

Usability Principles



Human Ability
Human Capabilities
Memory
Process
Observations
Problem Solving

Human Abilities

- Good

- Infinite capacity LTM
- LTM duration & complexity
- High-learning capability
- Powerful attention mechanism
- Powerful pattern recognition

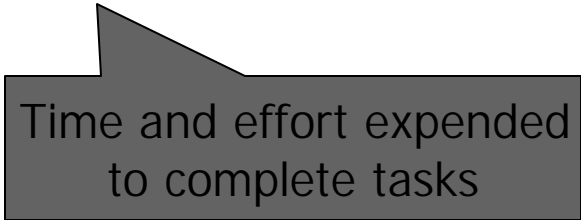
- Bad

- Limited capacity STM
- Limited duration STM
- Unreliable access to LTM
- Error-prone processing
- Slow processing

computer is opposite!
Allow one who does it
best to do it!
(function allocation)

Human Capabilities

- Why do we care? (better design!)
- Want to improve user performance



Time and effort expended
to complete tasks

- Knowing the user informs the design
 - Senses (Vision, Hearing, Touch)
 - Information processing
 - Motor System

SENSES

Vision, Hearing, Touch

VISION

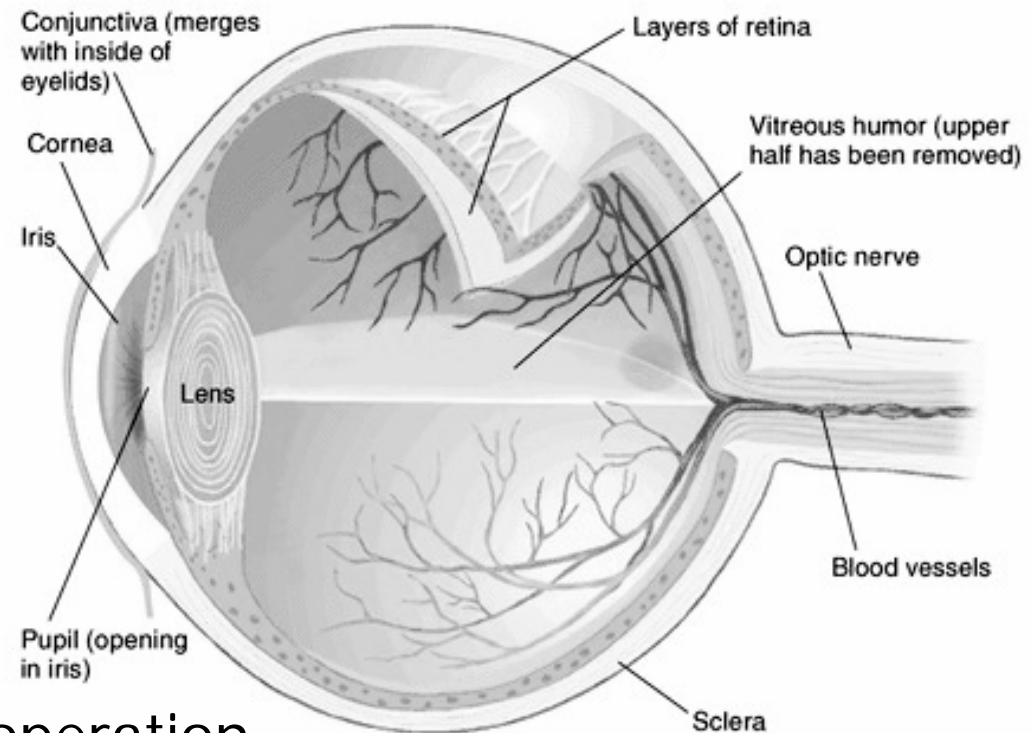
