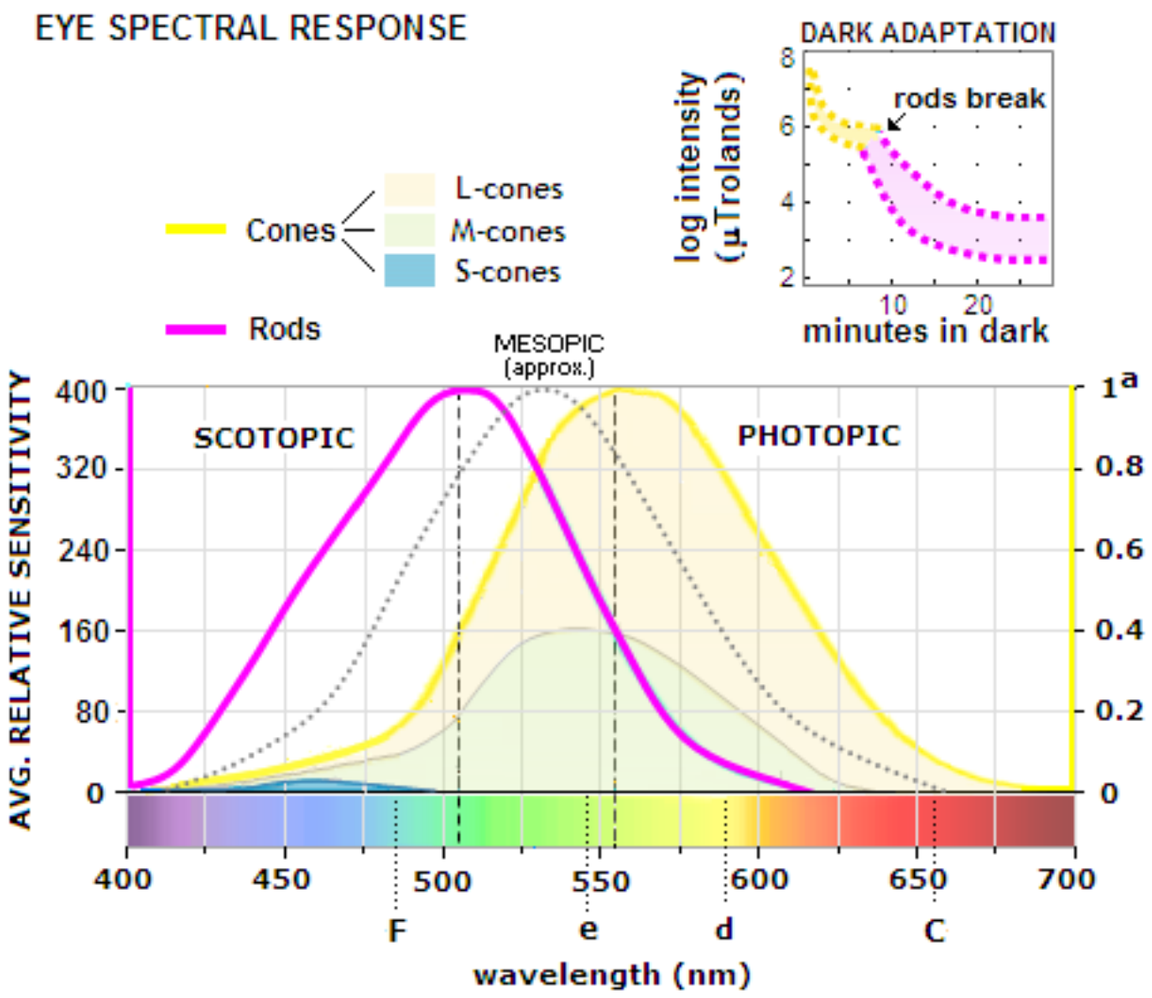
The Eye - Physical Reception

- mechanism for receiving light and transforming it into electrical energy
- light reflects from objects
- images are focused upside-down on retina
- retina contains rods for low light vision and cones for color vision
- ganglion cells (brain!) detect pattern and movement

