

Designing Interactive Systems I

Lecture 2: Gestalt Laws, Information Content, Visibility, Affordances and Signifiers

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<http://hci.rwth-aachen.de/dis>

User Errors Are Design Errors

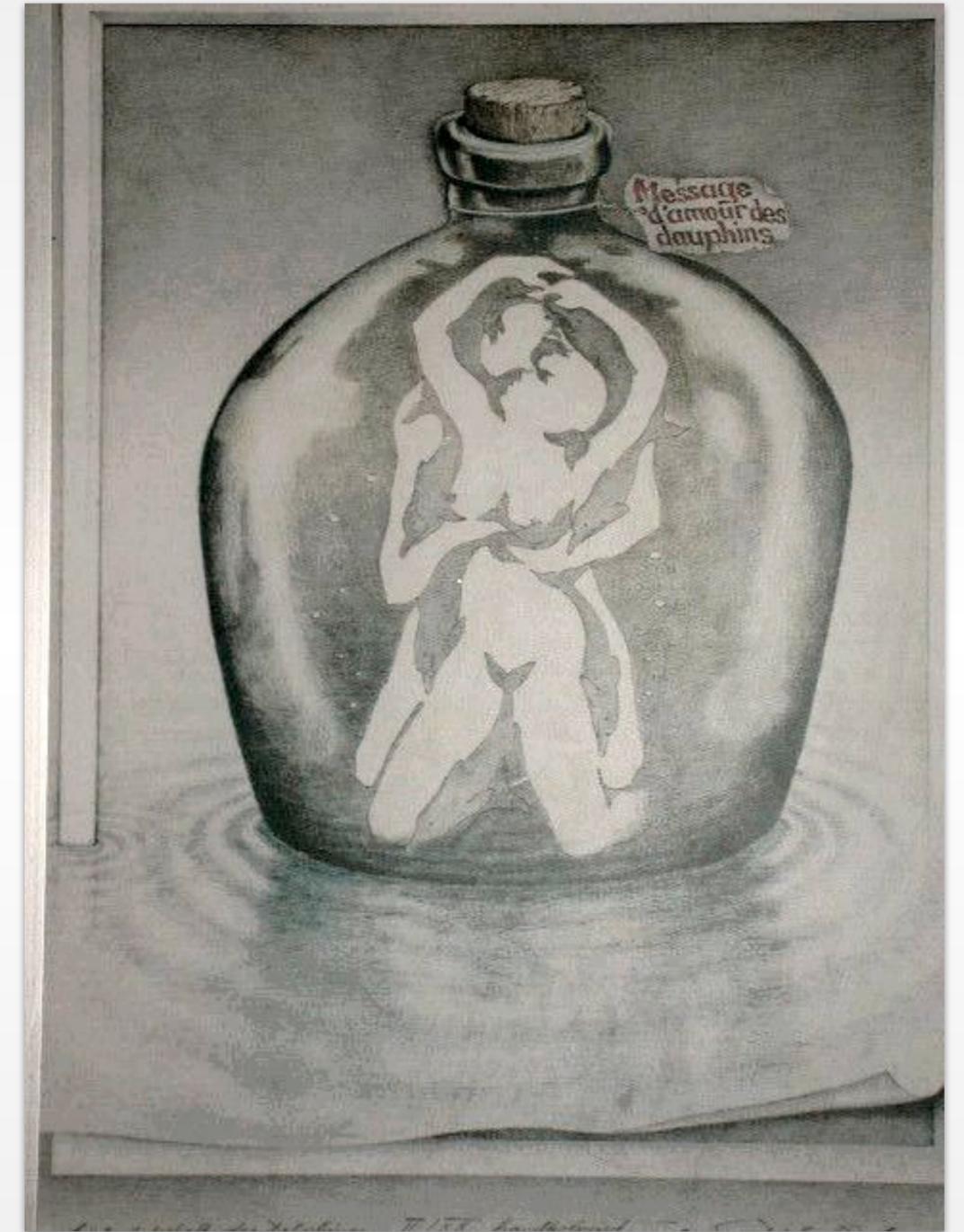
- A Big Message of DISI
- We tend to blame users for mistakes
- But usually it's the product/user interface design that is to blame
- Computers are nothing special—they have many of the same problems as everyday things (and others because of their flexibility)

Gestalt Laws

Perception

Our brains are wired to make sense of what we perceive.



