User Interaction: The Human

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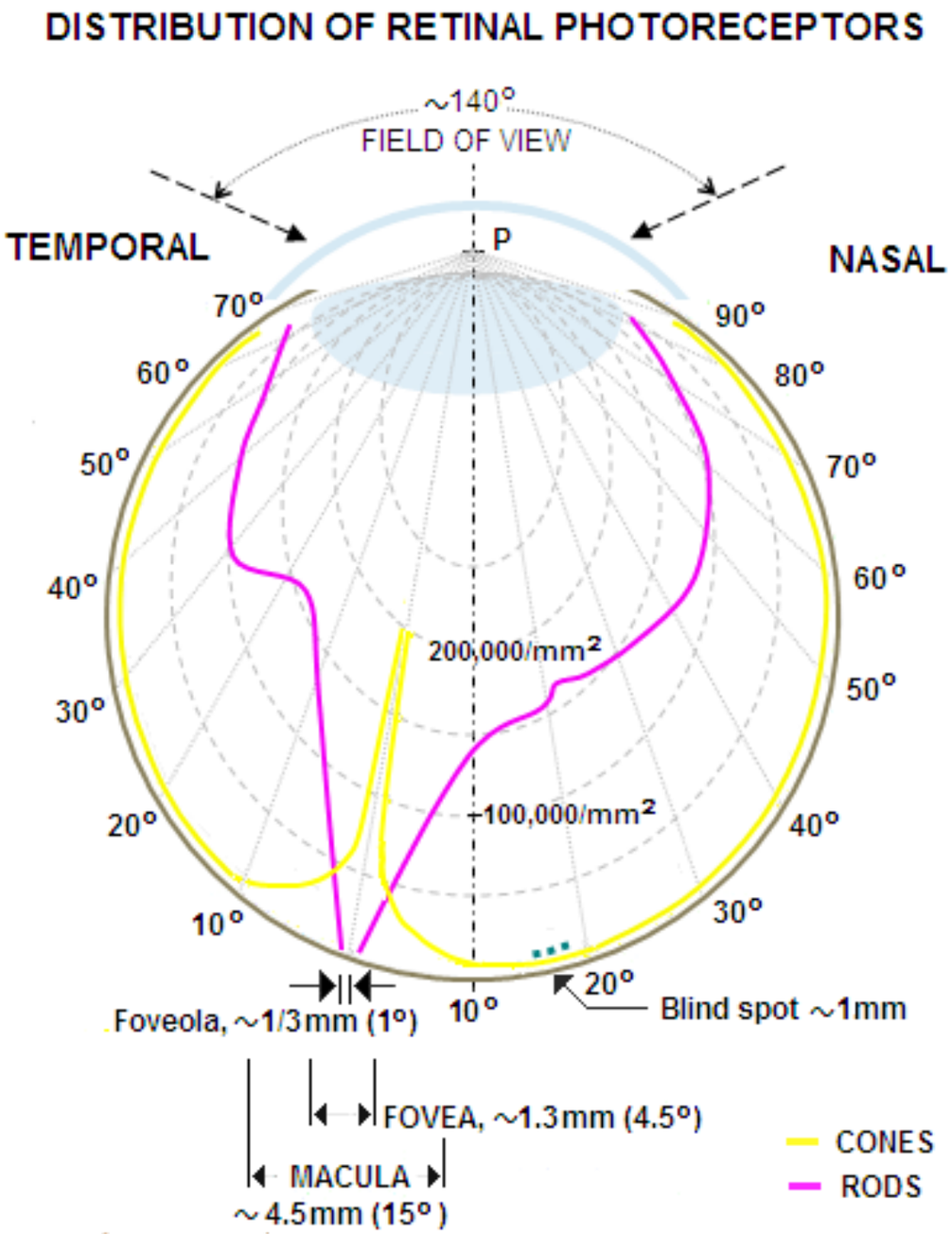
INF 133 Fall 2014