The Eye - Interpreting the signal

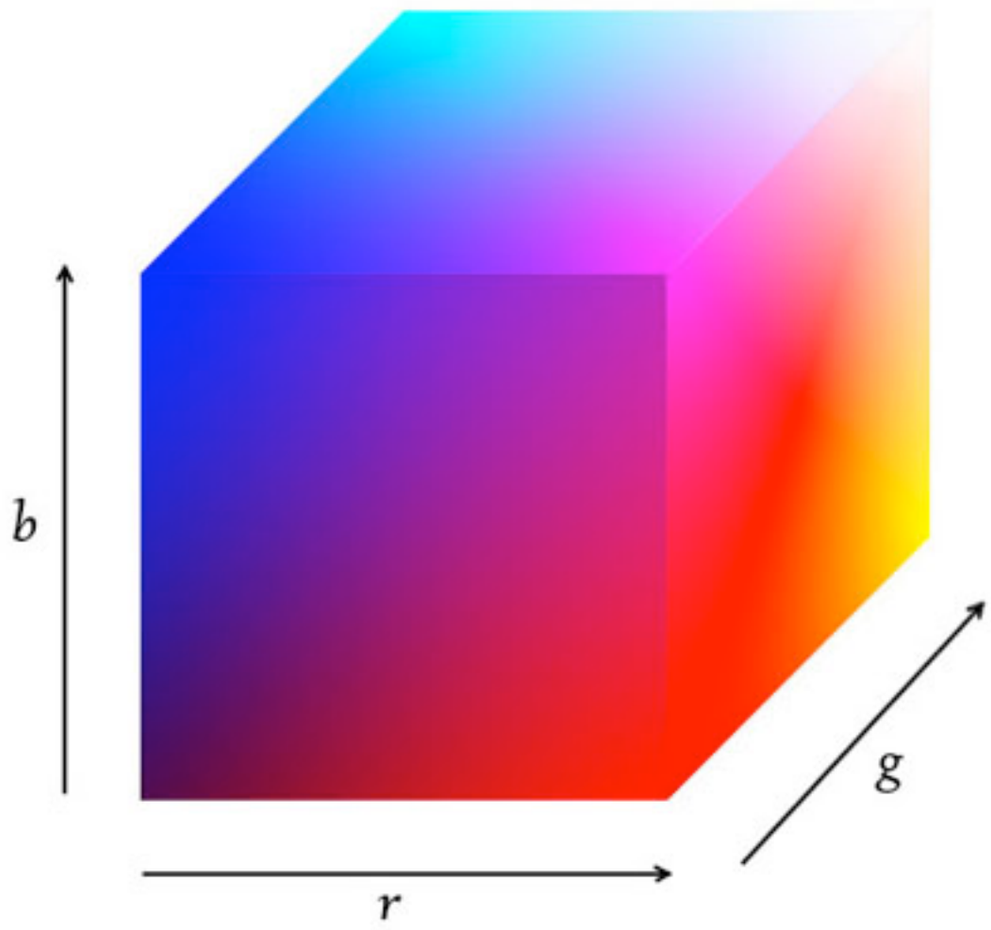
- Brightness
  - subjective reaction to levels of light
  - affected by luminance of object
  - measured by just noticeable difference
  - visual acuity increases with luminance as does flicker
- Color
  - made up of hue, intensity, saturation
  - cones sensitive to color wavelengths
  - blue acuity is lowest
  - 8% males and 1% females color blind