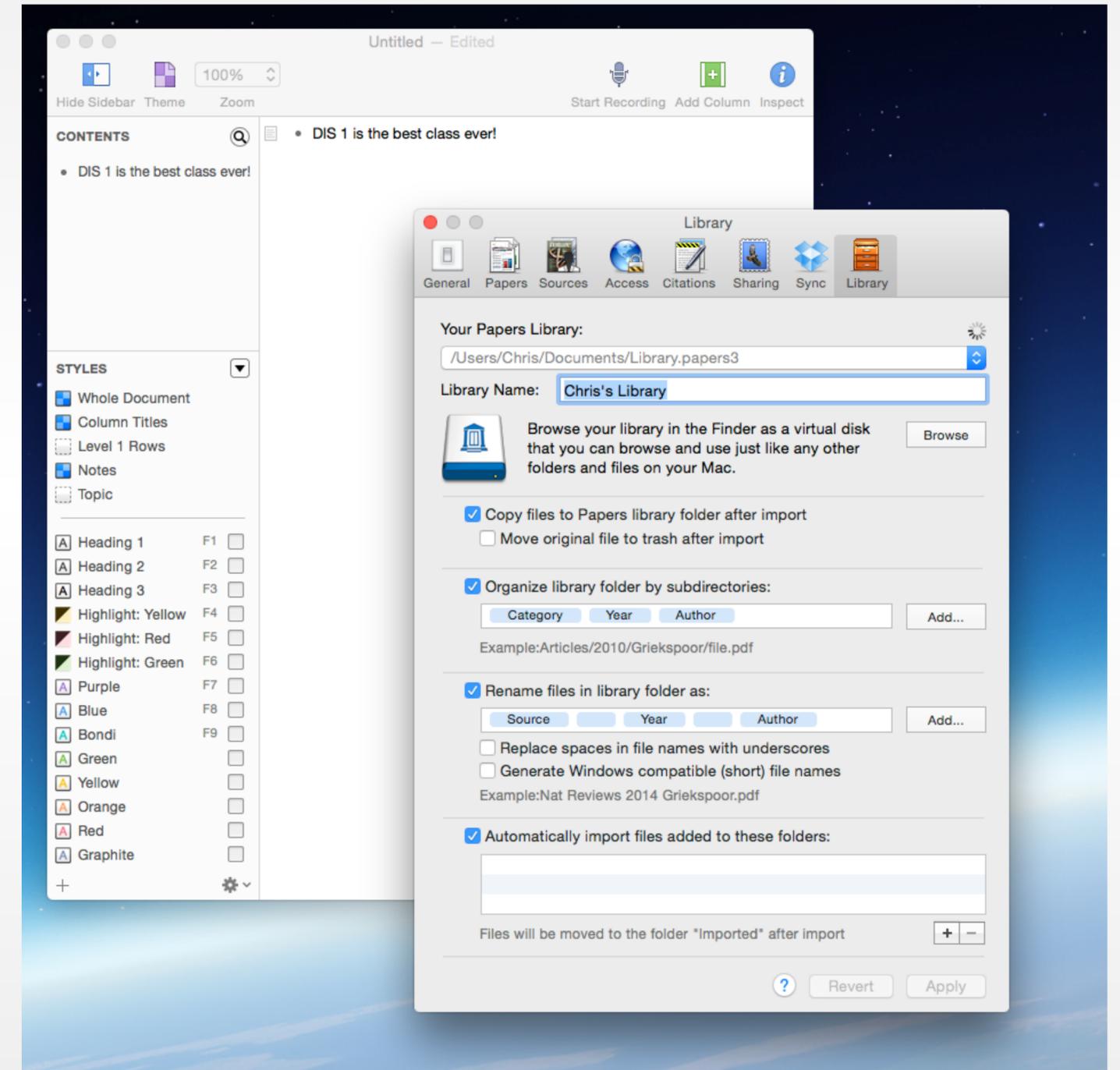


Gestalt Theory

- Köhler, Koffka, Wertheimer (Berliner Schule): “*Gestaltpsychologie*”, 1912
- What do humans perceive as belonging together spatially or temporally?
- Basis of order in perception, movement, memory, thinking, learning, and acting
- Overall 100+ Gestalt laws

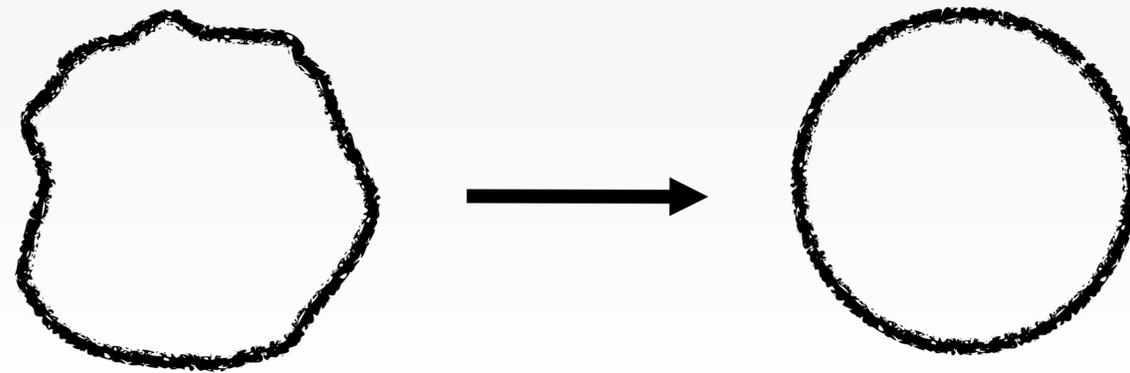
Why Should I Care?

- Simple rules for visual (and auditory) UI design
- Hints how users will react to spatial and temporal order
- Good UIs respect and use Gestalt laws for understandability and intuitiveness



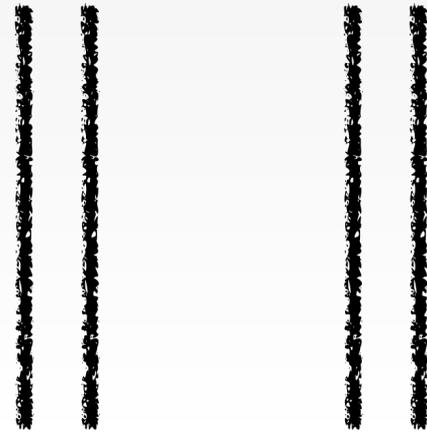
In-class Experiment

Law 1: Good Shape



- Perception has tendency towards remembering things as “good” / clear / simple shapes
- “Cognitive compression algorithm”!
- Easier shape \Rightarrow easier to remember

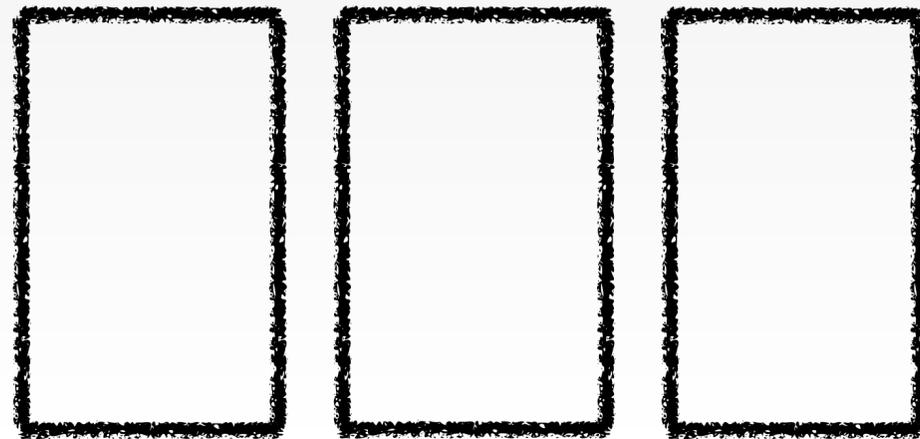
Law 2: Proximity



- Spatially (or temporally!) close objects (events) are perceived as belonging together.
- Advantage: allows for order by position only, without other aides
- Helps to keep the interface simple



