CS160: User Interface Design

Human Information Processing

02/13/12

Berkeley
UNIVERSITY OF CALIFORNIA

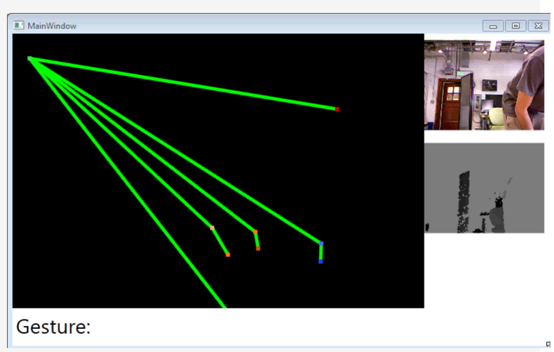
http://www.youtube.com/watch?v=WHxQU4RhyLk

Most heavily used features directly mapped (volume, play/pause)
Circular movements mapped to linear operations

Due Today

Individual Prog. Assignment 2

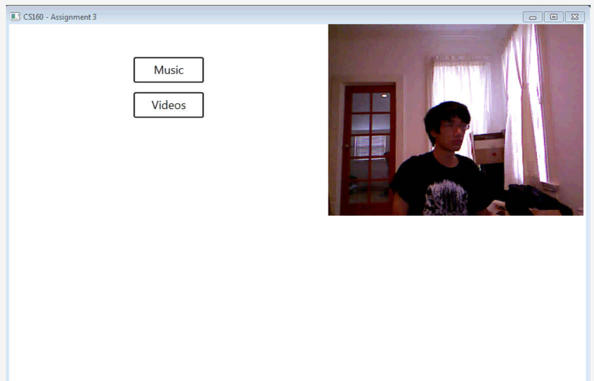
(Source code, executable
and video on wiki)



Assigned: IPA 3 (due Feb 27)

Control your media browser using the Kinect

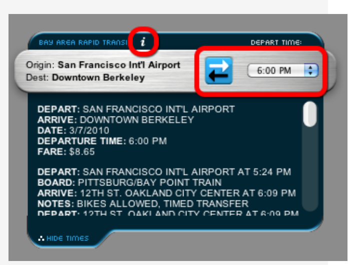
(Combine IPA1 and IPA 2)



Assigned: Ind. Heuristic Eval. (due Feb 22)

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

Example: BART Trip Planning

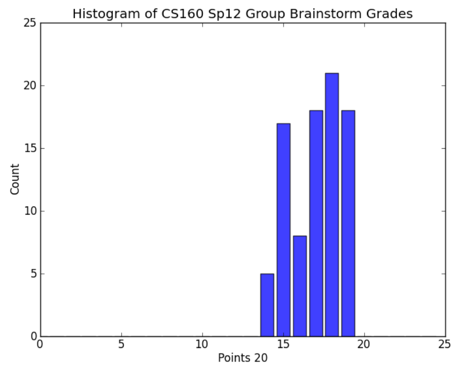


Heuristic: Consistency and Standards

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.

Group Brainstorm (20 pts)



Mean 17
Stddev 1.57

Great job on producing ideas and illustrating them
Need more targeted user groups!

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

Heuristic Evaluation

Usability Heuristics

"Rules of thumb" describing features of usable systems

Can be used as design principles

Can be used to evaluate a design

Example: Minimize users' memory load

Heuristic Evaluation

Developed by Jakob Nielsen (1994)

Can be performed on working UI or on sketches

Small set (3-5) of evaluators (experts) examine UI

Evaluators check compliance with usability heuristics

Different evaluators will find different problems

Evaluators only communicate afterwards to aggregate findings

Designers use violations to redesign/fix problems

Nielsen's Ten Heuristics

H2-1: Visibility of system status

H2-2: Match system and real world

H2-3: User control and freedom

H2-4: Consistency and standards

H2-5: Error prevention

H2-6: Recognition rather than recall

H2-7: Flexibility and efficiency of use

H2-8: Aesthetic and minimalist design

H2-9: Help users recognize, diagnose, recover from errors

H2-10: Help and documentation

H2-1: Visibility of System Status

Keep users informed about what is going on. Example: response time

0.1 sec: no special indicators needed

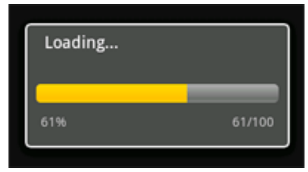
1.0 sec: user tends to lose track of data

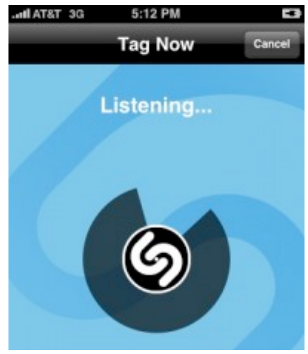
10 sec: max. duration if user to stay focused on action

