User Interaction: The Human

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The Model Human Processor

- Long-Term Memory
- Working Memory
  - Visual Image Store
  - Auditory Image Store
- Perceptual Processor
  - Ears
- Motor Processor
  - Eyes
- Cognitive Processor
  - Muscles

Card, Moran, Newell (1983)
The Human

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

- Long-Term Memory
- Working Memory
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- Motor Processor
- Cognitive Processor
- Ears
- Eyes
- Muscles
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

FIELD OF VIEW

TEMPORAL

NASAL

EYE SPECTRAL RESPONSE

CONES

M-cones

S-cones

RODS

SCOTOPIC

PHOTOPIC

AVG. RELATIVE SENSITIVITY

MESOPIC (approx.)

F

e

d

C

wavelength (nm)

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

The Eye - Interpreting the signal
Optical Illusions - Chromatic Adaptation
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The Eye - Interpreting the signal
Optical Illusions - Chromatic Adaptation
Your brain heavily compensates for effects of your biology
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

“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/
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?