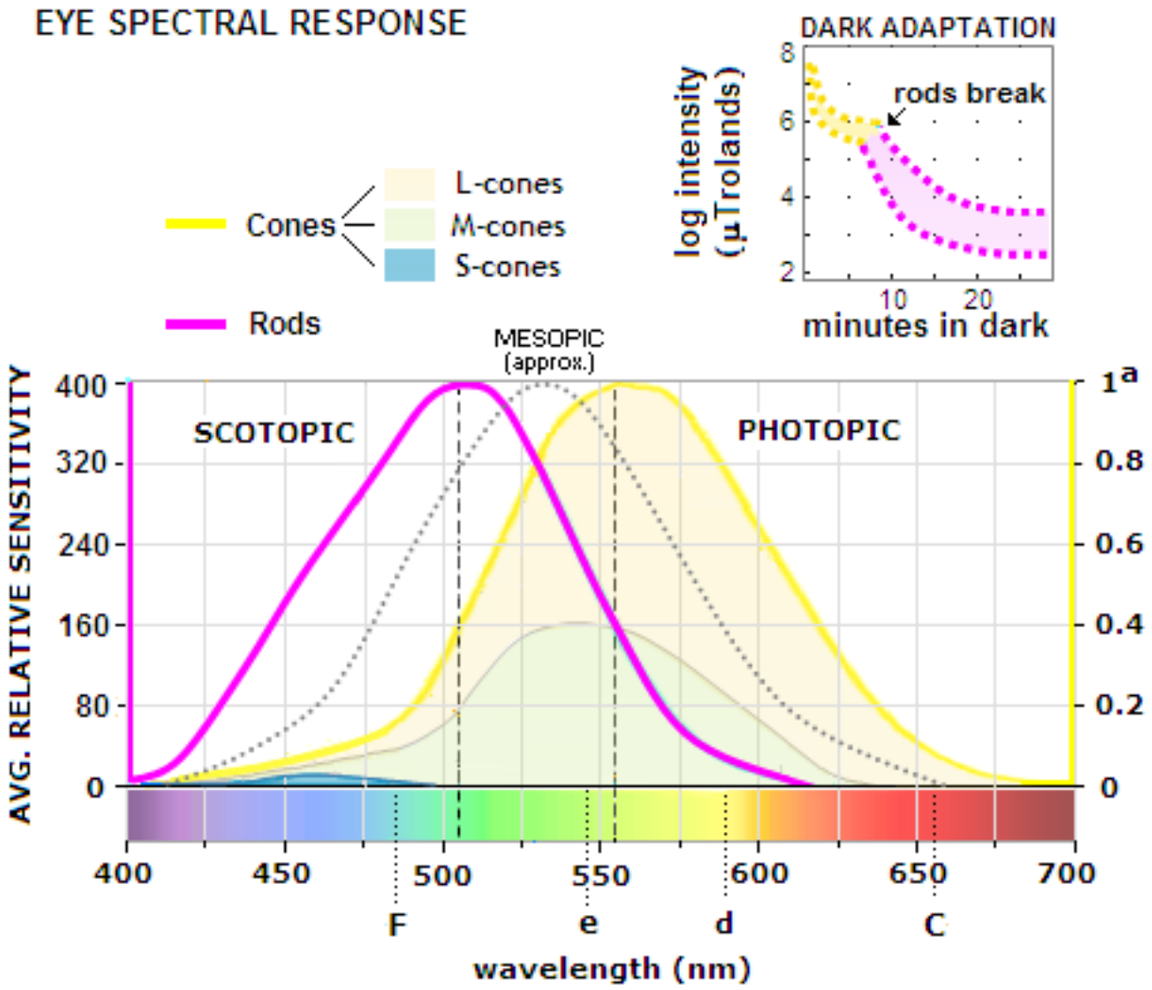
The Eye - Physical Reception

- 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