Short delays: Hourglass

Long delays: Use percent-done progress bars

Overestimate usually better



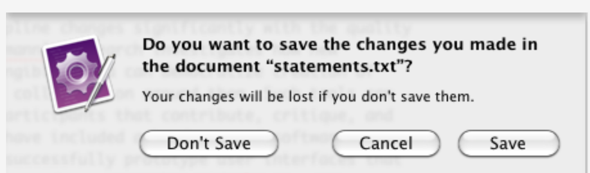


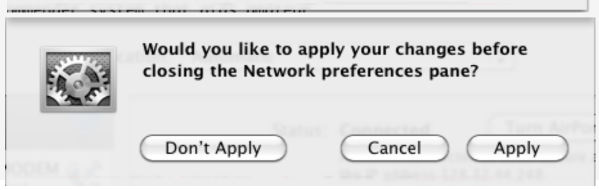
H2-1: Visibility of System Status

Users should always be aware of what is going on

So that they can make informed decision

Provide redundant information

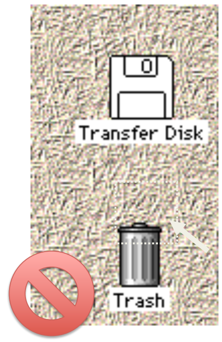




H2-2: Match System & World

Speak the users' language
Follow real world conventions
Pay attention to metaphors

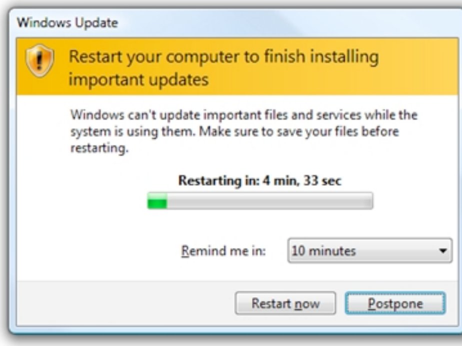
Bad example: Mac desktop



H2-2: Match System & World

H2-3: User Control & Freedom

Users don't like to be trapped!



Strategies

Cancel button
(or Esc key) for dialog

Make the cancel button responsive!

Universal undo

H2-3: User Control & Freedom

Offer "Exits" for mistaken choices, undo, redo

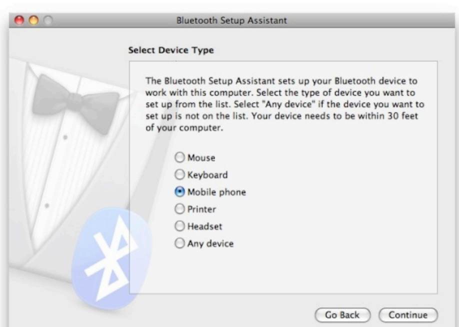
Don't force the user down fixed paths

Wizards

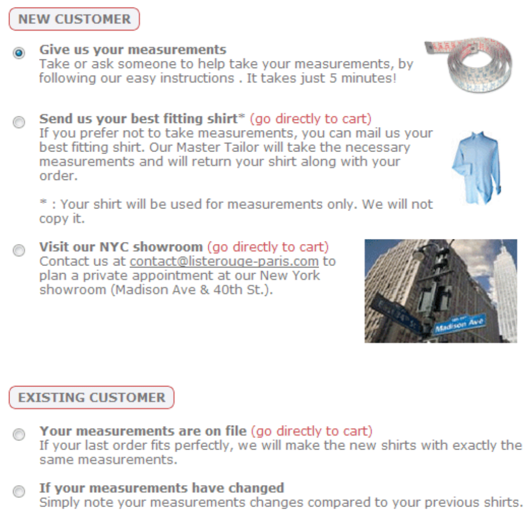
Must respond to Q before going to next step

Good for infrequent tasks (e.g., network setup) & beginners

Not good for common tasks (zip/unzip)