Law 3: Closure

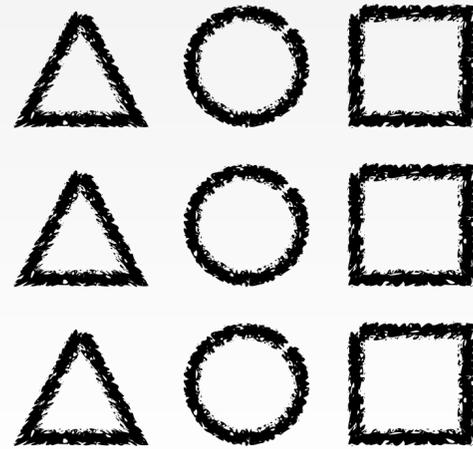


- Closed shapes appear as belonging together
 - Temporally?
- Foundation of window metaphor
- But: Don't overdo it

A screenshot of a form with many nested boxes, illustrating the concept of closure in design. The form is divided into two main sections: 'Contact Info' and 'Assets'. The 'Contact Info' section contains fields for Name (First: John, Last: Abercrombe), Address (Number: 123, Street: Pleasant St., City: Cleveland, State: OH, Zip Code: 12345). The 'Assets' section contains a Salary section with radio buttons for ranges (<=20K, >20-40K, >40-60K, >60-80K, >80K), a Real Estate section with checkboxes for Home, Rental, Farm, and Other, and a Bank section with a Name field (Bank of the West) and an Accounts section with fields for Checking (\$2500.24) and Savings (\$52,465.37). The form is cluttered with many overlapping and nested boxes, making it difficult to distinguish between different sections and fields.

Too many boxes. (From Johnson: *GUI Bloopers*)

Law 4: Similarity



- Similar shapes appear as belonging together
 - Temporally?
- Different objects have higher information content (i.e., cognitive effort)
 - This can be a good thing or a bad thing
- Similar is not necessarily constant
 - Linearity, “elegant curve”, ...

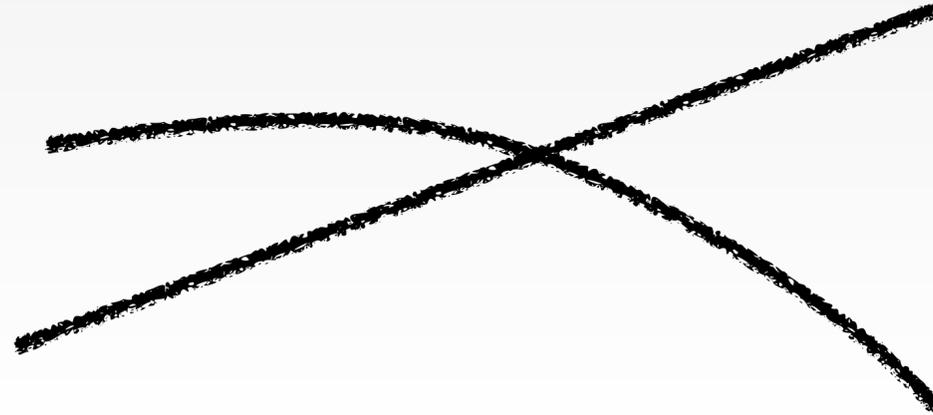
Unread news in rec.humor.funny	1 article	+	5 old
Unread news in rec.humor.funny.reruns	1 article	+	5 old
Unread news in clari.living.columns.miss_manners	1 article	+	1 old
Unread news in misc.taxes.moderated	98 articles	+	383 old
Unread news in comp.dcom.telecom	35 articles	+	74 old
Unread news in comp.dcom.modems	240 articles	+	969 old
Unread news in alt.security	18 articles	+	91 old
Unread news in comp.os.linux.announce	9 articles	+	24 old
Unread news in comp.os.linux.development.apps	92 articles	+	175 old
Unread news in comp.os.linux.development.system	115 articles	+	187 old
Unread news in comp.os.linux.misc	400 articles	+	924 old
Unread news in comp.os.linux.networking	301 articles	+	560 old
Unread news in comp.os.linux.setup	264 articles	+	1711 old
Unread news in comp.periphs.printers	5 articles	+	839 old
Unread news in comp.protocols.kerberos	16 articles	+	29 old
Unread news in comp.security.announce	2 articles	+	0 old
Unread news in comp.security.gss-api	2 articles	+	2 old
Unread news in comp.security.misc	36 articles	+	60 old
Unread news in comp.security.unix	94 articles	+	105 old
Unread news in comp.windows.x.announce	2 articles	+	2 old
Unread news in comp.windows.x.apps	4 articles	+	22 old
Unread news in gnu.emacs.bug	15 articles	+	31 old
Unread news in news.announce.newgroups	18 articles	+	5 old
Unread news in news.software.b	2 articles	+	7 old
Unread news in news.software.nntp	90 articles	+	90 old
Unread news in news.software.readers	42 articles	+	163 old
Unread news in shore.sys	1 article	+	5 old
Unread news in shore.news	1 article	+	2 old
Unread news in alt.sources	1 article	+	5 old
Unread news in alt.source-code	1 article	+	1 old

Operations apply to current selection or cursor position

Quit	Read	Next	Prev	Catch up	Subscribe	Unsubscribe	Goto group	All groups
Rescan	Prev group	List old	Select groups	Move	Exit	Checkpoint	Gripe	Post
Post & Mail								

