

# : My Background

- B.S., Computer Science from Cornell (NY)
  - M.Eng, Electrical Engineering
- STRIKE Officer
  - USS CURTIS WILBUR, DDG-54, Japan
- Operations Officer
  - USS SIMON LAKE, AS-33, Italy
- Ph.D in Computer Science and Engineering at UW
- Director of the Laboratory for Ubiquitous Computing and Interaction
- Co-founder of quub, whisper.fm, swayr



# User Interaction: The Human

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INF 133 Fall 2012



Human Computer Interaction is a misnomer.  
Rarely do people want to interact with a computer.  
They want to interact with people, data, media.  
Even gaming isn't about the computer as much as it is about  
having fun through a computer.

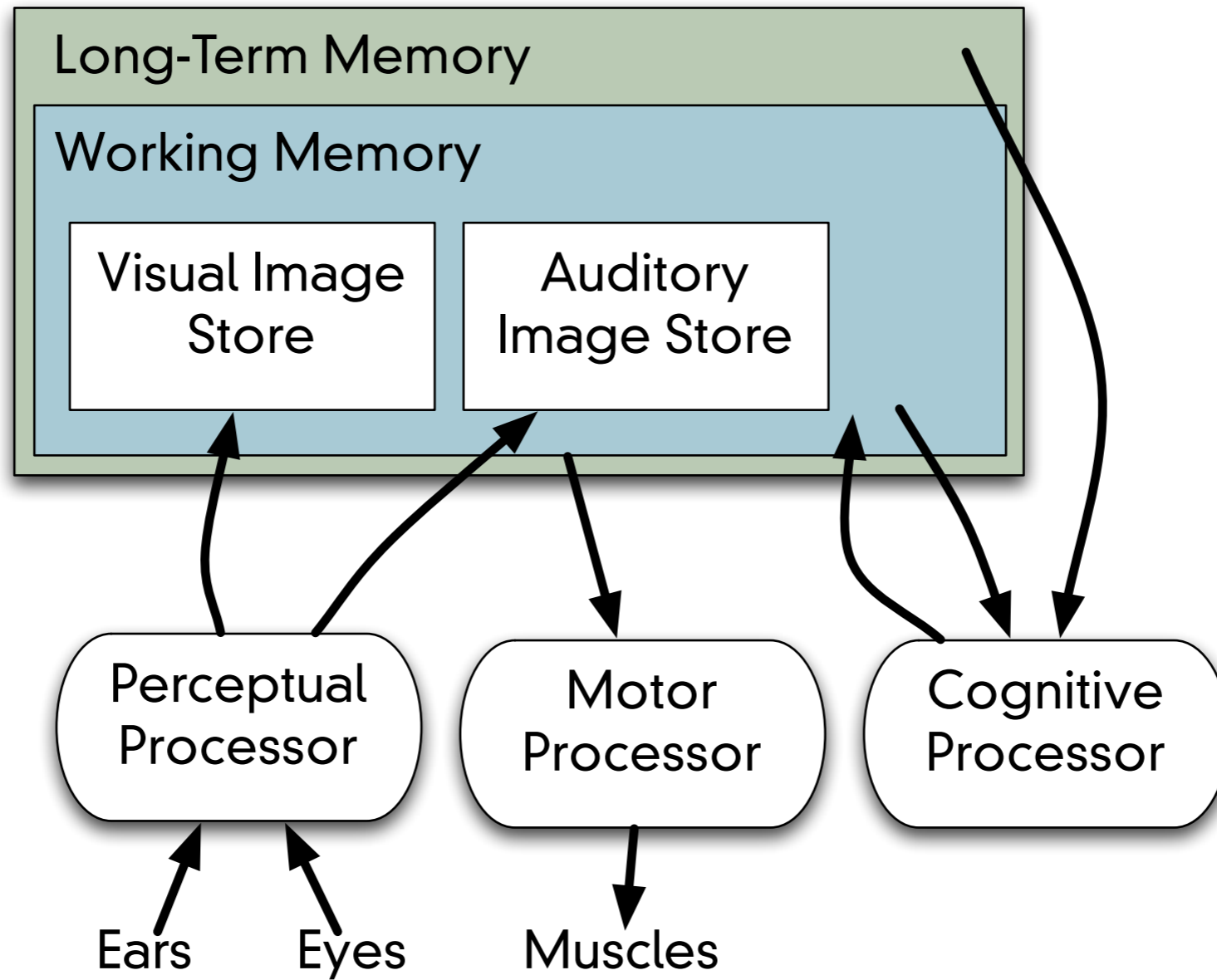


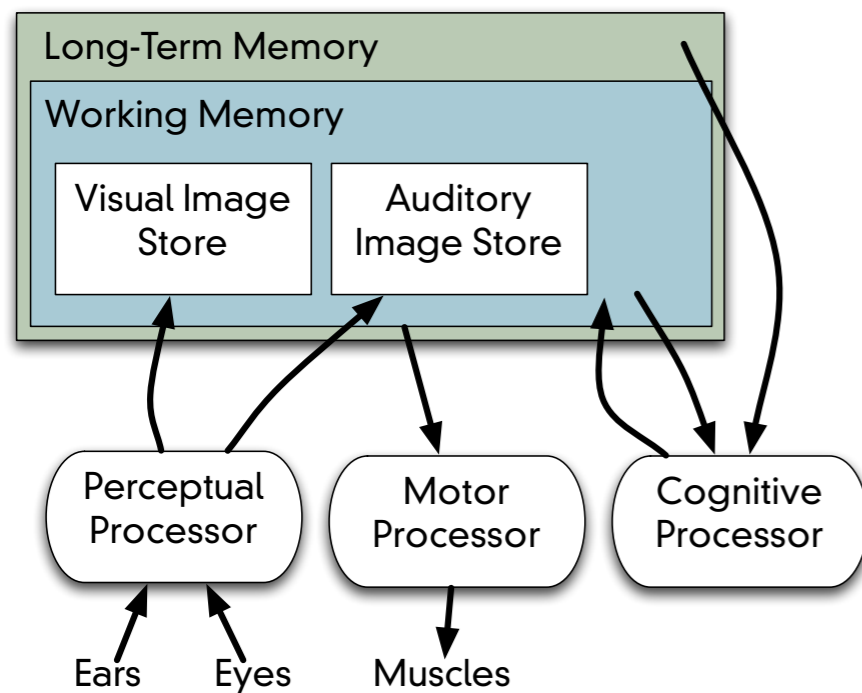


<http://www.flickr.com/photos/schultzlabs/933418919>

<http://www.flickr.com/photos/oxborrow/51812810/>

# The Model Human Processor





- 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