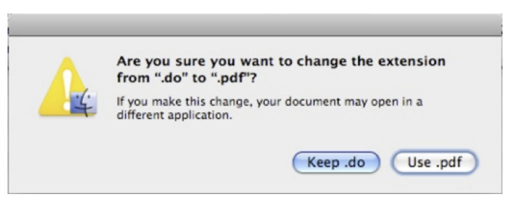
H2-4: Consistency and Standards



http://www.useit.com/alertbox/application-mistakes.html

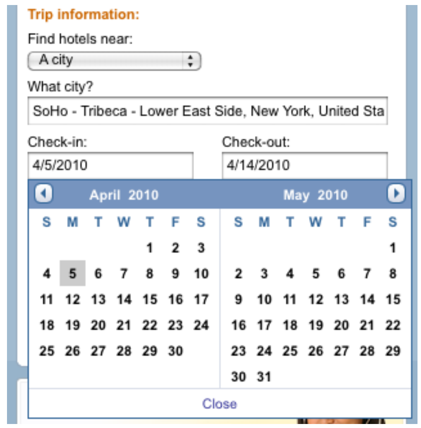
H2-5: Error Prevention

Eliminate error-prone conditions or check for them and ask for confirmation

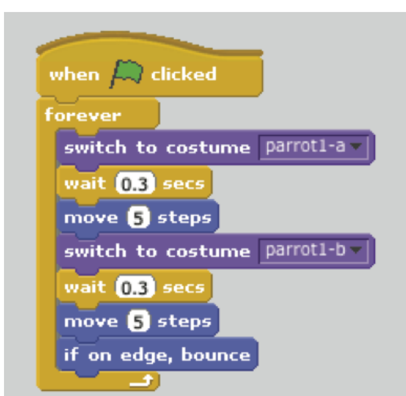


H2-5: Error Prevention

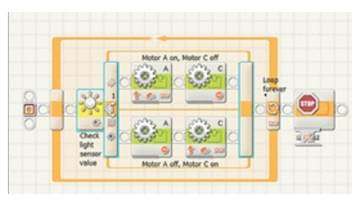
Aid users with specifying correct input



H2-5: Error Prevention



MIT Scratch



Lego Mindstorms

Don't allow incorrect input

Preventing Errors

Error types

Slips

User commits error during the execution of a correct plan.

Typos

Habitually answer "no" to a dialog box

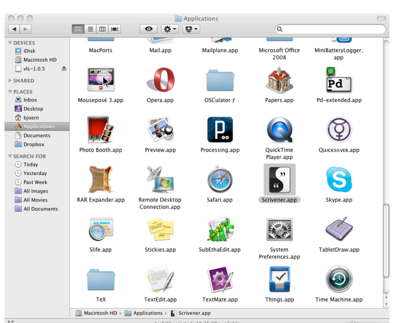
Forget the mode the application is in

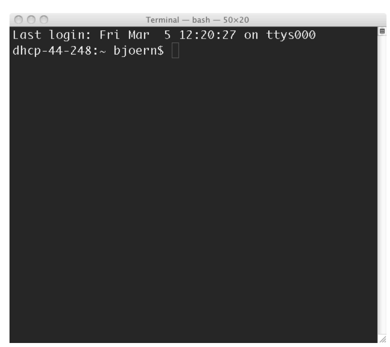
Mistakes

User correctly executes flawed mental plan

Ususally the result of a flawed mental model – harder to guard against

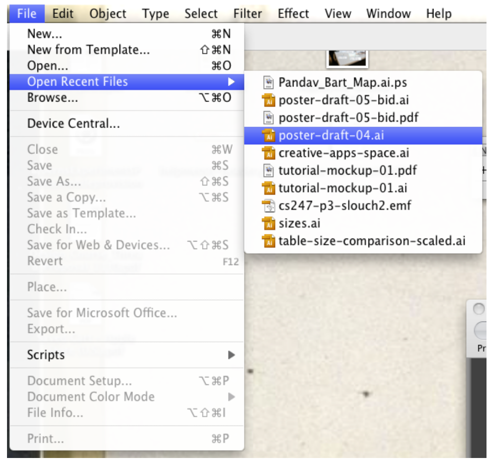
H2-6: Recognition over Recall



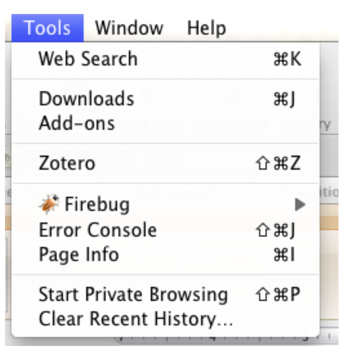


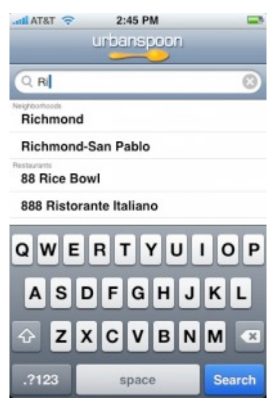
H2-6: Recognition over Recall

Minimize the user's memory load by making objects, actions, and options visible.



