Usability Evaluation without Users

Lecture 7

Chapter 7 Rosson & Carroll

Testing and Evaluation

- Purpose: Evaluation for usability
- Methods
  - Without Users (analytic)
    - Claims analysis
    - Usability inspection
      - » Guidelines
      - » Interface (Cognitive) walkthrough
      - » Expert (Heuristic) evaluation
    - Model-Based analysis
      - GOMS
      - Keystroke Level Model (KLM)
  - With Users (empirical)

When is evaluation done?

- Usability Evaluation without users
  - Formative "formation"
  - During design and early prototyping
  - Fairly inexpensive in time and $$$
- Usability Evaluation with users
  - Summative "summary"
  - After some prototypes implemented or fully functioning system
  - Expensive in time and $$$

Evaluation without Users

Goals

- Evaluate and test *overall usability*
- Evaluate and test *detailed usability*
- Evaluate and test *completeness*
  - Does each function have a sequence of user actions?
- Evaluate and test *correctness*
  - Do all actions have an end?
  - Do actions and input have error processing if needed?
- Evaluate and test *consistency*
  - Identical functions have identical actions & presentation
- Estimate *performance times*

Evaluation Goals vs. Method

	Guidelines	Walkthrough	Expert	Keystroke
Overall Usability				
Detailed Usability				
Completeness				
Correctness				
Consistency				
Performance Time				

Usability Inspection

- Guidelines
- Interface walkthrough
- Expert (heuristic) evaluation

Guidelines

- Definition
  - Guidelines are written "standards" and heuristics (rules of thumb) for interfaces. Following them should lead to more usable designs.
- Guidelines are used to evaluate the mockups, scenarios, storyboards and user interaction networks specifications

Guidelines (Apple Computer)

- Examples from Apple Computer's *Human Interface Guidelines,* 1985-1989
  - Friendly Dialog. Plain English, no jargon. Ask for clarification of risky operations.
  - Learnability. Use concrete metaphors.

Nielsen's Guidelines (R&C 7.2.1)

Guideline
Use simple and natural dialog
Speak the user's language
Minimize user memory load
Be consistent
Provide feedback
Provide clearly marked exits
Provide shortcuts
Provide good error messages
Prevent errors
Include good help and documentation

Guidelines: Web Accessibility

- Section 508 of Rehabilitation Act (June 2001)
- "Bobby" checks Web pages for compliance with
  http://bobby.watchfire.com/bobby/html/en/index.jsp
  - Section 508
  - W3C Web Content Accessibility Guidelines 1.0
  http://bobby.watchfire.com/bobby/html/en/index.jsp

Guidelines: Web Accessibility

- WC3 Web Accessibility Initiative (WAI) http://www.w3.org/WAI/
- Web Content Accessibility Guidelines 1.0
- "These guidelines explain how to make Web content accessible to people with disabilities. The guidelines are intended for all Web content developers (page authors and site designers) and for developers of authoring tools. The primary goal of these guidelines is to promote accessibility. However, following them will also make Web content more available to all users, whatever user agent they are using (e.g., desktop browser, voice browser, mobile phone, automobile-based personal computer, etc.) or constraints they may be operating under (e.g., noisy surroundings, under- or over-illuminated rooms, in a hands-free environment, etc.). Following these guidelines will also help people find information on the Web more quickly. These guidelines do not discourage content developers from using images, video, etc., but rather explain how to make multimedia content more accessible to a wide audience."

W3C Web Content Accessibility Guidelines 1.0 (5-May-1999)

http://www.w3.org/TR/WCAG10/

- Provide equivalent alternatives to auditory and visual content.
- Don't rely on color alone.
- Use markup and style sheets and do so properly.
- Clarify natural language usage
- Create tables that transform gracefully.
- Ensure that pages featuring new technologies transform gracefully.
- Ensure user control of time-sensitive content changes.
- Ensure direct accessibility of embedded user interfaces.
- Design for device-independence.
- Use interim solutions.
- Use W3C technologies and guidelines.
- Provide context and orientation information.
- Provide clear navigation mechanisms.
- Ensure that documents are clear and simple.

