Human Information Processing (Perception)

CS160: User Interfaces

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Slides based on those of John Canny, Francois Guimbretiere and James Landay

Assignment (due Oct 11)

Low-Fidelity Prototype

- Identify project mission statement
- Create low-fidelity prototype that supports 3 tasks
  - 1 easy, 1 moderate, 1 difficult task as found in the last assignment
- Test the prototype with target users
  - No one from this class
  - Not your friends

Next Class

We will hand out Anoto pens
- 1 pen per group

One member must take responsibility for equipment
- We will need contact information
- $50 check (deposit)
  - Will be returned when equipment returned at end of term
  - Won't be cashed
- Talk to us if this is a problem

Guest lecture on Anoto pen API
- Ron Yeh

Review: Creating Lo-Fi Prototypes

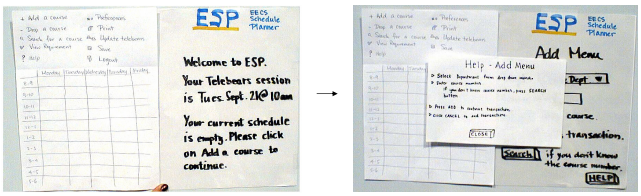
Set a deadline
- Don't think too long - build it!

Draw a window frame on large paper
- **Draw at a large size, but use correct aspect ratio**

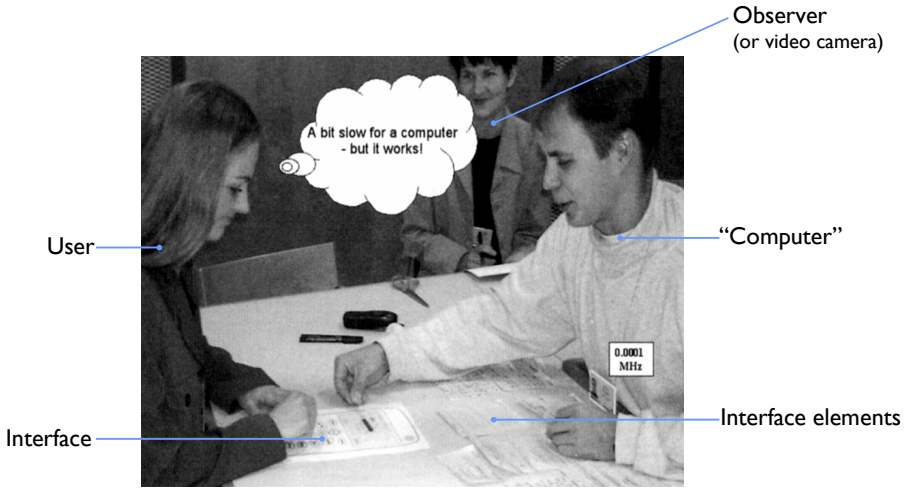
Put different screen regions on cards
- Anything that moves, changes, appears/disappears

Ready response for any user action
- e.g., Have those pull-down menus already made

Use photocopier to make many versions



Review: Testing Prototypes



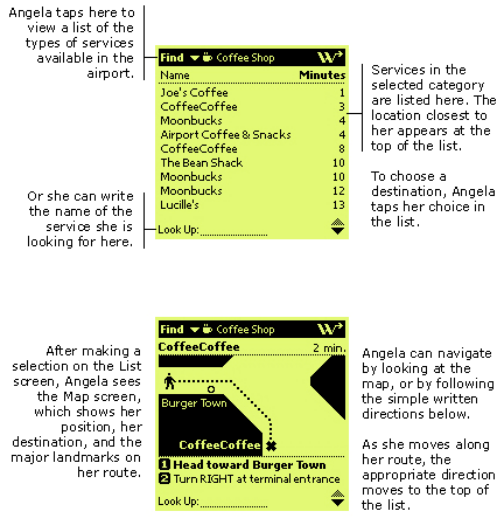
Review: Exercise

Target persona: Angela, ~31, business traveler
- Wants to travel without hassle
- 30 minute layover in unfamiliar airport
- What might she want to do in this time?
- What kind of interface would support her tasks?