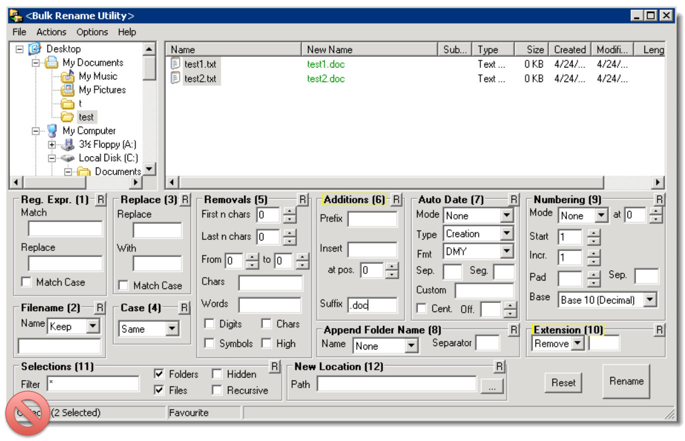
H2-7: Flexibility and Efficiency of Use





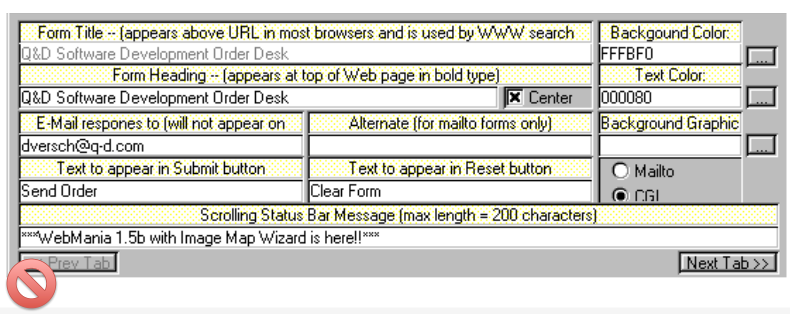
http://www.iphoneuxreviews.com/?p=114|

H2-8: Aesthetic and Minimalist Design



http://4sysops.com/wp-content/uploads/2006/04/Bulk_Rename_Utility.gif

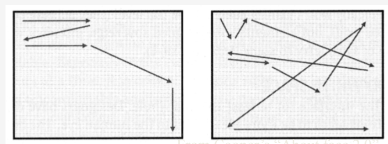
H2-8: Aesthetic and Minimalist Design



No irrelevant information in dialogues

H2-8: Aesthetic and Minimalist Design

Present information in natural order



From Cooper's "About face 2.0"

Occam's razor

Remove or hide irrelevant or rarely needed information – They compete with important information on screen

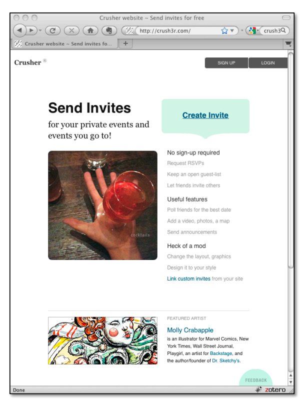
Pro: Palm Pilot, iPhone

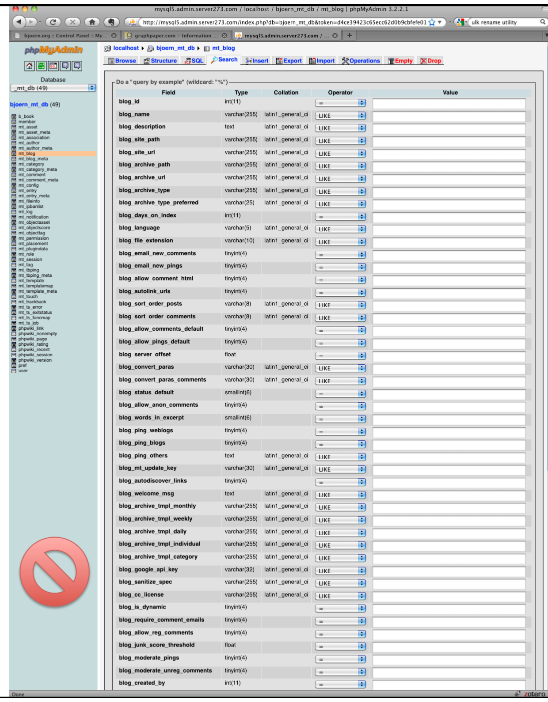
Against: Dynamic menus

Use windows frugally

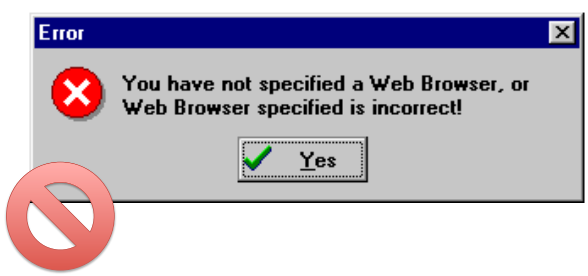
Avoid complex window management

H2-8: Aesthetic and Minimalist Design

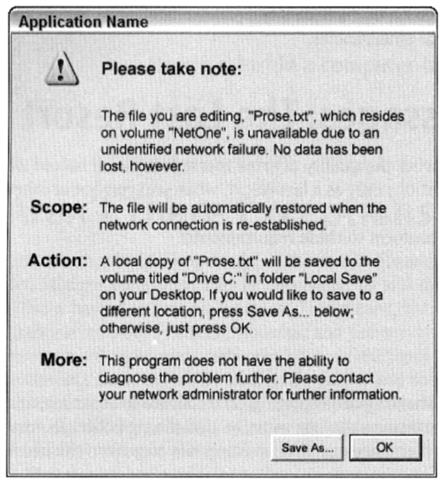




H2-9: Help Users Recognize, Diagnose, & Recover from Errors

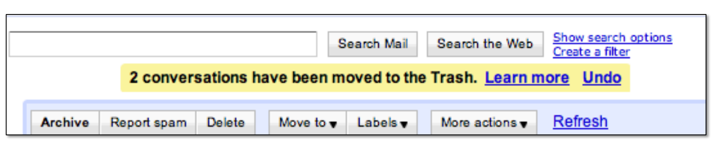


Good Error Messages



From Cooper's "About Face 2.0"