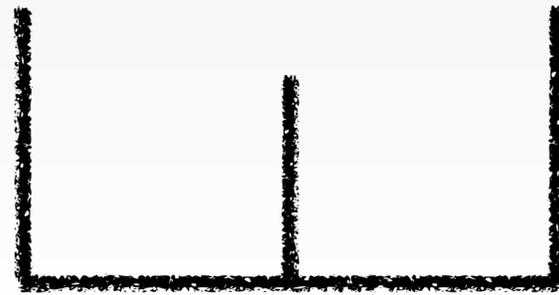
Bad button design in xrn

Law 5: Continuity



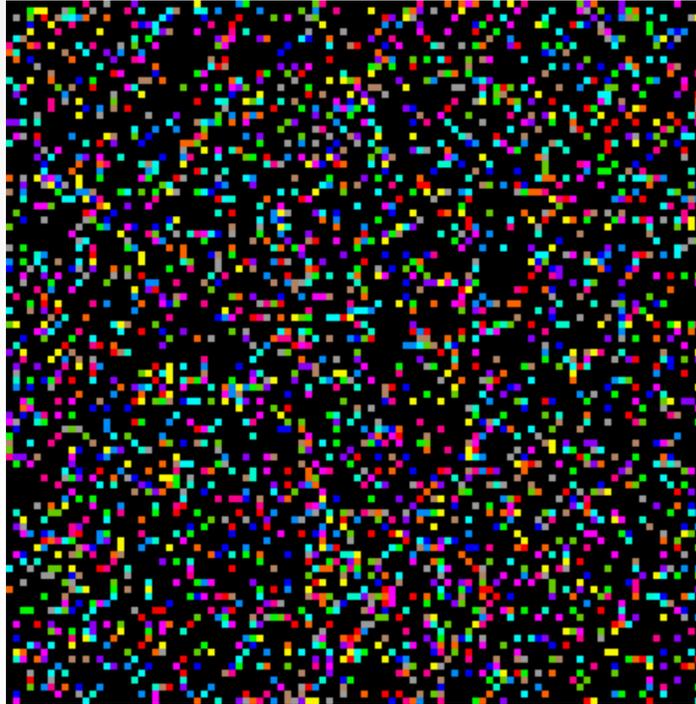
- A.k.a. “Law of the Good Curve”
- Continuous shapes appear as belonging together
 - Temporally?
- Example: music

Law 6: Experience



- We tend to “file” new things into categories we already know
- Uses existing knowledge, thereby saving learning effort and memory
- Foundation for the success of **metaphors** in UI design
 - Analog to real-world models
 - E.g., desktop metaphor

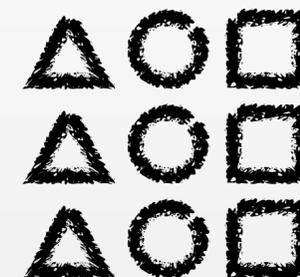
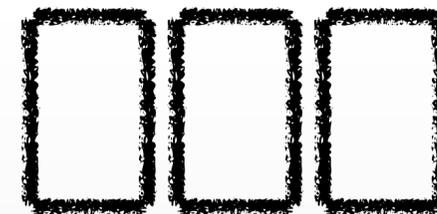
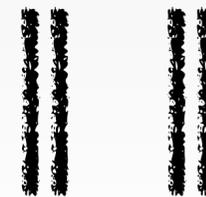
Law 7: Common Fate



- A.k.a. “Law of Common Movement”
- Animated objects within a static environment appear as a group
- By-Law: Animation has a very strong effect in UI design
 - Here: Synchronous animation groups the items

Blinking text is perceived as a group



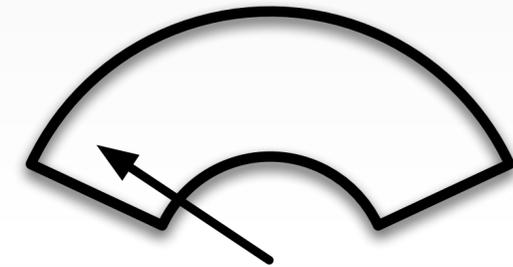


Information Content in UIs

- Basic unit of information: bit
- Toggle button:
 - 2 states: → $\log_2(2) = 1$ bit
- Single digit:
 - 10 states: 0...9 → $\log_2(10) \approx 3.3$ bits
- Single letter, upper- and lowercase, U.S.:
 - 52 states: a...z | A...Z → $\log_2(52) \approx 5.7$ bits

Information Content in UIs

- Analog scales (reading = estimate)
 - Unmarked scale (experiment)
 - 3 bits (8 different positions differentiable)
 - Audio pitch, volume, salt content
 - Pitch 2.5 bits (But: with perfect pitch 5–6 bits)
 - Volume 2 bits
 - Saltiness 1.8 bits



Analog or Digital?