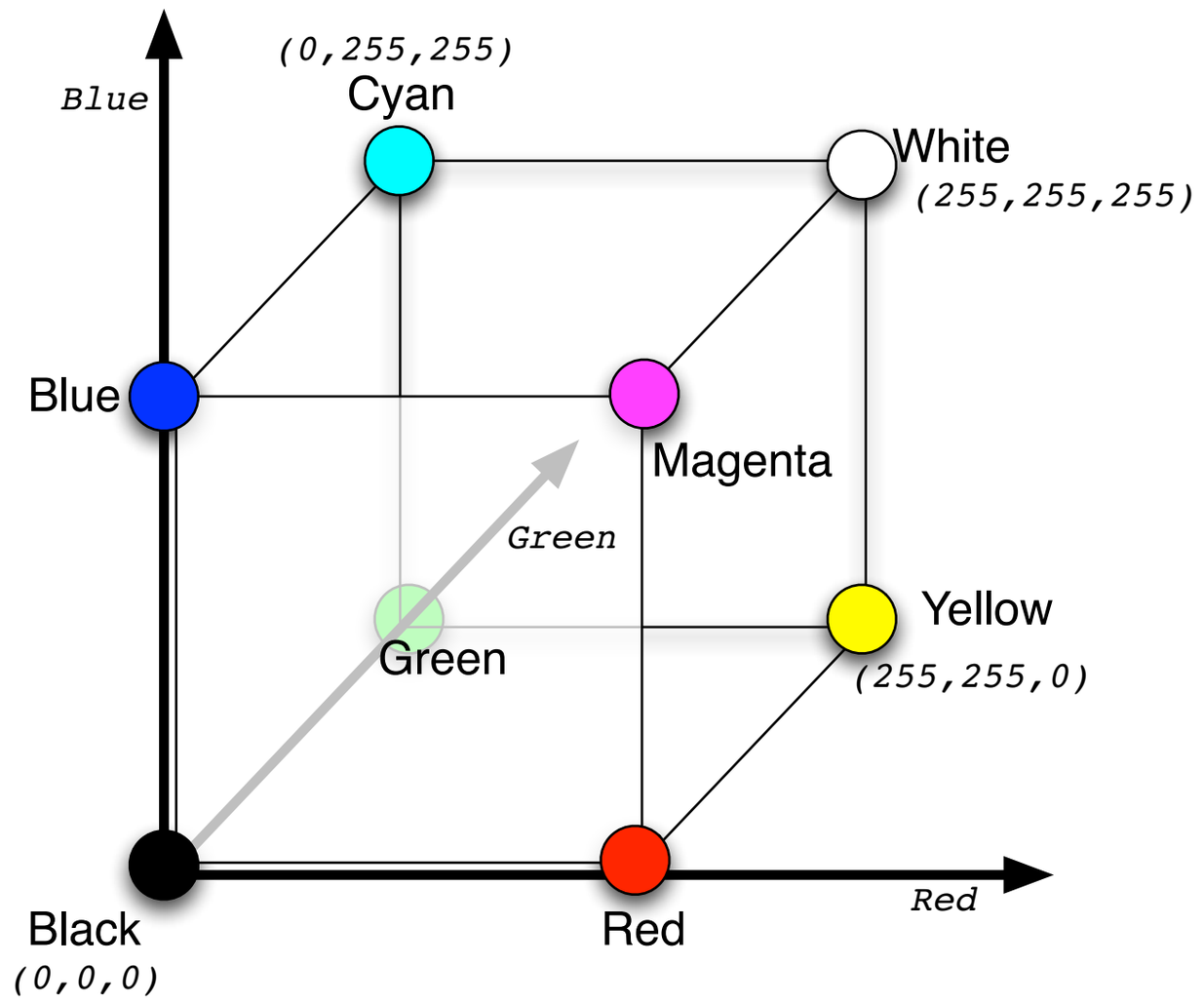

DISTRIBUTION OF RETINAL PHOTORECEPTORS
~140°
FIELD OF VIEW
TEMPORAL
NASAL
P
70°
60°
50°
40°
30°
20°
10°
90°
80°
70°
60°
50°
40°
20°
10°
200,000/mm²
100,000/mm²
Foveola, ~1/3mm (1°)
Blind spot ~1mm
FOVEA, ~1.3mm (4.5°)
MACULA
~4.5mm (15°)
CONES
RODS


EYE SPECTRAL RESPONSE
Cones
L-cones
M-cones
S-cones
Rods
DARK ADAPTATION
log intensity (μTrolands)
rods break
minutes in dark
MESOPIC (approx.)
SCOTOPIC
PHOTOPIC
AVG. RELATIVE SENSITIVITY
wavelength (nm)
F
e
d
C

rgb

rgb


b
r
g


Blue
(0,255,255)
Cyan
White
(255,255,255)
Blue
Magenta
Green
Green
Yellow
(255,255,0)
Black
(0,0,0)
Red
Red

The Eye - Interpreting the signal

- Size and depth
  - visual angle indicates how much of view an object occupies
    - (relates to size and distance from eye)
  - visual acuity is ability to perceive detail (limited)
  - familiar objects perceived as constant size
    - (in spite of changes in visual angle when far away)
- cues like overlapping help perception of size and depth
- thumbnail at arms length is equivalent to 640x480 pixels
  - resolution demo