H2-9: Help Users Recognize, Diagnose, & Recover from Errors



H2-10: Help and Documentation

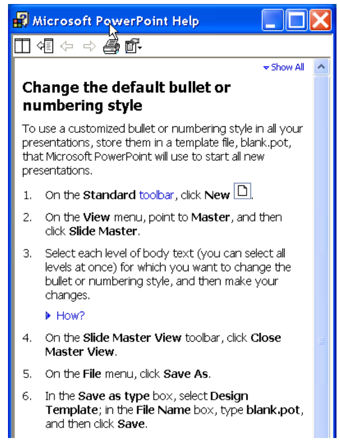
Help should be:

•Easy to search

•Focused on the user's task

•List concrete steps to carry out

•Not too long



Types of Help

Tutorial and/or getting started manuals

Presents the system conceptual model

Basis for successful explorations

Provides on-line tours and demos

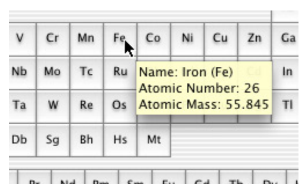
Demonstrates basic features

Reference manuals

Designed with experts in mind

Reminders

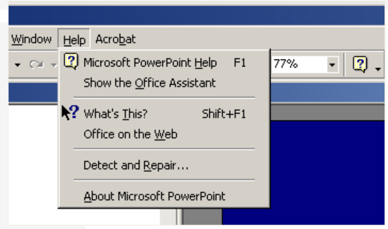
Short reference cards, keyboard templates, tooltips…

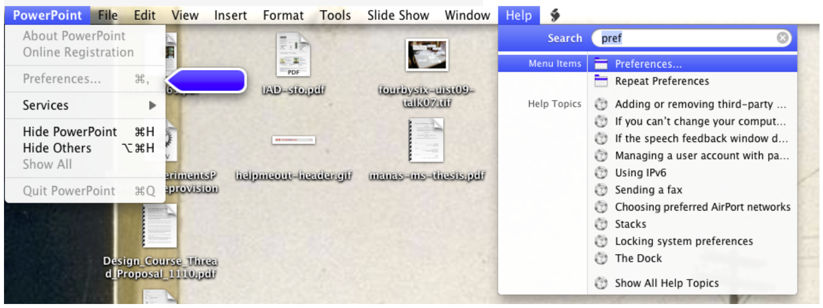


Types of Help

Context sensitive help

Search





The Process of Heuristic Evaluation

Phases of Heuristic Eval. (1-2)

1) Pre-evaluation training
- Provide the evaluator with domain knowledge if needed

2) Evaluation
- Individuals evaluate interface then aggregate results
  - Compare interface elements with heuristics
- Work in 2 passes
  - First pass: get a feel for flow and scope
  - Second pass: focus on specific elements
- Each evaluator produces list of problems
  - Explain why with reference to heuristic or other information
  - Be specific and list each problem separately

Phases of Heuristic Eval. (3-4)

3) Severity rating
- Establishes a ranking between problems
  - Cosmetic, minor, major and catastrophic
- First rate individually, then as a group

4) Debriefing
- Discuss outcome with design team
- Suggest potential solutions
- Assess how hard things are to fix

Examples

Typography uses mix of upper/lower case formats and fonts

Violates: *Consistency and Standards (H2-4)*

Problem: Slows users down

Fix: pick a single format for entire interface

Probably wouldn't be found by user testing

Severity Rating

Used to allocate resources to fix problems

Estimates of need for more usability efforts

Combination of Frequency, Impact and Persistence

Should be calculated after all evaluations are in

Should be done independently by all judges

Levels of Severity

0 - don’t agree that this is a usability problem
1 - cosmetic problem
2 - minor usability problem
3 - major usability problem; important to fix
4 - usability catastrophe; imperative to fix

Severity Ratings Example

1. [H2-4 Consistency] [Severity 3]

The interface used the string "Save" on the first screen for saving the user's file, but used the string "Write file" on the second screen. Users may be confused by this different terminology for the same function.

