GE 402
Principles of User Interface Design

Designing Usable Products & Computer Interfaces

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FF 213A

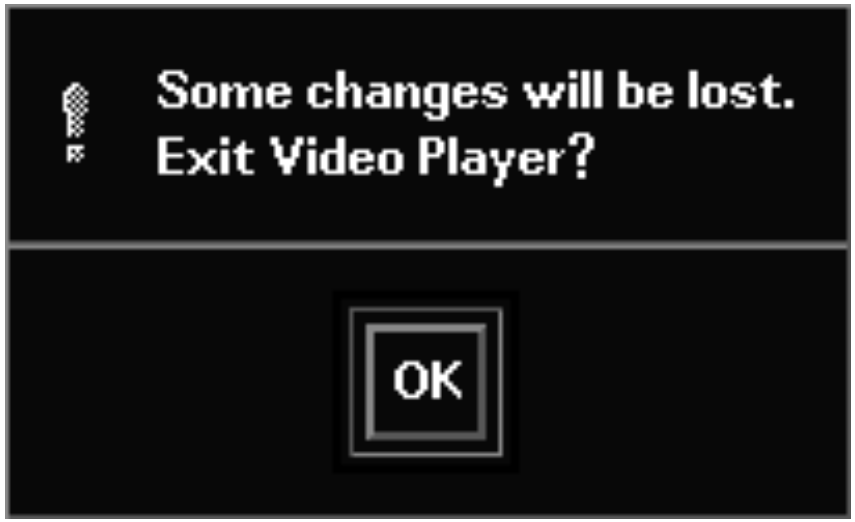
What is a User Interface?

- Computer Screen

- Controls of any Object

Coffee pot for Masochists

What is the problem with this design?

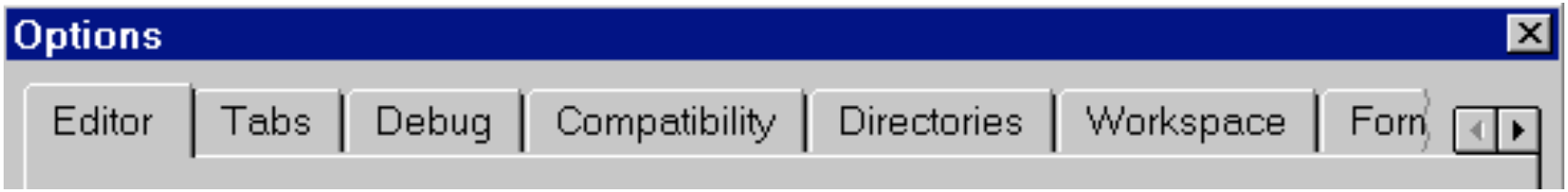


What is interaction design?

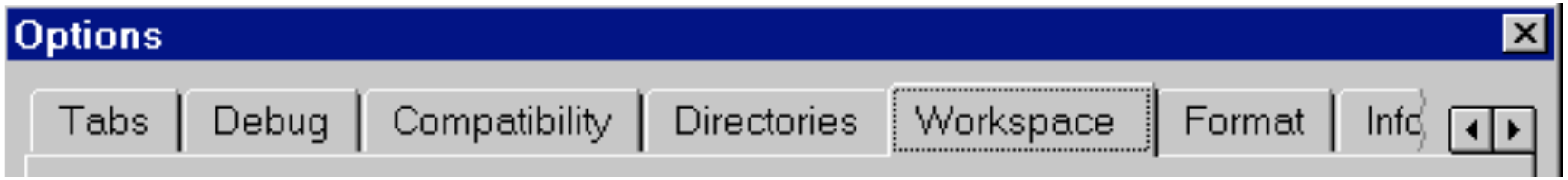
- Designing interactive products to support people in their everyday and working lives
  - Sharp, Rogers and Preece (2002)

Human-computer dialog construction appears deceptively simple, yet it is full of subtle pitfalls!

Interface Hall of Fame or Shame?