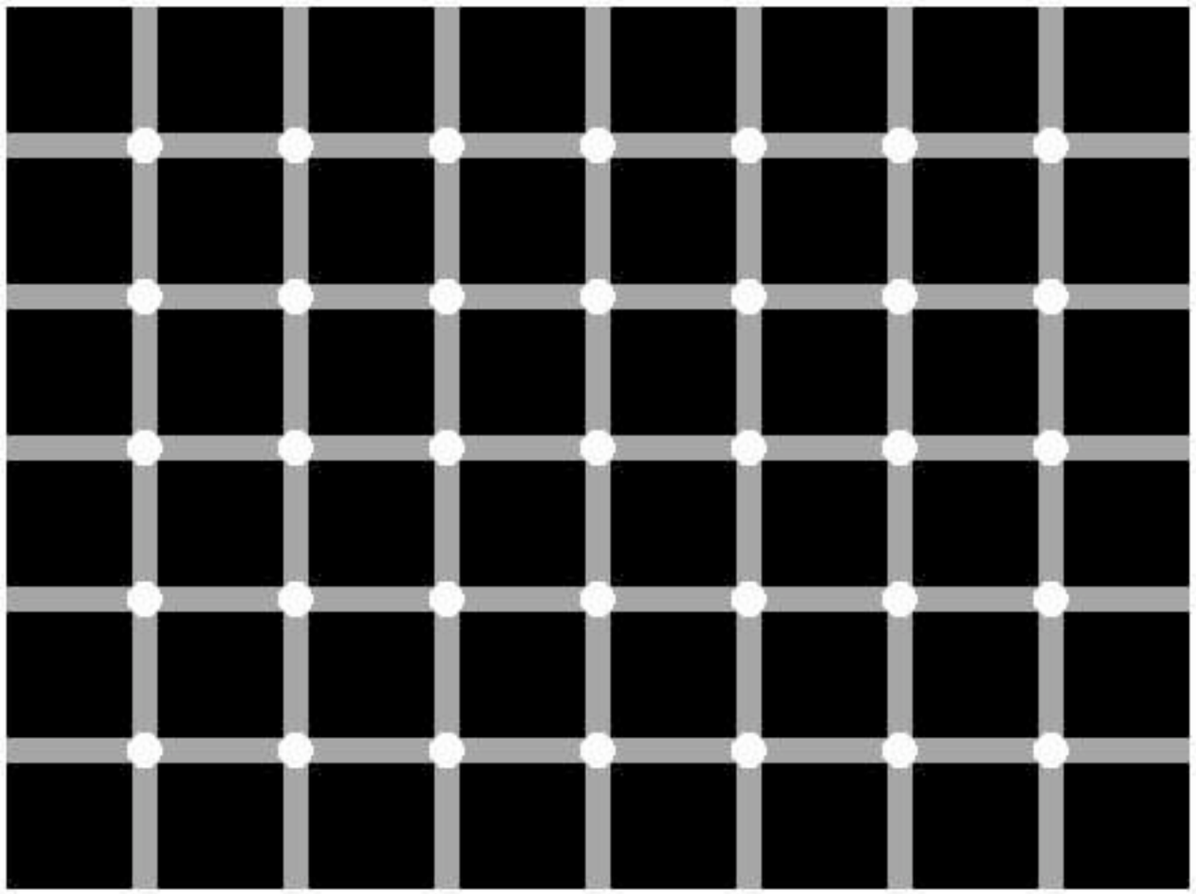
The Eye - Interpreting the signal

- The visual system compensates for:
  - movement
  - changes in luminance.
- Context is used to resolve ambiguity
- Optical illusions sometimes occur due to over compensation