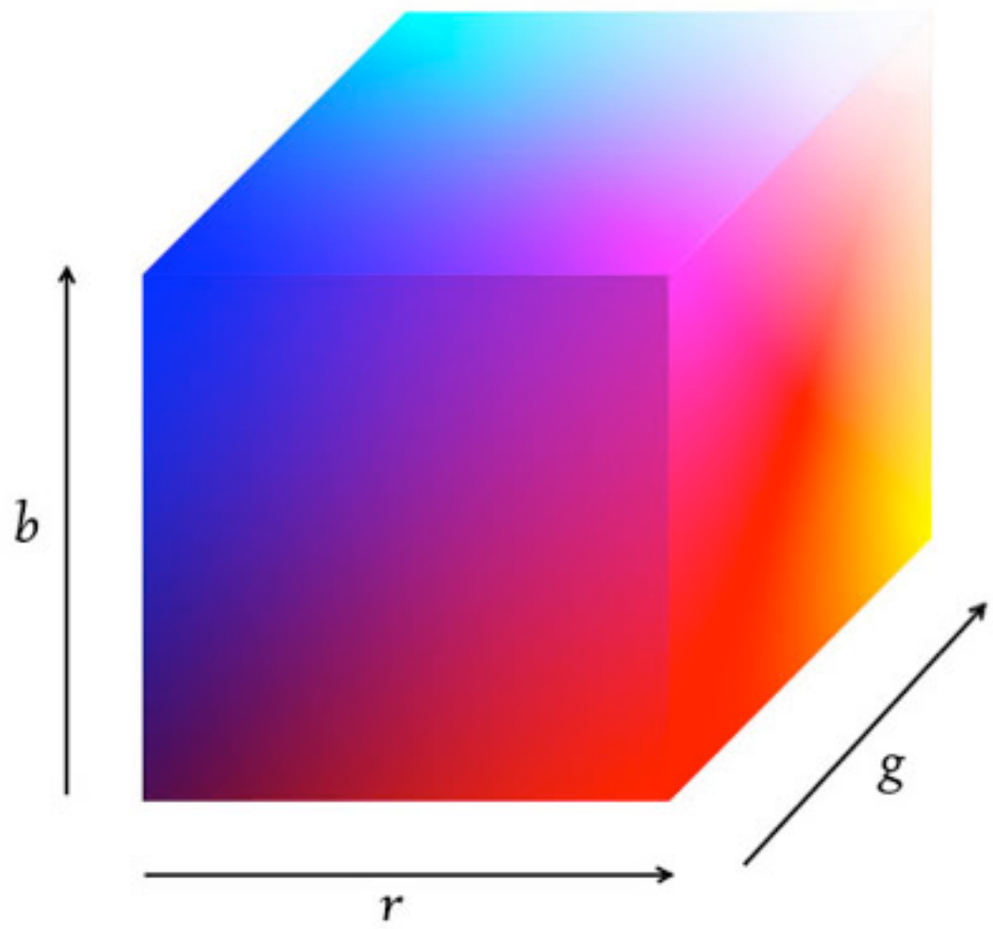


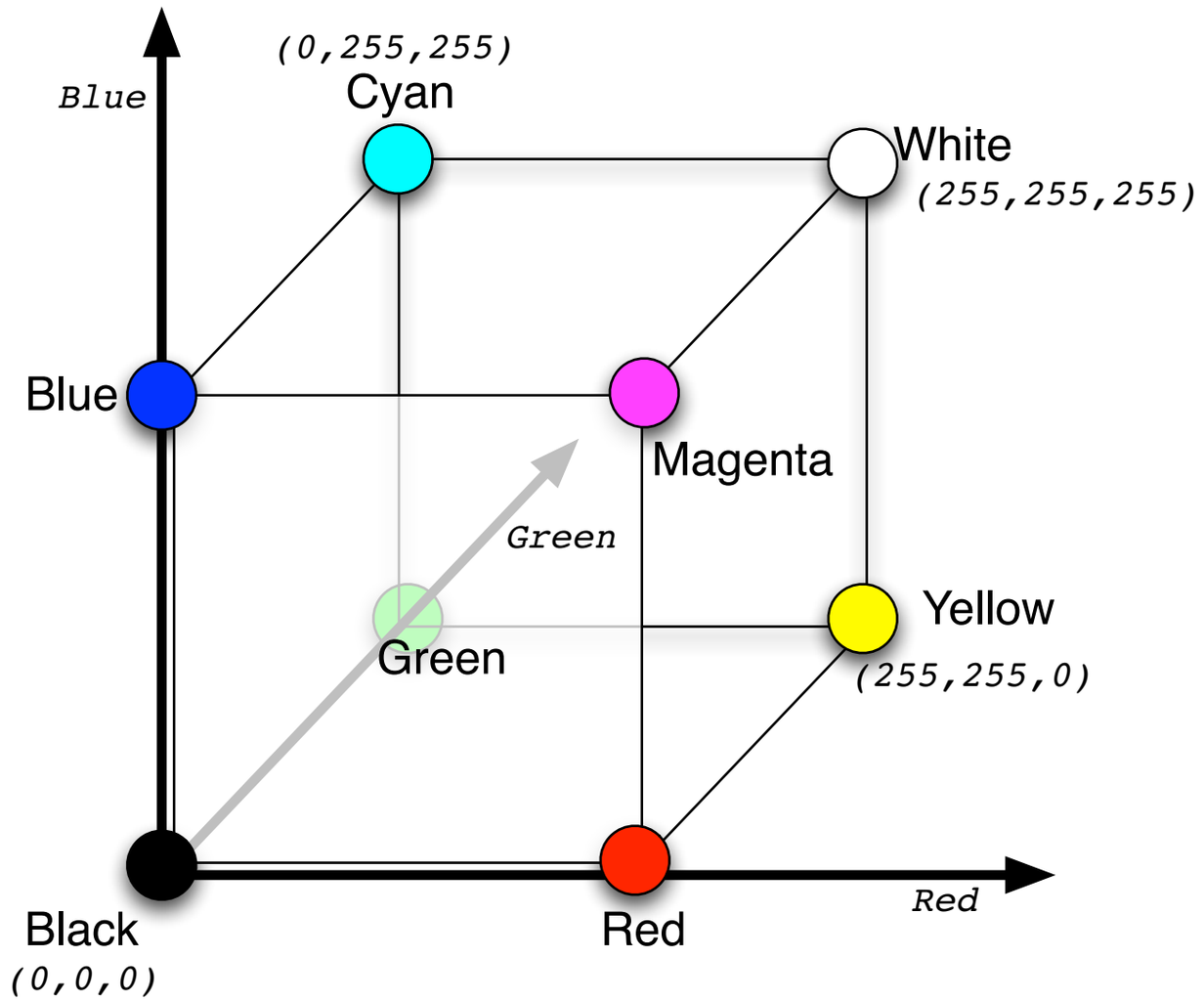
http://www.telescope-optics.net/eye_spectral_response.htm

