02: Design Language & Inclusive Design 101

March 28, 2024
Jesse Checklist

- Zoom: Speeding
  - Host: TA’d
  - Slides: Shared WITH AUDIO
  - Recording: Yes
- Panopto: Live & Recording
- Ed: Q&A’d
- Mic: on
- Slides: projected
- Captions: Captioning
Course Reminders

Assignment 0 (Intro Slide) Due tonight @ 8pm
Assignment 1a (Project Brainstorm) Due tonight @ 8pm
Keep an eye out for people looking for groupmates
Keep an eye out for email re: final section assignments
  Trying to make as few changes as possible
  If you expressed you can only be in your currently assigned section,
  that IS the section you will be in

Section Tomorrow:
  Be on time – MGH 058, 12:30 for Section C, 1:30 for Section D
  Have your 1a submission readily available (physically or digitally)
Overview

Some Design Language
   An End-to-End Design Process
   The Gulfs of Execution & Evaluation
   Intro to Tasks
   Mental Models
   Affordances

Inclusive Design (and how people fail at it)
   Design Tradeoffs & Value-Sensitive Design
   Can One Size *Really* Fit All?
Objectives

Be able to:

Describe the different phases of the Design Process
(in progress)

Describe the Execution-Evaluation Cycle and understand how to use it to anticipate design failures

Describe Task-Based Design, articulate user Tasks, and apply tasks to different phases of the Design Process
(in progress)

Define Mental, Implementation, and Manifest Models, their relationships, and how they are created

Describe and identify examples of affordances, including false and hidden affordances
Objectives

Be able to:

Identify design tradeoffs between designs and assess which design is “best” for a certain context

Describe Value-Sensitive Design, the role values play in design, and how to mitigate designer bias

(in progress)
Overview

Some Design Language

An End-to-End Design Process
The Gulfs of Execution & Evaluation
Intro to Tasks
Mental Models
Affordances

Inclusive Design (and how people fail at it)
Design Tradeoffs & Value-Sensitive Design
Can One Size Really Fit All?
An End-to-End Design Process

As told by IDEO (in 1999)
IDEO’s Deep Dive (ABC News, 1999)

http://courses.cs.washington.edu/courses/cse440/videos/design/IDEO-DeepDive.mp4
ABC News and IDEO’s Deep Dive

Things to see in this video:
- brainstorming
- design research
- sketching
- critique

A highly iterative design process with a variety of intermediate artifacts
IDEO’s Deep Dive (ABC News, 1999)

http://courses.cs.washington.edu/courses/cse440/videos/design/IDEO-DeepDive.mp4

CSE 440 – Introduction to HCI
Today: “Design Language & Intro to Inclusive Design”
IDEO’s Deep Dive (ABC News, 1999)
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IDEO’s Deep Dive (ABC News, 1999)
Is this the Perfect Shopping Cart?
It needs a little refining but I think that it’s ... great.
Perfect Shopping Cart?

Several design flaws
  - Kids will slide and fall out of that seat
  - Where to put bags of dog food, cases of beer?
  - Hook design with reusable bags
  - Self-scanning challenges with theft

Focus on the design process
  - Designs always have limitations and tradeoffs

(More on this later...)
Perfect Shopping Cart?

Several design flaws
  - Kids will slide and fall out of that seat
  - Where to put bags of dog food, cases of beer?
  - Hook design with reusable bags
  - Self-scanning challenges with theft

Focus on the design process
  - Designs always have limitations and tradeoffs

(Some limitations in the process you saw?)
The Design Process

0. Find a Problem
1. Brainstorming
2. Design Research
3. Sketching (+ Critique)
4. Prototyping (+ Critique)
5. Usability Testing
Design Language 101
Goal:

Be able to look at existing designs and understand how they fail / exclude users
Norman’s Execution-Evaluation Cycle

Goals → Evaluate Goals → Interpret State → Observe State → System Change → Execute Actions → Develop Action Plan → Form Intention → Goals
Turning on the Light

1. Establish the goal
   Increase light in the room

2. Form the intention
   To turn on the lamp

3. Specify the action sequence
   Walk to the lamp, reach for the knob, twist the knob

4. Execute the action sequence
   [walk, reach, twist]

5. Perceive the system state
   [hear “click” sound, see light from lamp]

6. Interpret the system state
   The knob rotated. The lamp is emitting light. The lamp seems to work

7. Evaluate the system state with respect to the goals and intentions
   The lamp did indeed increase the light in the room [goal satisfied]
Norman’s Execution-Evaluation Cycle

- Goals
- Evaluate Goals
- Interpret State
- Observe State
- System Change
- Execute Actions
- Develop Action Plan
- Form Intention
- Goals
Norman’s Execution-Evaluation Cycle