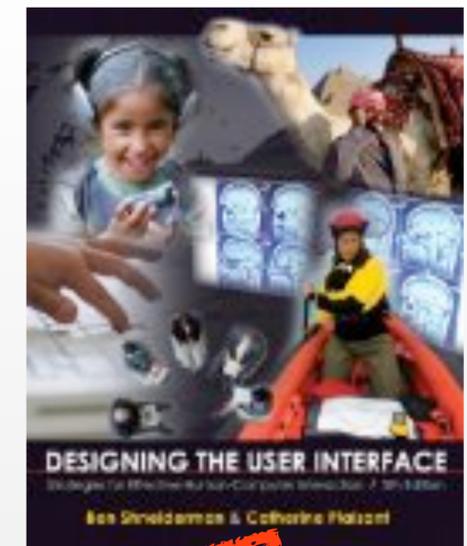
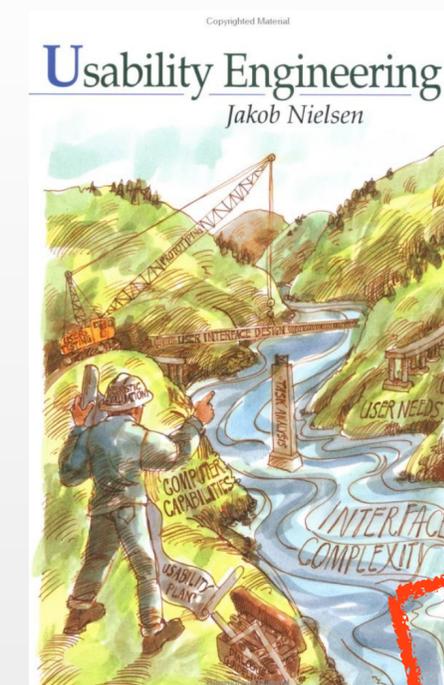
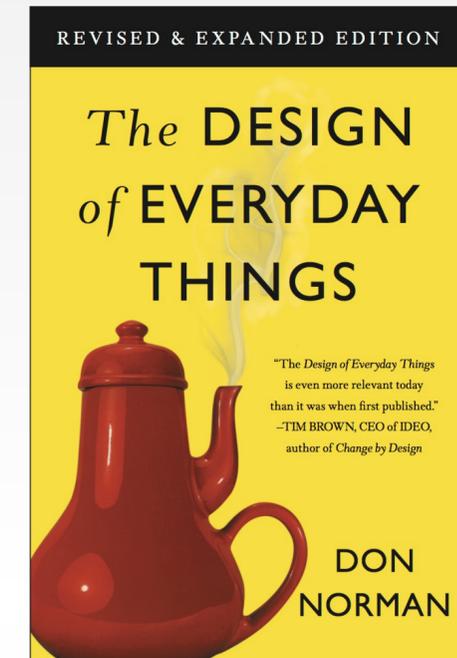
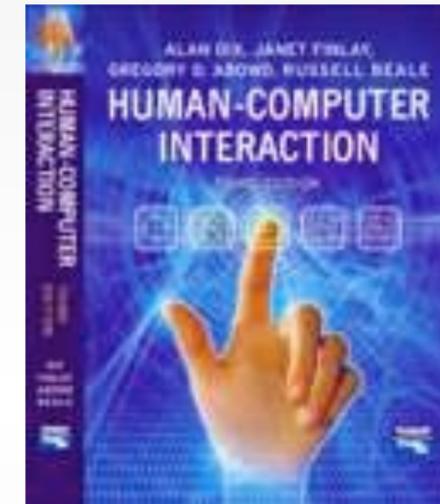
- Example: speedometer in the car
- Analog displays (scales, ...)
 - Quick estimate possible, range limits visible
 - Easy to detect trends
 - But: reading time increases linearly with number of significant digits
- Digital displays (digits, ...)
 - Reading time ~ constant up to 3–4 digits
 - But: hard to estimate quickly, trends hard to detect, limits invisible without external labeling

HCI Literature Sources

- Conferences
 - CHI (main), UIST (technical), DIS (design), INTERACT (Euro-Asian), CSCW (group work), Ubicomp, ACM Multimedia
- Journals
 - TOCHI (archival), Interactions (magazine), PUC (Ubicomp)
- Online
 - ACM Digital Library (dl.acm.org), hcibib.org

HCI Literature Sources: Books

- Norman '13: Design of Everyday Things
(*Revised & Expanded Edition*)
 - Affordances, mappings, constraints
- Dix '04: Human-Computer Interaction
 - Very good general textbook
- Shneiderman '09: Designing the UI
 - Technology, interviews
- Nielsen '93: Usability Engineering (prototyping)
 - How to bring usability to the business



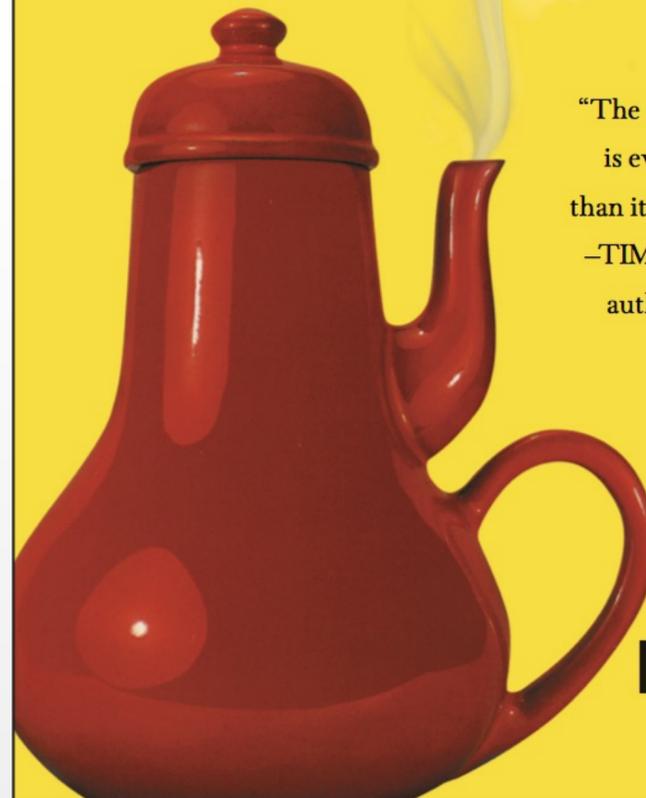
Christmas!

