Why do we need to know about this stuff?

- Do not change very rapidly
- Present important design constraints
- Brief review of some key Human Factors
**Human Abilities**

- Our senses
  - How to sense changes/information

- Our motor system
  - How we react to input and output

- Our cognition
  - How we process and interpret input

**Our Senses**
Vision: Our most acute sense

- Interacts with other senses, including balance, taste, smell
- Acute in central focal point, which is where we have color vision, but poor night vision
- Peripheral vision in black and white, very movement sensitive, very sensitive to low light conditions
- Stereopsis through both binocular and monocular cues, can override other senses

Vision: Limitations

- Color perception
  - 7-8% of males cannot distinguish red from green
  - Only 0.4% of women red-green colorblind
Vision: Limitations

- Color perception
  - 7-8% of males cannot distinguish red from green
  - Only 0.4% of women red-green colorblind
- Optical effects
- Bias

Other senses
**Hearing**

Capabilities (best case scenario)
- Pitch - frequency (20 - 20,000 Hz)
- Loudness - amplitude (30-100dB)
- Location - (±5° of source + stream separation)
- Timbre - type of sound (lots of instruments)

Often taken for granted how good it is

Also affects
- Balance

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**Touch**

Three main sensations handled by different types of receptors:
- Pressure (normal)
- Intense pressure (heat/pain)
- Temperature (hot/cold)
Other senses?

Key Concepts

• Absolute thresholds
  • Max and min detectable signals, applies to all senses

• Signal detection
  • We have the ability to “tune in” or “tune out” signals

• Just noticeable difference threshold
  • Stimulus has to differ from previous by a large enough value for us to notice change
  • Depends on person and type of signal
  • Logarithmic scale (Webbers law)

• Sensory adaptation
  • We react to change
  • Absence of change leads to loss of sensitivity (psychological nystagmus)
Cognition

Cognitive Processes

- Attention
- Perception and recognition
- Memory
- Learning
- Reading, speaking and listening
- Problem-solving, planning, reasoning and decision-making
The “Model Human Processor” - Card, Moran & Newell

- Published in *The psychology of Human Computer Interaction* (1983)
  - Microprocessor-human analogue using results from experimental psychology
  - Provided a view of the human that fits much experimental data
  - But it is a partial model

- Focus is on a single user interacting with some entity (computer, environment, tool)
- Still used as a foundation for many of our models of users

Memory

- Perceptual “buffers”
  - Brief impressions
  - Second or less

- Short-term (working) memory
  - Conscious thought, calculations, observations
  - Order of seconds

- Long-term memory
  - Minutes, hours, days, years, decades…
  - Long term, large storage space
**Short Term (Working) Memory**

Working memory
- Visuospatial sketchpad, phonological loop, central control

Characteristics
- Details decay quickly (70 - 1000 ms visual; 0.9 - 3.5 sec auditory)
- Limited capacity (7 - 17 letters visual; 4 - 6 auditory)
- Rehearsal prevents decay
- Chunking to remember more (7+-2)
- Interference from LTM & recent items

**Long-term Memory**

- Seemingly permanent & unlimited
- Access is harder, slower
- Retrieval depends on network of associations

- 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
**Conceptual vs. Mental vs. System Models**

![Diagram showing the relationship between Conceptual vs. Mental vs. System Models]

- **Conceptual Model**: Leveraged knowledge to invoke correct associations/assumptions through good cognitive models.
- **Mental Model**: Embeds knowledge in the system.
  - Reduce memory load
  - Computational offloading
- **System Model/Image**: Remember: Physics, devices & environment shape mental models as well.
- **User**: Test hypotheses
- **System**: Affordances guide action

**Building Good Mental Models**

- Leverage existing knowledge and invoke correct associations/assumptions through good cognitive models
- Embed knowledge in the system
  - Reduce memory load
  - Computational offloading
- Remember: Physics, devices & environment shape mental models as well
- Allow for transparency to allow users to develop better models