Assigned: IPA 3 (due Feb 27)

Control your media browser using the Kinect
(Combine IPA1 and IPA 2)
Assigned: Ind. Heuristic Eval. (due Feb 22)

Apply Nielsen’s notes on Heuristic Evaluation to application of your choosing

Example: BART Trip Planning

Heuristic: Consistency and Standards

Explanation: The interface offers inconsistent ways to change different trip options. While a dropdown box to choose departure time and a button to reverse stations are available on the main screen, the origin and destination stations cannot be changed on this screen. To change these options, the user must click on the “i” icon in the top bar (which only becomes visible on mouse rollover).

Severity: 3 = Major usability problem: important to fix, so should be given high priority. I rank this problem as major because it occurs frequently - every time the user wants to change stations; and because it is persistent - there is no way for the user to change application behavior to put all controls on the same page.

Contextual Inquiry and Task Analysis

Due Feb 22

Find and interview 3 target users (not from class)
Analyze their tasks
Explain how your application addresses their needs
Compare to five closest existing applications
See wiki for details

Start now!

Finding participants will take time
We will not accept late group project assignments
The Model Human Processor

**Human Info. Processor**

Processors:
- Perceptual
- Cognitive
- Motor

Memory:
- Working memory
- Long-term memory

**Unified model**

Probably inaccurate
Predicts perf. well
Very influential
Perceptual Processor

**Cycle time**

Quantum experience: 100ms

Percept fusion
Working Memory

Access in chunks
Task dependent construct
7 +/- 2 (Miller)

Decay
Content dependant
1 chunk 73 sec
3 chunks 7 sec

Attention span
Interruptions > decay time

Long Term Memory

Very large capacity
Semantic encoding
Associative access
Fast read: 70ms
Expensive write: 10s
Can also move from WM to LTM via rehearsal

Context at the time of acquisition key for retrieval
Cognitive Processor

**Cycle time:** 70ms
- Can be modulated

**Typical matching time**
- Digits: 33ms
- Colors: 38ms
- Geometry: 50ms...

**Fundamentally serial**
- **One locus of attention at a time**
  - Eastern 401, December 1972
  - Crew focused on landing gear indicator bulb,
  - Aircraft is loosing altitude (horn, warning indicator ...),
  - Aircraft crashed in the Everglades
  - see "The Human Interface" by Raskin, p25

But what about driving and talking?
Motor Processor

Receive input from the cognitive processor
Execute motor programs
Pianist: up to 16 finger movements per second
Point of no-return for muscle action

5 sec
68 Corrections

20 Corrections
Contour of Stroke Bottoms
Recognize-Act Cycle

Are two symbols letters? Class Match

2/16/12
Cognitive Processor

Page 70 of Card Moran and Newell

Clocks starts when 2\textsuperscript{nd} letter is flashed
Move 2\textsuperscript{nd} symbol into visual store WM

\[ T_p \]

Recognize the symbol as codes \[ + T_c \]
Classify the codes as letters \[ + T_c \]
Match the fact that they are both letters \[ + T_c \]
Initiate motor response \[ + T_c \]
Process motor command \[ + T_m \]

Approx 450 (180-980) ms

Human Interaction Loops

(Newell)

Social Band
-----------------
Rational Band
-----------------
Cognitive band
-----------------
Biological band \( 10^{-5}-10^5 \)s

System loop: 10\textsuperscript{6} (years)
Design loop: 10\textsuperscript{3}-(days)-10\textsuperscript{2} (months)
Task loop: 10\textsuperscript{-2}-10\textsuperscript{5} (weeks)
Unit task loop: 10s
Operator loop: 1s
Motor loop: 0.1s
Evaluation
Execution
Memory

Simple Experiment

Volunteer

Start saying colors you see in list of words
When slide comes up
As fast as you can

Say “done” when finished

Everyone else time it…
Simple Experiment

Do it again

Say “done” when finished
**Interference**

**Stroop Effect:**
when the *color spelled out by a word* is incongruent with the *color used to show that word*, naming the word color is slower and more error prone.

Explanation: relationship between meaning and physical form of stimulus are in conflict.
Stage Theory

**Working memory is small**
- Temporary storage
  - decay
  - displacement

**Maintenance rehearsal**
- Rote repetition
- Not enough to learn information well
LTM and Elaboration

- Recodes information
- Organize (chunking)
- Relate new material to already learned material
- Link to existing knowledge, categories
- Attach meaning
  - Make a story

LTM Forgetting

**Causes for not remembering an item?**

1) Never stored: encoding failure
2) Gone from storage: storage failure
3) Can't get out of storage: retrieval failure

**Interference model of forgetting**

One item reduces ability to retrieve another

**Proactive interference (3)**

Earlier learning reduces ability to retrieve later info.