A Note on Active Reading

- Highlight 1–2 key points per page
- Scribble brief summaries, “!” marks, crazy associations, project ideas, ... in margins
- Put sticky notes with keywords onto pages you keep referring back to
- Type short bullet-point summaries of each chapter
- Make sure you can tell your copy of the book apart from 10ft
- Increases value of the book for you many times

REVISED & EXPANDED EDITION

The DESIGN
of EVERYDAY
THINGS

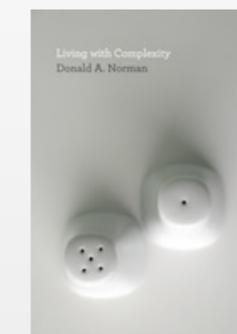
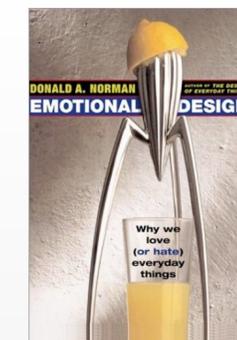
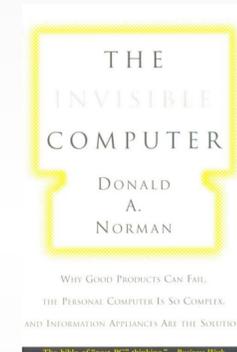
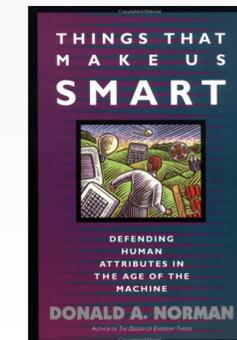
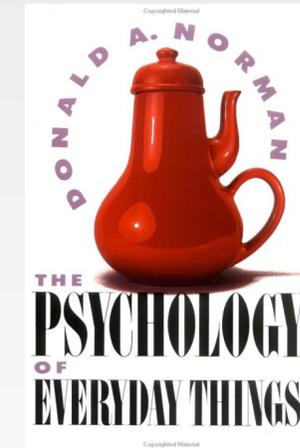


“*The Design of Everyday Things*
is even more relevant today
than it was when first published.”
–TIM BROWN, CEO of IDEO,
author of *Change by Design*

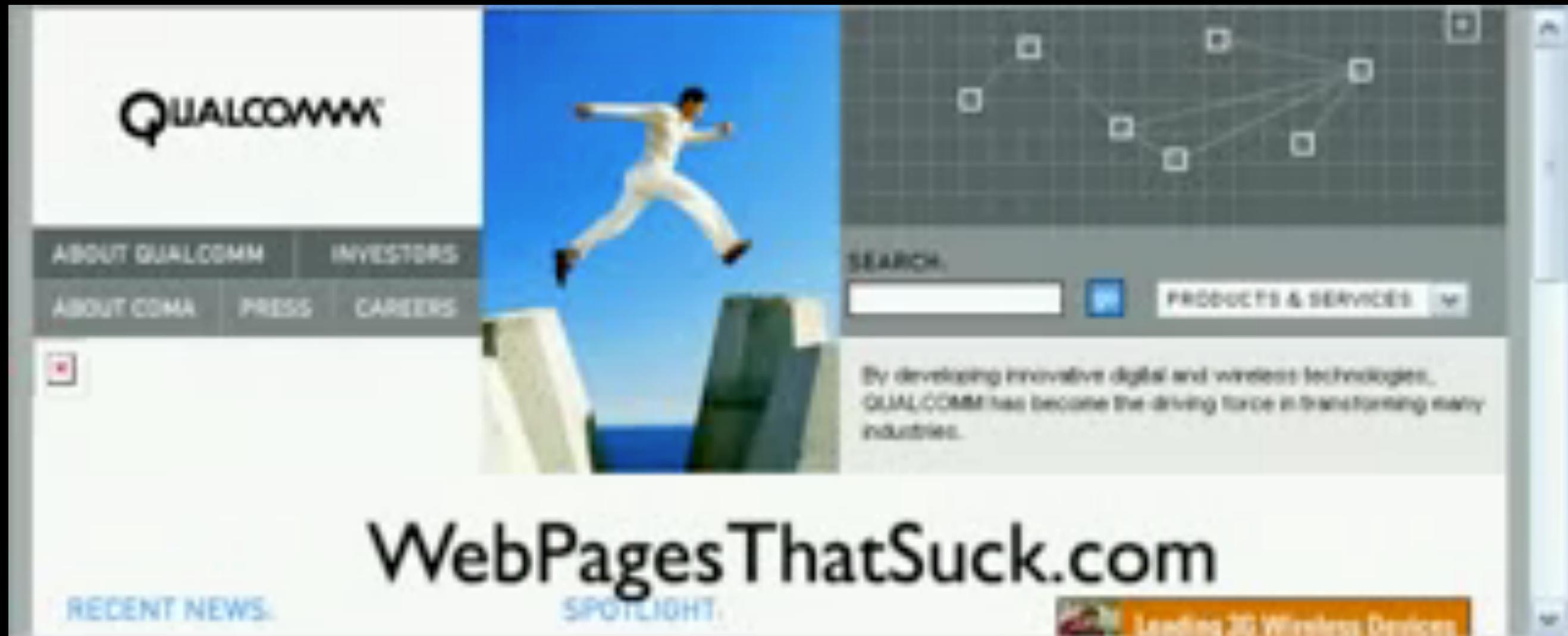
DON
NORMAN

The Design of Everyday Things

- Originally published as “*The Psychology of Everyday Things*” (POET) in 1988
- One of the ‘bibles’ for HCI
- Introduced the concept of **affordances** and **signifiers** to HCI in general
- Followed by
 - *Things That Make Us Smart: Defending Human Attributes in the Age of the Machine* (1994)
 - *The Invisible Computer: Why Good Products Can Fail, the Personal Computer Is So Complex and Information Appliances Are the Solution* (1998)
 - *Emotional Design: Why We Love (Or Hate) Everyday Things* (2004)
 - *The Design of Future Things: Automation in our homes and automobiles and why it is done so badly* (2007)
 - *Living with Complexity* (Oct., 2010)



“Mystery Meat Navigation”



<http://www.webpagesthatsuck.com/>

Visibility

- The mind is excellent at noticing and interpreting clues in the world, rationalizing, explaining cause and effect
 - Much everyday knowledge is in the world, not in the head
 - So **visibility** is one of the most important aspects in design
 - Ideally, **natural** clues are made visible, requiring no conscious thought: **natural design**
 - Just the right things have to be visible: excess is as bad as lack of visible clues



Swedish Hair Dryer







Improving the Swedish Hair Dryer

- Detach scale (labels) and control
- Provide at-a-glance overview of possible settings (What Can I Do?)
- Design control knob to show how it can be operated (e.g., pushed)
- Make current setting of control against scale easy to determine (Where Am I?)
- Use natural ordering of settings ($0 < I < II$)
- These all work for a new product—but design for use
 - One-handed operation, labels must not wear off, water-resistant controls, voltage settings,...
- Apply the First Rule of UI Design: **Keep It Simple**

Visibility & Superstitions

- Coincidence and lack of visibility can cause **false causalities** (thinking your action had a bad or no effect).
- They lead to superstition and loss of control.
- Example: Multiple clicks because system doesn't respond—and then the chaos when it does...