Your brain heavily compensates for effects of your biology

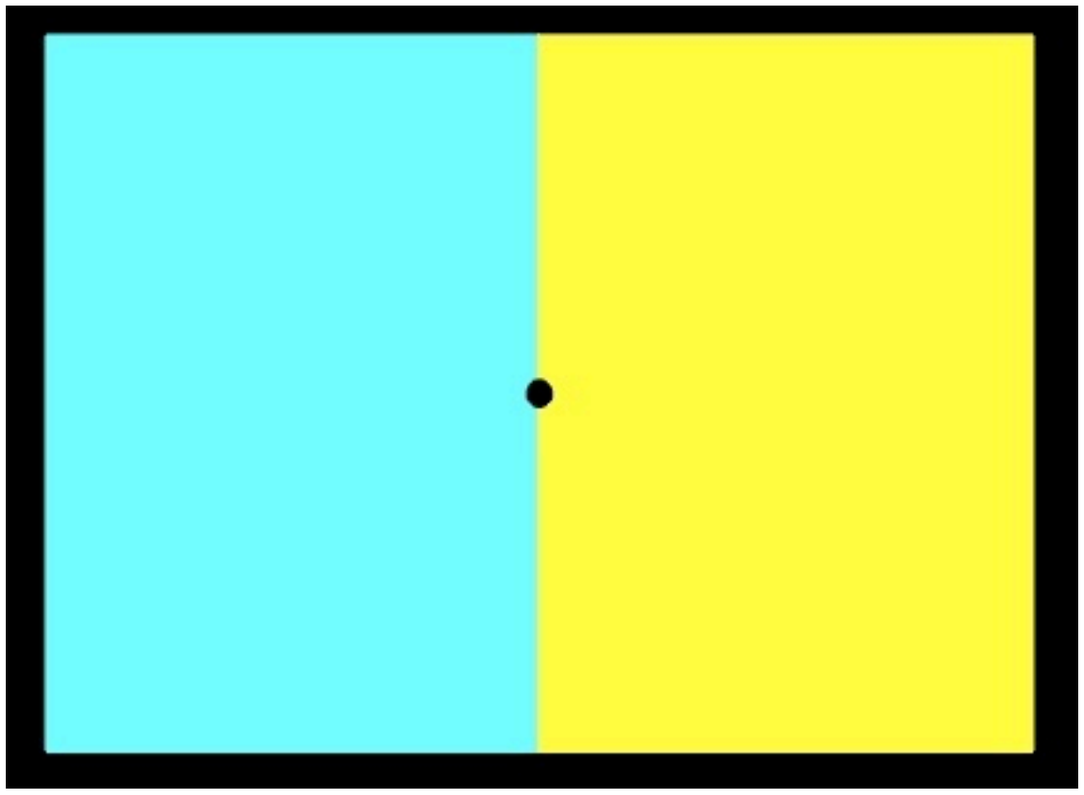
The Eye - Interpreting the signal
Optical Illusions

The Eye - Interpreting the signal
Optical Illusions



The Eye - Interpreting the signal
Optical Illusions - Chromatic Adaptation

The Eye - Interpreting the signal
Optical Illusions - Chromatic Adaptation



The Eye - Interpreting the signal
Optical Illusions - Chromatic Adaptation

Your brain heavily compensates for effects of your biology

Rubin, N., Nakayama, K. and Shapley, R. (2002), The role of insight in perceptual learning: evidence from illusory contour perception. In: Perceptual Learning, Fahle, M. and Poggio,

- There are similar effects for other input and output
  - Hearing
    - Pitch, Loudness, Timbre
    - Frequency and Processing
      - MP3s
  - Touch
    - Heat, Pain, Pressure
    - Adaptation
  - Movement
    - Reaction Time, Fidelity

Phantom Words

Rubin, N., Nakayama, K. and Shapley, R. (2002), The role of insight in perceptual learning: evidence from illusory contour perception. In: Perceptual Learning, Fahle, M. and Poggio,

"People appear to hear words and phrases that reflect what is on their minds – rather as in a Rorschach test, though it's my impression that the present effect is stronger. I can bet who is likely to be on a diet, as they report words like 'I'm hungry'. 'diet coke' or 'feel fat'. And students who are stressed tend to report words that are related to stress – if I play these sounds close to exam time, some students may well hear phrases like 'I'm tired', 'no brain', or 'no time'. Interestingly, female students often report the word 'love', while male students are more likely to report sexually explicit words and phrases."