**Retroactive interference (3 & 2)**

Later learning reduces the ability to retrieve earlier info.
Recognition over Recall

Recall
Info reproduced from memory

Recognition
Presentation of info helps retrieve info (helps remember it was seen before)
Easier because of cues to retrieval

We want to design UIs that rely on recognition!

Recall
<table>
<thead>
<tr>
<th>Recognition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grouchy</td>
</tr>
<tr>
<td>Sneezy</td>
</tr>
<tr>
<td>Smiley</td>
</tr>
<tr>
<td>Sleepy</td>
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<tr>
<td>Pop</td>
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</tr>
<tr>
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</tr>
<tr>
<td>Doc</td>
</tr>
<tr>
<td>Lazy</td>
</tr>
<tr>
<td>Happy</td>
</tr>
<tr>
<td>Nifty</td>
</tr>
</tbody>
</table>
Facilitating Retrieval: Cues

Any stimulus that improves retrieval
Example: giving hints
Other examples in software?
    icons, labels, menu names, etc.

Anything related to
Item or situation where it was learned

Summary

Model human processor
5 parts
    Perceptual processor
    Working memory
    Long term memory
    Cognitive processor
    Motor processor

May not be biologically accurate
But ...
    Provides rough estimate of performance
    Can help us compare and evaluate interfaces

Interfaces should both aid and exploit human capabilities
Decision Making and Learning
Hick’s Law

Cost of taking a decision: \( T = a + b \log_2(n + 1) \)

Power Law of Practice

Task time on the nth trial follows a power law

\[ T_n = T_1 n^{-a} + c \]

where \( a = .4 \), \( c = \) limiting constant
Power Law of Practice

Task time on the nth trial follows a power law

\[ T_n = T_1 n^{-a} + c \]

You get faster the more times you do something!

Applies to skilled behavior (sensory & motor)

Does not apply to
Knowledge acquisition
Improving quality
Stages of Skill Acquisition

Example: Using a manual transmission

**Cognitive**
Verbal representation of knowledge

**Associative**
Proceduralization
Form of chunking

**Autonomous**
More and more automated
Faster and faster
No cognitive involvement
Difficult to describe what to do

Fitts' Law
Fitts’ Law

\[ T = a + b \log_2 \left( \frac{D}{S} + 1 \right) \]

- \( a, b \) = constants (empirically derived)
- \( D \) = distance
- \( S \) = size

ID is Index of Difficulty = \( \log_2(D/S+1) \)

Models well-rehearsed selection task
- \( T \) increases as the \textbf{distance} to the target increases
- \( T \) decreases as the \textbf{size} of the target increases
Considers Distance and Target Size

\[ T = a + b \log_2(D/S + 1) \]

Same ID → Same Difficulty

Smaller ID → Easier
Considers Distance and Target Size

\[ T = a + b \log_2(D/S + 1) \]

Target 1

Target 2

Larger ID \(\rightarrow\) Harder

Experimental Data

![Graph showing experimental data for target widths. The x-axis represents \(\log_2(D/S + .5)\) corrected for errors, and the y-axis represents Time Per Movement in seconds. The graph includes data points for different target widths: 2 in., 1 in., 1/2 in., and 1/4 in. The data points are connected by a line.](image)
Toolbar Example

Microsoft Toolbars offer the user the option of displaying a label below each tool. Name at least one reason why labeled tools can be accessed faster. (Assume, for this, that the user knows the tool.)

Extend Fitts' Law to 2D Targets?

![Diagram showing Extend Fitts' Law to 2D Targets](image)
Summary

Decision Making and Learning
Time to make decisions depends on number of options
Choosing a movie at Blockbuster
Learning follows a power law
You get faster as you practice

Fitts’ Law
Models movement time to select target
Time depends on distance and size of target

Input Devices
Questions:

What (low-level) tasks are the users trying to accomplish with an input device?

How can we think about the space of possible input devices?

What interaction techniques are encouraged/discouraged by a particular device?

Important Tasks

Text Entry

Pointing/Marking

- Target acquisition
- Steering / positioning
- Freehand drawing
- Drawing lines
- Tracing and digitizing
- …
Text Entry: Keystroke Devices

Array of Discrete Inputs
Many variants of form and key layout
Can be one-handed or two
Wide range of sizes
Two-hand full keyboard is relatively standardized, Less standardization on others: Command keys, generic function keys, cursor movement, numeric keypad,...

Take advantage of procedural memory
Power law of practice

\[ T_n = T_1 n^{-a} + c \]
Key Layouts

QWERTY

<table>
<thead>
<tr>
<th>!</th>
<th>@</th>
<th>#</th>
<th>$</th>
<th>%</th>
<th>^</th>
<th>&amp;</th>
<th>*</th>
</tr>
</thead>
<tbody>
<tr>
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