- Tabbed dialog for setting options in MS Web Studio
  - More tabs than space to display them
- Clicking on the right arrow once gives:



- Inconsistent display of possible tabs
  - Left side not torn vs. right side torn
- Position of arrows awkward (split to each side?)

Goals of interaction design

- Develop usable products
- Usability means
  - *easy to learn*
  - *effective to use*
  - *provide an enjoyable experience*
- Involve users in the design process

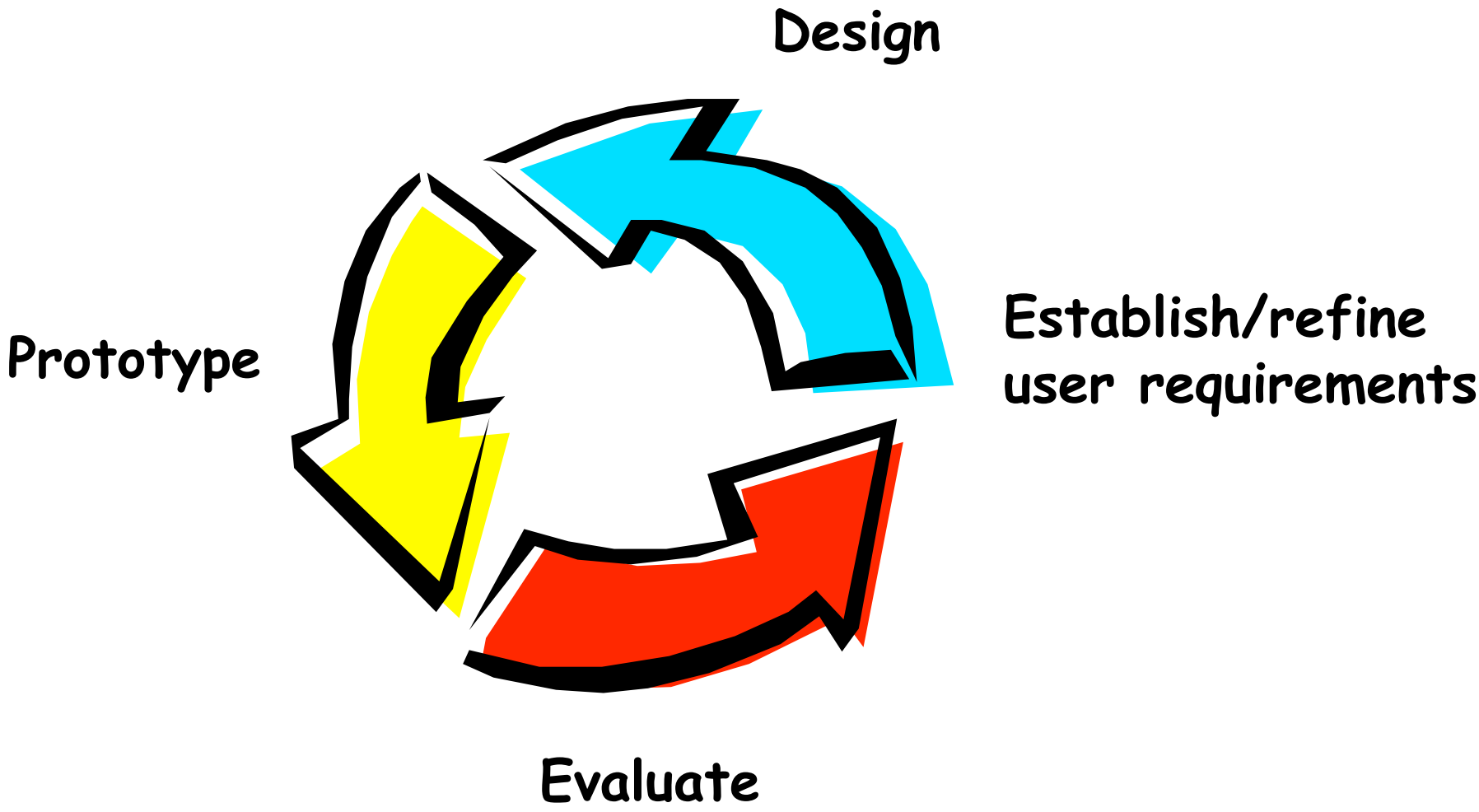
Why Study User Interfaces?

