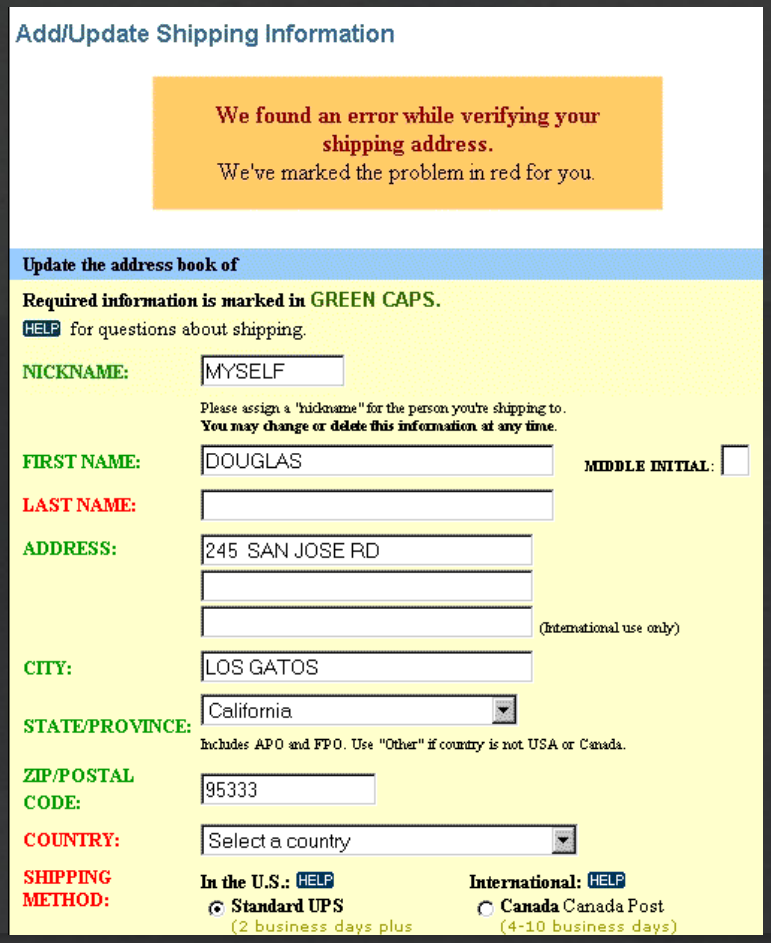
Conceptual Models & Interface Metaphors

刘哲明
Prof. James A. Landay
Computer Science Department
Stanford University

Autumn 2026
October 28, 2026

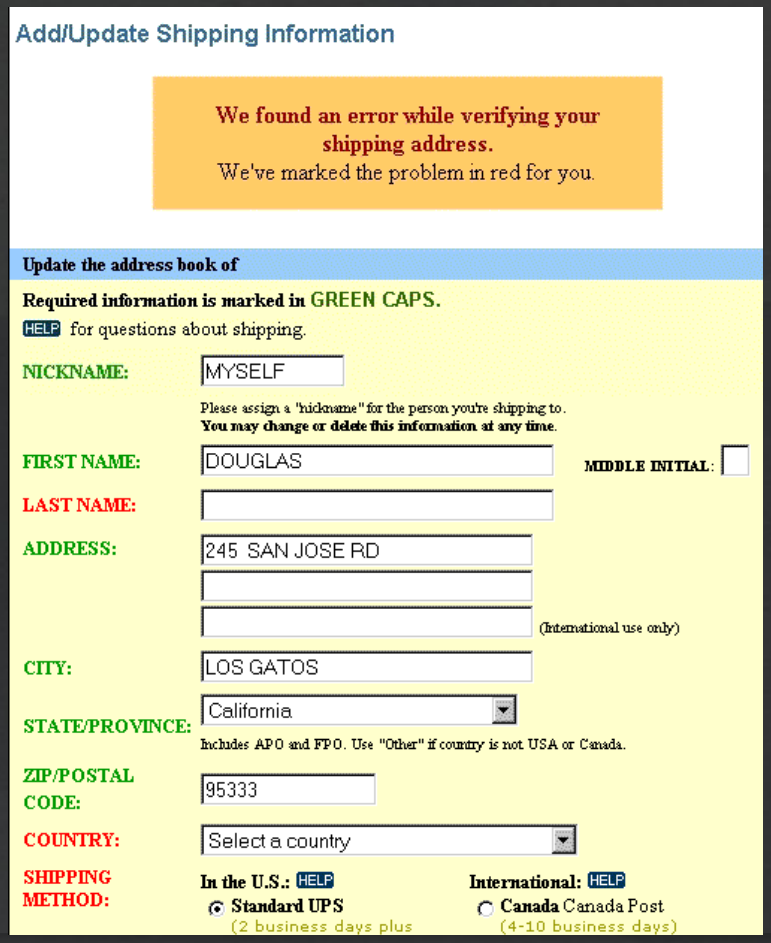
Hall of Fame or Shame?





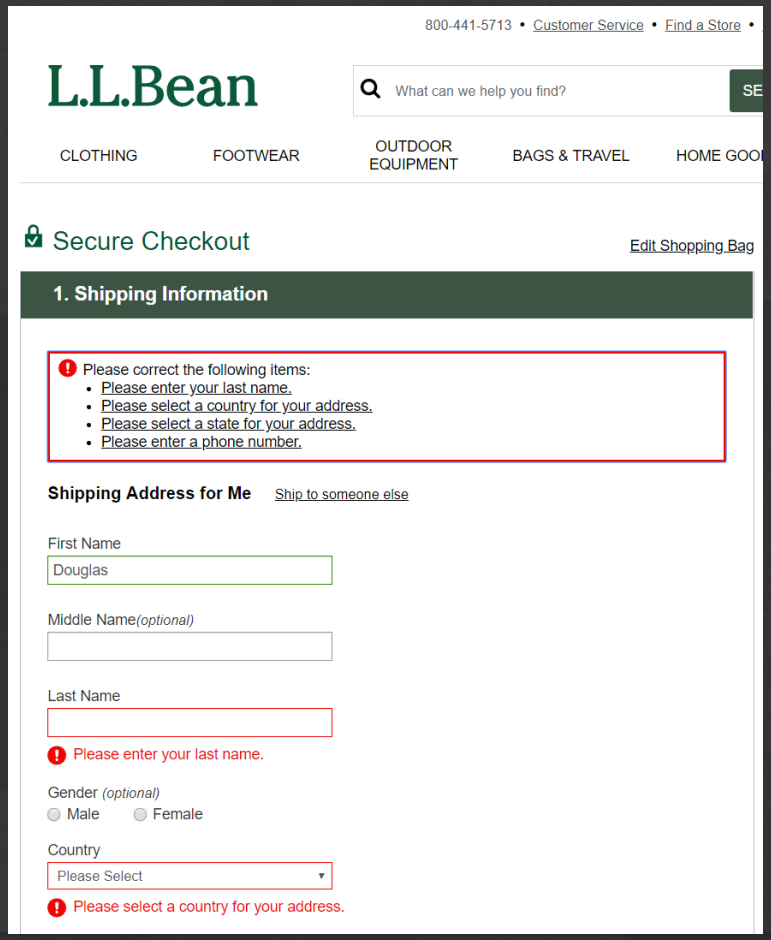
- Design based on a top retailer's site

Hall of Shame!



- Design based on a top retailer's site
- Color deficiency
  - can't distinguish between red & green
- In study, user could not get by this screen!
- How to fix?
  - redundant cues

A Better Design

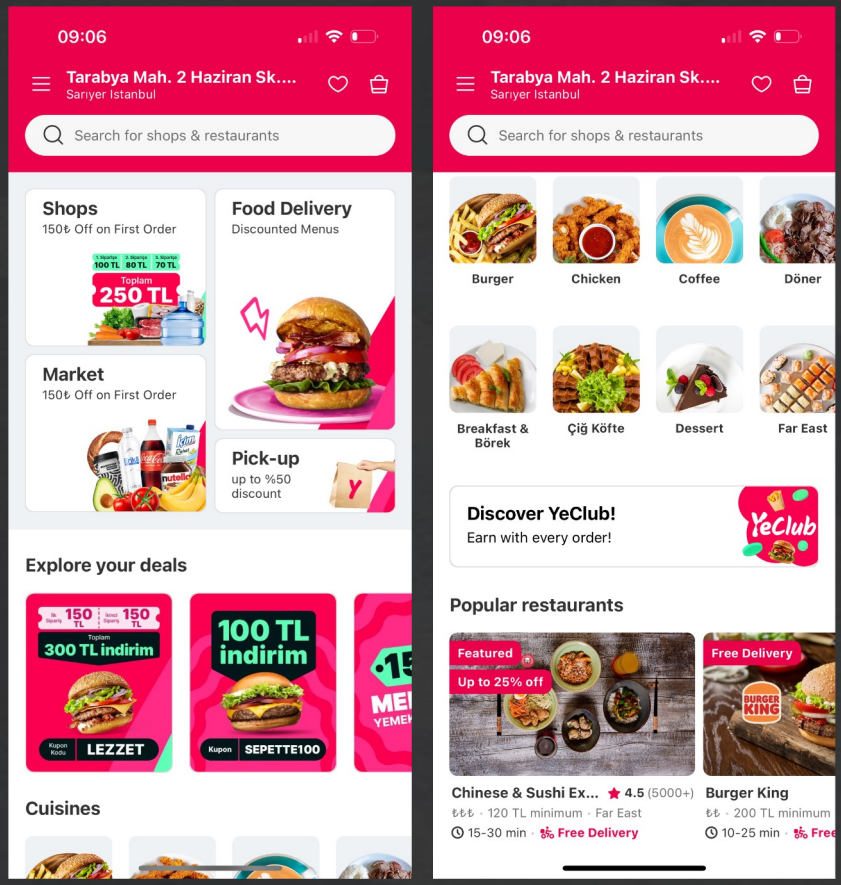


1. Instructions at the top for all errors
2. Redundant exclamation icons
3. Changed color on boxes around input fields with errors
4. Instructions on what to fix near each error

Hall of Fame or Shame?