Market Constraints

- Better UIs are not automatically business goals
- Consumers have to prioritize usability before industry changes (it's happening gradually)
- Goal of this class: Turn you into nitpickers that notice bad (and good) UIs everywhere.





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How do you check your voicemail?





Dial *71

RWTH University Phones

- More phone issues
 - Tone dialing doesn't work, have to dial “* * 8” to activate
 - Missed calls are hard to retrieve, and numbers disappear after looking at them once
 - Etc. ...
- Mobile phones (“network features”) are not much better (e.g., blocking caller ID)

British Rail Shelters

- British Rail shelters with glass walls were being vandalized routinely
 - Glass suggests (“affords”) being broken
- After replacing them with equally strong plywood, the demolishing stopped
 - Wood suggests/affords stability and support
- However, now they were being scribbled upon...
 - Smooth, even surfaces “afford” drawing!



Affordances

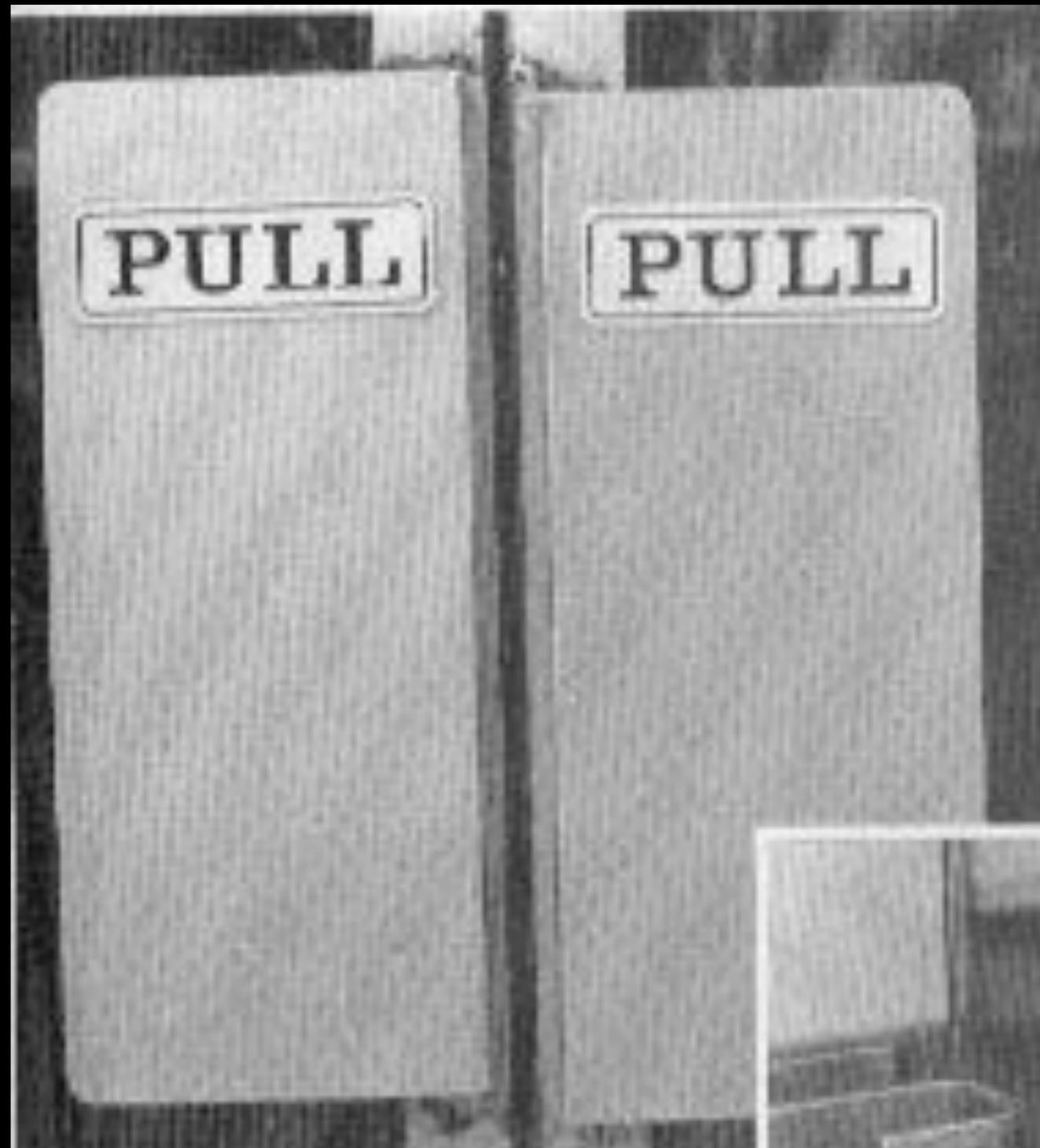
- Model by Norman, after Gibson
 - “...**affordances** of the environment are what it offers the animal...” [Gibson77]
- Affordances are the actions that the design of an object suggests to the user
 - “...the term **affordance** refers to the perceived and actual **properties** of the thing, primarily those fundamental properties that determine just **how** the thing could possibly be used...” [Norman88]

Utility of Affordances

- Affordances provide strong clues
 - No instructions/labels needed
 - A design with labels is often a bad design!
 - Also true for many software UIs
 - Exceptions: complex, abstract functions that do not support simple “physical” affordances
- Product design can support usability when using affordances well

Example: Headlamp





Flat surfaces suggest pushing, so a label “PULL” is needed.