- Major part of "real" programs
  - Approximately 50-70%
- You will work on "real" software
  - Intended for users other than yourself
- Bad user interfaces cost…
  - Money (↓ 5% satisfaction -> up to 85% ↓ profits)
  - Lives
- UI's are hard to get right
  - People are different and unpredictable

Core characteristics of interaction design

- users should be involved through the development of the project
- specific *usability* and *user experience* **goals** need to be identified, clearly documented and agreed at the beginning of the project
- *iteration* is needed through the core activities

Interaction Design Cycle



Usability goals

- Easy to learn
- Effective to use
- Efficient to use
- Low error rate and safe to use
- Ability to Customise
- Easy to remember how to use (retention of learned skills)
- Subjective user satisfaction

User experience goals

- Satisfying
- Fun
- Enjoyable
- Entertaining
- Helpful
- Motivating
- Aesthetically pleasing

- rewarding
- support creativity
- emotionally fulfilling

…and more

http://www.baddesigns.com/
http://usableweb.com/
http://www.useit.com/

Usability Goals

Usability Goals are always Tradeoffs

Rapid learning	→	Low power
Safety/error constraint	→	Awkward/extra steps
Subjective satisfaction for novices	→	Extreme irritation for experts

Usability Goals can and should be *operationalized*, e.g.

- User should exhibit error-free performance on second time using interface
- User should be able to complete task X in Y seconds
- Effective training on how to use the device should take no more than 8 hours
- 80% of users should rate the system at least 8 on a 10 point scale of satisfaction
- User should remember how to complete task X perfectly, three weeks after training
- Less than 10% of users should report confusion about how to start the device

What is involved in the process of interaction design?

- Identify needs and establish requirements
- Set Usability Goals
- Develop alternative designs
- Build interactive prototypes that can be communicated and assessed
- Evaluate what is being built throughout the process

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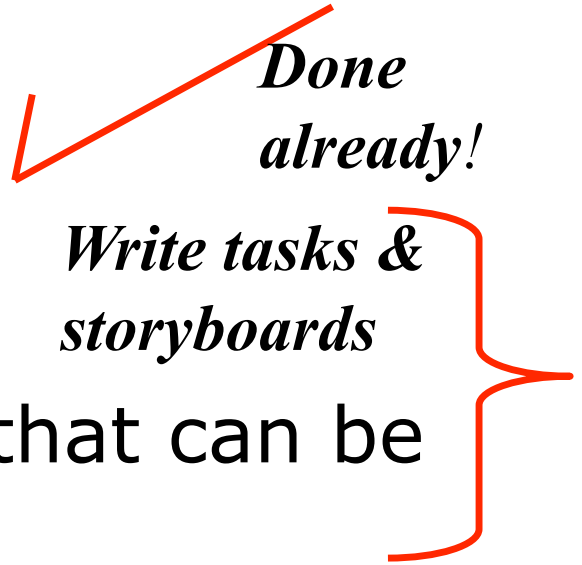