Debriefing

Conduct with evaluators, observers, and development team members

Discuss general characteristics of UI

Suggest improvements to address major usability problems

Development team rates how hard things are to fix

Make it a brainstorming session
- Little criticism until end of session

Pros and Cons of Heuristic Evaluation

HE vs. User Testing

HE is much faster
1-2 hours each evaluator vs. days-weeks

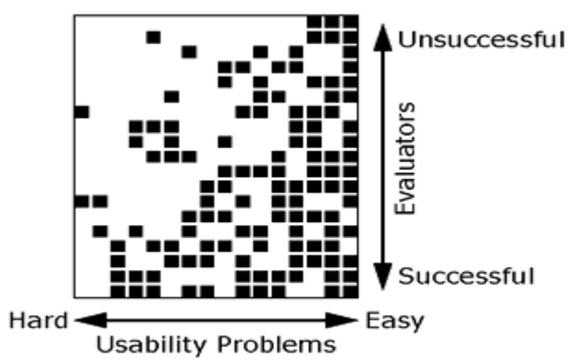
HE doesn't require interpreting user's actions

User testing is far more accurate
Takes into account actual users and tasks
HE may miss problems & find "false positives"

Good to alternate between HE & user-based testing
Find different problems
Don't waste participants

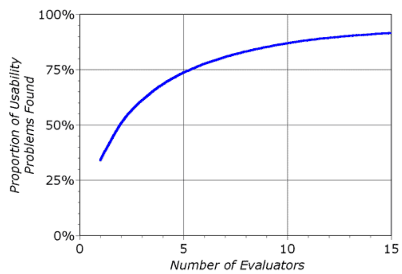
Why Multiple Evaluators?

Every evaluator doesn't find every problem
Good evaluators find both easy & hard ones

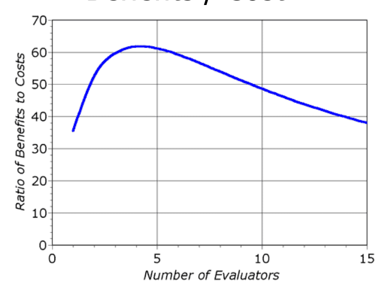


Decreasing Returns

Problems Found



Benefits / Cost



Caveat: graphs are for one specific example!

Number of Evaluators

Single evaluator achieves poor results

- Only finds 35% of usability problems
- 5 evaluators find ~ 75% of usability problems
- Why not more evaluators???? 10? 20?
  - Adding evaluators costs more
  - Many evaluators won't find many more problems

But always depends on market for product:

- popular products → high support cost for small bugs

Summary

Heuristic evaluation is a discount usability method

Have evaluators go through the UI twice
- Ask them to see if it complies with heuristics
  - Note where it doesn't and say why

Have evaluators independently rate severity

Combine the findings from 3 to 5 evaluators
Discuss problems with design team

Cheaper alternative to user testing
- Finds different problems, so good to alternate

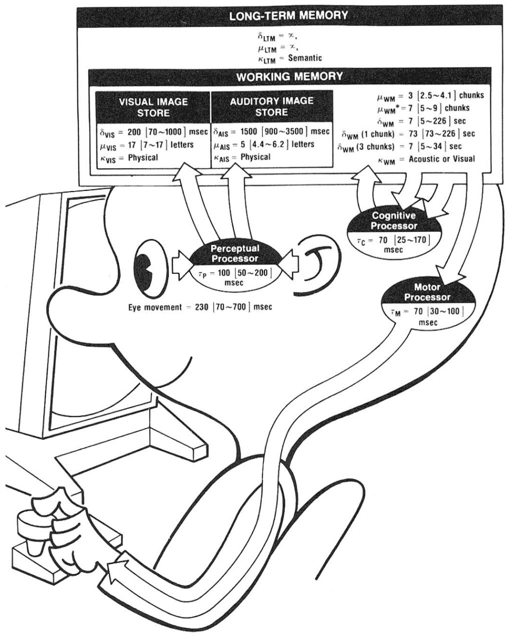
The Model Human Processor

Why Model Human Performance?

Why Model Human Performance?

To predict impact of new technology/interface

- Apply model to predict effectiveness
- Could build a simulator to evaluate user interface designs



Human Info. Processor

Processors:
- Perceptual
- Cognitive
- Motor

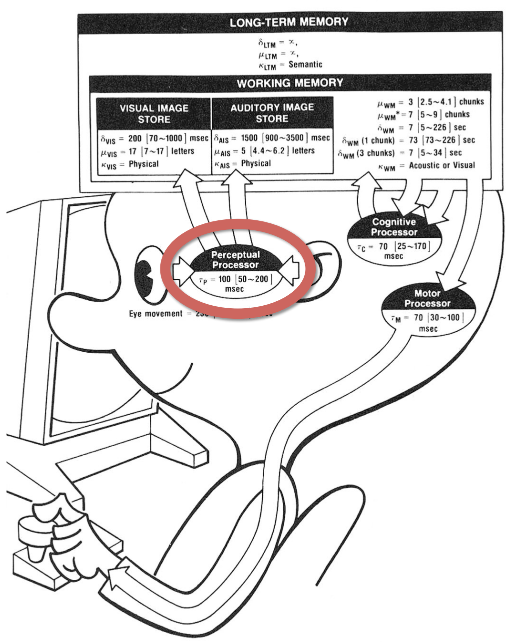
Memory:
- Working memory
- Long-term memory

Unified model

Probably inaccurate

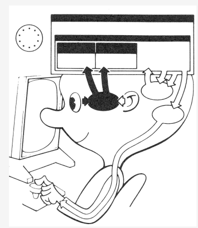
Predicts perf. well

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 of visual store
  - Example: 17 letters
- Decay time for working memory: 200ms
- Recoded for transfer to working memory
  - Progressive: 10ms/letter