Gulf of Execution

Goals
Form Intention
Develop Action Plan
Execute Actions
System Change
Observe State
Interpret State
Evaluate Goals
Goals

Gulf of Evaluation

Form Intention
Develop Action Plan
Execute Actions
System Change
Observe State
Interpret State
Evaluate Goals
Goals

Norman's Execution-Evaluation Cycle
Norman’s Execution-Evaluation Cycle

Gulf of Execution

- Goals
- Evaluate Goals
- Form Intention
- Develop Action Plan
- Execute Actions
- System Change

Gulf of Evaluation

- Interpret State
- Observe State
- Goals

“I don’t know what I can do”
OR
“I don’t know how to handle that”
Norman’s Execution-Evaluation Cycle

Gulf of Execution
- Goals
  - Evaluate Goals
- Form Intention
  - “I don’t know how to do that”
  - Develop Action Plan
- Execute Actions

Gulf of Evaluation
- Observe State
- System Change
- Interpret State
- Evaluate Goals
- Goals

“I don’t know how to do that”

CSE 440 – Introduction to HCI
Today: “Design Language & Intro to Inclusive Design”
Norman’s Execution-Evaluation Cycle

Gulf of Execution

- Goals
- Form Intention
- Develop Action Plan

Gulf of Evaluation

- Evaluate Goals
- Interpret State
- Observe State
- System Change

Execute Actions

“I can’t do that”
Norman’s Execution-Evaluation Cycle

**Gulf of Execution**
- **Goals**
  - Form Intention
  - Develop Action Plan
  - Execute Actions
  - System Change

**Gulf of Evaluation**
- **Evaluate Goals**
  - Interpret State
  - Observe State
  - “I don’t understand what happened”

**Goals**
- Form Intention
- Develop Action Plan
- Execute Actions
- System Change

**Evaluate Goals**
- Interpret State
- Observe State
- “I don’t understand what happened”

CSE 440 – Introduction to HCI
Today: “Design Language & Intro to Inclusive Design”
Norman’s Execution-Evaluation Cycle

**Gulf of Execution**

- **Goals**
- **Form Intention**
- **Develop Action Plan**
- **Execute Actions**

**Gulf of Evaluation**

- **Observe State**
- **System Change**
- **Interpret State**
- **Evaluate Goals**

**“I don’t know if that solved the problem”**

Norman's Execution-Evaluation Cycle

- Goals
- Form Intention
- Develop Action Plan
- Execute Actions
- Observe State
- System Change
- Interpret State
- Evaluate Goals
Today: “Design Language & Intro to Inclusive Design”

Norman’s Execution-Evaluation Cycle

Goals

Gulf of Execution

Gulf of Evaluation

Evaluate Goals

“I don’t know if that solved the problem”

Observe State

System Change

Interpret

State

Execute Actions

“Given this diagram of Norman’s Execution-Evaluation Cycle, explain what failure looks like at each of the 6 gulf stages”

If someone wanted to make an exam question about this, it might be:
Bridging the Gulfs

Gulf of Execution: “How do I do it?”
- Commands and mechanisms need to match the goals, thoughts, and expectations of a person

Gulf of Evaluation: “What does it mean?”
- Output needs to present a view of the system that is readily perceived, interpreted, and evaluated

**Tasks** are a useful model for understanding and describing what people are trying to do
Intro to Task-Based Design

A **Task** represents something that a user is trying to accomplish

A task can be:

*Based on a Long- or Short-term Goal*

- **Long-term goal:** Brad wants to get in shape by working out more
- **Related Tasks:**
  - “Track physical fitness progression”
  - “Schedule more workouts”

- **Short-term goal:** Nina wants to go see a movie right now
- **Related Tasks:**
  - “Find nearby theaters”
  - “Learn what movies are playing”

More on this as we move through the design process...
Intro to Task-Based Design

A Task represents something that a user is trying to accomplish.

A task can be:

Oriented around an outcome in any part of the System

- Goal: Be able to read in a dark room
- Related Tasks: “Increase the light in the room”
  “Find the book on a smartphone with a lit screen”
  “Acquire night-vision”

More on this as we move through the design process…
Intro to Task-Based Design

A **Task** represents *something that a user is trying to accomplish*

A task can be:

*Composed of Other Tasks*

- **Long-term goal:** Increase the light in the room
- **Subtasks:**
  - “Determine if opening the curtains would fix this”
  - “Learn if there are lamps in the room”
  - “Turn on a lamp”

More on this as we move through the design process...
Bridging the Gulfs

Gulf of Execution: “How do I do it?”
   Commands and mechanisms need to match the goals, thoughts, and expectations of a person