YemekSepeti

Top food delivery app in Turkey



Hall of Fame or Shame?

YemekSepeti

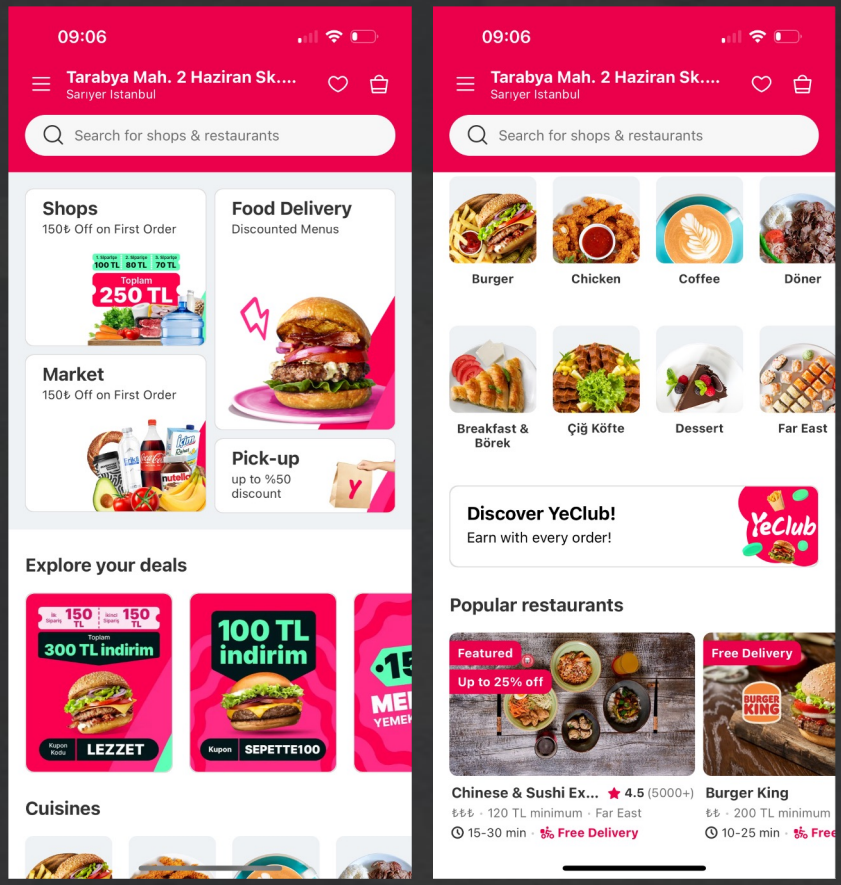
Top food delivery app in Turkey

Good

- clear grouping of categories (Gestalt)
- main actions visible above the fold
- large touch targets for easy tapping

Wish Could be Better

- liberal use of highly saturated colors
- visual clutter from numerous deal cards and icons



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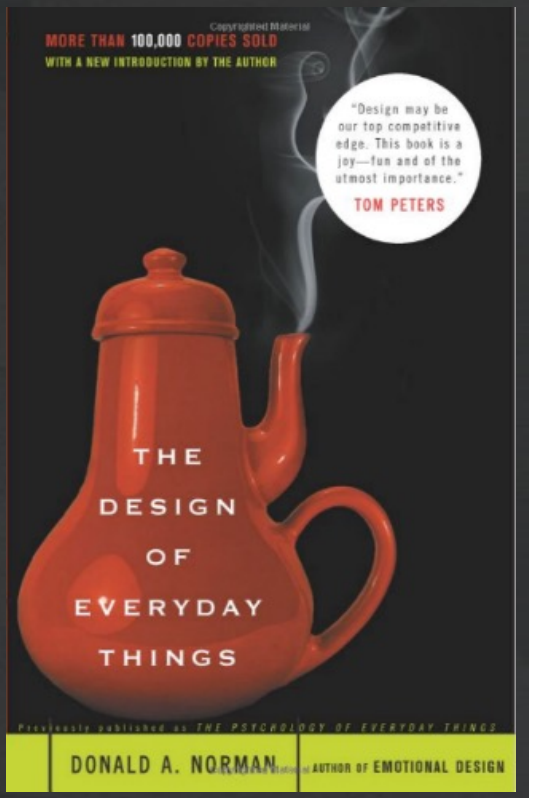
Outline

- *Design of Everyday Things*
- Conceptual models
- Team break
- Design guides for conceptual models
- Interface metaphors
- UI consistency

Design of Everyday Things

- By Don Norman
  - UCSD, Apple, HP, NN Group, NU, UCSD
- Design of everyday objects illustrates problems faced by designers of systems
- Explains conceptual models
  - doors, washing machines, digital watches, phones
- Resulting design guides

→ Highly recommended



Conceptual Model?

Def. *Mental representation of how an artifact works & how interface controls affect it*

- People may have preconceived models that are hard to change
  - (4 + 5) vs. (4 5 +) on a calculator
  - dragging to trash?
    - deletes file but ejects disk
- Interface must communicate model
  - visually, possibly physically or using sound



David Shillinglaw

Affordances as Perceptual Clues

Well-designed objects have affordances

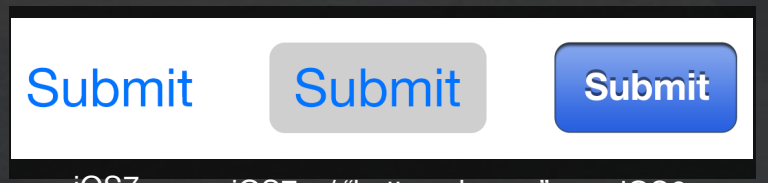
- clues to their operation
- often visual, but not always (e.g., speech)



Gibson: “actionable possibilities”





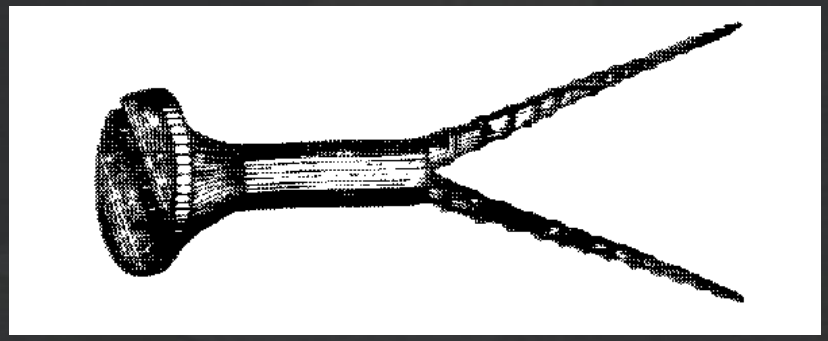


iOS7 iOS7 w/ “button shapes” iOS6

Affordances as Perceptual Clues

Poorly-designed objects

- no clues or misleading clues



Jacques Carelman, *Catalogue d'Objets Introuvables*
Crazy design for a screw punch!





Affordances as Perceptual Clues

Poorly-designed objects

- no clues or misleading clues







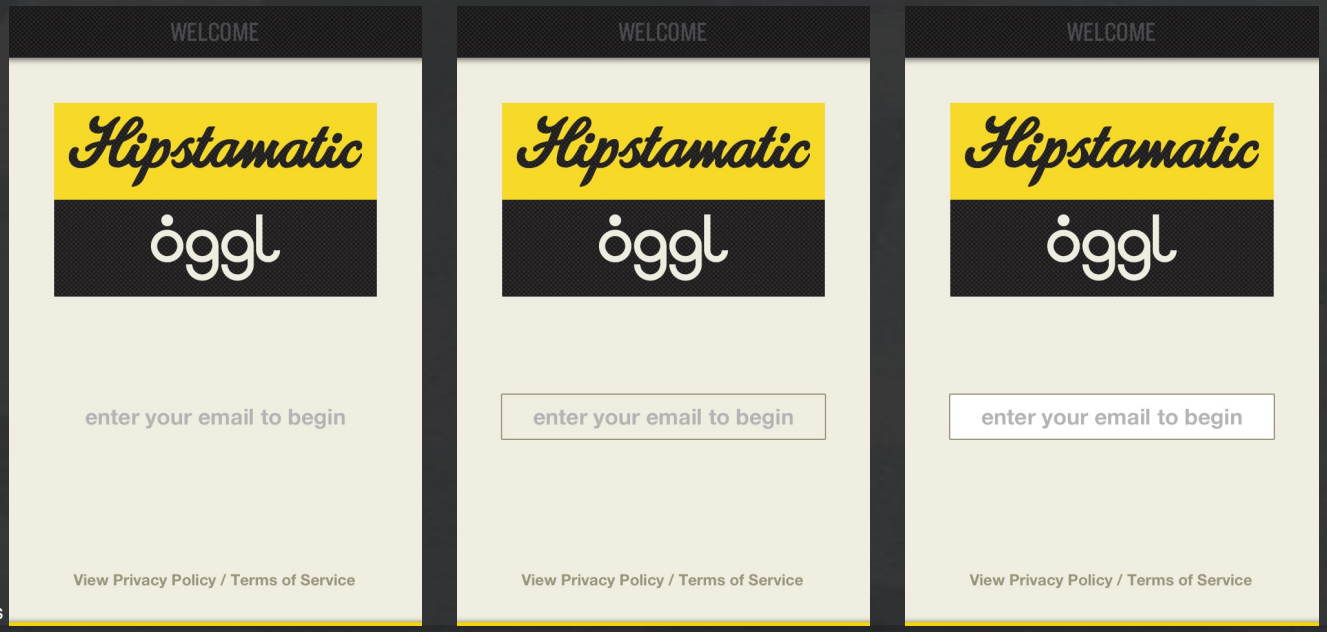
"Norman doors"

https://99percentinvisible.org/article/norman-doors-dont-know-whether-push-pull-blame-design/" (5:31)