Visual System

Eye

Retina

Neural pathway

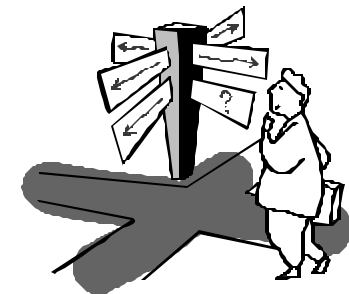
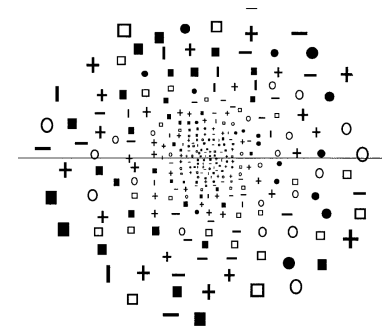
~ 80% of brain's operation



Visual Abilities

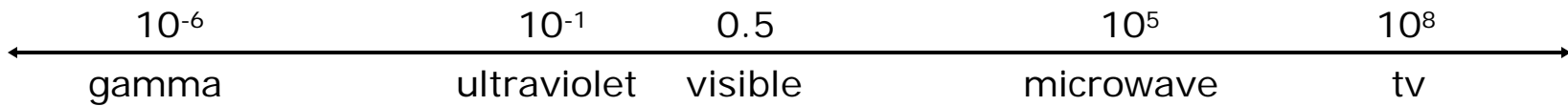


- **Sensitivity**
 - luminance: $10^{-6} \sim 10^7$ mL (see notes)
- **Acuity**
 - detection, alignment, recognition (visual angle)
 - retinal position: fovea has best acuity
- **Movement**
 - tracking, reading, vibrations
- **Note:** Vision decreases with age
- **Implications (??)**
 - Font size & location depends on task
 - Much done by context & grouping



COLOR

- Sensory response to electromagnetic radiation in the spectrum between wavelengths 0.4 - 0.7 micrometers



Color & the retina

380 (blue) ~ 770nm (red)

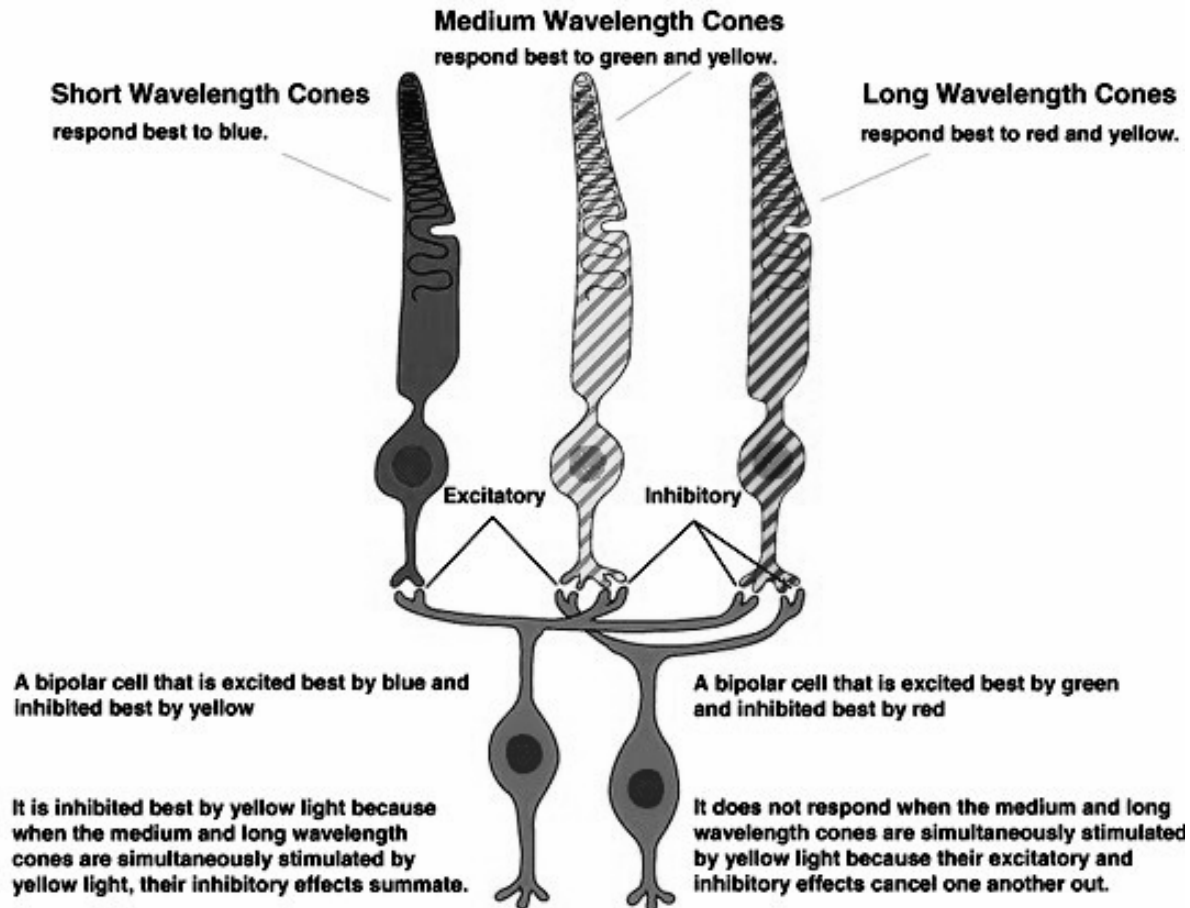
Problems with cones or ganglion cells causes problems with color perception

