Today

- **Homework:** Breakdowns (group)
- **Lectures:** Evaluation: Qualitative and Quantitative
  Generative Walkthroughs
- **Class work:** Experiment design
  Generative Walkthrough

- **due Jan. 29:** Revise your storyboard:
  Add two interaction points
  that express a sociotechnical principle

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**Evaluation**

*Does it work?*
Evaluation: Does it work?

Collect information
Design Walkthrough
Experiment

Analyse information
Qualitative
Quantitative

Resources for design
List of problems, issues
Implications for redesign

Simple experiment

Goal
Choose the best design alternatives by watching users try the prototype

Procedure
Describe the design objective
Identify several alternatives
Choose the independent and dependent
Specify the null hypothesis and make a prediction
Set up the test conditions to compare each condition
Use at least three real users
Analyse the results: are they significantly different?

Design a simple experiment

Specify the functionality offered to users
What does the system do?

Specify alternative interaction techniques
How does the user accomplish it?

Specify the independent variables (factors)
Experimenter decides on the values

Specify the dependent variables (measures)
User behavior determines the values

Specify the tasks the user will perform (operationalize behavior)
Specify experimental and control groups

Specify appropriate statistical tests
Is the difference real?

Example

Compare linear and circular menus

Null hypothesis ($H_0$)

There is no difference in performance between users in terms of time or error when selecting an item from a linear or a circular menu regardless of type of menu, number of menu items or previous experience
Specify the independent variables

Independent variables (factors) are those we want to vary or control. The combinations of variables define the conditions.

**Independent variables:**
- Type of menu: linear, circular
- Number of items: 3, 6, 9, 12, 15
- Expertise: expert, novice, intermittent

\[2 \times 5 \times 3\] = 30 unique conditions

Caution: Most user-related variables are dependent on the user’s behavior. User experience is an independent variable, chosen independently by the experimenter.

Specify the dependent variables

Dependent variables depend on the user’s behavior. Also called measures because they measure user’s behavior.

For a reliable statistical test, you need sufficient measures per condition.

Rule of thumb:
- ~12 for small-n statistics (student’s t)
- ~30 for normally distributed tests

Dependent variable might include:
- Time to select an item
- Number of errors
- What else?

Operationalize the behavior

Trickiest part of the experimental design but when it’s done well, it seems obvious.

Simplify the task as much as possible, to eliminate bias and external factors, without making it unrealistic.

Example: Fitts’ pointing task
- only one dimension (target = vertical band)
- reciprocal pointing (back and forth between 2 targets)
Run the experiment

Prediction:
Always write your subjective predictions before you discover the results
Another example of looking for surprises
Control any factors that might bias the results:
All subjects receive the same instructions
All subjects perform tasks under the same conditions
All instructions are simple and clear
Informal contact kept to a minimum
Double blind experiment:
Neither the experimenter nor the subject know which group receives which treatment
Can our experiment be double blind?

Run the experiment

Obtain informed consent from the subjects
Ensure that subjects remain anonymous
Associate a number with each subject
Choose conditions based on those numbers
Gather experimental data
Test that they are reliable and valid
Minimize data treatment and preserve raw data

Collect data

Ensure that the data log is human-readable yet easy to analyze by both people and machines

Start S1 E C-L 3-12-15-9-6 Mon 21 Nov 2012 15:45:54
Condition S1 E C 3 Mon 21 Nov 2012 15:46:35
# sujet expertise type taille item hit/miss tps(ms)
Trial S1 E C 3 2 Hit 1254
Trial S1 E C 3 1 Miss 885
... Condition S1 E C 12 Mon 21 Nov 2012 15:54:22
Trial ...
End S1 E C-L 3-12-15-9-6 Mon 21 Nov 2012 16:23:55

Prediction ≠ Null Hypothesis

For this experiment:
I think that circular menus will be faster than linear menus regardless of experience and the number of menu items

Other predictions
Linear menu performance will decrease with more items
Circular menu performance will drop as more items are added
Exercise: Creating an Experiment

**Goal:** Choose the best interaction technique among several alternatives

**Procedure**
- Identify the key independent variables (factors)
- Identify the key dependent variables (measures)
- Operationalize the behavior and define test conditions
- Run the experiment with at least 3 subjects
- Analyze the data: are they significant?

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Generative Design: a reminder

- **Discovery**: Who is the user?
- **Invention**: What is possible?
- **Design**: What should it be?
- **Evaluation**: Does it work?
- **Redesign**: How to improve it?

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Redesign

*How to improve it?*

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Design is an iterative process …

Create design artifacts that serve as resources for design.
Multi-disciplinary Design Methods

These design techniques are derived from Human-Computer Interaction’s component disciplines. No individual technique is best nor can it stand alone. All have advantages and disadvantages, each is influenced by the norms of the parent discipline. We can choose from among these techniques and modify them as needed or create our own.

Iterative design means redesign

Within an iterative design process redesign is more important than initial design. Do not just “do it again!” reflect on your designs in context.

What are socio-technical principles?