Affordances as Perceptual Clues

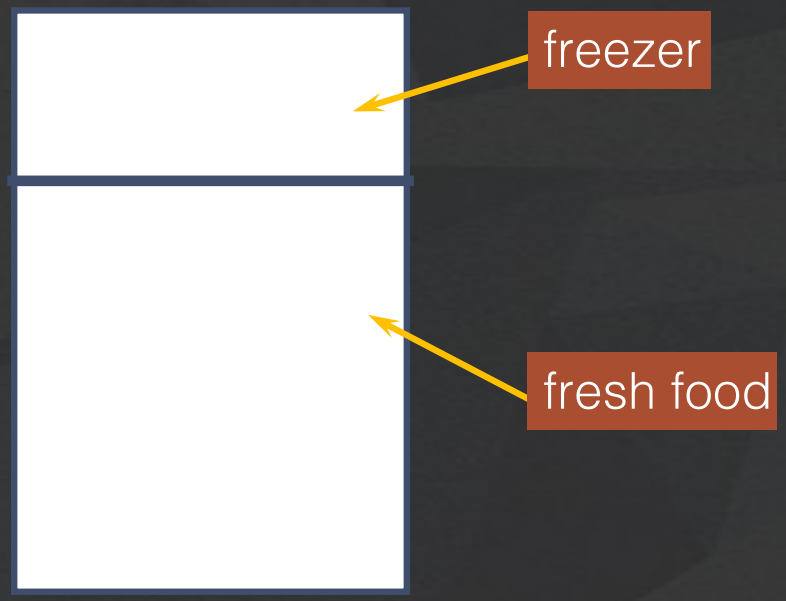
Poorly-designed objects

- no clues or misleading clues



http://alistapart.com/article/flat-ui-and-forms

Refrigerator



Problem: freezer too cold, but fresh food just right

Refrigerator Controls

Normal Settings	**C** and **5**
Colder Fresh Food	**C** and **6-7**
Coldest Fresh Food	**B** and **8-9**
Colder Freezer	**D** and **7-8**
Warmer Fresh Food	**C** and **4-1**
OFF *(both)*	**0**



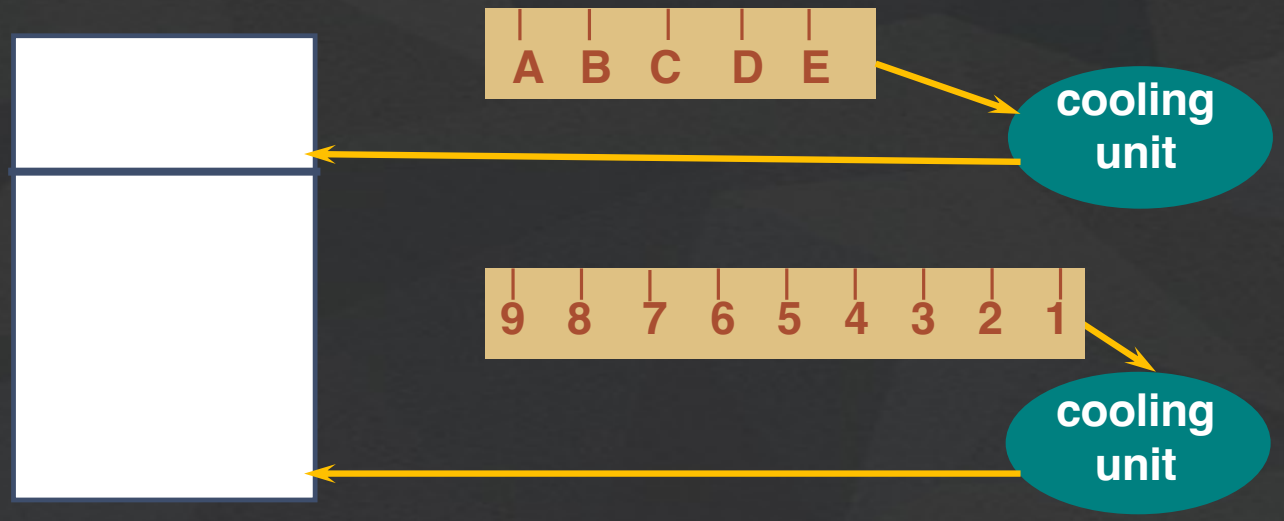
What is your conceptual model?

Spend 60 sec. drawing a diagram showing your model

- where the cooling units are & how they are controlled

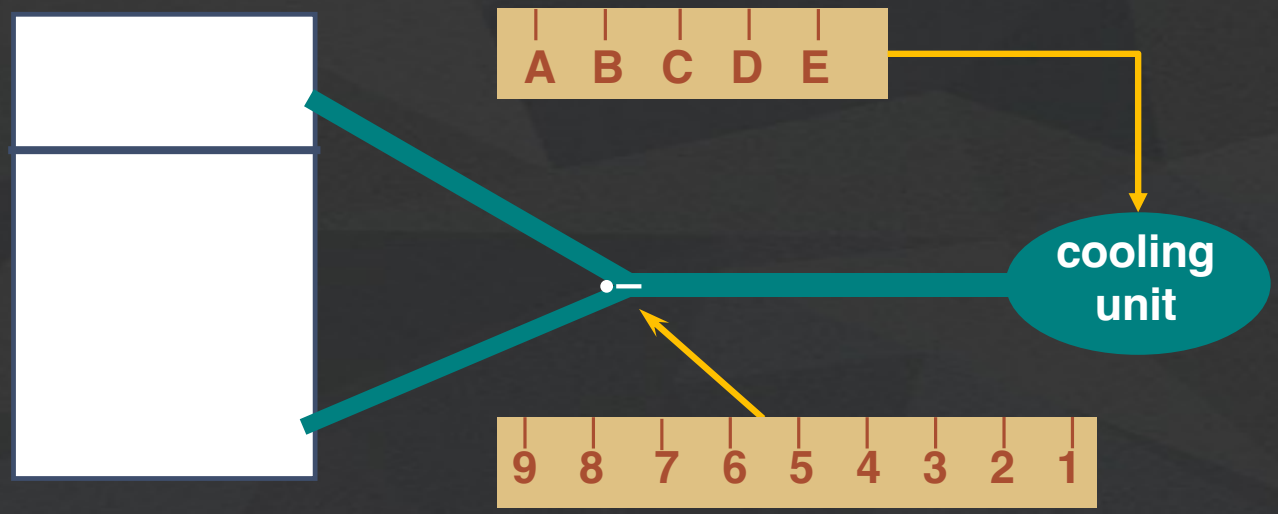
Share with your neighbor & put a picture in the slack channel

A Common Conceptual Model



independent cooling units

Actual Conceptual Model

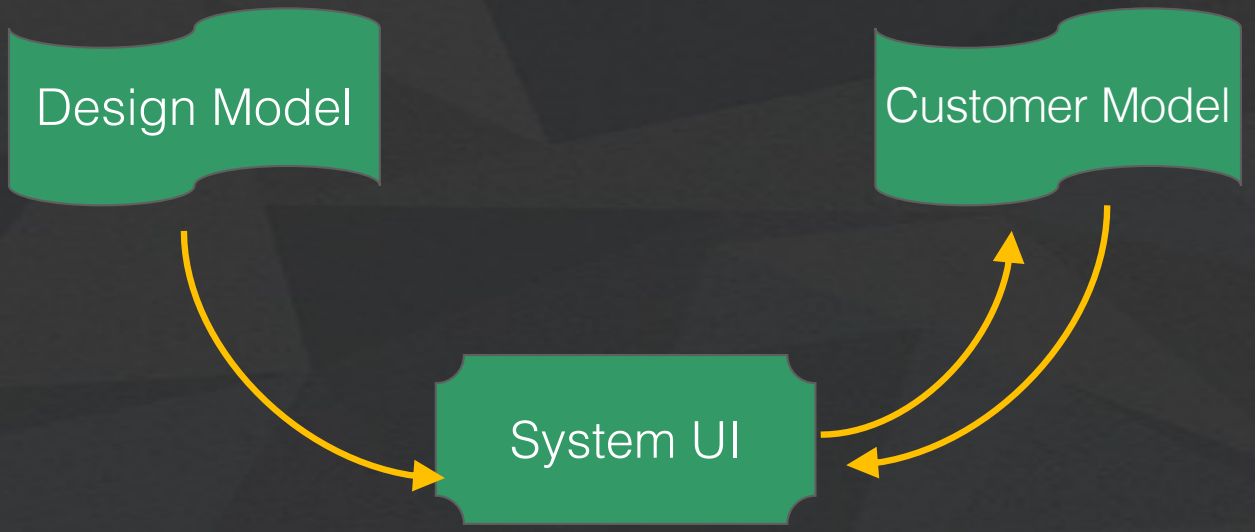


Can you fix the problem?

Possible solutions

- make controls map to customer's model
- make controls map to actual system

Design Model & Customer Model



- Customers get model from prior experience & usage of new
  - through System UI
- What if the two models don't match?