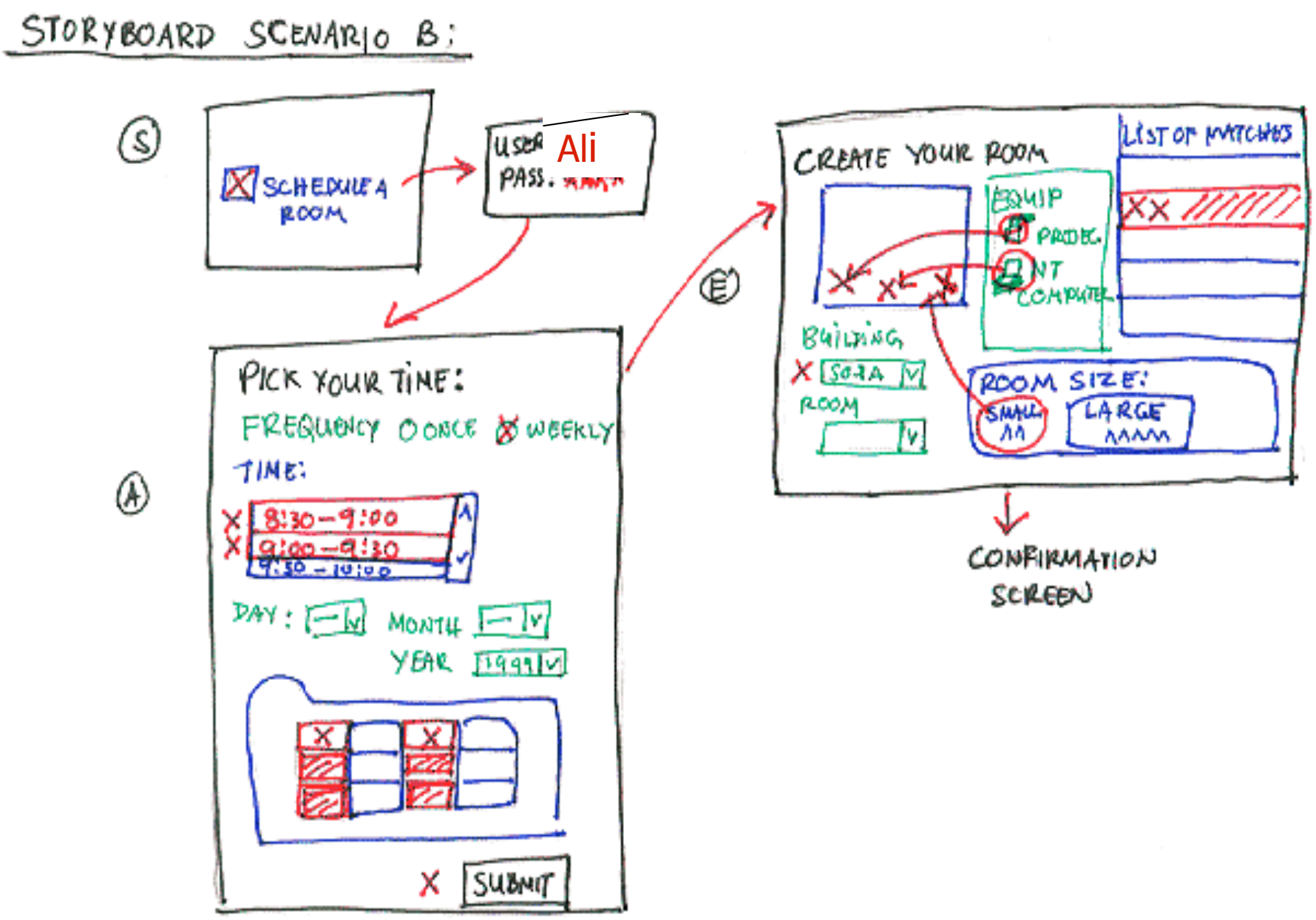
Write Tasks

- A professor is holding a series of lectures on non-regular dates. This professor is new in the university and wants the location (hopefully with a map) displayed on his web page. With only a basic web page, this professor would be able to have his web site dynamically updated to reflect the time and room for the next occurring lecture.