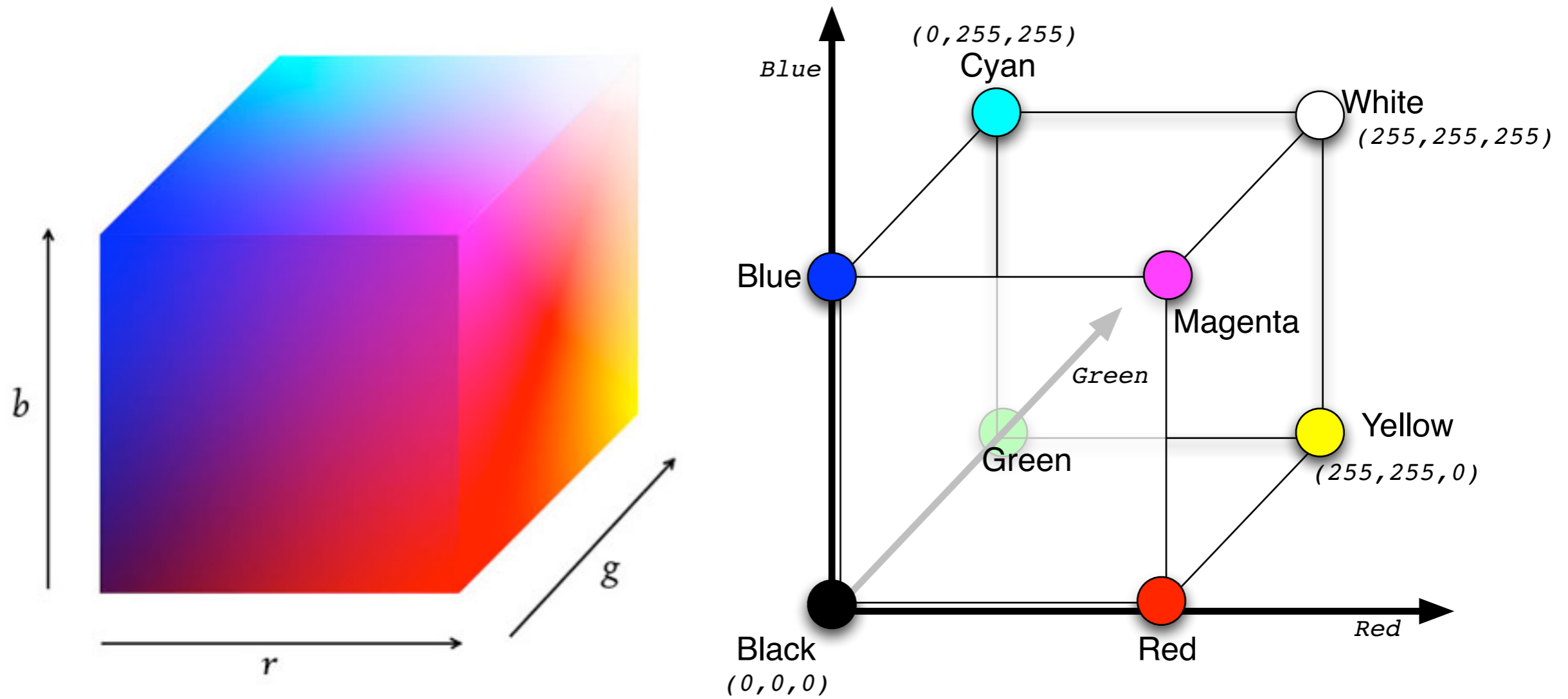


# The Eye - Interpreting the signal

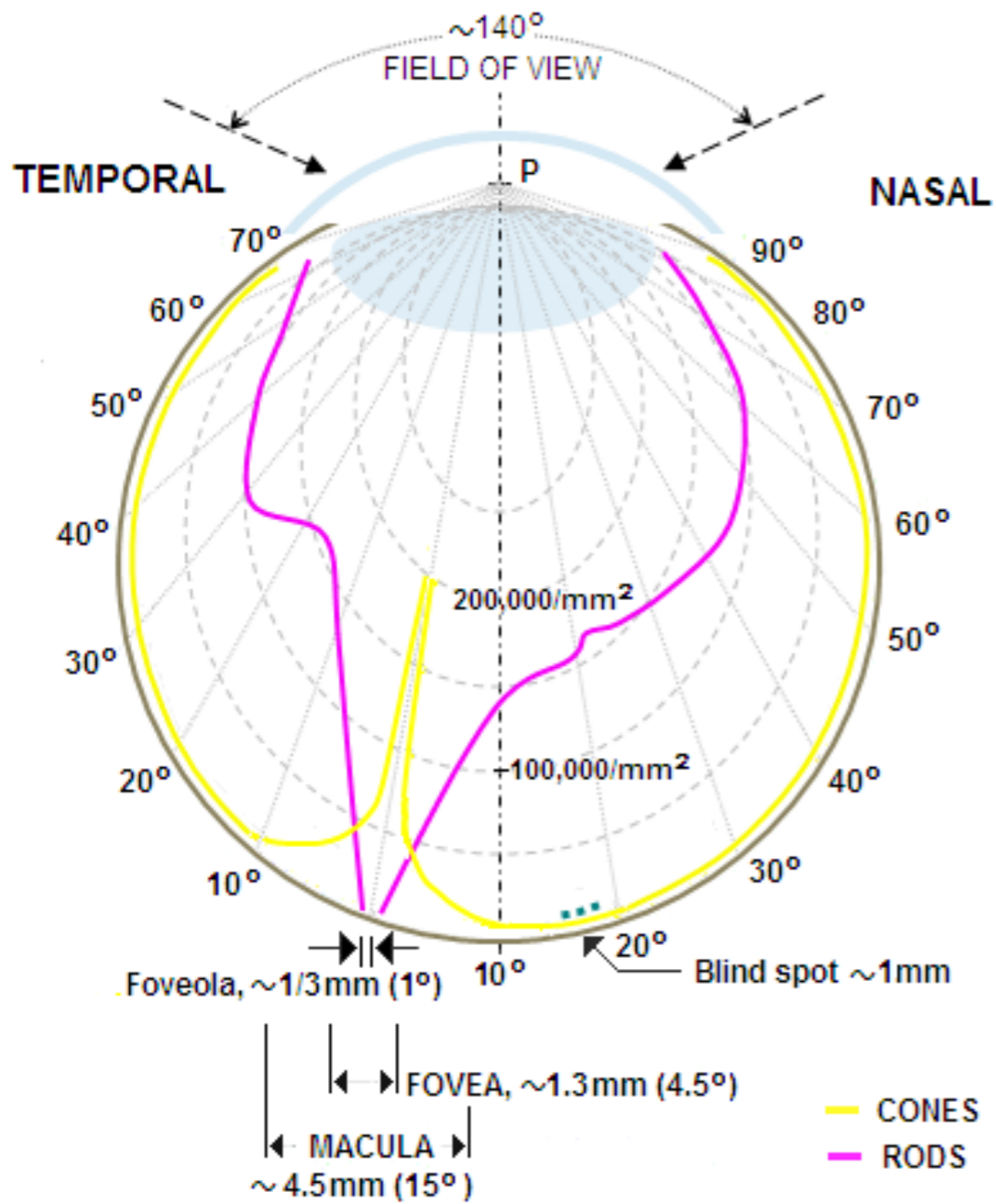
- Brightness
  - subjective reaction to levels of light
  - affected by luminance of object
  - measured by just noticeable difference
  - visual acuity increases with luminance as does flicker
- Color
  - made up of hue, intensity, saturation
  - cones sensitive to color wavelengths
  - blue acuity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