Contraints
- PDA/Smart phone class hardware
- Wireless infrastructure available
- Low resolution location information available

Your Tasks
- Brainstorm about Angela's goals
- **Create an initial low fidelity prototype**
- **Debug interface with users from another group**
  - **Does the interface meet Angela's needs?**
  - **Is the interface hassle-free?**
  - **Is the interface confusing or difficult?**

Solution from Cooper Design



Cooper Design's storyboard

Topics

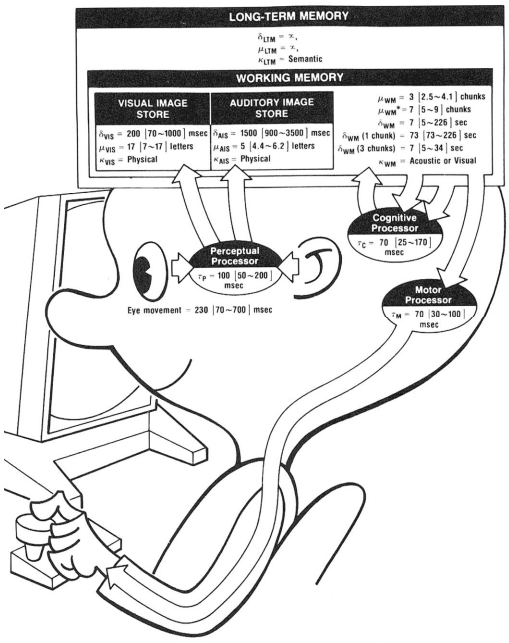
- The Model Human Processor
- Memory

The Model Human Processor

Why Model Human Performance?

Why Model Human Performance?

- To test understanding of behavior
- To predict impact of new technology
  - We can build a simulator to evaluate user interface designs



Human Info. Processor
- Perceptual
- Cognitive
- Motor (will discuss later)
- Working memory
- Long-term memory

Unified model
- Probably inaccurate
- Predicts perf. well
- Very influential

Perceptual Processor

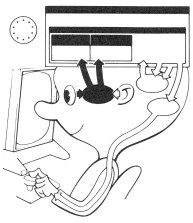
Physical store from our senses: sight, sound, touch, …
- Code directly based on sense used
  - Visual, audio, haptic, … features

Selective
- Spatial
- Pre-attentive: color, direction…

Capacity
- Example: 17 letters

Decay 200ms

Recoded for transfer to working memory
- Progressive: 10ms/letter



How many 3's

1281768756138976546984506985604982826762
9809858458224509856458945098450980943585
9091030209905959595772564675050678904567
8845789809821677654876364908560912949686

[based on slide from Stasko]

How many 3's

1281768756138976546984506985604982826762
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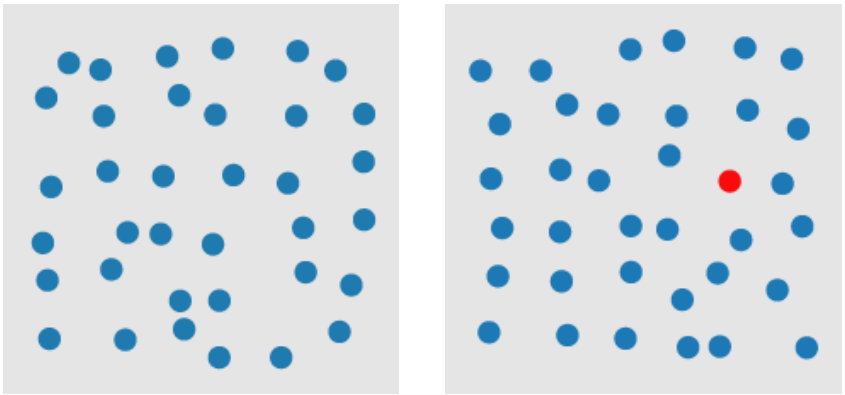
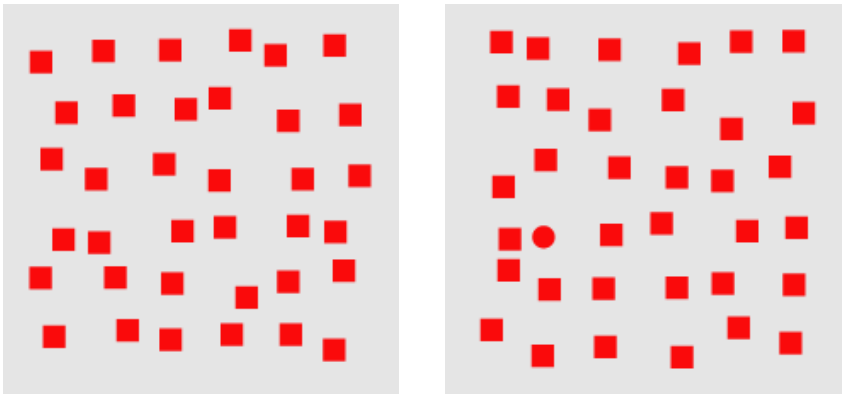
[based on slide from Stasko]