Poll

- Vision

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

Video

- Chroma

The Eye - Interpreting the signal

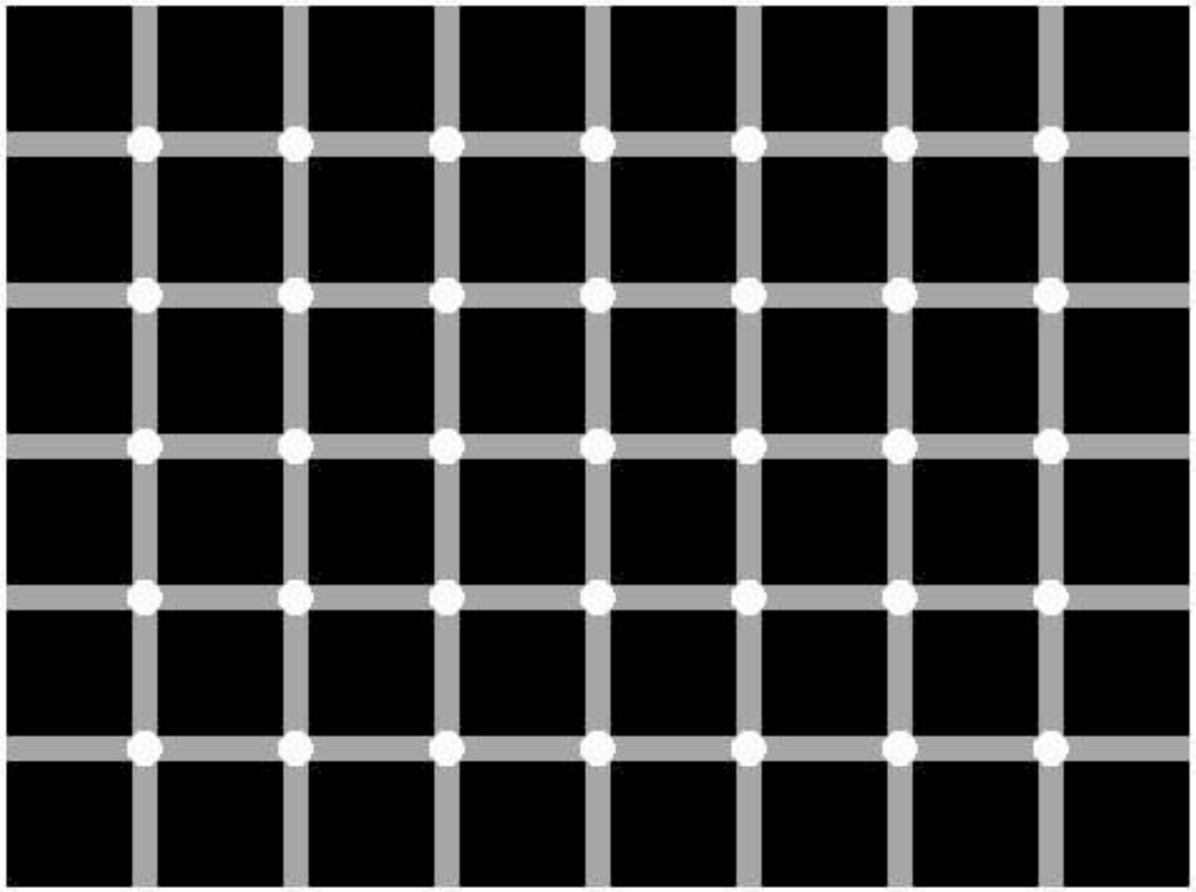
- Size and depth
  - visual angle indicates how much of view an object occupies
    - (relates to size and distance from eye)
  - visual acuity is ability to perceive detail (limited)
    - familiar objects perceived as constant size
      - (in spite of changes in visual angle when far away)
- cues 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

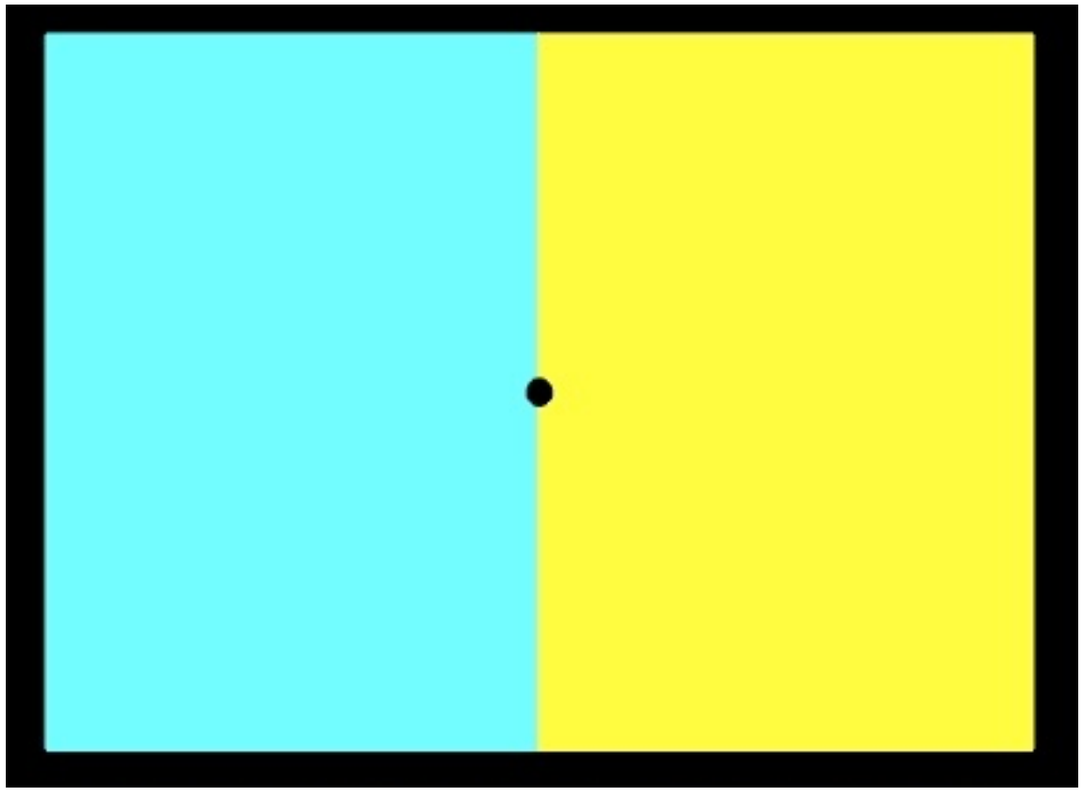
Your brain heavily compensates for effects of your biology

