

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 STM
 - 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

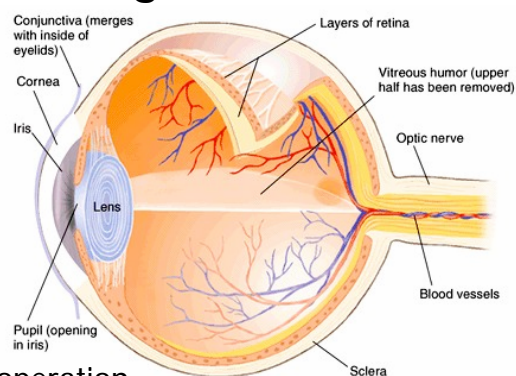
Vision, Hearing, Touch

VISION

Visual System
Eye

Retina

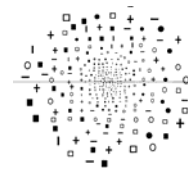
Neural pathway
~ 80% of brain's operation



Visual Abilities

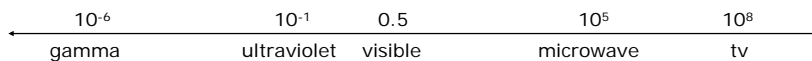


- **Sensitivity**
 - luminance: 10^{-6} ~ 10^7 mL (see notes)
- **Acuity**
 - detection, alignment, recognition (visual angle)
 - retinal position: fovea has best acuity
- **Movement**
 - tracking, reading, vibrations
- **Note:** Vision decreases with age
- **Implications (??)**
 - Font size & location 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)

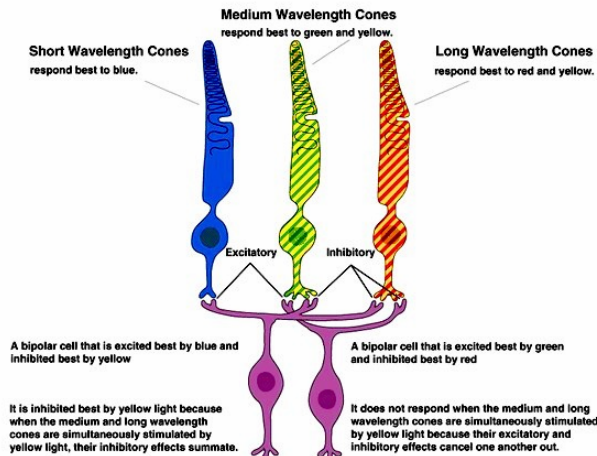
Problems with cones or ganglion cells causes problems with color perception

(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 (??)



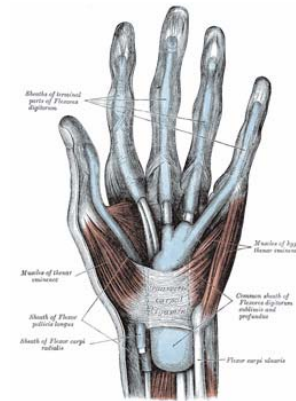
TOUCH

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

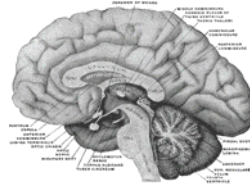


Cognitive (Think)

- Cognitive model

—

How does it work?



- **Capabilities**

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

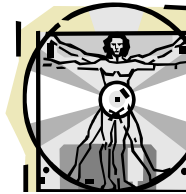
Motor System

- **Often cause of errors**

- Wrong button
- Double-click vs. single click

- **Principles**

- Feedback is important
- Minimize eye movement



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

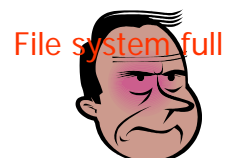
Exercise

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)



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