Conceptual Model Mismatch

- Mismatch between designer's & customer's conceptual models leads to…
  - slow performance
  - errors
  - frustration
  - …



Model Mismatch: Windows 10 Bluetooth

- Is Bluetooth on or off?
- Often switches show the state that sliding towards will execute



Example and images from https://www.nngroup.com/articles/two-ux-gulfs-evaluation-execution/

Model Mismatch: Windows 10 Bluetooth

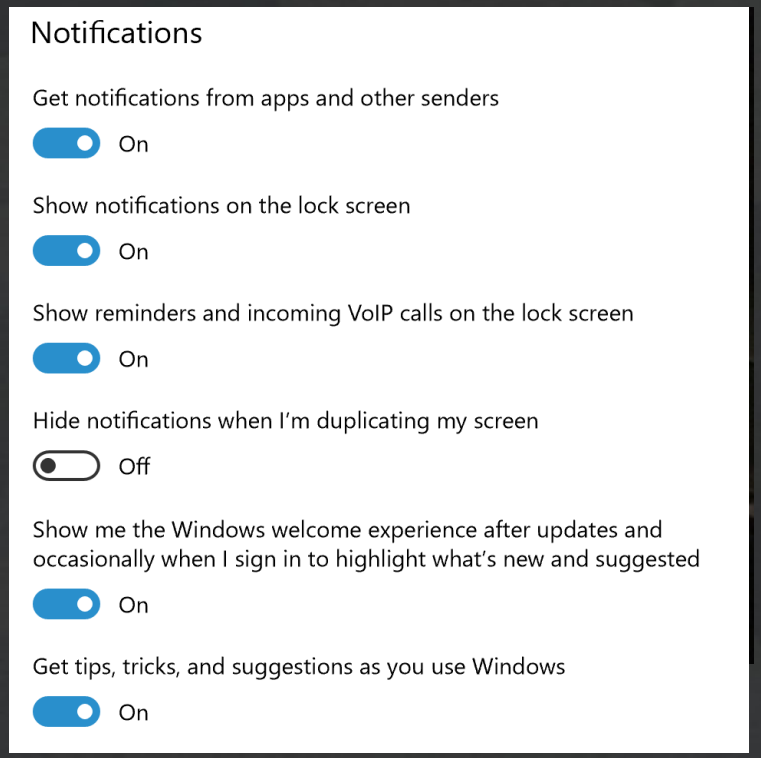
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Model Mismatch: Windows 10 Bluetooth

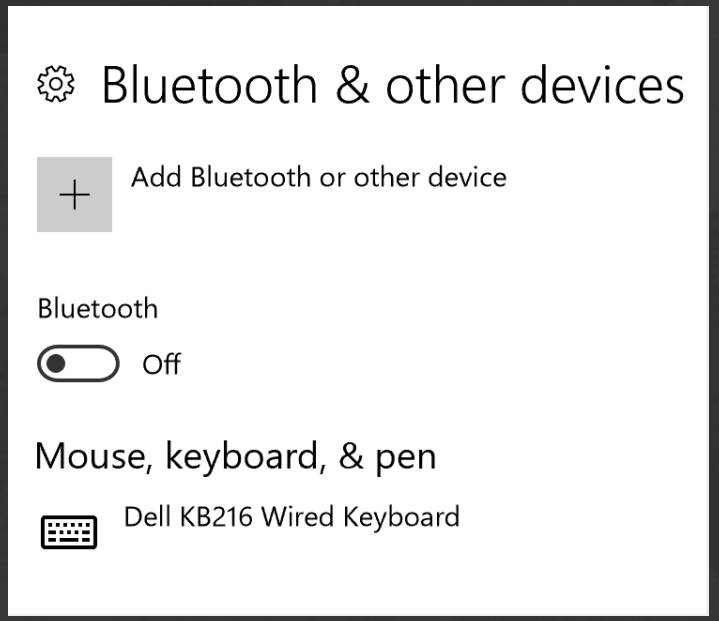
- Is Bluetooth on or off?
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- We see how it works when we see several switches



Example and images from https://www.nngroup.com/articles/two-ux-gulfs-evaluation-execution/

Model Mismatch: Windows 10 Bluetooth

- Is Bluetooth on or off?
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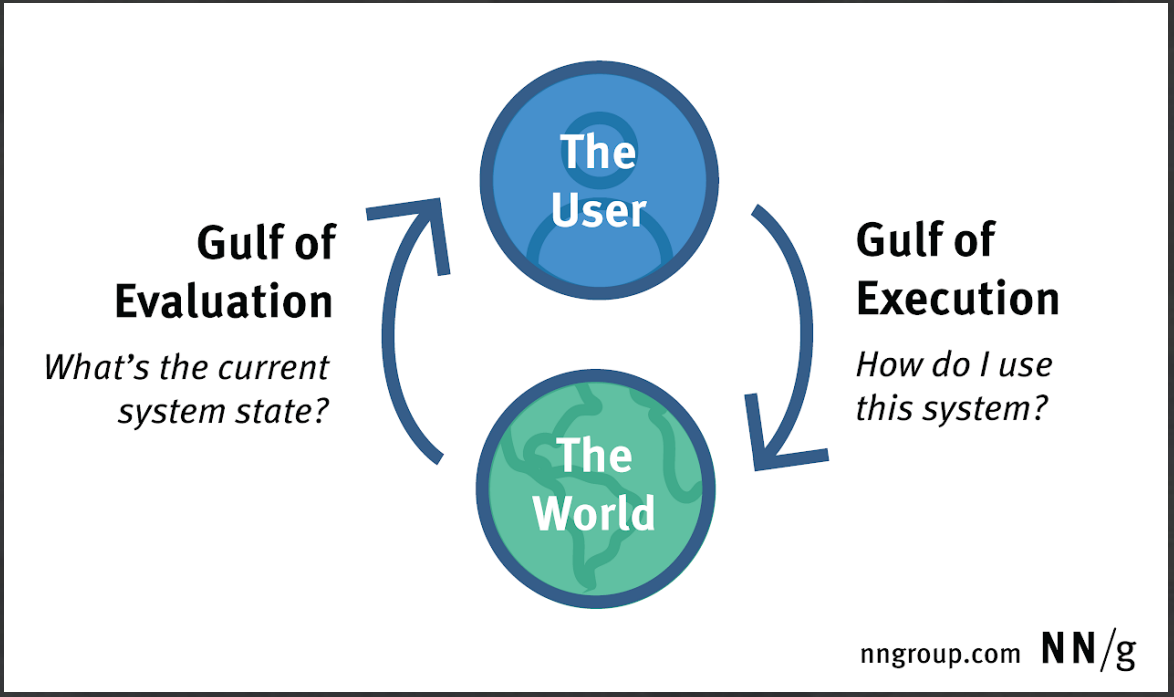


The system state is ***visible***, but we fail to ***evaluate*** the state correctly

Example and images from https://www.nngroup.com/articles/two-ux-gulfs-evaluation-execution/

Gulf of Evaluation & Gulf of Execution

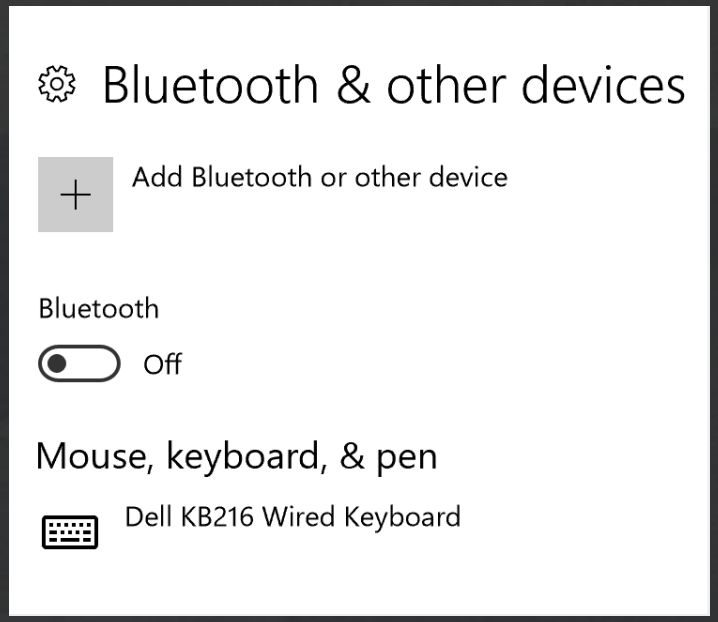
reduce the gulf through design

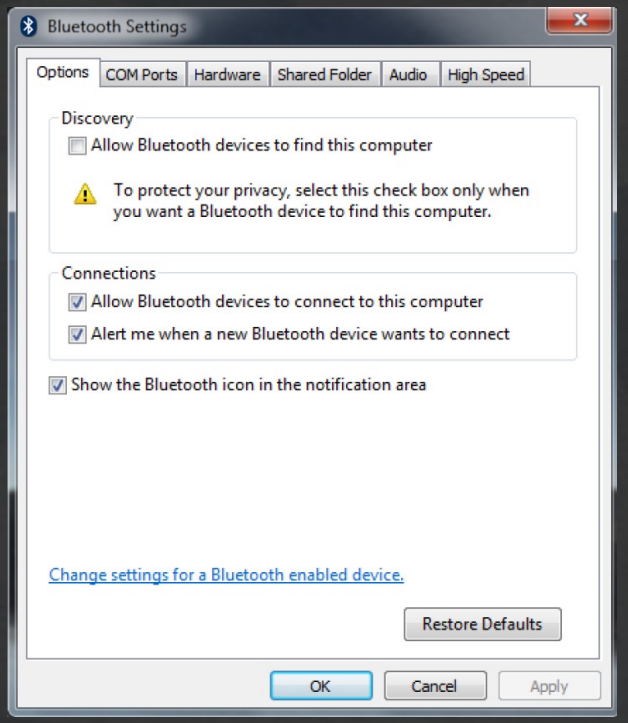


Example and images from https://www.nngroup.com/articles/two-ux-gulfs-evaluation-execution/

Gulf of Evaluation & Gulf of Execution

reduce the gulf through design





Example and images from https://www.nngroup.com/articles/two-ux-gulfs-evaluation-execution/

Activity: Conceptual Models

Instructions

1. Think about how a light switch works.
2. Spend 30 seconds drawing a quick sketch of your idea.
3. Share your drawing with the person next to you.
4. Discuss: Did you both draw the same thing? How could different designs affect how people use the switch?