Web Accessibility and Usability (Theofanos & Redish, 2003)

- Visually impaired users
- Problem: W3C Web Content Accessibility Guidelines aren't necessarily usable!
- 32 Guidelines developed using 16 blind participants
  - Some guidelines are for "screenreaders" such as JAWS
  - Most are for Web page content designers

Guidelines of Usability Experts (Arnold Lund, Ameritech, 1995)

- Experts in HCI design field suggested rules of thumb they found particularly useful during design
- 34 rules defined
- 31 HCI experts rated each of the rules of thumb by their estimate of magnitude of impact on usability of designs
- 5 is most impact; 1 is least
- Forced choice (20% of rules "5", 20% "4", etc.)
- 82% inter-rater correlation: high consensus

Guidelines of Usability Experts (5 is most impact on usability)

4.1	Know they user, and YOU are not thy user.
4	Things that look the same should act the same.
4	Everyone makes mistakes, so every mistake should be fixable.
3.9	The information for the decision needs to be there when the decision is needed.
3.8	Error messages should actually mean something to the user, and tell the user how to fix the problem.
3.8	Every action should have a reaction.
3.7	Don't overload the user's buffers.
3.6	Consistency, consistency, consistency.
3.5	Minimize the need for a mighty memory.
3.5	Keep it simple.

Guidelines of Usability Experts - cont.

3.4	The more you do something, the easier it should be to do.
3.4	The user should always know what is happening.
3.4	The user should control the system. The system shouldn't control the user. The user is the boss, and the system should show it.
3.3	The idea is to empower the user, not speed up the system.
3.3	Eliminate unnecessary decisions, and illuminate the rest.
3.3	If I made an error, let me know about it before I get into REAL trouble.
3.3	The best journey is the one with the fewest steps. Shorten the distance between the user and their goal.

Guidelines of Usability Experts - cont.

3.2	The user should be able to do what the user wants to do.
3.2	Things that look different should act different.
3.2	You should always know how to find out what to do next.
2.9	Don't let people accidentally shoot themselves.
2.9	Even experts are novices at some point. Provide help.
2.9	Design for regular people and the real world.
2.9	Keep it neat. Keep it organized.
2.9	Provide a way to bail out and start over.
2.7	The fault is not in thyself, but in thy system.
2.5	If it is not needed, it's not needed.
2.5	Color is information.

Guidelines of Usability Experts

2.3	Everything in its place, and a place for everything.
2.3	The user should be in a good mood when done.
2	If I made an error, at least let me finish my thought before I have to fix it.
1.7	Cute is not a good adjective for systems.
1.7	Let people shape the system to themselves, and paint it with their own personality.
1.3	To know the system is to love it.

Guidelines

- Problems
  - Unsystematic folklore
  - Imprecise implementation
  - Tradeoffs

Interface (Cognitive) Walkthrough

- Definition
  - Given an interface and a set of tasks as captured in scenarios, for each task the developers walk through the user's action sequence noting any usability problems. This can also be done with user interaction networks.
- Purpose
  - To test *completeness*: For each function in the functional requirements, define a sequence of user actions with the proposed interface (a task)
  - To test correctness: Verify that each task has an end
  - To test consistency: Similar functions, similar interaction
  - To spot any affordance or confusion in usability.

Interface (Cognitive) Walkthrough

- Problems
  - Incomplete since the developers may have made oversights
  - Developers are not the users.