Social scientists conduct extensive field studies and provide deep insights in the form of socio-technical principles about how people interact with technology in context. But it is difficult to translate these principles into specific designs.
Implications for design

Dourish argues that we should not force social scientists to generalize from specific field studies to create general implications for design. But we CAN bring social science insights to bear on specific design artifacts to enhance and explore the design space.

Generative Deconstruction

Apply socio-technical principles to generate grounded designs

<table>
<thead>
<tr>
<th>SOCIO-TECHNICAL PRINCIPLES</th>
<th>OBSERVE</th>
<th>DECONSTRUCT</th>
<th>RECONSTRUCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>use-technology-context</td>
<td>Specific anecdotes, breakdowns, surprises</td>
<td>design problem from: abstractions to: patterns</td>
<td>design solution</td>
</tr>
</tbody>
</table>

Examples: Socio-technical Principles

- **Situated Action**: Go beyond planned activities; Users decide how to act in unforeseen circumstances
- **Rhythms & routines**: Build upon routine activities and spatial patterns; Users integrate systems into their daily lives
- **Peripheral awareness**: Design for both focus and periphery; Users vary degree of engagement
- **Co-adaptation**: Expect users to re-interpret and customize; Enable capture and sharing of customizations
- **Distributed cognition**: Let objects and other people reduce cognitive load for memory or communication tasks

So ...

How do we incorporate socio-technical principles into the design process?
Crossing disciplines

Technical training emphasizes:
solving pre-defined problems
but not articulating new design problems

Social Science training emphasizes:
analyzing socio-technical phenomena
but not developing design solutions

Generative walkthroughs attempt to explicitly link
socio-technical principles with the specifics of a design

Generative Deconstruction & Reconstruction

Observe users either:
to understand what to design or
to evaluate what has been designed

First deconstruct what is going on:
Who is the user?
What is the technology?
What is the user's context?
What is the interaction like?

Then reconstruct the design
to design a new technology or
to fix an existing one

Generative Walkthroughs: Creative redesign

Structured walkthroughs
Systematic critique of design artifacts,
such as scenarios & storyboards

Generative Walkthroughs: Creative redesign

Structured walkthroughs
Systematic critique of design artifacts,
such as scenarios & storyboards

plus

Focused brainstorming
Generation of novel ideas,
based on socio-technical principles
Exercise: Generative Walkthroughs

Analyze your storyboard

<table>
<thead>
<tr>
<th>scenario or storyboard</th>
<th>situated action</th>
<th>rhythms &amp; routines</th>
<th>peripheral awareness</th>
<th>co-adaptive systems</th>
<th>distributed cognition</th>
</tr>
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</table>

Exercise: Generative Walkthrough

Applying socio-technical principles using post-it notes

Socio-technical Principles

- **Situated Action**
  - Go beyond planned activities; Users decide how to act in unforeseen circumstances
- **Rhythms & routines**
  - Identify use patterns
  - Build upon routine activities and spatial patterns; Users integrate systems into their daily lives
- **Peripheral awareness**
  - Design the periphery
  - Design for both focus and periphery; Users vary degree of engagement
- **Co-adaptation**
  - Re-integrate use
  - Expect users to re-interpret and customize; Enable capture and sharing of customizations
- **Distributed cognition**
  - "outside the head"
  - Let objects and other people reduce cognitive load for memory or communication tasks

Reflecting on Post-It Notes

- What is a ‘post-it note’?
- What are they used for?
- What are their most important properties?
- Why do they work?
- Have you seen any creative uses of post-it notes?
Socio-technical Principles

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Situated Action

LucySuchman

We can plan our activities but we always act within a real-world context.

How can we take context into account? What about interruptions? Breakdowns?

How can we give users the ability to change their plans at any moment?

Situated Action

a. What actions emerge when the user is in a specific situation? (Emergent action)
b. What objects are physically next to each other? (Co-located artifacts)
c. What are useful properties of the physical objects involved?
d. What are useful properties of the surrounding environment?
Situated Action

The plan consisted of navigating on a direct course from point A to point B including a small detour to avoid a rock. In reality, the course was an intricate series of adjustments to circumstances including changing wind, water currents, drift, and operator over-compensation.

Situated Action

| 1. What is Sandy's problem? |
| 2. How does she use the post-it note to solve the problem? |
| 3. Explain why this is an example of situated action. |

Situated Action

Actual path taken
Navigation plan
Point A
Point B

Situated Action

Sandy knows that she needs to meet with Fred this week, but doesn't know exactly when. This post-it note is stuck to her calendar, in no particular spot. It acts as a reminder that she plans to talk to Fred, but she still needs to specify the precise time.

Emergent action:
Sandy knows that the dates may change, her system is flexible.

Co-localisation of artifacts:
Sandy knows that when she next looks at the calendar, she'll see the post-it.

Situated Action

What properties make it work?
  a. What does Sandy do in what specific situation?
     (emergent action)
  b. What objects are physically next to each other?
     (co-located artifacts)
  c. What are useful properties of the physical objects involved?
  d. What are useful properties of the surrounding environment?
Situated Action

Apply this principle to your scenario

Rhythms &
Routines

Rhythms et Routines

In everyday life:
- people are influenced by external rhythms: the sun rises, the night falls, days pass which create their biological rhythms when to eat, when to sleep
- people also establish routines eat, sleep, go to work every day perform activities in certain places

How can we take this into account when designing interactive systems?

