Lecture 6

Usability Evaluation with Users
(Chapter 4.3)

Usability Evaluation Summary

- Purpose: Evaluation for usability
- Methods
  - Without Users (analytic)
    - Guidelines (Chapter 2.2)
    - Interface Walkthrough
    - Expert Review (Chapter 4.2)
    - Model-Based analysis (Keystroke Model)
  - With Users (empirical)
    - Field Studies (Chapter 4.5)
    - Experiments (Chapter 4.7)
    - Usability testing (Chapter 4.3)
    - Surveys (Chapter 4.4)

Field Studies (Observations)

Field Studies

- Observational
  - Use of software in *context* of work or play
  - Method used for studying use over a long period of time (longitudinal)
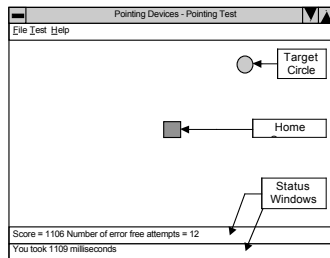 - Uses ethnographic methods from anthropology

Controlled Experiment

Controlled Experiments

- Hypothesis testing
  - Does a cause b to change?
  - a is independent factor manipulated by the experiment
  - b is dependent factor measured by experiment
- Example
  - Which device is faster to point with: A mouse or a finger-controlled joystick? Does having the joystick on the keyboard save "homing" time?
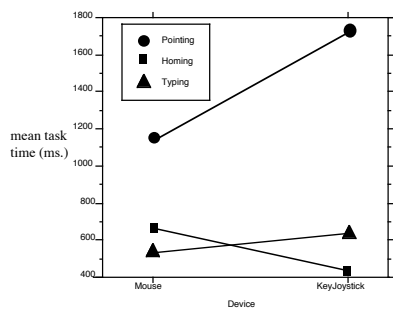 - What is a? What is b?

Pointing Device Experiment

- Hypotheses
  - "The key joystick is faster to home."
  - "The key joystick is faster to point."
  - "The key joystick is the same at typing."
- Independent variables
  - Device: mouse vs. key joystick
  - Task: pointing, typing, homing
- Dependent variables (tested by ANOVA)
  - Time
- 12 participants on each device do all tasks

Fitts Pointing Task on the Computer


```
Pointing Devices - Pointing Test          ▼ ▲
File Test Help

                              ○ ← Target
                                    Circle

              ■ ← Home

                              Status
                              Windows

Score = 1106 Number of error free attempts = 12
You took 1109 milliseconds
```

Task Times for Practiced Users

Task Times for Practiced Users

Device	Mean Trial Time (ms) for Mode Switching Subtasks		
	Pointing	Homing	Typing
Mouse	1158	667	531
Key Joy	1746	438	639
KJ:Mouse	1.51*	0.66*	not significant

* is significant at $p \leq 0.001$

Usability Testing with Users

Testing Goals vs. Method

	Guidelines	Walkthrough	Expert	Keystroke Level Model	Usability Testing
Overall Usability	√		√		√
Detailed Usability		√	√		√
Completeness		√	√		
Correctness		√	√		
Consistency		√	√		
Performance Time				√	√

Usability Testing

- Definition
  - Usability testing is an empirical method which puts typical users in a laboratory, gives them a prototype and a set of tasks, and records their interactions, usually on videotape.

Usability Testing

- What can you get from usability testing?
  - Testing against usability requirements: Does the system meet the usability design goals? Usability testing allows measurement of performance time.
  - Design improvements: What changes should be made to the system?
  - Conceptual problems: What misconceptions exist?
  - Repair strategies: What did the person do to recover from failure?
  - Problem solving strategies: What strategies did the person use that could promote a more supportive design?

Usability Testing

- Benefits
  - Focus on first-time users
  - Detects most serious problems
  - Uses real tasks and real users
- Problems
  - Only tests learning for first-time users
  - Finds problems but doesn't always suggest how to fix them!
  - Expensive and time-consuming

How to do it

- Plan: Before the testing
  - Determine goals of usability testing
    - Usability problems
    - Usability specifications
  - Choose pairs of users
    - Real users, not actors or other developers
    - Typical users and note relationships
      - Select users (Background Survey Form)
      - Get informed consent (Consent Form)
  - Choose tasks to test
    - Develop testing materials
      - Working prototype
    - Instructions to participants (Instructions Form)
    - Qualitative assessment of testing (User Reaction Form)
  - Setup video equipment and test