Visual Pop-Out: Color



http://www.csc.ncsu.edu/faculty/healey/PP/index.html

Visual Pop-Out: Shape



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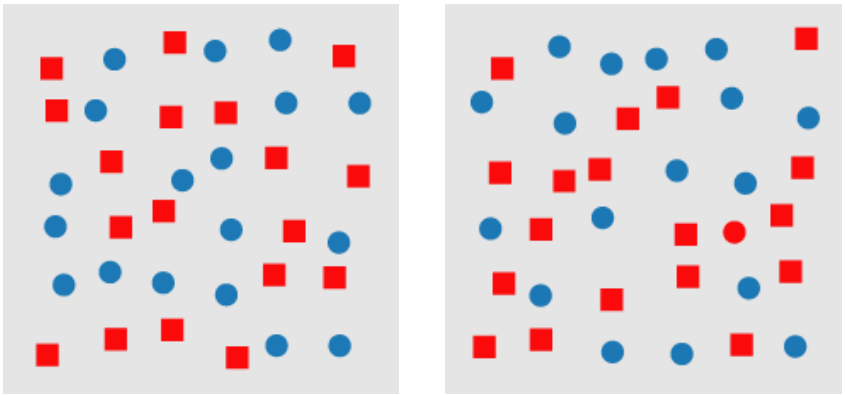
Feature Conjunctions



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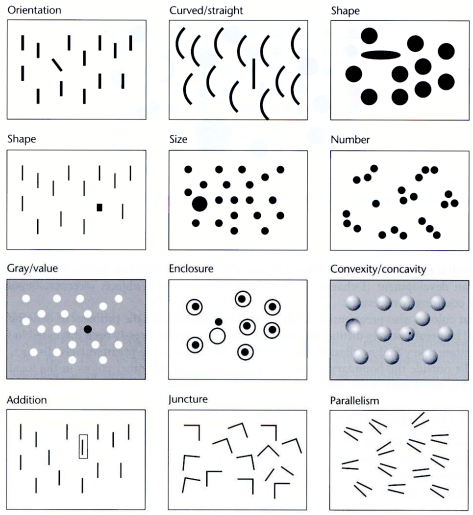
Preattentive Features

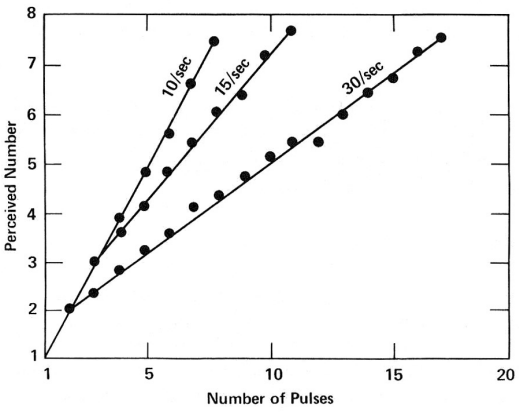


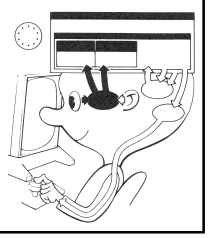
[Information Visualization. Figure 5. 5 Ware 04]