What you practiced: You're applying the concept of conceptual models — how users mentally picture how an object works. This exercise helps you see how different people can have varied mental models for the same object.

Administrivia: Assignment 5 Grades/Feedback

Assignment #5 Low-fi Prototype & Test

A5 Group Grade:	✓--: 0%	✓-: 0%	✓: 56%	✓+: 44%	✓++: 0%
A5 Individual Presentation:	✓--: 0%	✓-: 0%	✓: 61%	✓+: 33%	✓++: 6%

A5 Group Average: 92%
A5 Individual Presentation Average: 92%

We liked

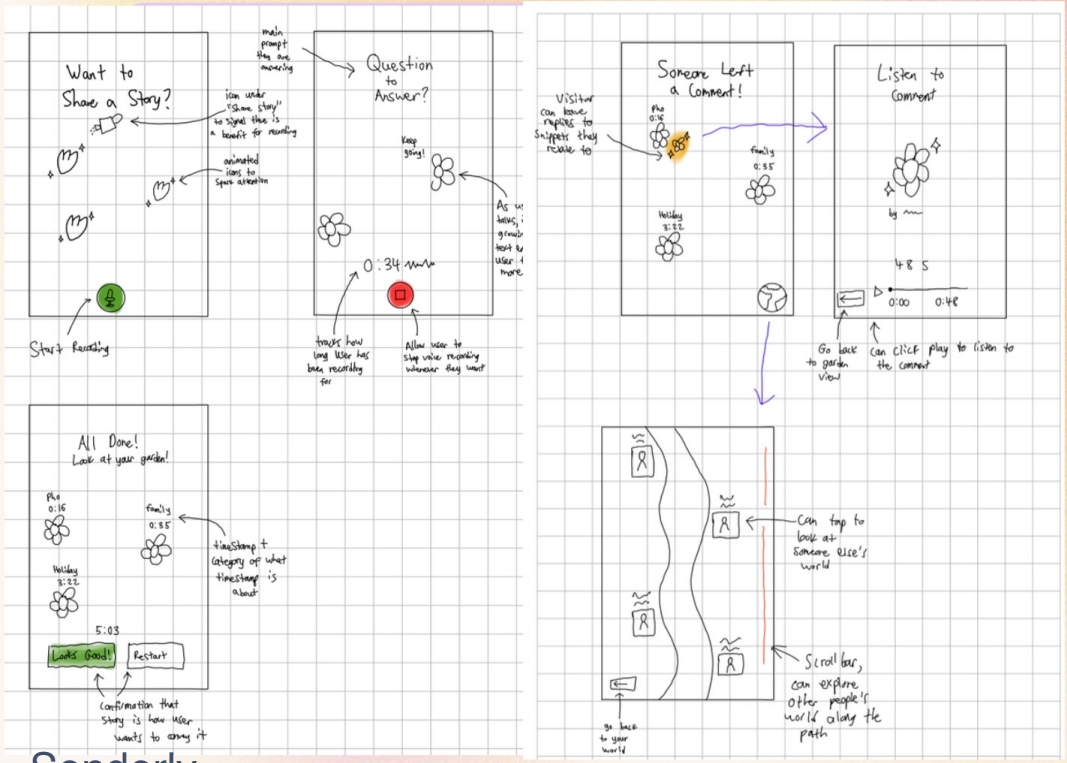
- "*Creative widgets and overlays* in low-fi prototype"
- "*Pros and cons that went beyond surface-level* characteristics of the technology"
- "Use of *annotations and color* to communicate different aspects of sketches"
- "*Thorough description* of testing environment and procedures"
- "Use of *charts and graphs* to discuss bottom-line data"
- "*Clear discussion* on usability progress with reference to key measurements"

We wished

- "Rationale for final realization *grounded in evidence*"
- "Realizations were *honestly considered* during brainstorming rather than generated to be discarded"
- "Critical incident logs include *severities and actionable implications*"