(Not really "color blindness")

8% males, 0.5% females

- Implications: (??)**
- Avoid saturated colors
 - Color coding should be redundant when possible

Color Vision



HEARING

- Capabilities (best-case scenario)
 - pitch - frequency (20 - 20,000 Hz)
 - loudness - amplitude (30 - 100dB)
 - location (5° source & stream separation)
 - timbre - type of sound (lots of instruments)
- Often take for granted how good it is (disk whirring)
- Implications (??)



TOUCH

Three main sensations handled by different types of receptors:

Pressure (normal)

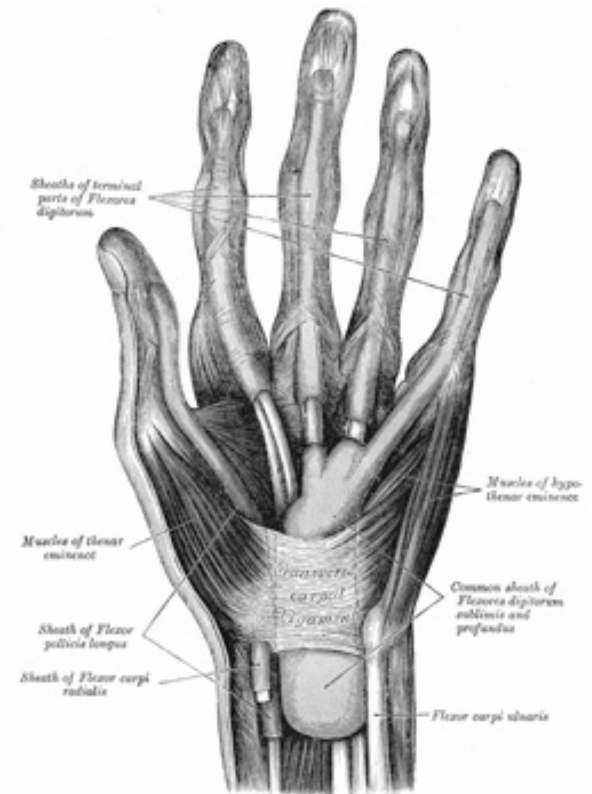
Intense pressure (heat/pain)

Temperature (hot/cold)

Sensitivity, Dexterity, Flexibility, Speed

Where important?