Gulf of Evaluation: “What does it mean?”
   Output needs to present a view of the system that is readily perceived, interpreted, and evaluated

Tasks are a useful model for understanding and describing what people are trying to do
Bridging the Gulfs

Gulf of Execution: “How do I do it?”
Commands and mechanisms need to match the goals, thoughts, and expectations of a person

Gulf of Evaluation: “What does it mean?”
Output needs to present a view of the system that is readily perceived, interpreted, and evaluated

People build **mental models** to anticipate and interpret system response to their actions
- What can I do?  How do I do it?
- What result will it have?  What is it telling me?
Cooper’s Mental Model Terminology

Implementation Model
How it works
(Design Model, Designer’s Conceptual Model)

Manifest Model
How it presents itself
(System Image)

Mental Model
How a person thinks it works
(User Model, User’s Conceptual Model)

These terms are sloppy and ambiguous out in the world
Manifest and Mental Models

Designer projects their model into an artifact
Person forms their model based on interaction
People struggle until model matches manifest model
Update mental model in response to breakdowns
Matching the implementation model is not necessary
Mental Models

• Problem: freezer too cold, fresh food just right

![Diagram showing mental models of a freezer with labels for freezer and fresh food]
Manifest Model

What if I want to make just the freezer warmer?

<table>
<thead>
<tr>
<th>Settings</th>
<th>Freezer</th>
<th>Fresh Food</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Settings</td>
<td>C AND 5</td>
<td>1</td>
</tr>
<tr>
<td>Colder Fresh Food</td>
<td>C AND 6-7</td>
<td>2 ALLOW 24 HOURS</td>
</tr>
<tr>
<td>Coldest Fresh Food</td>
<td>B AND 8-9</td>
<td>TO STABILIZE</td>
</tr>
<tr>
<td>Colder Freezer</td>
<td>D AND 7-8</td>
<td></td>
</tr>
<tr>
<td>Warmer Fresh Food</td>
<td>C AND 4-1</td>
<td></td>
</tr>
<tr>
<td>Off (Fresh FD &amp; FRZ)</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
A Sensible Mental Model

“The Freezer Control controls the freezer temperature and the Fresh Food Control controls the fresh food temperature”
The Implementation Model
A Problem with Feedback

<table>
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1. Set both controls
2. Allow 24 hours to stabilize
The Implementation Model

Why is the system designed like this?

Can you fix the problem?
The Implementation Model

Why is the system designed like this?
Cost constraints, probably

Can you fix the problem?
Make controls correspond to a person’s mental model
OR
Make controls correspond to the implementation model

“Design depends largely on constraints.”
Charles Eames
Building the Right Model

Having **the right model** helps people bridge the Gulf of Execution and the Gulf of Evaluation

How can we help people build the right models:

- Affordances
- Visibility
- Constraints
- Consistency
- Metaphors
- Knowledge in the World
- Mapping
- Modes
Building the Right Model

Having **the right model** helps people bridge the Gulf of Execution and the Gulf of Evaluation

How can we help people build the right models:

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</tbody>
</table>

Coming soon...!
Affordances

Visual clue to interaction

- knobs afford turning
- levers afford moving
- buttons afford pushing
Affordances

“The affordances of the environment are what it offers animals, what it provides or furnishes, for good or ill.”

Gibson, ecological approach to psychology

“The term ‘affordance’ refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used.”

Norman
What’s the Affordance?
Affordances
Affordances

Digital affordances are often based in affordances from the physical world
Affordances

What is the affordance? Where does it come from?

Knurling
In Other Words

An affordance is what a thing communicates about how it can be used, often by its appearance.

“In general, when the apparent affordances of an artifact matches its intended use, the artifact is easy to operate. When apparent affordances suggest different actions than those for which the object is designed, errors are common.”

Gaver

Challenges arise if there is a mismatch between implied use versus intended use.
False Affordances

• When there is perceptual information suggesting an implied use that does not exist
False Affordances
False Affordances
False Affordances
False Affordances
Hidden Affordances

When there is no perceptual information suggesting an actual intended use
Intro to Inclusive Design

(And how people fail at it)
BEWARE: The [Disability] Dongle

Disability Dongle: A well intended elegant, yet useless solution to a problem we never knew we had. Disability Dongles are most often conceived of and created in design schools and at IDEO.