Expert (heuristic) evaluation

- Definition
  - Usability expert evaluates interface
  - Uses Guidelines to evaluate mockups and overall design.
  - Suggests changes
- Problems
  - Expert may be unavailable
  - Experts may disagree
  - An expert is not a user

Expert evaluation

(Niesen & Molich, CHI 1990, "Heuristic evaluation of user interfaces")

- Problem
  - Individual evaluators found between 20-51% of usability problems
- Solution
  - Use aggregated results from 3 to 5+ evaluators

VSF Usability Inspection

- Usability issues raised during an informal usability inspection based on Nielsen's *guidelines* (see left column). The inspection was carried out as an informal *walkthrough* of the design scenarios. A *usability expert* stepped through each scenario and considered whether the actors might have problems in any of the ten areas identified by Nielsen's guidelines.

Guideline	Potential VSF Usability Problem
Use simple and natural dialog	Control+F used to synchronize views; Control+1 to query activity
Speak the user's language	Young or experienced students may not understand "Nested Components"
Minimize user memory load	Chat bubbles stay on the screen only for 20 seconds
Be consistent	People appear as avatars in exhibit space, but as a text list at exhibit; map is replaced by miniaturized windows in exhibit display
Provide feedback	Information on others' activities only available with extra effort; chat bubbles in room overlap for large groups; red color used for alerts will not be detectable by color-blind individuals
Provide clearly marked exits	Relationship between exhibit and nested components not clear; when you change view, what happens to nested components?
Provide shortcuts	Must open each nested component individually, i.e. no "display all"
Provide good error messages	"File type not recognized" doesn't include how to fix problem when Excel or other source applications are not installed on client machine.
Prevent errors	Multiple independent windows are difficult to distinguish and manage
Include good help and documentation	Help information on how to extend file types assumes familiarity with similar dialogs in web browsers

Model-Based Analysis

- GOMS (Card, Moran & Newell, 1983)
  - Hierarchical model of human system goals, sub-goals, mental and physical actions.
- KLM
  - Derived from GOMS
  - Depicts actions at the human physical level

GOMS

- Representation of user's interaction with system
  - **G**oals (system)
  - **O**perators (physical or mental actions)
  - **M**ethods (procedures of operators)
  - **S**election rules (choose between methods)

GOMS example

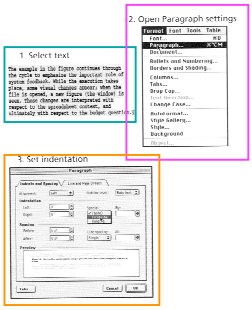
System goal: Indent paragraph

Subgoals:

1. Select text
2. Open Paragraph settings
3. Set indentation

Sub-subgoals:

1. Specify text selection start
2. Specify text selection end
3. Select Format menu
4. Select Paragraph option
5. Set Special to First Line
6. Type value for First Line
7. Accept new settings



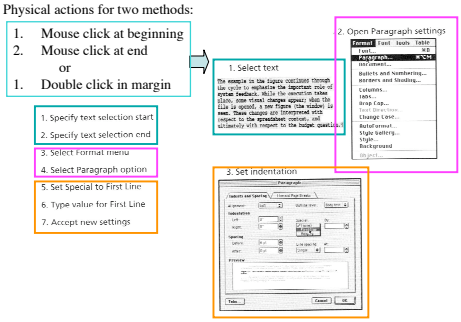
GOMS example

Physical actions for two methods:

1. Mouse click at beginning
2. Mouse click at end

or

1. Double click in margin



GOMS

- Problems
  - Very detailed and time-consuming to apply to a whole system
  - Not a good design tool
  - Predicts behavior for methods but not selection rules
  - Many aspects of human behavior cannot be captured such as prediction of mistakes or UI usability failure

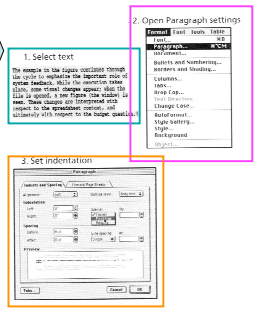
Keystroke Level Model (KLM)