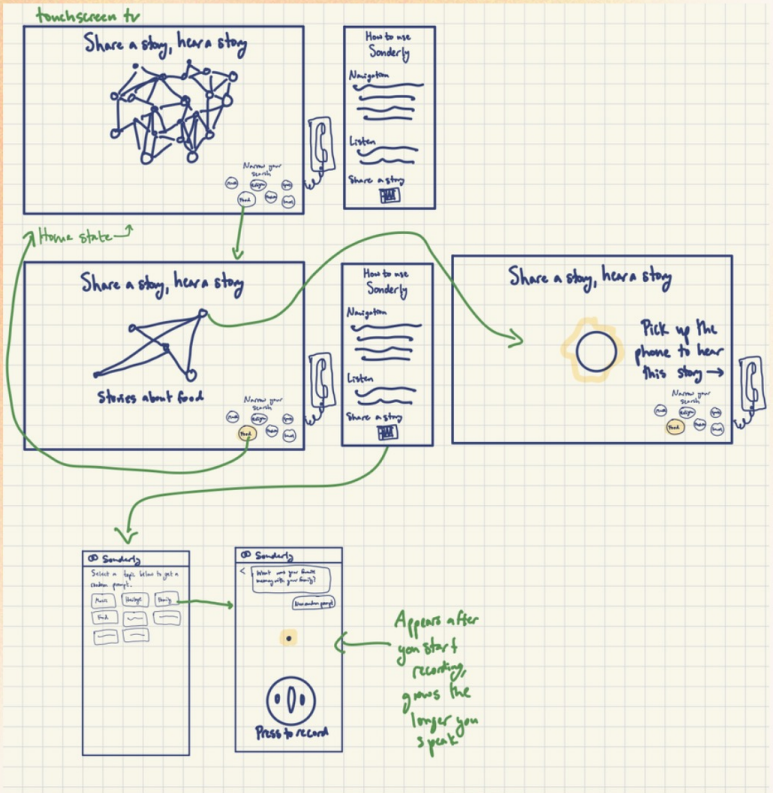
2 further fleshed out realizations

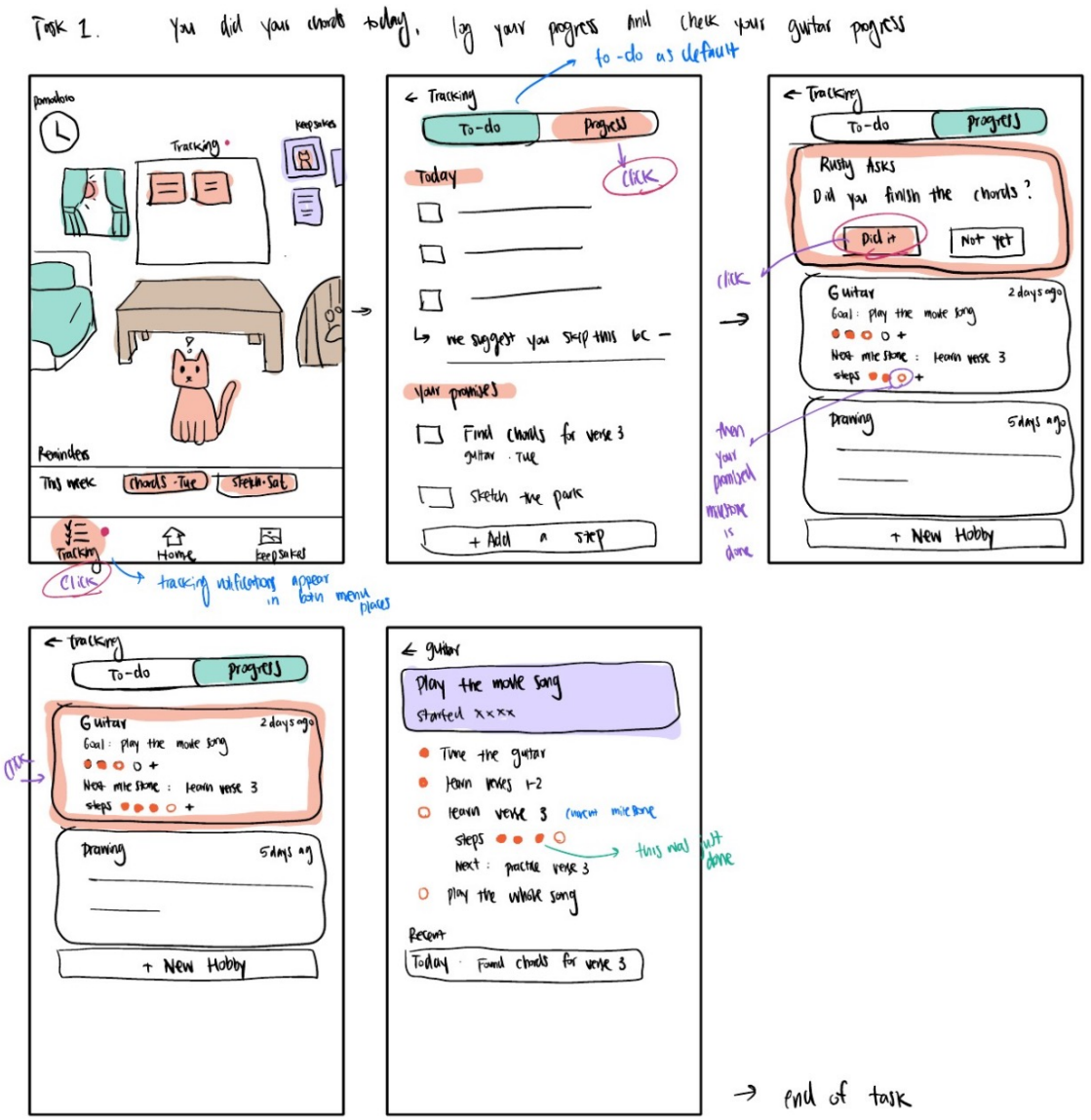
Mobile App



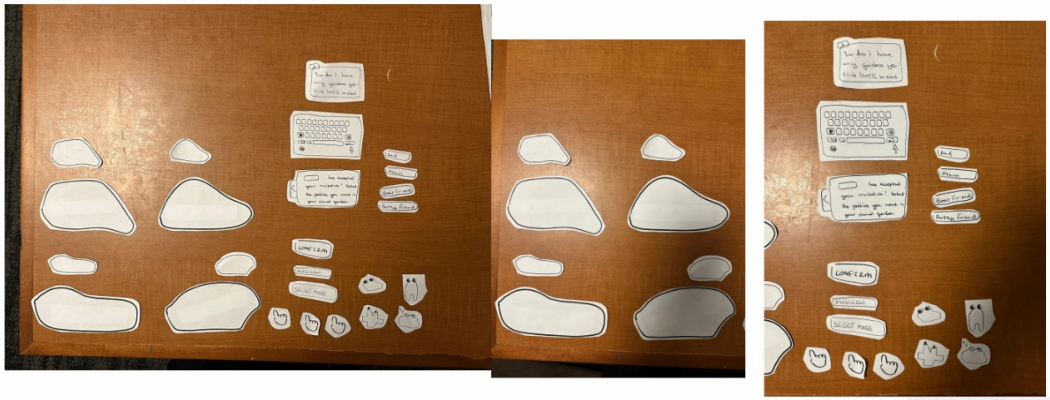
Sonderly

Community Space (Large Screen)

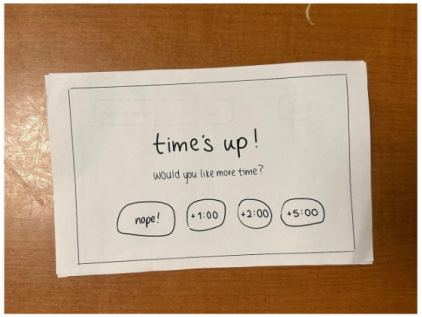


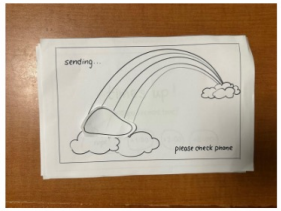

Task 1. You did your chords today, log your progress and check your guitar progress
to-do as default
Tracking
Keepsakes
Reminders
This week
Chords · Tue
Steps · Sat
Tracking
Home
Keepsakes
Click
tracking notifications appear both menu places
To-do
Progress
Today
Click
me suggest you skip this bc —
Your promises
Find chords for verse 3
guitar · Tue
Sketch the park
+ Add a step
Rusty Asks
Did you finish the chords?
Did it
Not yet
click
then your planted milestone is done
Guitar
2 days ago
Goal: play the made song
Next milestone: learn verse 3
steps
Drawing
5 days ago
+ New Hobby
click
Guitar
Play the made song
started xxxx
Tune the guitar
learn verses 1-2
learn verse 3
current milestone
steps
Next: practice verse 3
this was just done
play the whole song
Recent
Today · Found chords for verse 3
→ end of task

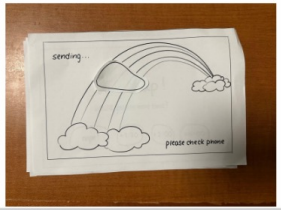
Bird's eye view, Interactable Objects



Adding time or sending drawing to phone from Pebble







Pebble

SAID VS RATED: (they sometimes contradict)

Scores ran higher than what people said while giving them

6 out of 7

TASK 1, Cyrus (P3)

"I didn't quite understand the change from the waves to the mountain"

Missed that swiping showed a new artwork

7 out of 7

TASK 2, James (P4)

"Uploading our work, that's like a seven"

Then: "I'd like to save my art myself, to my camera"

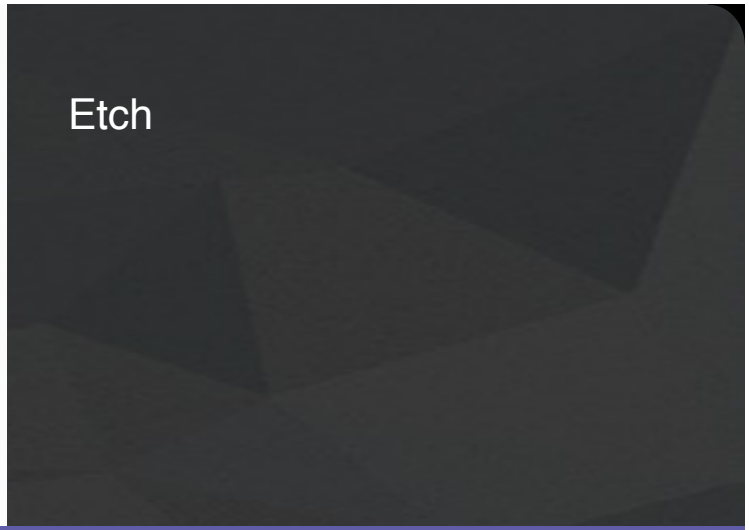
5 out of 7

TASK 3, Booker (P1)

"Often the end result does not actually matter much to me"

Task 3 asked them to look back at finished pieces

Testing one des





Key takeaways

Home Screen	4/4	Stuck after scrolling, unsure what's clickable
Tappable Duck & Stats	3/4	Expected the duck and focus stats to be tappable
Complex Task	2/4	Couldn't tell whether focus had improved
My Duck Tab	2/4	Hard to navigate
Duck Expression	1/4	Unclear what the face means
Contact List	1/4	Too long to pick exceptions
Setup	1/4	Blocking toggle, calendar + times

2026au CS147 Film Festival Awards

- Best Music/Soundtrack
- Funniest/Most Humorous
- Best Locations
- Best Production Value
- Best Project Concept
- Best Overall Video

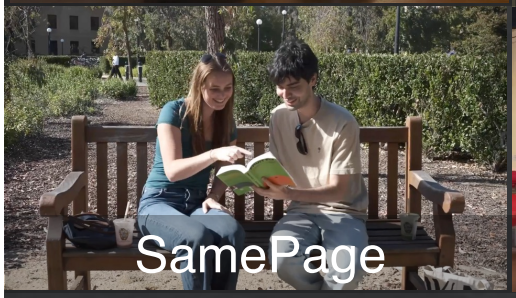
The Nominees…



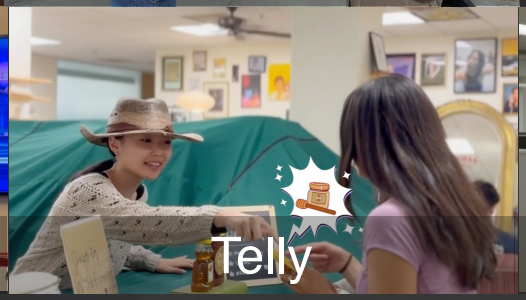














Best Music / Soundtrack

Runners-Up

Open When & Trunkate

ALONG

Winner

etch

Funniest/Most Humorous Video

Runners-Up

Hidden Gems

Telly

Winner

Trunkate

Best Locations

Runners-Up

ALONG

etch

Winner

Hidden Gems

Best Production Value

Runners-Up

ALONG

Open When

Winner

etch

Best Project Concept

Runners-Up

ALONG

etch

Winner

Open When

Best Overall Video

Runners-Up

Hidden Gems

etch

Winner

ALONG

TEAM BREAK

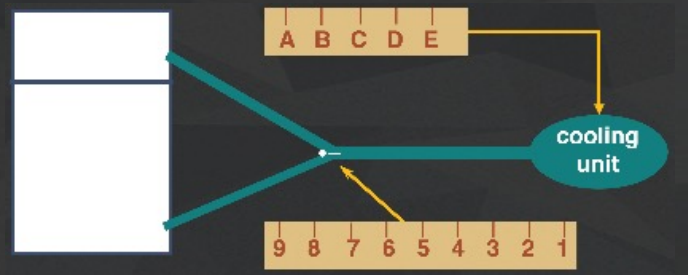
Talk about how to build your medium-fi prototype

Design Guides

- Provide good conceptual model
  - customer wants to understand how controls affect object
- Make things visible
  - if object has function, interface should show it
- Map interface controls to customer's model
  - infix vs. postfix calculator – whose model is that?
- Provide feedback
  - what you see is what you get! (WYSIWYG)

Make Things Visible

- Refrigerator?
  - make the 1..9 dial something about percentage of cooling between the two compartments?



- Functions available on watch w/ 4 buttons? Is there an issue?
  - too many & they are not visible!