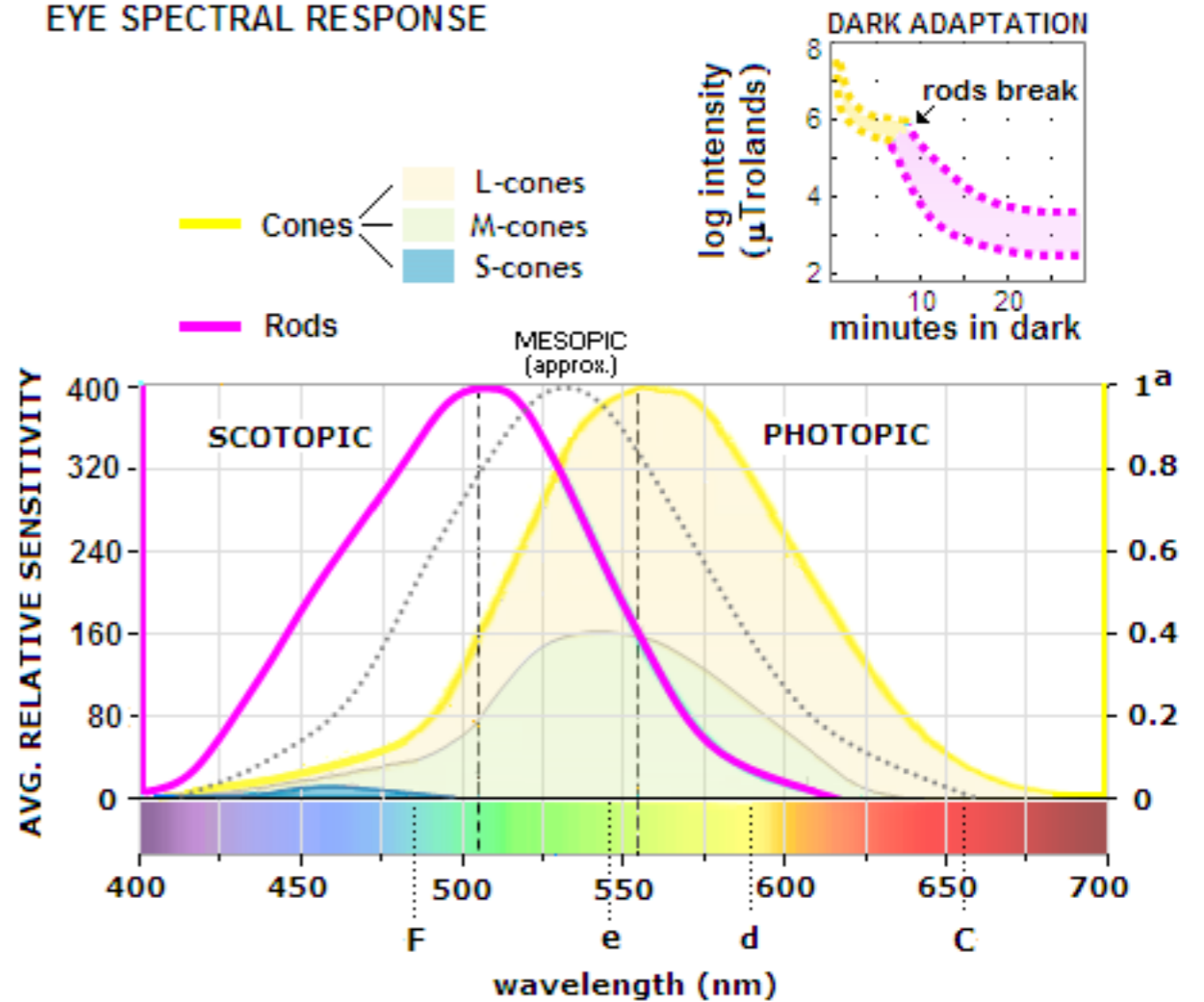
rgb



DISTRIBUTION OF RETINAL PHOTORECEPTORS



EYE SPECTRAL RESPONSE



rgb

# 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



The background features a dark teal horizontal bar at the top. Below it, the main area is white with three large, overlapping, semi-transparent shapes: a light blue shape at the top right, a light green shape at the bottom left, and a light orange shape at the bottom right. These shapes overlap in the center, creating a white square void.