The Eye - Interpreting the signal
Optical Illusions



The Eye - Interpreting the signal
Optical Illusions - 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

Sine Wave Speech

Sine Wave Speech

Sine Wave Speech

Sine Wave Speech

Sine Wave Speech

Sine Wave Speech

Sine Wave Speech

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

Example


Raid
RITE AID
Plastic
BANDAGES
A Collection of many
PROBLEMS
SECRETS and EXPERIMENTS
TRADER JOE'S
SOYMILK Extra
7 grams SOY PROTEIN
Vanilla
NON-DAIRY DRINK
ARMOR ALL
Original
ESPRESSO PILLOWS
all day pain relief
dental floss
ACE The helpful place. ACE

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

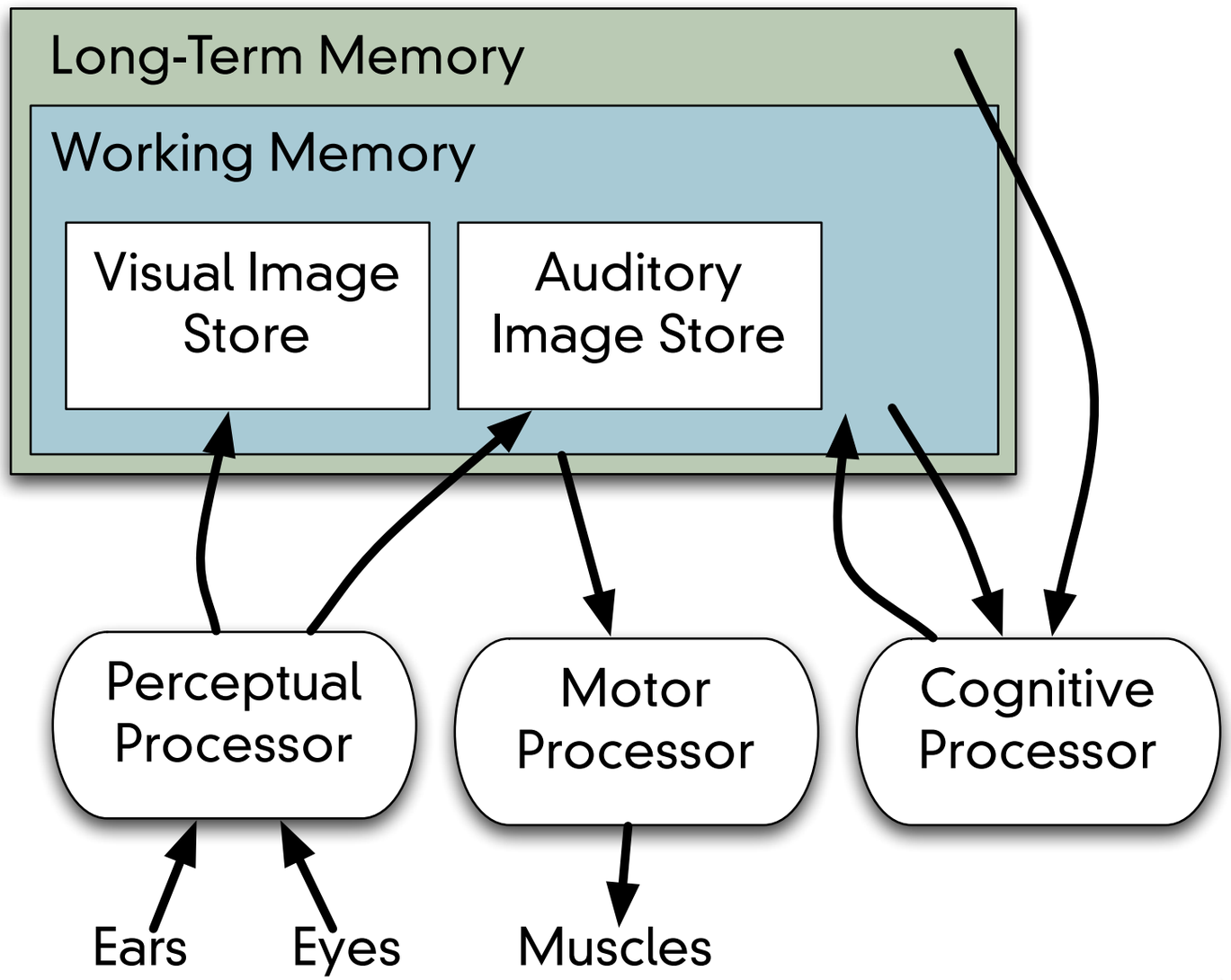
Thinking

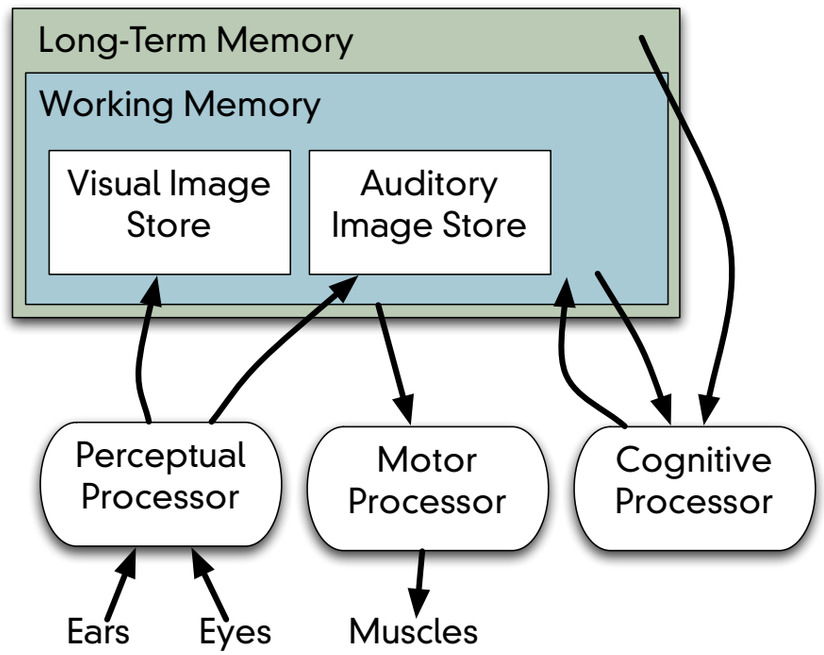