Perceptual Processor

Cycle time

- Quantum experience: 100ms
  - Percept fusion





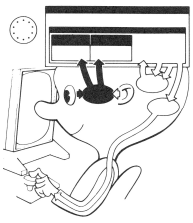
Perceptual Processor

Cycle time

- Quantum experience: 100ms
  - Percept fusion
- Frame rate necessary for movies to look real?
  - time for 1 frame < Tp (100 msec) -> 10 frame/sec.
- Max. morse code rate can be similarly calculated

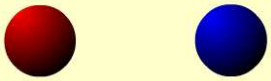
Perceptual causality

- Two distinct stimuli can fuse if the first event appears to *cause* the other
- Events must occur in the same cycle



Perception of Causality [Michotte 46]

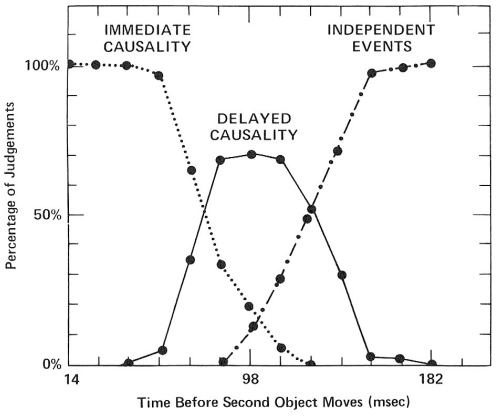
Michotte demonstration 1. What do you see? Most observers report that "the red ball **hit** the blue ball." The blue ball moved "**because** the red ball hit it." Thus, the red ball is perceived to **"cause"** the blue ball to move, even though the balls are nothing more than color disks on your screen that move according to a programme.

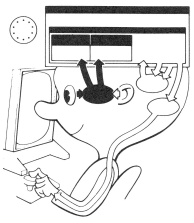


http://cogweb.ucla.edu/Discourse/Narrative/Heider_45.html

Perceptual Processor

Cycle time
- Quantum experience: 100ms
  - Causality

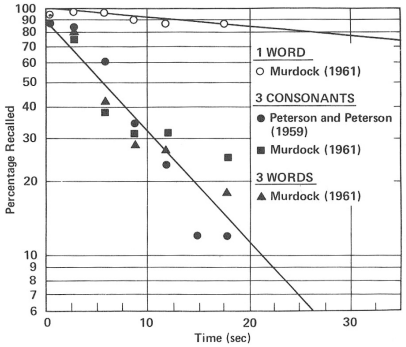


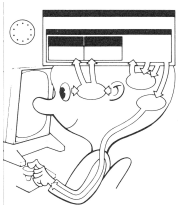


Working Memory

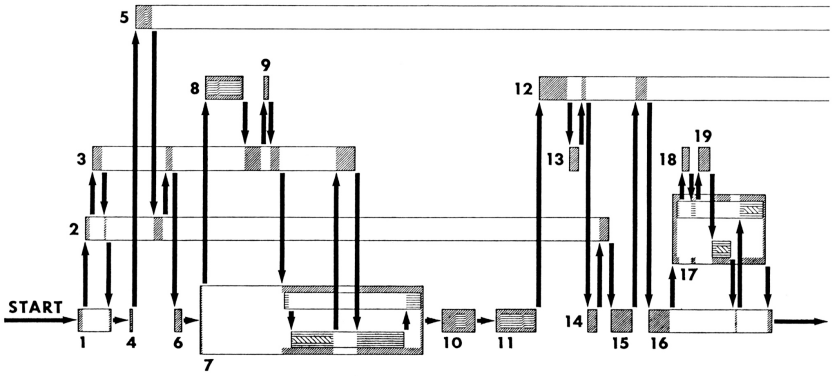
Access in chunks
- Task dependent construct
- 7 +/- 2 (Miller)

Decay
- Content dependant
  - 1 chunk 73 sec
  - 3 chunks 7 sec
- Attention span
  - Interruptions > decay time