Usability Specifications
Virtual Science Fair Example

Scenario and Subtasks	Worst Case	Planned	Best Case
Scenario Context: Alicia and Delia visit the fair	3 on usefulness and ease of use	4 on usefulness and ease of use	5 on usefulness and ease of use
1. Finding a co-present visitor	15 seconds, 1 error 3 on awareness	5 seconds, 0 error 4 on awareness	1 second, 0 error 5 on awareness
2. Navigating to a specified exhibit	20 seconds, 1 error 3 on directness	5 seconds, 1 error 4 on directness	3 seconds, 0 error 5 on directness
3. Positioning an activity rectangle	30 seconds, 3 errors 3 on naturalness	15 seconds, 1 error 4.5 on naturalness	3 seconds, 0 error 5 on naturalness
4. Opening and manipulating Excel chart	2 minutes, 2 errors 3 on intuitiveness	1 minute, 0 error 4 on intuitiveness	30 seconds, 0 error 5 on intuitiveness
5. Chat review and input	2 minutes, 2 errors 3 on comprehension	1 minute, 0 error 4 on comprehension	30 seconds, 0 error 5 on comprehension

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Forms

- User background survey
  - Only ask for what you need!

User Background Survey
Virginia Tech Computer Science Department and Center for Human-Computer Interaction

Thank you for agreeing to participate in the study. Before we begin, it will be useful for us to know more about your background—your experience with science fairs, with technology, and so on. This will help us to better understand your interactions and reactions to the system. Remember that all personal data will be treated confidentially and reported with no identifying information.

Name: _____   Age: _____
Occupation: _____   Years of Education: _____
Years a resident in Blacksburg: _____

For how many years have you been using computers? _____

Please describe your typical computer use (e.g., over a period of a week):
_____
_____

Have you had any experience with science fairs? If yes, please describe:
_____
_____

Have you had any experience with virtual worlds (MOOs, MUDs, other online communities)? If yes, please describe:
_____
_____

Please respond to the following 3 items by circling the opinion that best corresponds to your own. Note that in some cases, this may require you to make a prediction about online activities.

1. Browsing an online science exhibit is like visiting a science fair in the real world.
   Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree
2. Online science exhibits are diverse and of interest to a wide range of visitors.
   Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree
3. There are many opportunities for me to become involved in students' science projects.
   Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

Is there anything else we should know about your interests or background? If yes, briefly describe:
_____
_____

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Forms

- Informed Consent
  - What they are going to do
  - How you will evaluate the data
  - Anonymity
  - Can quit at any time
  - Contact information for person doing study
  - Signature

User Study of A Virtual Science Fair: Consent Form
Virginia Tech Computer Science Department and Center for Human-Computer Interaction

Study Goals:
This research is being conducted to explore the usefulness, ease of learning and use, and satisfaction experienced by students, teachers, and community members interacting with a Virtual Science Fair (VSF). The VSF is an extension of physical science fairs, in that exhibits can be created and browse online, communication can take place among visitors and exhibitors, judging takes place online, and so on. We will use the results of the study to refine the VSF. **Note:** we are interested in how well the **system** performs, not how well any individual is able to use it.

Procedures:
You will begin by filling out a brief background survey. Then, after reading some brief instructions you will work through several tasks designed to introduce you to features of the VSF. These instructions will be deliberately brief, in order to see how well the system can support use on its own. After the tasks, you will fill out a user reaction survey, and then will be given an opportunity to ask any questions you have about this study's goals, procedures, or outcomes.

Throughout your interactions with the VSF, we will be collecting several sorts of information: we will be videotaping your actions with the system, as well as recording what happens on each screen of the VSF. One or more evaluators will be taking notes, measuring task start and stop time, and noting any problems that you encounter. To help us gather as much information about the VSF as possible, we also will be asking you to *think aloud* about your goals, expectations, and reactions to the system as you work. At times we may prompt you to tell us what you are thinking. We realize that providing a think-aloud commentary may be distracting, but it is important for us to know what you are thinking as you carry out the tasks.

Participant Consent:
Your participation in this experiment is entirely voluntary; there will be no remuneration for the time you spend evaluating it. All data gathered from the usability study will be treated in a confidential fashion: it will be archived in a secure location and will be interpreted only for purposes of this evaluation. When your data are reported or described, all identifying information will be removed. There are no known risks to participation in this experiment, and you may withdraw at any point. Please feel free to ask the evaluators if you have any other questions; otherwise, if you are willing to participate, please sign and date this form:

_____   _____
Name   **Date**

If there are any questions, please contact Dr. Mary Beth Rosson, 231-6470, rosson@vt.edu

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How to do it

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Prototype Implementation

- Software Storyboard
- Software Prototype with GUI Builder or Prototyping language
- Partial Target Software Implementation
- Completed Target Software Implementation

Forms (cont.)

- General instructions
  - Do the tasks as described
  - Ask for help only when give up
  - Explain purpose; evaluating system, not participants
  - Can leave at any time

General Instructions for VSF Study

"In the next 30 minutes or so, you will be carrying out ten tasks within the Virtual Science Fair. These tasks are organized into two groups of four and six. Each group will be introduced with a storyline that describes the role and situation we would like you to adopt for that set of tasks, then each task is specified individually. Note that we intentionally leave out some of the detailed task steps so that we can determine how well the system can guide your interactions with it. If you are confused at any point, please just make your best guess about how to proceed, using the information that you have been given. We will intervene if necessary to help you make progress.