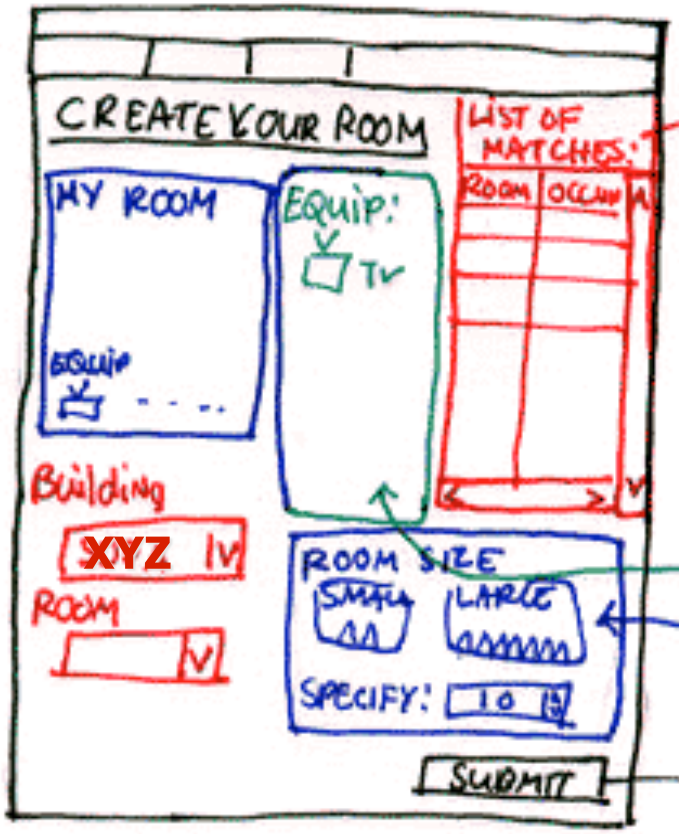
Write Task Scenarios

- The campus is a large and confusing place. Prof. Doe, like the reserves a room for a particular date. Upon selecting a room number, the system displays an overview map of the campus highlighting the building where the room is located. At this stage Prof. Doe by clicking on the building "zooms in" to see a floor plan with the room's absolute location highlighted. After a couple of weeks Prof. Doe logs in to reserve another. The system remembers the previous booking and