- Definition
  - Predicts time to do a task for an expert user
  - GOMS at the physical action level
- How to do it
  - Specify a task with low-level actions
    - key press, mouse pointing action, reach for mouse or keyboard
    - Add mental action at the beginning of a command
    - Add system response time
  - Give times for each action and system response
    - key press = .2 sec; mouse point = 1.1 sec; reach = .4 sec
    - mental time = 1.35 sec
  - Sum to compute estimated time for the task

Indent paragraph example

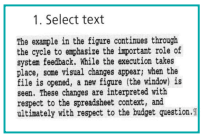
1. Mouse click at beginning
2. Mouse click at end
   or
1. Double click in margin

1. Specify text selection start
2. Specify text selection end
3. Select Format menu
4. Select Paragraph option
5. Set Special to First Line
6. Type value for First Line
7. Accept new settings



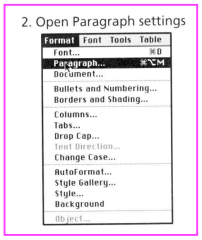
Indent Paragraph example

1. Select Paragraph
   (total = 3.95 secs)
   a) Select beginning of text
      1. Mental (1.35 secs)
      2. Point to beginning of text (1.1 secs)
      3. Press mouse button down (0.2 secs)
   b) Select end of text
      1. Point to end of text (1.1 secs)
      2. Release mouse button (0.2 secs)



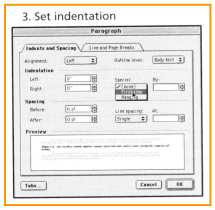
Indent Paragraph example

2. Select "Format Paragraph" Command
   (total = 3.95 secs)
   a) Select "Format" Menu
      1. Mental (1.35 secs)
      2. Point to "Format" menu (1.1 secs)
      3. Press mouse button down (0.2 secs)
   b) Select "Paragraph" Option
      1. Point to "Paragraph" item (1.1 secs)
      2. Release mouse button (0.2 secs)



Indent Paragraph example

3. Select indentation options (total = 8.5 secs)
   a) Set special to First Line
      1. Mental (1.35 secs)
      2. Point to "Special" menu (1.1 secs)
      3. Press mouse button down (0.2 secs)
      4. Point to "First Line" item (1.1 secs)
      5. Release mouse button (0.2 secs)
   b) Type value for First Line
      1. Mental (1.35 secs)
      2. Point to text box (1.1 secs)
      3. Click mouse button (0.2 secs)
      4. Type 3 character (0.2 x 3 = 0.6secs)
   c) Accept new setting
      a) Point to OK button (1.1 secs)
      b) Click mouse button (0.2 secs)



Indent Paragraph example

1. Select Paragaph total = 3.95 secs
2. Select "Format Paragraph" Command total = 3.95 secs
3. Select indentation options total = 8.5 secs

Total = 16.4 secs

Indent Paragraph example

- Optimizing
  - Double-click for paragraph instead of highlighting the text
  - Shortcut keys instead of menu selection

KLM

- Advantages
  - Predicts 80-90% average performance time
  - Can be done for core activities of the system
- Problems
  - Does not predict learning, only practiced users
  - Does not predict where people will make mistakes or types of usability problems

Review of Usability Evaluation without Users

- Analytic vs. empirical method
- Types
  - Claims analysis
  - Usability inspection: spots usability problems
    - Guidelines
    - Interface (Cognitive) walkthrough
    - Expert (Heuristic) evaluation
  - Model-Based analysis: predicts skilled performance time
    - GOMS
    - Keystroke Level Model (KLM)

Final Thoughts

- Human psychology and social sciences do not have a robust predictive science for most human cognition
  - Can successfully predict learning and performance time of repetitive tasks
  - Very difficult to predict creativity, problem solving, searching, mistakes, misunderstandings
- THEREFORE: We *must* rely on empirical methods to evaluate usability