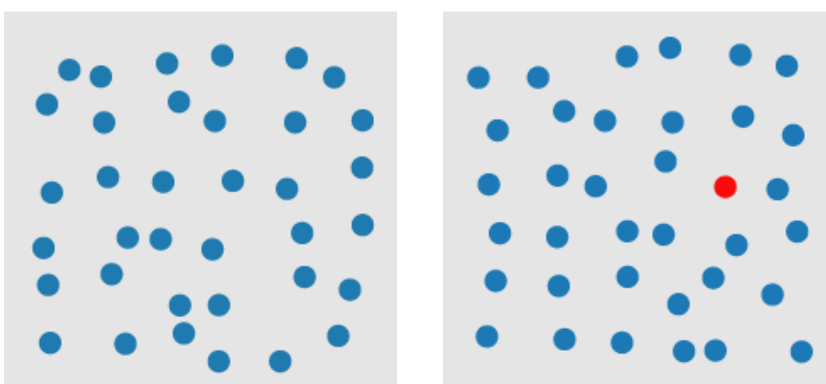
How many 3's

1281768756138976546984506985604982826762
9809858458224509856458945098450980943585
9091030209905959595772564675050678904567
8845789809821677654876364908560912949686

How many 3's

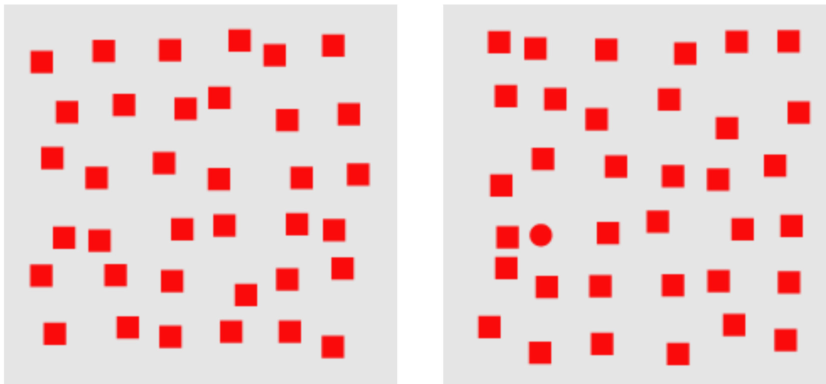
1281768756138976546984506985604982826762
9809858458224509856458945098450980943585
9091030209905959595772564675050678904567
8845789809821677654876364908560912949686

Visual Pop-Out: Color



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

Visual Pop-Out: Shape



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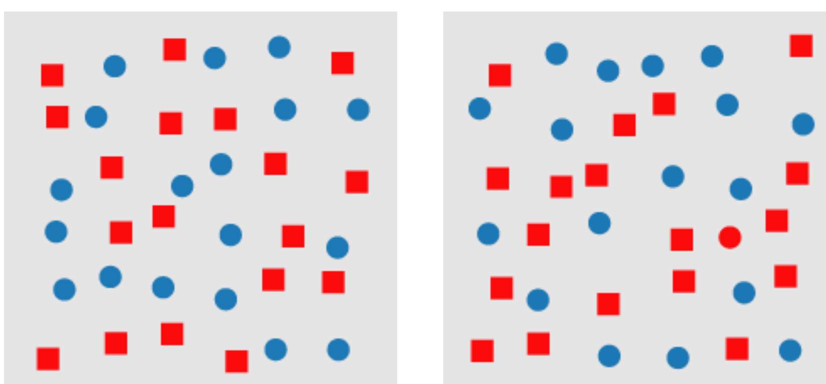
Feature Conjunctions



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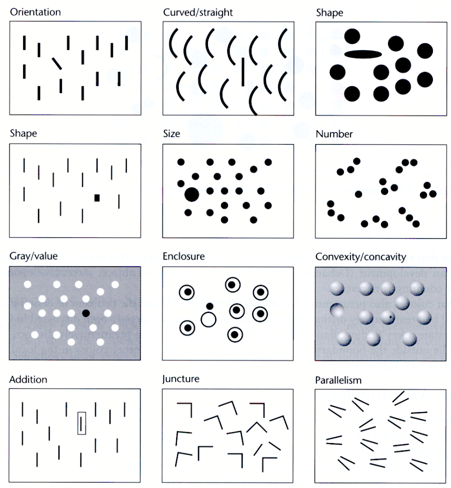
Preattentive Features



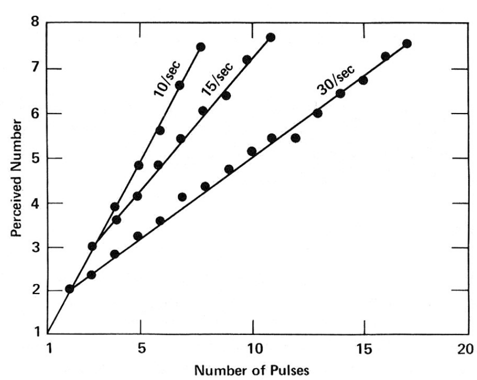
[Information Visualization. Figure 5. 5 Ware 04]

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 continuous?
  - 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 red ball to move, even though the balls are nothing more than color disks on your screen that move according to a program.