Rhythms and Routines

Ralph took a call from his son’s best friend, Tara. He wrote a message on a post-it note and left it at his son’s place at the dinner table.

Temporal rhythm:
- Ralph knows his son will come home at dinnertime.

Spatial routine:
- Ralph knows his son’s place at the table
Rhythms and Routines

1. What is Ralph’s problem?
2. How does he use the post-it note to solve the problem?
3. Explain why this is an example of rhythms and routines.

Mary places her pills next to the coffee maker to remind her to take her pill every morning.

1. What is Mary’s problem?
2. How does she use the post-it note to solve the problem?
3. Explain why this is an example of rhythms and routines.

What properties make it work?

a. What biological rhythms influence people? (temporal rhythms)
b. What spatial layouts help people find things? (spatial routines)
c. What routines occur on a regular basis at home? at work? in the car?
Rhythms and Routines

Apply this principle to your scenario.

Peripheral Awareness

Human perception involves both focus and periphery.

Example: Vision
  Central vision: you see color, detail
  Peripheral vision: you see black & white, movement

Most interactive system designers assume they have the user’s full attention
  … but users multi-task and live in a complex world

How can we design for what happens in the periphery?

Peripheral Awareness

Paul puts his chores on post-it notes on the fridge. He doesn’t look at them all the time, but when he has the sense that it’s “too yellow”, he knows it’s time to stop procrastinating.

Focused attention:
  Paul can read the note when he’s ready to act

Peripheral awareness:
  Paul senses when the fridge is ‘yellow’ and he should act
Peripheral Awareness

1. What is Paul’s problem?
2. How does he use the post-it note to solve the problem?
3. Explain why this is an example of peripheral awareness.

What properties make it work?

a. What happens when Paul does not pay much attention?
b. What happens when Paul is actively engaged in a task?
c. How does Paul transition between levels of attention?
d. What tasks are appropriate for what types of awareness?

Peripheral Awareness

Apply this principle to your scenario

Distributed Cognition
Distributed Cognition

Physical objects form part of our memory
It is not necessary to remember everything

Objects can be shared among people
but they are not necessarily interpreted the same

Distributed Cognition

Dan and Mary share a home computer. Dan leaves a post-it note with the list of commands needed to perform a specific function.

Memory aid:
The post-it allows them to forget the details – they know where to find them

Boundary object:
Dan and Mary use the instructions differently

Distributed Cognition

1. What is Dan’s and Mary’s problem?
2. How do they use the post-it note to solve their problem?
3. Explain why this is an example of distributed cognition.
### Distributed Cognition

<table>
<thead>
<tr>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. How can objects be placed to aid Dan’s memory?</td>
</tr>
<tr>
<td>b. What properties of objects make them useful for distributed cognition?</td>
</tr>
<tr>
<td>c. How do different people interpret the same object? <em>(boundary objects)</em></td>
</tr>
<tr>
<td>d. What is the division of processing between the user and the computer?</td>
</tr>
<tr>
<td>e. What cultural knowledge is needed to understand the objects and how they are distributed among people?</td>
</tr>
</tbody>
</table>

### Co-Adaptive Systems

Designers of interactive systems assume that users will use them as intended.

But ... although users clearly learn to use new systems, adapting their behavior according to the system design, they also adapt them to meet their own needs.

How can we make interactive systems easier to learn and easier to appropriate in creative ways?
Co-Adaptive Systems

Ann gets a business card and is afraid to lose it so she uses a post-it note to attach it to her agenda.

**System adaptation:**
Connie understands the properties of post-it notes and uses them for a new new purpose.

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**Co-Adaptive Systems**

**a.** What does the user need to learn to use the system?
**b.** What elements of the system can be left ‘open’ to interpretation by the user?
**c.** How can the system be explicitly customized?
**d.** How can customizations be shared?
**e.** How can customizations apply in different situations?

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**Co-Adaptive Systems**

What properties make it work?
- a. What does Connie need to know about the post-it note?
- b. What elements were left ‘open’ to interpretation?
- c. How was the post-it customized?
- d. Can this customization be shared or applied in different situations?

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**Co-Adaptive Systems**

Apply this principle to your scenario.
Generative Walkthroughs

... combine two techniques:
structured walkthroughs and focused brainstorming at each step

- situation
- action
- rhythms & routines
- peripheral awareness
- co-adaptive systems
- distributed cognition

Exercise: Generative Walkthrough

Goal: Deconstruct your system based on socio-technical design principles, then reconstruct it, using them to generate new ideas for improving the system.

Procedure:
- Choose one of the principles (or assign a principle to different team members).
- Reread the storyboard out loud.
- Go through the storyboard, step-by-step, examining each interaction point.
- Generate at least three ideas inspired by one of the principles to improve the system from the user's perspective.