displays the details. Fred, a student of Prof. Doe logs in to check the location of this weeks seminar. He enters the name of the professor and all bookings by that user is displayed on the screen. Clicking the appropriate date/time booked by Prof. Doe, Fred gets the map displaying the location of the seminar room.

Sketch Task Storyboard



UI Sketches



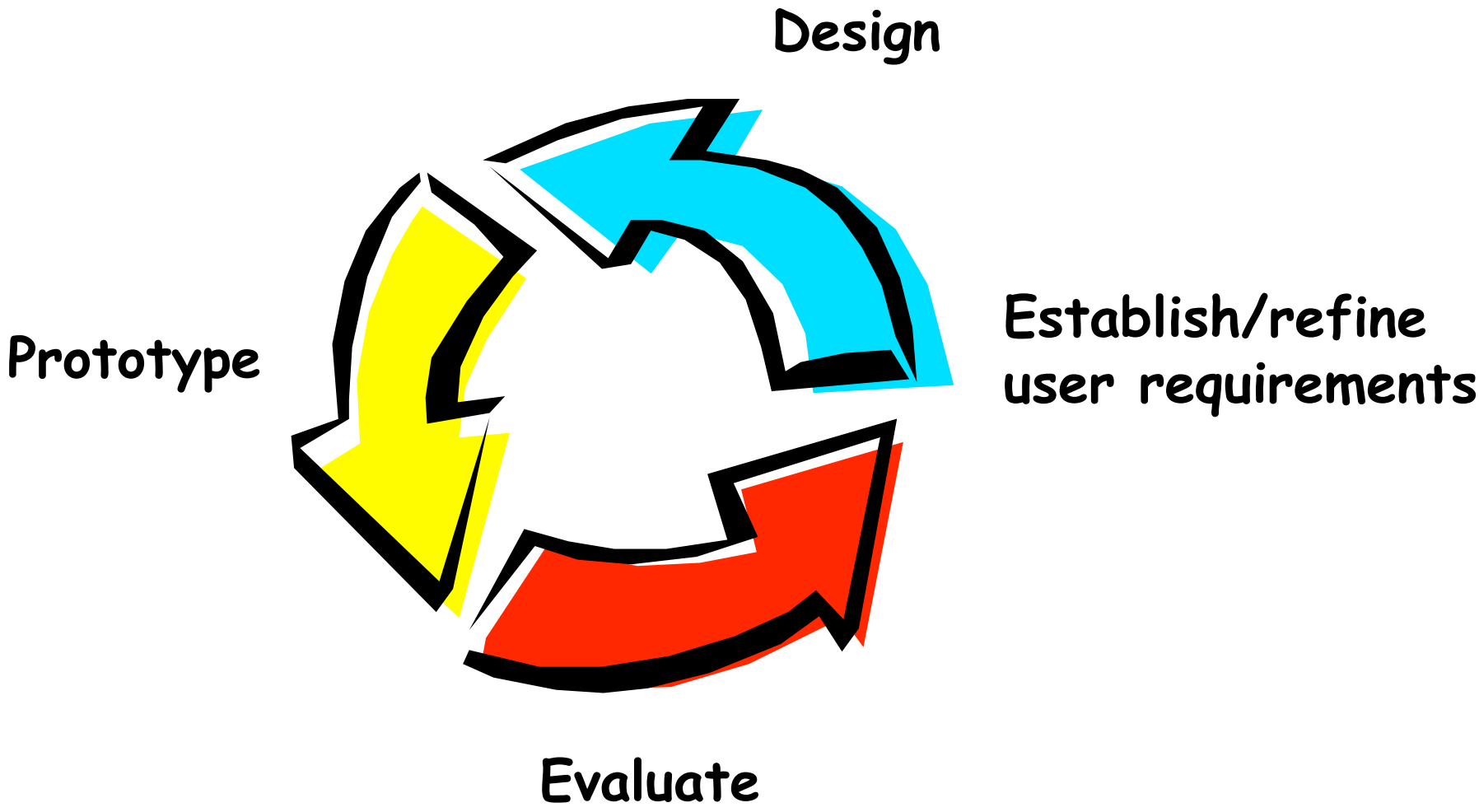
AUTOMATICALLY UPDATES BASED ON YOUR PREFERENCES
- DOUBLE CLICKING A ROOM IS EQUAL TO SAYING YOU WANT IT
- SINGLE CLICK WILL UPDATE THE SCREEN