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

Perception of Causality [Michotte 46]

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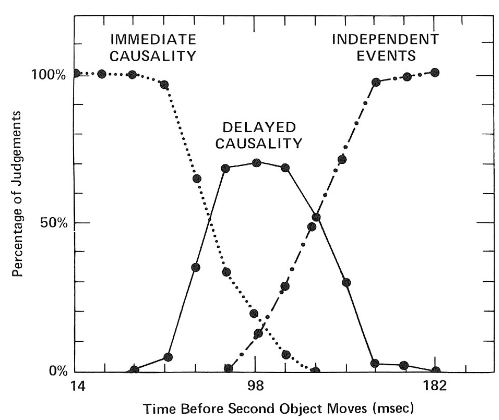
Perceptual Processor

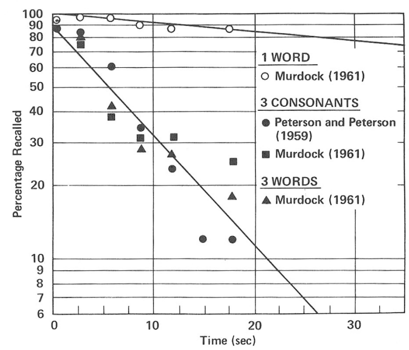
Cycle time

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

Long Term Memory

Very large capacity

Semantic encoding

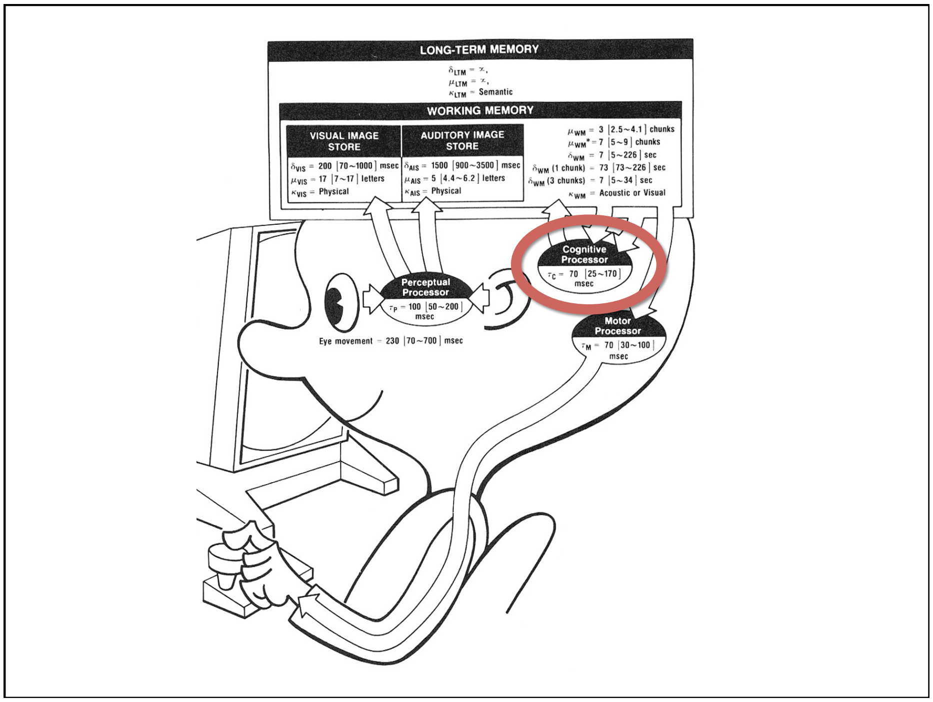
Associative access

Fast read: 70ms

Expensive write: 10s

Can also move from WM to LTM via rehearsal

Context at the time of acquisition key for retrieval



LONG-TERM MEMORY
δLTM = ∞,
μLTM = ∞,
κLTM = Semantic
WORKING MEMORY
VISUAL IMAGE STORE
δVIS = 200 [70~1000] msec
μVIS = 17 [7~17] letters
κVIS = Physical
AUDITORY IMAGE STORE
δAIS = 1500 [900~3500] msec
μAIS = 5 [4.4~6.2] letters
κAIS = Physical
μWM = 3 [2.5~4.1] chunks
μWM* = 7 [5~9] chunks
δWM = 7 [5~226] sec
δWM (1 chunk) = 73 [73~226] sec
δWM (3 chunks) = 7 [5~34] sec
κWM = Acoustic or Visual
Cognitive Processor
τC = 70 [25~170] msec
Perceptual Processor
τP = 100 [50~200] msec
Motor Processor
τM = 70 [30~100] msec
Eye movement = 230 [70~700] msec