12:49 PM · Mar 26, 2019

Liz Jackson
@elizejackson · Follow

365
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Read 3 replies
BEWARE: The [Disability] Dongle

Good (-ish) Intentions + Lack of Understanding =

[Image of a person with a disability aid and a barcode]

#LECHALEMPowersME

WITH LECHAL, MY DREAMS GATHER PACE AS THE WORLD’S NOW A BIGGER PLACE

HANDS FREE, HEADS-UP, VIBRATIONS TO FOOT FEET
BEWARE: The [Disability] Dongle

Good (-ish) Intentions + Lack of Understanding =

Rahman et al., *Take My Hand: Automated Hand-Based Spatial Guidance for the Visually Impaired*. CHI ‘23
BEWARE: The [Disability] Dongle

Good (-ish) Intentions + Lack of Understanding =
BEWARE: “Be Normal” Designs

If the challenge is that certain audiences navigate the world differently...

...the answer is almost never to try to “make the audience behave “normally””
BEWARE: “Be Normal” Designs

If the challenge is that certain audiences navigate the world differently...

...the answer is almost never to try to “make the audience behave “normally””

Change the system, not your audience!
Overview

Some Design Language

- An End-to-End Design Process
- The Gulfs of Execution & Evaluation
- Intro to Tasks
- Mental Models
- Affordances

Inclusive Design (and how people fail at it)

- Design Tradeoffs & Value-Sensitive Design
- Can One Size Really Fit All?
Which is the Best Shopping Cart?

1. The shopping cart on the left has its wheel turned 90 degrees so it can move side-ways.

2. The middle shopping cart is a standard design.

3. The right shopping cart has a double-deck design, which might be more space-efficient for some users.
Design Tradeoffs

Reusable Travel Mug
Keeps Coffee Warm
Holds a lot of coffee
Reusable
Expensive
Design Tradeoffs

Reusable Travel Mug
Keeps Coffee Warm
Holds a lot of coffee
Reusable
Expensive

Disposable To-Go Cup
Keeps Coffee Warm
Only holds a little coffee
Disposable
Affordable
Design Tradeoffs

**Reusable Travel Mug**
- Keeps Coffee Warm
- Holds a lot of coffee
- Reusable
- Expensive

**Disposable To-Go Cup**
- Keeps Coffee Warm
- Only holds a little coffee
- Disposable
- Affordable

**Soup Takeout Container**
- Keeps Coffee Warm
- Holds a lot of coffee
- Reusable (?)
- Affordable
Design Tradeoffs

Reusable Travel Mug
- Keeps Coffee Warm
- Holds a lot of coffee
- Reusable
- Expensive
- Socially acceptable

Disposable To-Go Cup
- Keeps Coffee Warm
- Only holds a little coffee
- Disposable
- Affordable
- Socially acceptable

Soup Takeout Container
- Keeps Coffee Warm
- Holds a lot of coffee
- Reusable (?)
- Affordable
- Socially “dubious”
Value-Sensitive Design

“Value Sensitive Design is a theoretically grounded approach to the design of technology that accounts for human values in a principled and comprehensive manner throughout the design process.”

Friedman, Kahn & Borning, 2013
Value-Sensitive Design

“Value Sensitive Design is a theoretically grounded approach to the design of technology that accounts for human values in a principled and comprehensive manner throughout the design process.”

Friedman, Kahn & Borning, 2013
EX: Privacy by Design

TASK: Design a privacy-sensitive crosswalk pedestrian sensor

**Typical Design**

- Send raw footage from traffic cameras to server
- Perform analysis to produce “signal”
- Return signal to traffic lights
EX: Privacy by Design

TASK: Design a privacy-sensitive crosswalk pedestrian sensor

Typical Design

• Send raw footage from traffic cameras to server
• Censor video before analysis
• Perform analysis to produce “signal”
• Return signal to traffic lights
EX: Privacy by Design

**TASK: Design a privacy-sensitive crosswalk pedestrian sensor**

**Typical Design**
- Send raw footage from traffic cameras to server
- Censor video before analysis
- Perform analysis to produce “signal”
- Return signal to traffic lights

**PbD Design**
- Design new sensor using IR sensing (privacy protective)
- Process on-device
- NO data retention
Whose Values?

Often, it’s just the designer’s values

(...and their biases)

Good designers know to account for their own biases!

(This is why learning design is important!)

Design Research is a possible remedy

More on this soon!
Value Mismatches

When a design’s values don’t align with the user’s values:

- Hostile/Exclusionary Systems
- Disability Dongles
- Abandoned Designs

Important:
People know what they value!

Trying to change a user’s values isn’t a solution here
Every system has SOME values it considers
Whose values?
Is there space for incorporating new values?

What values do people bring with them?
What tradeoffs are we forced to make?
“People who care about [value]” is a valid audience for you to design for!
CSE 440: Introduction to HCI

02: Design Language & Inclusive Design 101

March 28, 2024

Jesse J. Martinez | Avery Mack | Simona Liao