DRAG AND DROP PEICES OF EQUIPMENT

DRAG AND DROP ROOM SIZE OR SPECIFY

TAKES YOU TO SOME SORT OF CONFIRMATION SCREEN OR MAYBE ASKS YOU MORE INFO ABOUT YOUR CLASS/ REASON FOR ROOM

Interaction Design Cycle



A framework for analysing the problem space

Guiding Questions

- Are there problems with an existing product?
- Why do you think there are problems?
- Why do you think your proposed ideas might be useful?
- How would you see people using it with their current way of doing things?
- How will it support people in their activities?
- Will it really help them?

An example

- What were the assumptions made by cell phone companies when developing WAP services?
- Was it a solution looking for a problem?

Design Assumptions: realistic or wish-list?

- People want to be kept informed of up-to-date news wherever they are - reasonable
- People want to interact with information on the move - reasonable
- People are happy using a very small display and using an extremely restricted interface - not reasonable
- People will be happy doing things on a cell phone that they normally do on their PCs (e.g. surf the web, read email, shop, bet, play video games) - reasonable only for a very select bunch of users

From problem space to design space

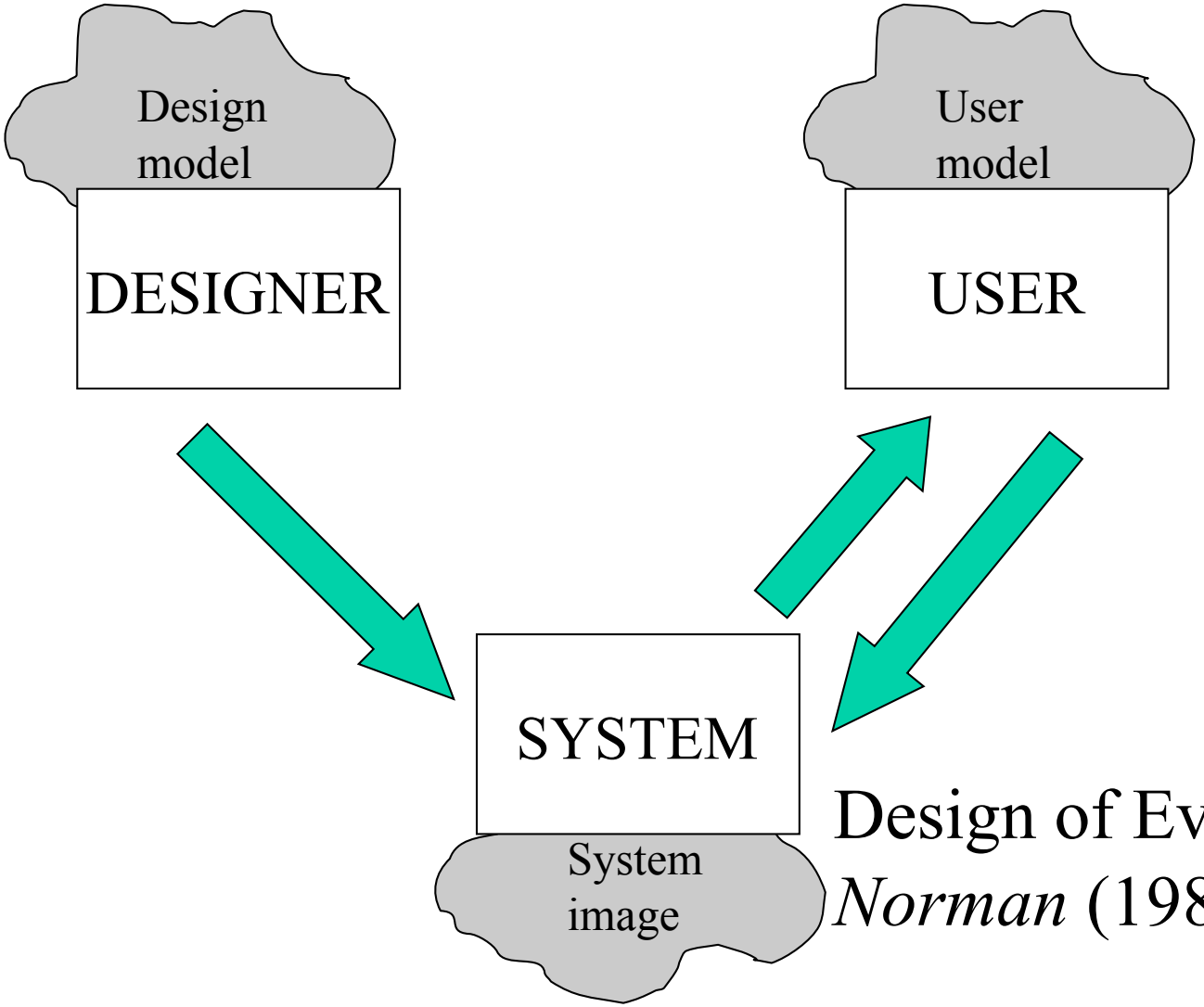
- Having a good understanding of the problem space can help inform the design space
  - e.g. what kind of interface, behavior, functionality to provide
- But before deciding upon these it is important to develop a conceptual model

Conceptual model

- Need to first think about how the system will appear to users (i.e. how they will understand it)

- A conceptual model is a high-level description of:
  - the proposed system in terms of a set of integrated ideas and concepts about what it should do, behave and look like, that will be understandable by the users in the manner intended"

Users should understand the designer's conceptual model



Design of Everyday Things by *Norman* (1988)

Visual Clues (Affordances)

- Well-designed objects have **affordances**
  - Visible clues to their operation
- Poorly-designed objects
  - No clues
  - False clues (e.g., teapot with handle and spout on the same side)

Coffeepot for Masochists

Affordances

Learning by Observation?

Affordances

Robert St. Amant: Tool Use With the AIBO

- "Some tools seem to have the property that one can tell how they should be used just by looking and experimenting – no instruction or specialized knowledge is needed. Affordances are part of the explanation why, as is general tool-using ability."