Mouse, Other I/O, VR, surgery



Information Processing

• **Three major systems of human information processing :**

1. Perceptual (read-scan)

• **Memory structures**

– Sensory buffer - Holds fixed image of outside world

long enough for some analysis .

• **Processes - info goes to brain for more processing**

– e.q. Pattern recognition

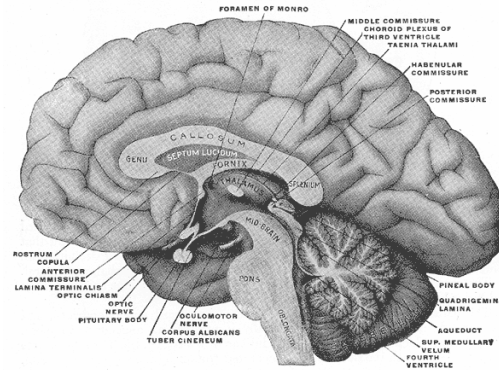
– Uses context & Knowledge



Cognitive (Think)

- Cognitive model

— How does it work?



- **Capabilities**

- Range of movement, reach, speed, strength, dexterity, accuracy

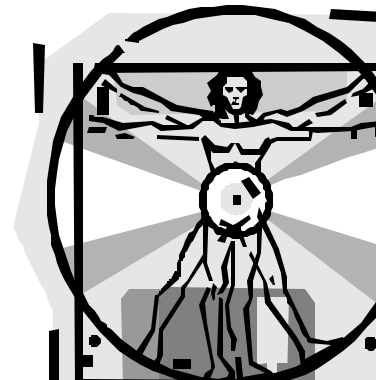
- **Often cause of errors**

- Wrong button
- Double-click vs. single click

- **Principles**

- Feedback is important
- Minimize eye movement

Motor System



MEMORY

- Four “types”
 - **Perceptual “buffers”**
Brief Impressions
 - **Short-term memory**
Conscious thought, calculations
 - **Intermediate**
Storing intermediate results, future plans
 - **Long-term**
Permanent, remember everything ever happened to us



Memory Characteristics

- Things move from STM to LTM by rehearsal & practice and by use in context

Unclear if we ever
really forget something



Lack of use



- We “forget” things due to decay and interference

Similar gets in
way of old



Exercise

Short-term memory

- Use “chunks”: 4-5 units
- Display format should match memory system used to perform task
- New info can interfere with old info
- Exercises
 - My name is John, I like ...
 - Numbers

Long-term Memory

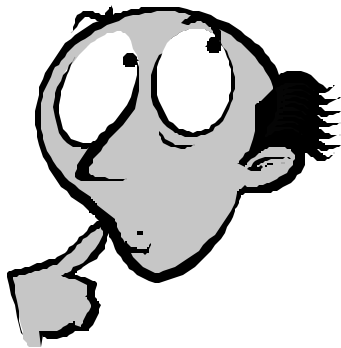
- Seemingly permanent & unlimited
- Access is harder, slower
 - > Activity helps (we have a cache)

File system full



LT Memory Structure

- Episodic memory
 - Events & experiences in serial form
 - Helps us recall what occurred
- Semantic memory
 - Structured record of facts, concepts & skills
 - One theory says it's like a network
 - Another uses frames & scripts (like record structs)



Processes

- Four main processes of cognitive system:
 - Selective Attention
 - Learning
 - Problem Solving
 - Language

Observations

- Users focus on getting job done, not learning to effectively use system
- Users apply analogy even when it doesn't apply
- People are more heuristic than algorithmic
 - Try a few quick shots rather than plan Resources simply not available
- People often choose suboptimal strategies for low priority problems
- People learn better strategies with practice

Problem Solving

- Storage in LTM, then application
- Reasoning
 - Deductive- If A, then B
 - Inductive- Generalizing from previous cases to learn about new ones
 - Abductive- Reasons from a fact to the action or state that caused it