- Reasoning
  - Deduction
  - Induction
  - Abduction
- Problem Solving

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.
    - “Correlation is not casualty” Spurious Correlations

- What is missing from this model?





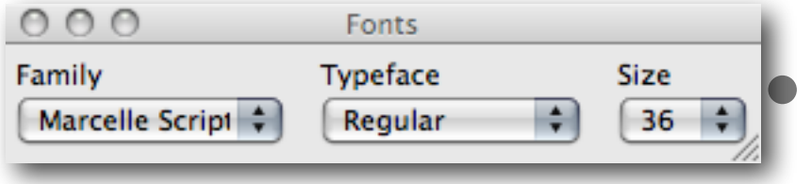
- Eyes as human output
- Touch as human input
- Sensory Memory
- Social Organization Around the individual
- External cognitive aids
  - Augmented Reality
  - Search

Individuals vary in their abilities

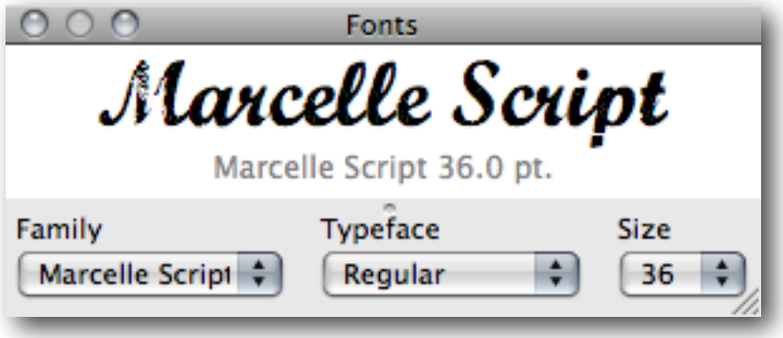
- long term
  - sex, physical and intellectual abilities
- short term
  - effect of stress or fatigue
- changing
  - age

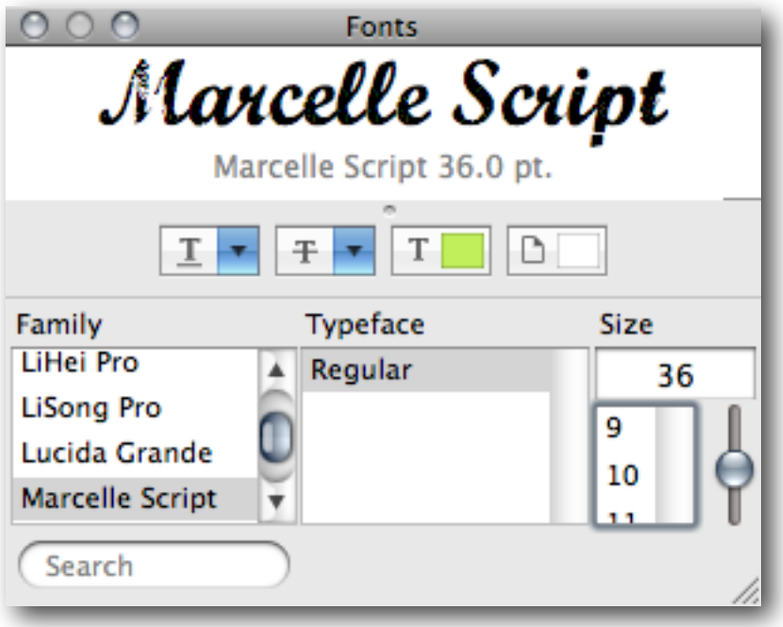
- Ask yourself:
  will design decision exclude section of user population?