Make Things Visible



http://www.brucesallan.com/wp-content/uploads/2013/03/Becker-Car-Stereo.jpg

- Compare to controls on old & new car radios
  - #controls = #functions
  - controls are labeled (mostly) and grouped together

Make Things Visible



- Compare to controls on old & new car radios
  - #controls = #functions
  - controls are labeled (?) and grouped together

Make Things Visible

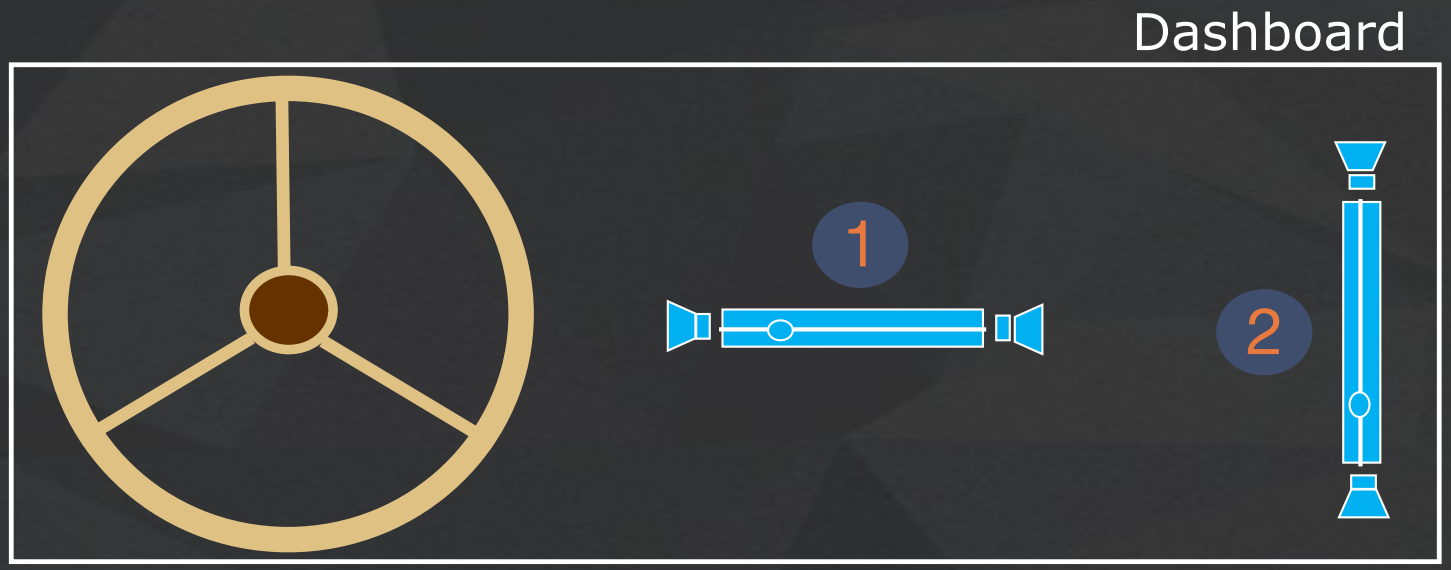


- Compare to controls on old & ne
  - #controls = #functions
  - controls are labeled (?) and group
  - tradeoffs of the “glass UI” (e.g., Te



Map Interface Controls to Customer's Model

- Which is better for car dashboard speaker front / back control?
- Control should *mirror real-world*



Map Interface Controls to Customer's Model

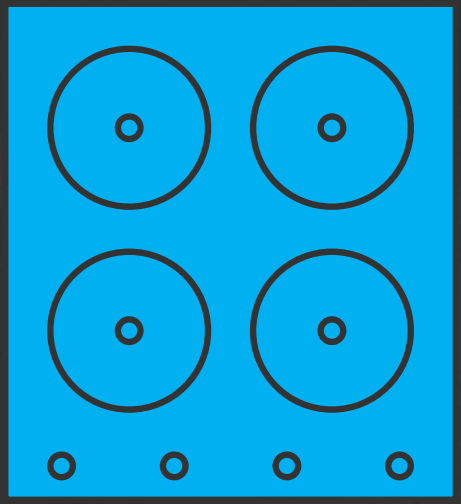
- Which is better for car dashboard speaker front / back control?
- Control should *mirror real-world*



Mercedes Benz Seat Control maps to real world

Map Interface Controls to Customer's Model



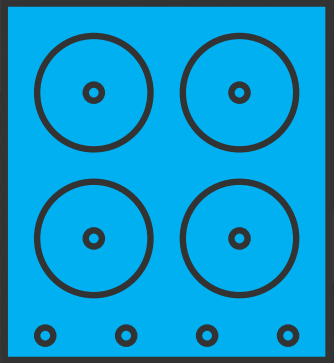


Problem?

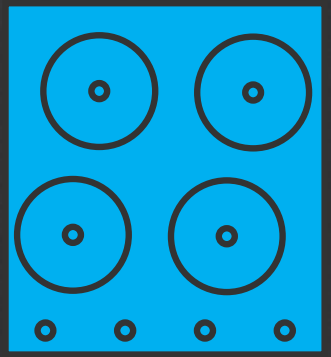
Which knob controls which burner?

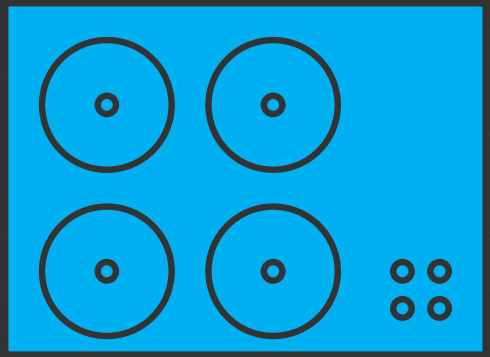
Map Interface Controls to Customer's Model



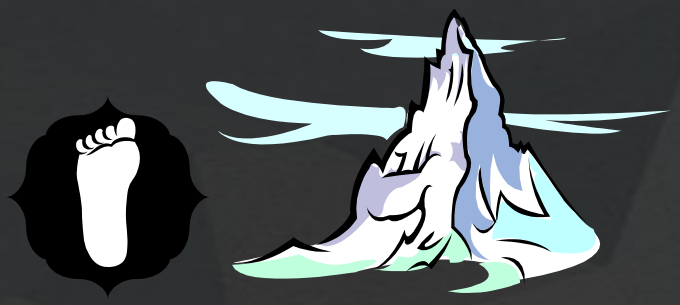


Possible fixes?





Metaphor



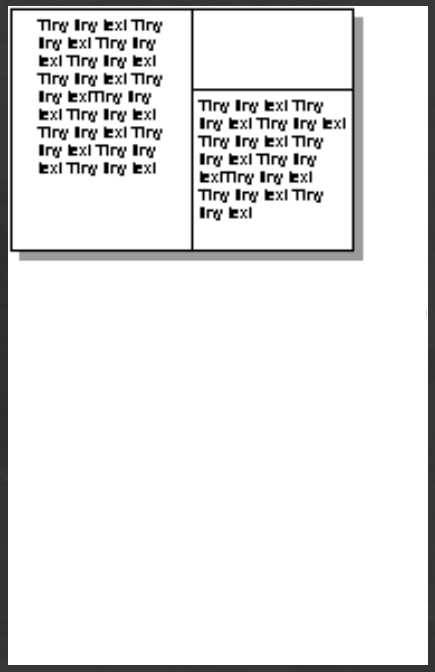
- Definition ?

  “The transference of the relation between one set of objects to another set for the purpose of brief explanation.”

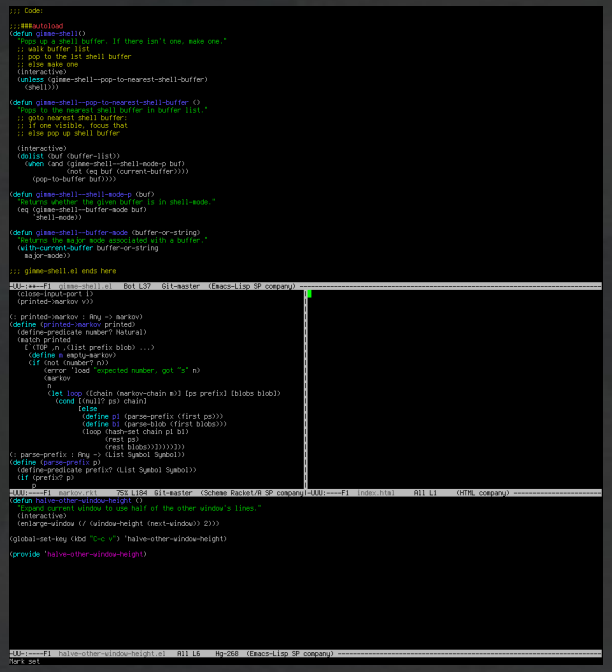
- Lakoff & Johnson, *Metaphors We Live By*
  - “...the way we think, what we experience, and what we do everyday is very much a matter of metaphor.”
  - in our language & thinking – “argument is war”
    - … he attacked every weak point
    - … criticisms right on target
    - … if you use that strategy