Task Structure

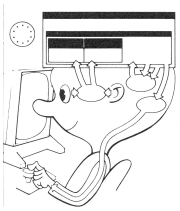


Long Term Memory

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

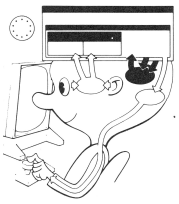


Cognitive Processor

Cycle time: 70ms
- Can be modulated

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

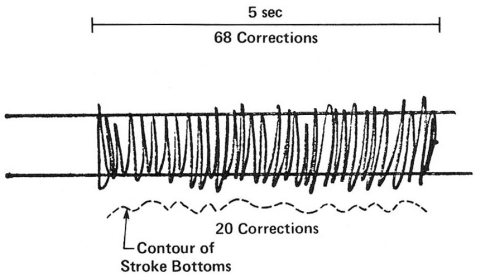
Fundamentally serial
- One locus of attention at a time
  - Eastern 401, December 1972
    - Crew focused on landing gear indicator bulb,
    - Aircraft is loosing altitude (horn, warning indicator…),
    - Aircraft crashed in the Everglades
    - see "The Human Interface" by Raskin, p25
  - But what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



Motor Processor

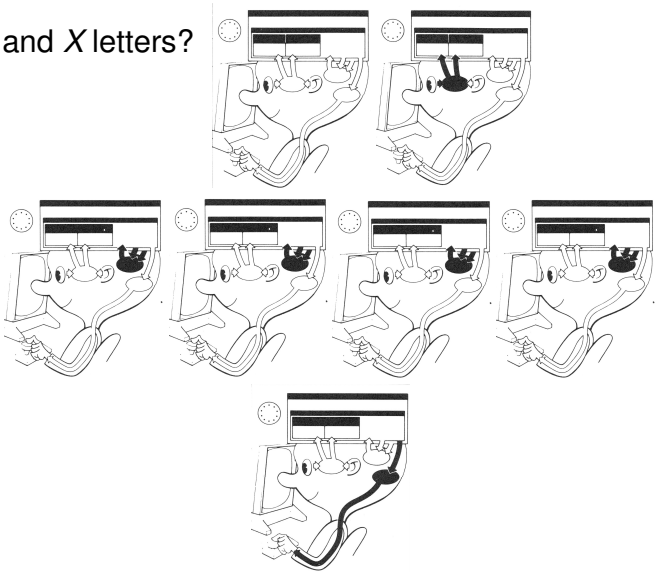
Receive input from the cognitive processor

Execute motor programs
- Pianist: up to 16 finger movements per second
- Point of no-return for muscle action



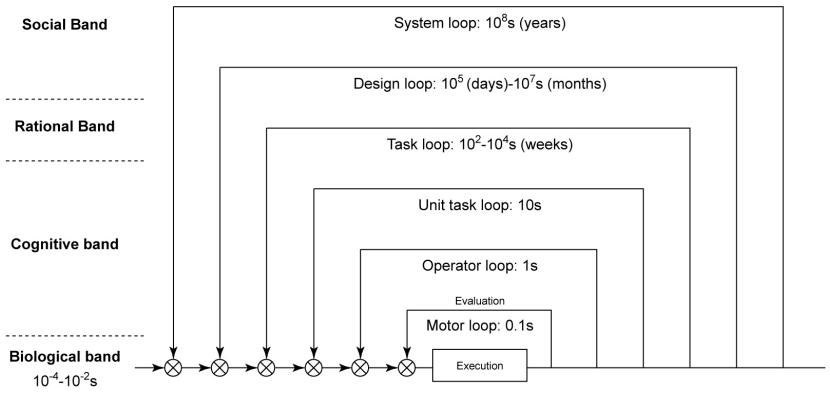
Recognize-Act Cycle

Are *Q* and *X* letters?



Human Interaction Loops

(Newell)



Principles of Operation

Interface should respect limits of human performance
- Preattentive features pop-out
- Events within cycle time fuse together
- Causality

Recognize-Act Cycle of the cognitive processor
- On each cycle contents in WM initiate cognitive actions
- Cognitive actions modify the contents of WM

Discrimination Principle
- Retrieval is determined by candidates that exist in memory relative to retrieval cues
- Interference by strongly activated chunks
  - Two strong cues in working memory
  - Link to different chunks in long term memory