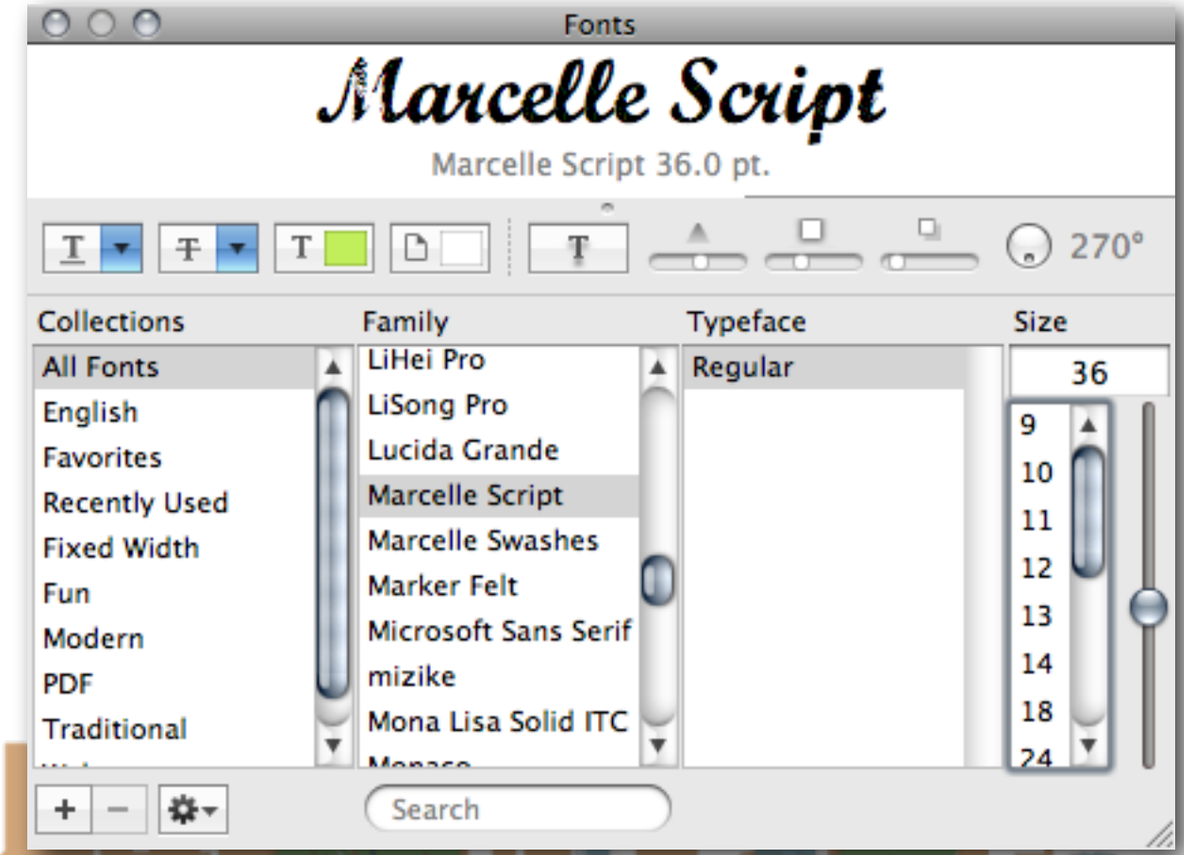
Addressing different skills and environments