At the start of each task, please say out loud: "Beginning Task" followed by the number of the task. When you are done, please say: "Task Complete". Also, please remember to think out loud as you work. It is very important for us to understand your goals, expectations, and reactions as you work through the tasks. Any further questions?"

Forms (cont.)

- Task instructions
  - don't give away the interface!

Specific Task Instructions for Science Fair Study
Virginia Tech Computer Science Department and Center for Human-Computer Interaction

Background to Tasks 1-4:
Imagine that you are Mr. King, an experienced science teacher who has coached many student projects in the past. This year you are advising Sally Harris on her black holes project. You are both very busy, but have arranged to meet in the VSF at 8 PM tonight. When you arrive, Sally is already there working.

Task 1:
• Find out what exhibit component Sally is working on and synchronize your view with hers.

Task 2:
• While Sally works on her Title Page, upload the Word file "Bibliography.doc" (on your desktop) into the exhibit element named "Bibliography".

Task 3:
• Open the exhibit element that is an Excel document and modify the title of the chart to be "Interaction of Mass and Movement". Save your change.

Task 4:
• Open the simulation element and add a nested folder named "Visitor Experiments".

Forms (cont.)

- User Reactions Survey
  - Ask only for what you need
  - Pilot test it to be sure you're asking the right questions

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User Reactions Survey
Virginia Tech Computer Science Department and Center for Human-Computer Interaction

Now that you have completed the VSF tasks, we would like to know some of your reactions, both in general, and to specific features of the system.

Name: _____

What three things did you like **most** about the VSF? Why?
1. _____
2. _____
3. _____

What three things did you like **least** about the VSF? Why?
1. _____
2. _____
3. _____

If the VSF was made available to you, would you use it or not? ○ Yes ○ No
Why? _____

Please respond to the following 10 items by circling the opinion that best corresponds to your own.
1. Browsing an online science exhibit is like visiting a science fair in the real world.
   Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree
2. Online science exhibits are diverse and of interest to a wide range of visitors.
   Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree
3. There are many opportunities for me to become involved in students' science projects.
   Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree
4. I am aware of other visitors' locations and activities while in the VSF.
   Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree
5. Movement from one location in the VSF to another is awkward.
   Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree
6. It is easy and natural to join other visitors at an exhibit.
   Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree
7. Experimenting with exhibit components (e.g. spreadsheets) is fun and enlightening.
   Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree
8. Chatting with multiple visitors at the same time is confusing
   Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree

*<more Likert scales, assessing reactions to other subtasks>*

How to do it (cont.)

- Data Collection: Videotaping Method
- Analysis of Data
- Generating solutions to the usability problems
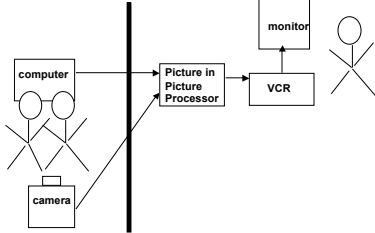
Videotaping

- Number of participants
  - Thinking aloud (one person)
  - Constructive interaction (two or more people)
- Number of cameras
  - One camera
  - Two cameras
- Don't watch what they are doing.
  - Set up camera and leave
  - Put camera on tripod over their heads aimed at display
- Don't answer their questions unless they are very stuck

Usability Testing
Single Camera Videotaping Method
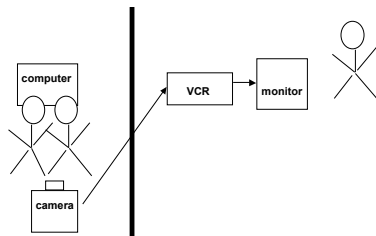
Usability Testing
Two Camera Videotaping Method

Analysis of Videotape

- Review tape, noting where participants have problems
- Try to understand reasons for problems
- Prioritize problems by severity
- Summarize findings in terms of overall interface characteristics
    - Were the usability requirements met?
    - Overall impression of the software

Analysis Worksheet

Interface Name, Date, Time, Participants
Location of problem on tape
Task attempting to do
What were the users' stated or assumed goal?
What were the users' actions?
What did the users think happened? (perceived effect)
Priority of the problem
Analysis and recommendation

Integrating Usability Testing back into the Design

- Overall Usability
  - Overall usability requirements achieved?
  - Identify and prioritize usability problems
  - Explain causes
- Generate design alternatives to solve most important problems
  - Justify advantages/disadvantages/tradeoffs of each solution
- Choose one solution for each problem
- Implement in prototype and test again