Your brain heavily compensates for effects of your biology



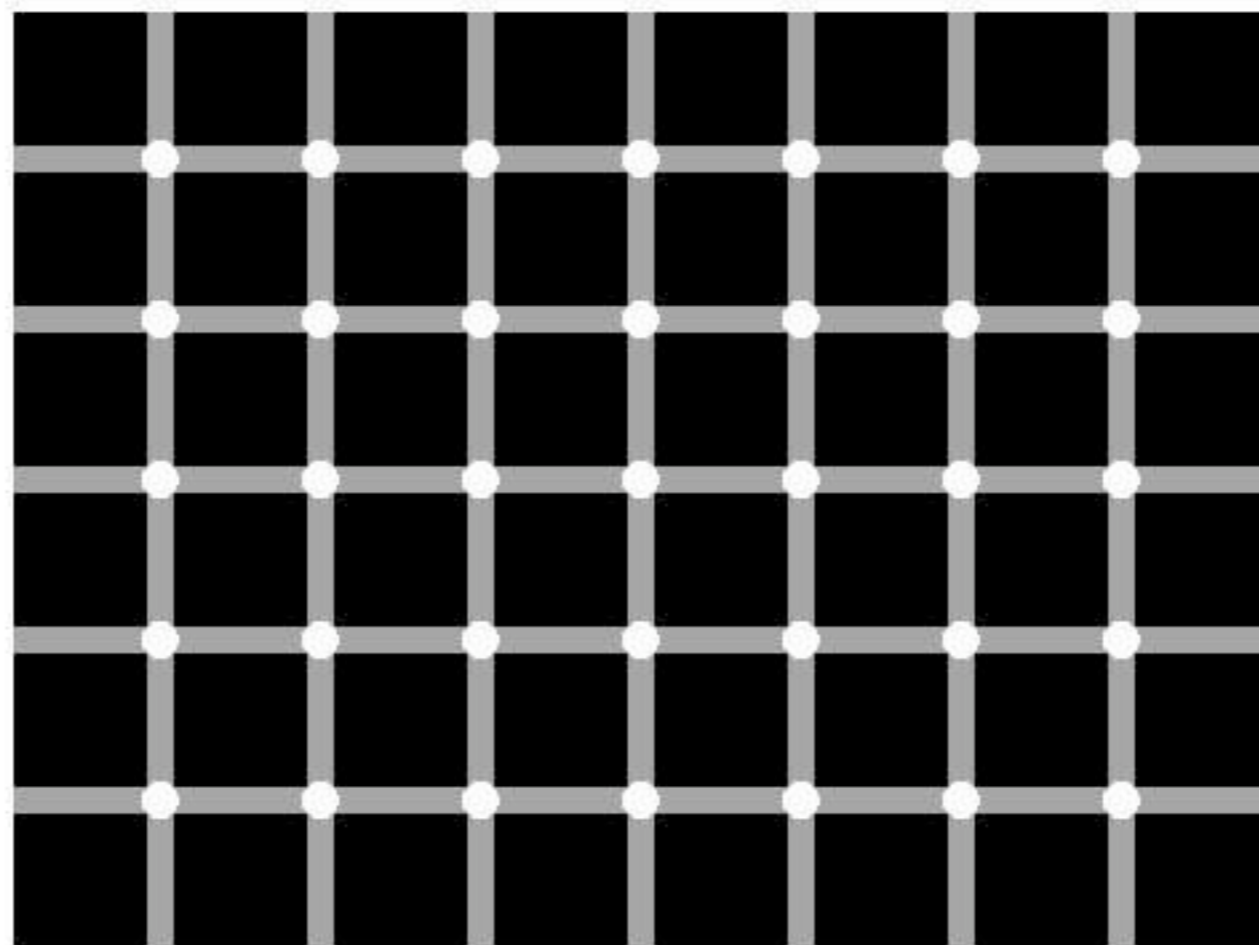
# The Eye - Interpreting the signal

## Optical Illusions



# The Eye - Interpreting the signal

## Optical Illusions



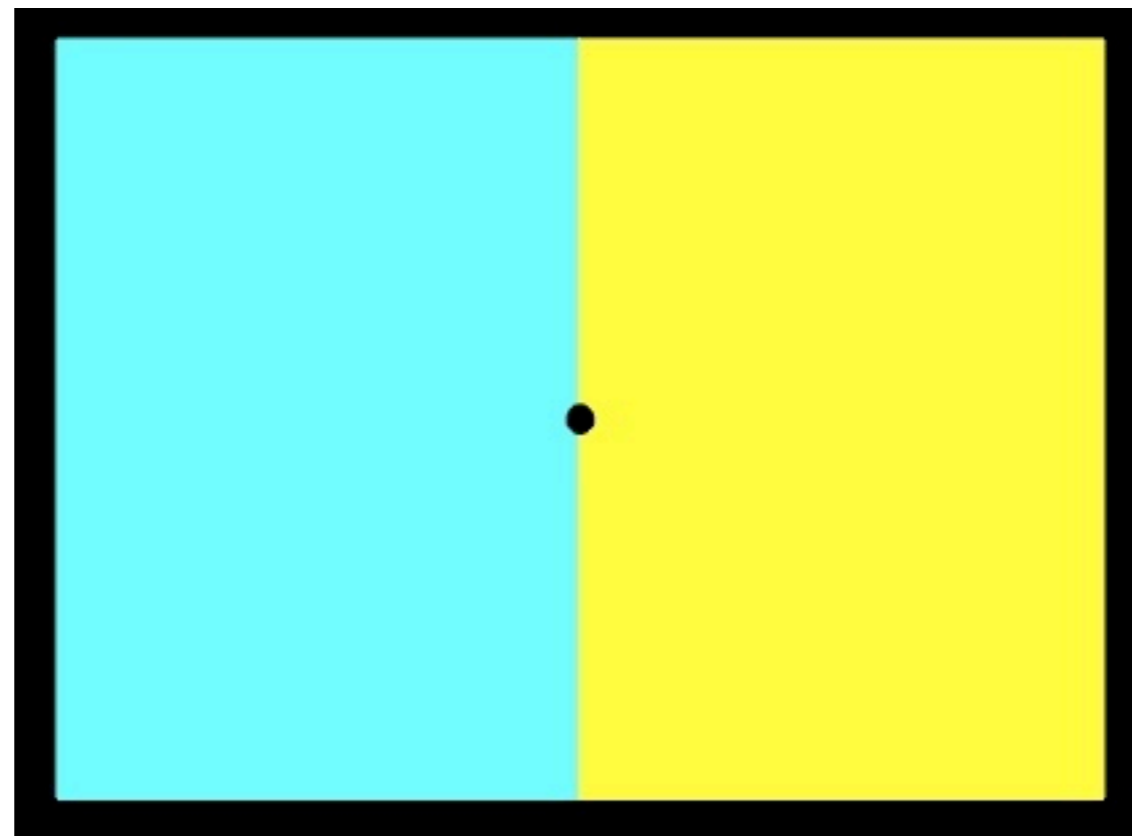
# The Eye - Interpreting the signal

## Optical Illusions - Chromatic Adaptation



# The Eye - Interpreting the signal

## Optical Illusions - Chromatic Adaptation



# The Eye - Interpreting the signal

## Optical Illusions - Chromatic Adaptation





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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 -  $7 \pm 2$  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