-Diana Deutsch

http://www.psychologytoday.com/blog/illusions-and-curiosities/200906/phantom-words

Sine Wave Speech

http://www.mrc-cbu.cam.ac.uk/people/matt.davis/sine-wave-speech/

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Memory

- Three types of memory which build on each other
  - Sensory Memory
  - Short-Term or Working Memory
  - Long-Term Memory

Sensory Memory

- Buffers for stimuli received through senses
  - iconic memory: visual stimuli
  - echoic memory: aural stimuli
  - haptic memory: tactile stimuli
- Examples
  - non cognitive recall
- Continuously overwritten

Short-Term Memory

- Scratch-pad for temporary recall
  - rapid access ~ 70ms
  - rapid decay ~ 200ms
  - limited capacity - 7± 2 chunks

Long-Term Memory

- Repository for all our knowledge
  - slow access ~ 1/10 second
  - slow decay, if any
  - huge or unlimited capacity
- Two types
  - episodic – serial memory of events
  - semantic – structured memory of facts,concepts, skills
  - semantic LTM derived from episodic LTM

Thinking

- Reasoning
  - Deduction
  - Induction
  - Abduction
- Problem Solving

Thinking

- Reasoning
  - Deduction
    - derive logically necessary conclusion from given premises.
  - Induction
    - generalize from cases seen to cases unseen
- Abduction
  - reasoning from event to cause
    - Sam drives fast when drunk.
    - If I see Sam driving fast, assume drunk.

Thinking

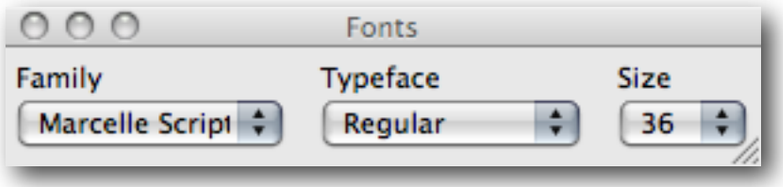
- Problem Solving
  - Process of finding solution to unfamiliar task using knowledge.
  - Many theories of this process

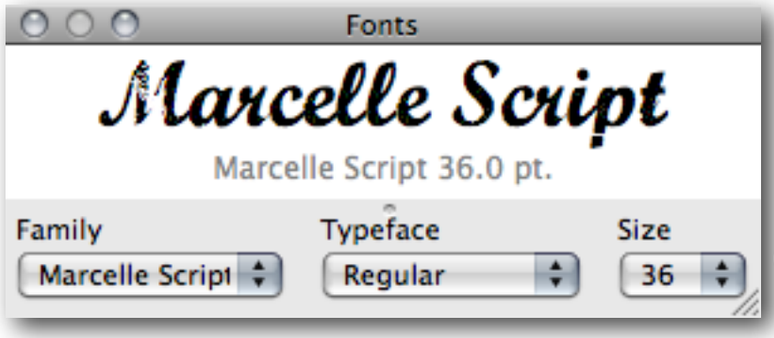
Individuals vary in their abilities

- long term
  - sex, physical and intellectual abilities
- short term
  - effect of stress or fatigue
- changing
  - age

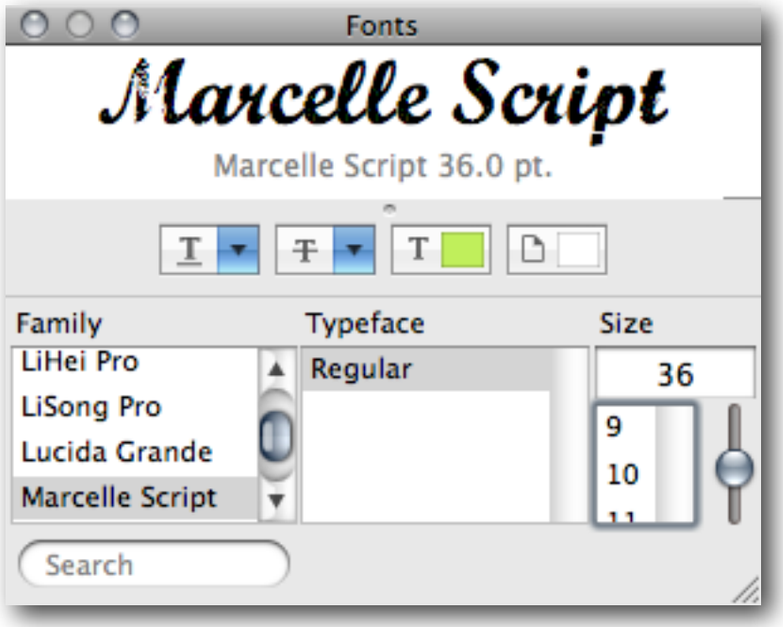
- Ask yourself:
  will design decision exclude section of user population?