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







Emotion influences human capabilities

Emotion

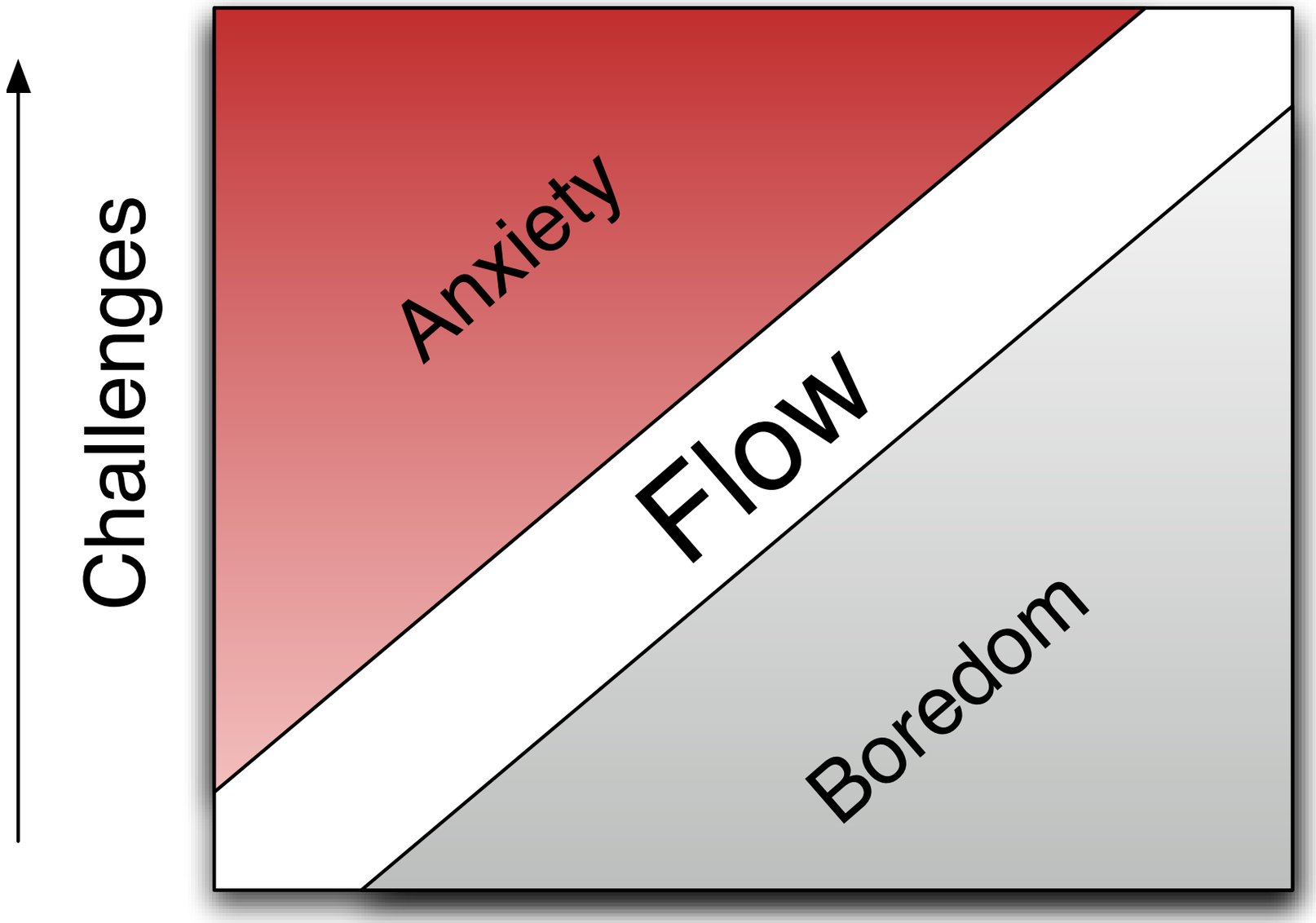
- Various theories of how emotion works
  - James-Lange: emotion is our interpretation of a physiological response to a stimuli
  - Cannon: emotion is more than a psychological response to a stimuli
  - Schacter-Singer: emotion is the result of our evaluation of our physiological responses, in the light of the whole situation we are in
- Emotion clearly involves both cognitive and physical responses to stimuli

Emotion

- The biological response to physical stimuli is called affect
- Affect influences how we respond to situations
  - positive → creative problem solving
  - negative → narrow thinking

"Negative affect can make it harder to do even easy tasks; positive affect can make it easier to do difficult tasks."

D.A. Norman, 2002


Challenges
Anxiety
Flow
Boredom
Skills

- "Aesthetic-Usability Effect" is a phenomenon
- aesthetic designs
  - are perceived as more usable
  - are more likely to be used
  - make people more tolerant of problems
- unaesthetic designs
  - may be more usable, but don't get used

http://youtu.be/EBqHjEbLHEc

- 3 Models of Humans
  - Model Human Processor
    - Theoretical
  - Fitt's Law
    - Empirical [a+b log2(d/s +1)]
  - Flow
    - Design Concept
- Humans are heavily biased by expectations
  - From our biology to our cognitive response
- Think about design in terms of your actual real users
  - What are their capabilities?
  - What do they expect?

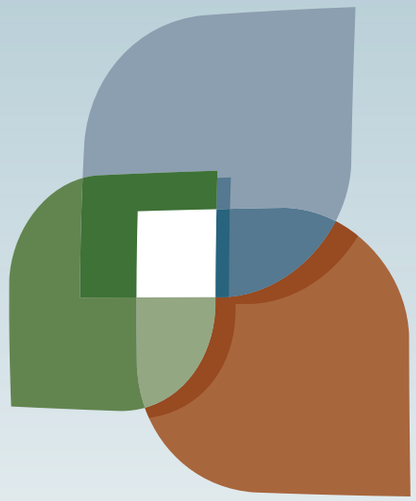
Humans are limited in their capacity to process information.

This has important implications for design.

"...in an information-rich world, the wealth of information means a dearth of something else: a scarcity of whatever it is that information consumes. What information consumes is rather obvious: it consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention and a need to allocate that attention efficiently among the overabundance of information sources that might consume it" (Simon 1971, p. 40-41).

“Designing an object to be simple and clear takes at least twice as long as the usual way. It requires concentration at the outset on how a clear and simple system would work, followed by the steps required to make it come out that way -- steps which are often much harder and more complex than the ordinary ones. It also requires relentless pursuit of that simplicity even when obstacles appear which would seem to stand in the way of that simplicity.”

T.H. Nelson, 1977



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