- We use metaphor in UI design to *leverage existing conceptual models*

Desktop Metaphor

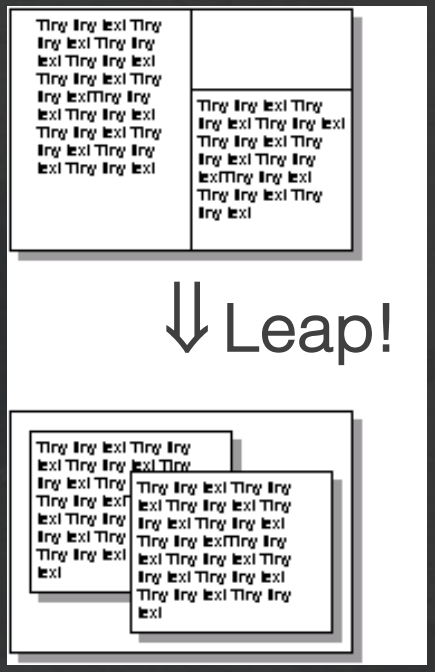


Engelbart’s windows



In today’s Emacs

Desktop Metaphor



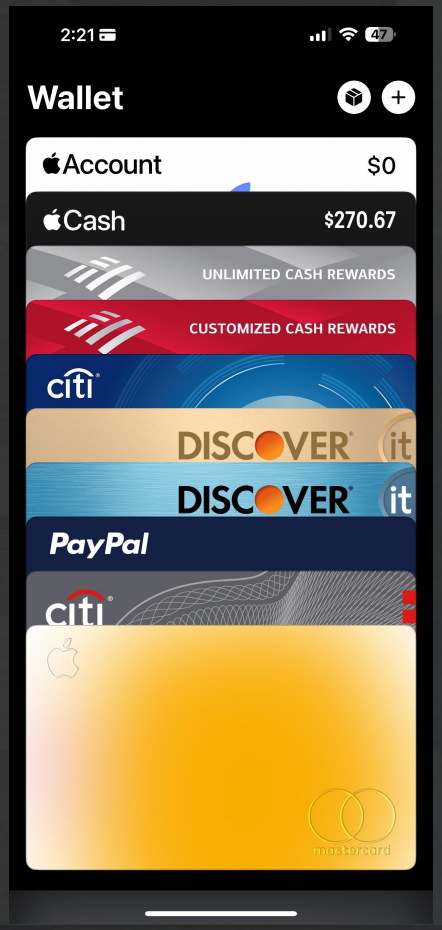
Xerox PARC's overlapping windows

Suggests a conceptual model

- not really an attempt to simulate a real desktop
- a way to explain why some windows overlapped
- leverages knowledge about files, folders & trash

Example Metaphors

- Global metaphors
  - personal assistant, wallet, clothing, cards
- Data & function
  - to-do list, calendar, documents, find, assist
- Collections
  - drawers, files, books, newspapers, photo albums



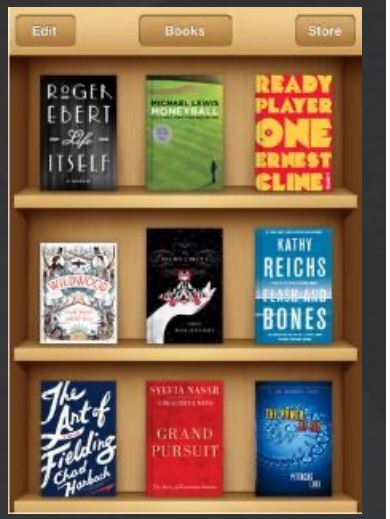
How to Use Metaphor

- Develop interface metaphor tied to conceptual model
- Communicate that metaphor to the user
- Provide high-level task-oriented operations, not low-level implementation commands

Avoid Metaphor for Metaphor's Sake

- Skeuomorphism
  - "making items resemble their real-world counterparts"
    or
    "a physical ornament or design on an object made to resemble another material or technique"

- Argument against: takes up space & leads to inconsistent look
- Argument for: helps people learn



Apple iBooks2

Avoid Metaphor for Metaphor's Sake

- Metaphors can become dated



iPhone metaphors dated?

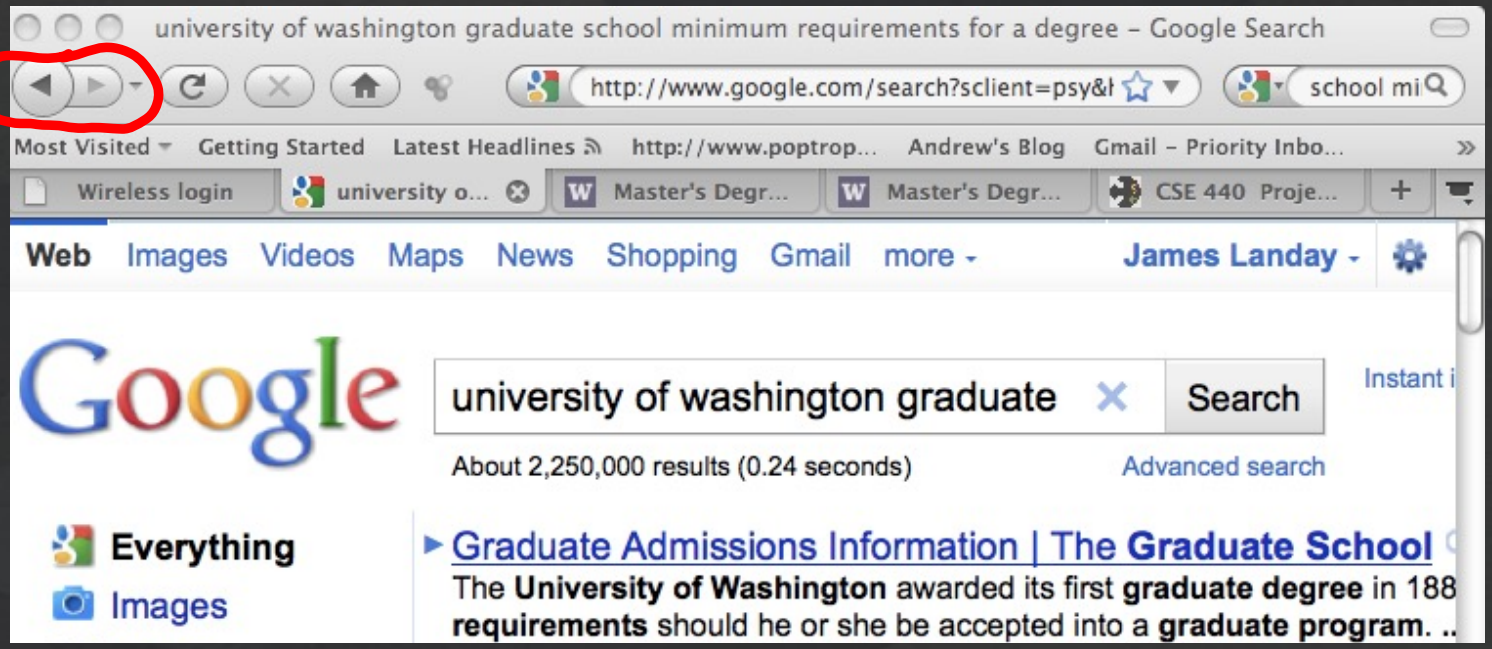


iPad Podcast app – ever seen a reel-to-reel tape deck?

Ways of Being Consistent

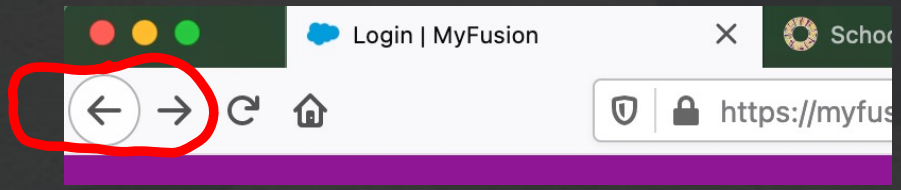
- Interfaces should be consistent in a *meaningful* way
  - e.g., ubiquitous use of same keys for cut/copy/paste
  - H4: Consistency & Standards
- Types of consistency
  - consistent internally
    - e.g., same terminology & layout throughout app
  - consistent with other apps
    - e.g., works like MS Word, uses same keyboard conventions
    - design patterns (across many apps)
  - consistent with physical world

Is Consistent Always Better? NO



Firefox 3 Back/Forward Buttons

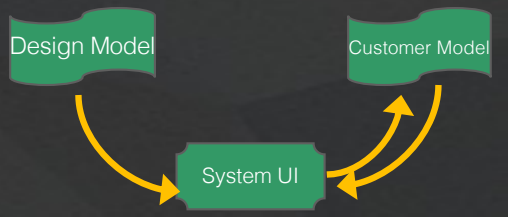
Is Consistent Always Better? NO

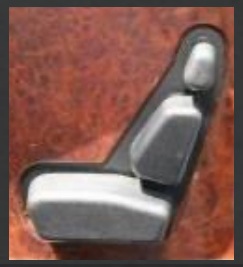


More Recent Firefox Back/Forward Buttons

Summary

- Conceptual model?
  - mental representation of how the object works & how interface controls effect it
- Design model should equal customer's model?
  - mismatches lead to errors
  - use customer's likely conceptual model to design
- Design guides?
  - provide good conceptual model
  - make things visible
  - map interface controls to customer's model
  - provide feedback





Further Reading

- *Design of Everyday Things*, Donald Norman
- Design as Practiced, Donald Norman
  - Talks about failure to make changes to Macintosh
  - http://www.jnd.org/dn.mss/Design_as_Practiced.html
- Computing the Case Against User Interface Consistency, Jonathan Grudin
  - Talks about why interfaces should not always be consistent
  - https://www.semanticscholar.org/paper/The-Case-Against-User-Interface-Consistency-for-can-Jonathan-Grudin/71cc342910a4add7ee522c5510769a1c51df2ebd

Next Time

- Mon
  - Heuristic Evaluation
  - Read
    - How to Conduct a Heuristic Evaluation by Jakob Nielsen
- Studio
  - Half-way review with outside experts

Exit Ticket

hci.st/cs147-26au-exit-6-157