False Affordances

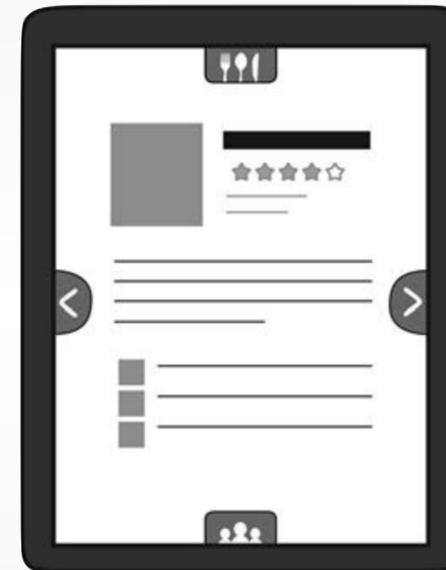


- False affordances suggest actions that are not actually possible or the right ones
- Example: Winchester Mystery House
 - Staircases leading nowhere
 - Cupboards with nothing behind their door



Signifiers

- The signaling component of an affordance (i.e., it signifies the affordance)
- Affordances: **what** action?
Signifiers: **where**?
- More important than affordances



Intentional and Unintentional Signifiers

- Intentional
 - Door signs (any signs for that matter)
 - “Click here” buttons
- Unintentional or accidental
 - Footpath in a snow terrain
 - Wind direction from flag
- Either way, users interpret it as strong cue
- Misleading signifiers
 - People sitting on staircase (helpful)
 - Empty bottles on railings (not helpful)



Conceptual Models

- We are surrounded by innumerable objects (20,000 everyday things)
- How do we cope?
 - Mind aims to make sense of things
 - Affordances support using objects easily
 - Designers can provide a good image of how a system works
- Humans form a conceptual model of how something works when they encounter it

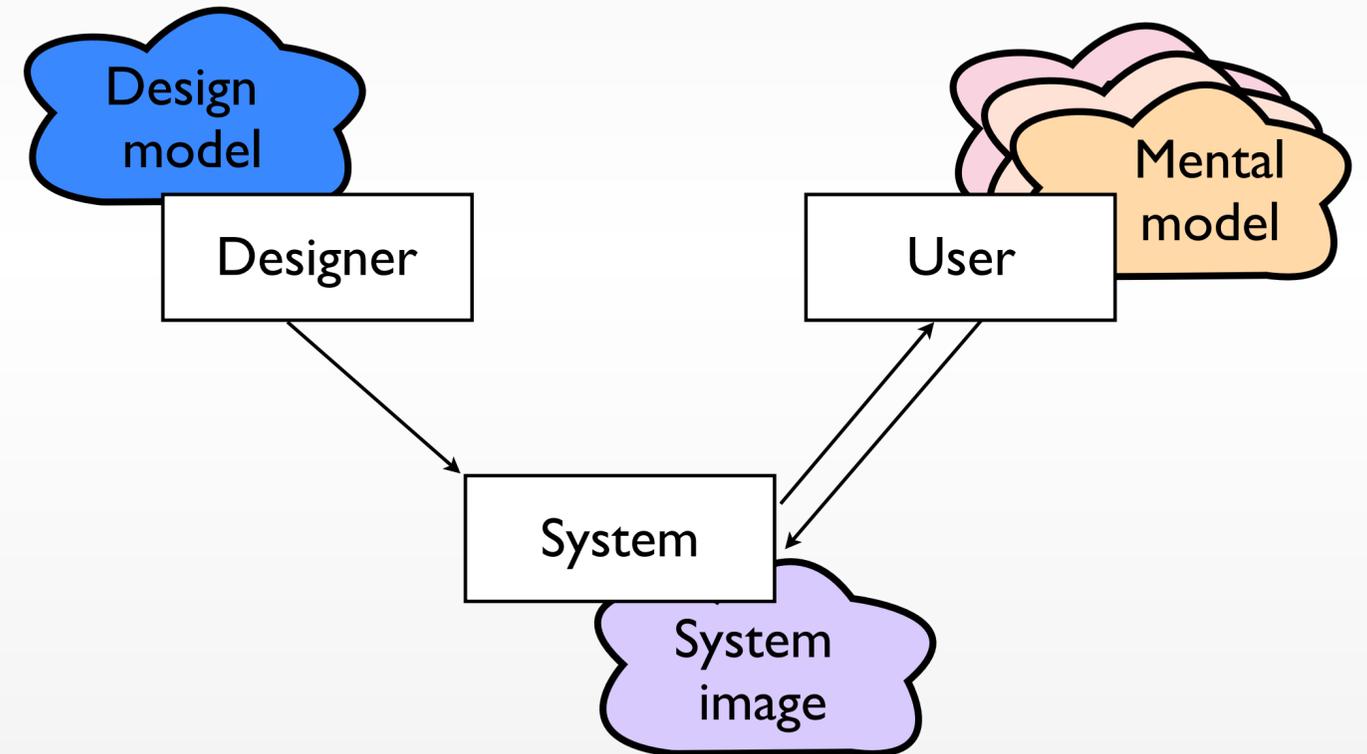


Providing Good Conceptual Models

- Principle of good design
- Allows to predict effects of our actions, and cope with problems
- Conceptual models are mental models of things
 - Other mental models: Of ourselves, others, the environment, ...
 - Formed through experience, training, instruction

Design Model, System Image, and User's Model

- By carefully crafting the system image, designers can provide a good idea of how a system works
- Problems arise when the designer's conceptual model is different from what emerges as the user's mental model
- Important concept to remember when designing UIs!





“Interface design is about crafting the user illusion.”

Required Reading Assignments

- Get Norman's book and start reading
 - You have four weeks to finish the book
 - As of this moment, we are already 12% into the book
- Dix et al.: Human-Computer Interaction, Chapter 3: "The Interaction" (on L2P)
- Shneiderman et al.: Designing the User Interface, Chapter 2.4: "Theories" (on L2P)