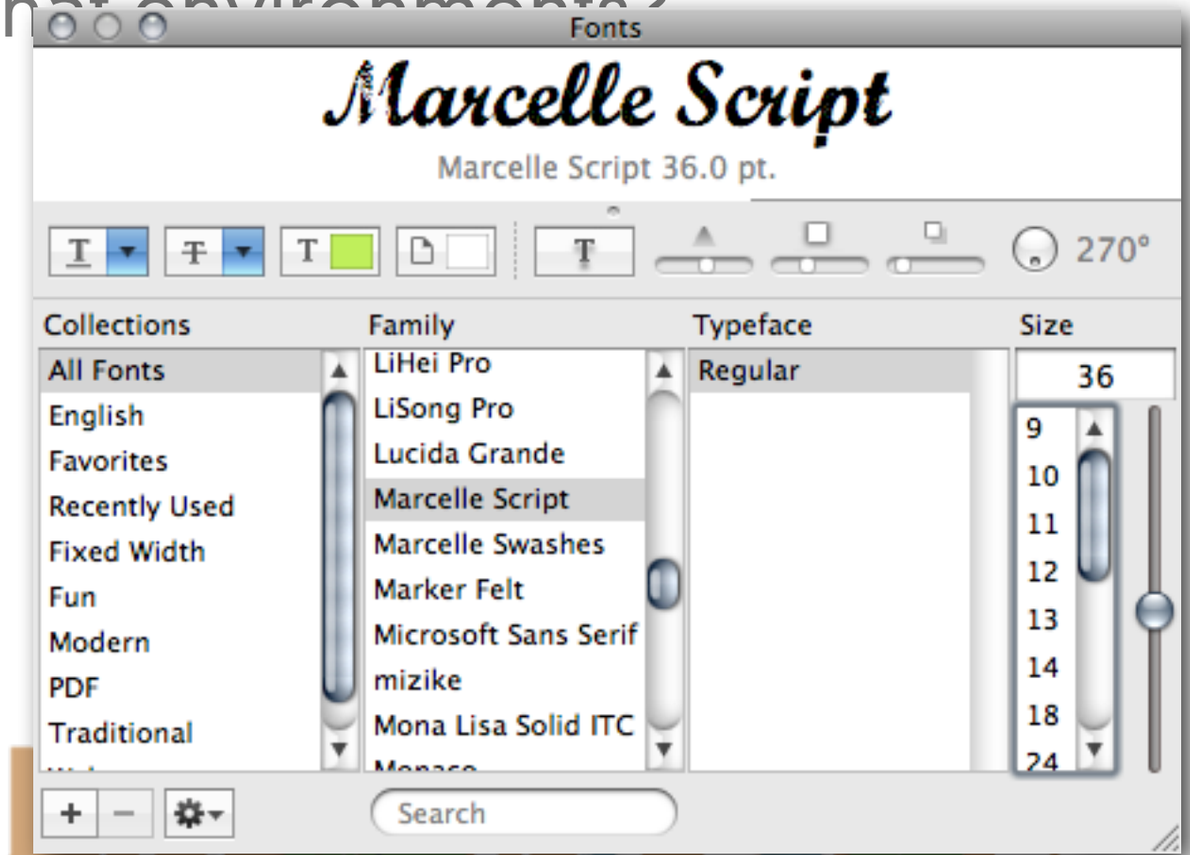
Addressing different skills and environments

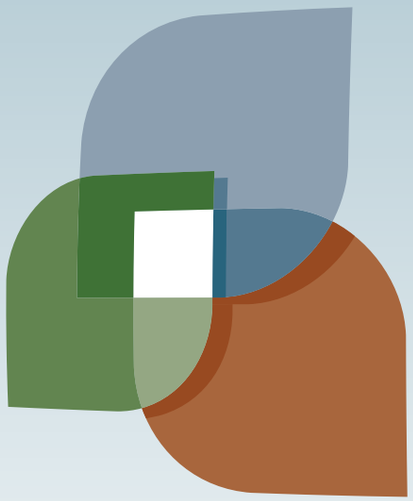




- "Plasticity"
  - Adapting to different environments easily.
  - What environments?







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