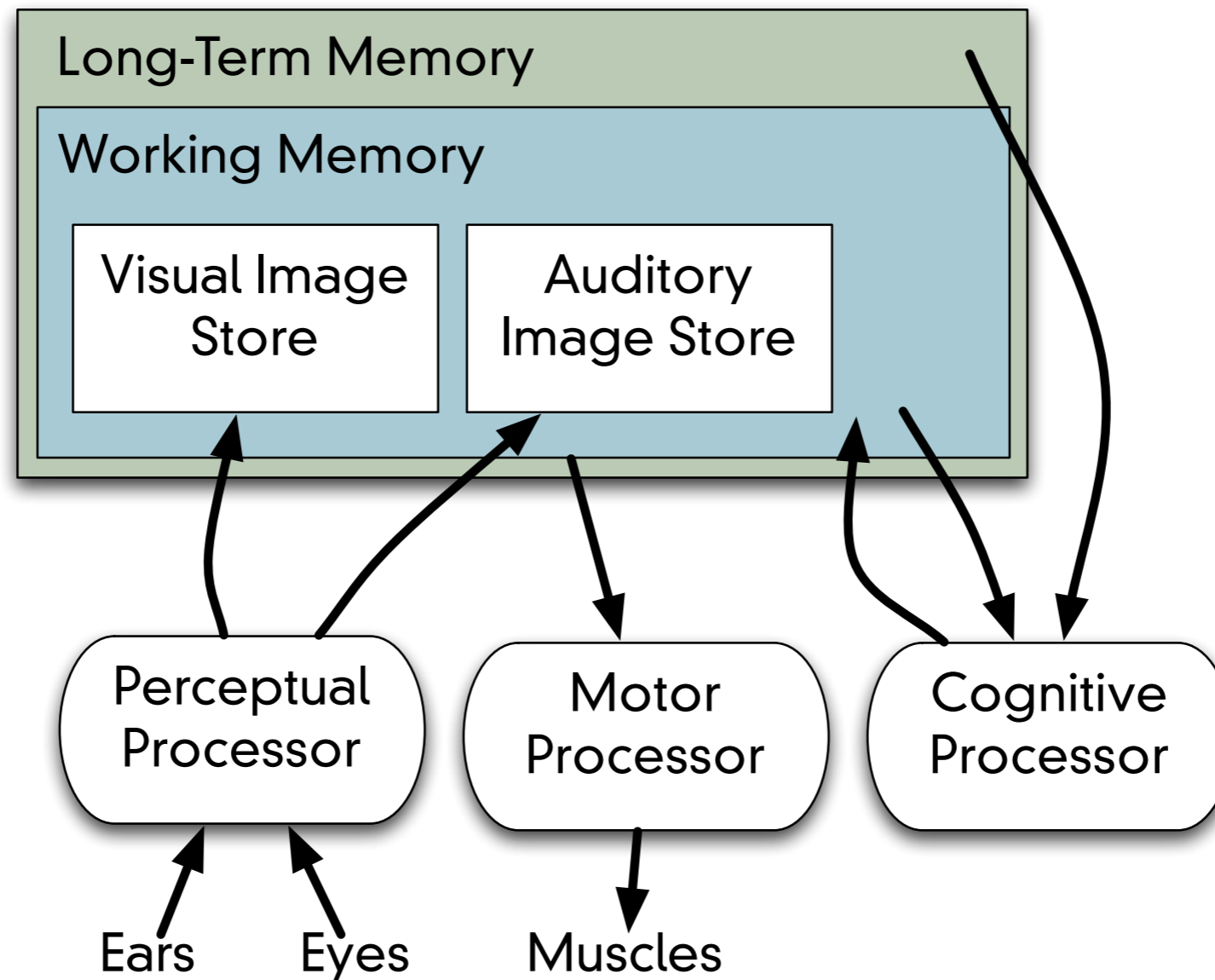


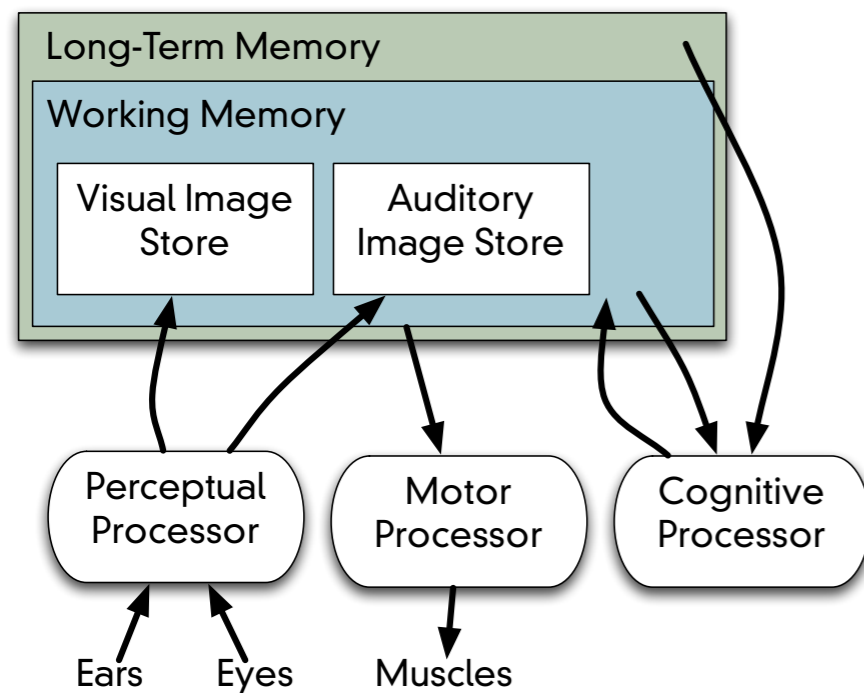
# Individuals vary in their abilities

- 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?



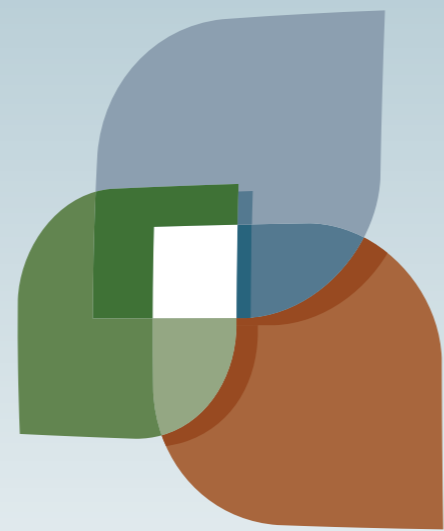
- What is missing from this model?





- Eyes as human output
- Touch as human input
- Sensory Memory
- Social Organization Around the individual
- External cognitive aids
  - Augmented Reality
  - Search





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