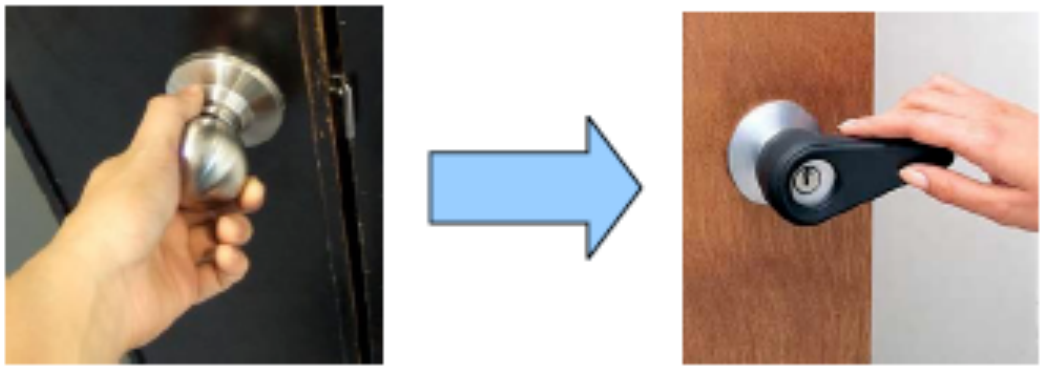
Affordances

How To Open a Door

Shape determines grasp strategy:

Affordances

Changing An Affordance



Rubber handle fits on doorknob to allow easier opening by people with gripping difficulties.

Affordances

Kodak DC-290 Camera

Example from Joel Spolsky's "User Interface Design for Programmers", ch. 4.

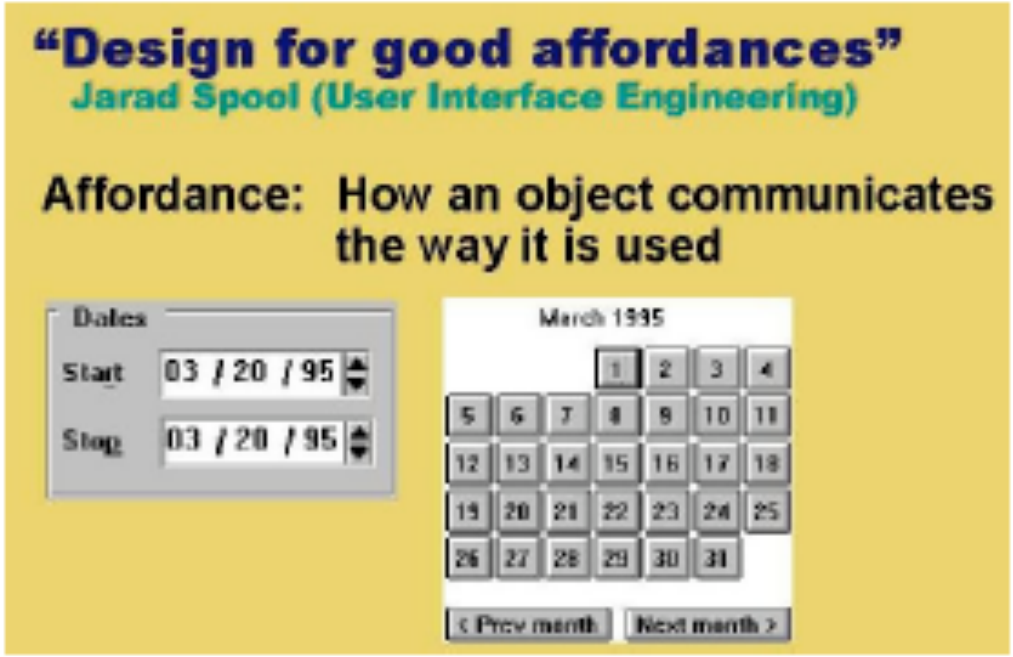
- Encourages users to hold camera with both hands.
- Keeps fingers away from the lens and viewfinder.

Right hand fingers curl around grip

Left thumb goes here

Affordances in Graphical User Interfaces (GUI)

- Buttons drawn as 3D shapes appear to "stick out" and hence afford pushing.
- Sliders and scroll bars afford dragging.



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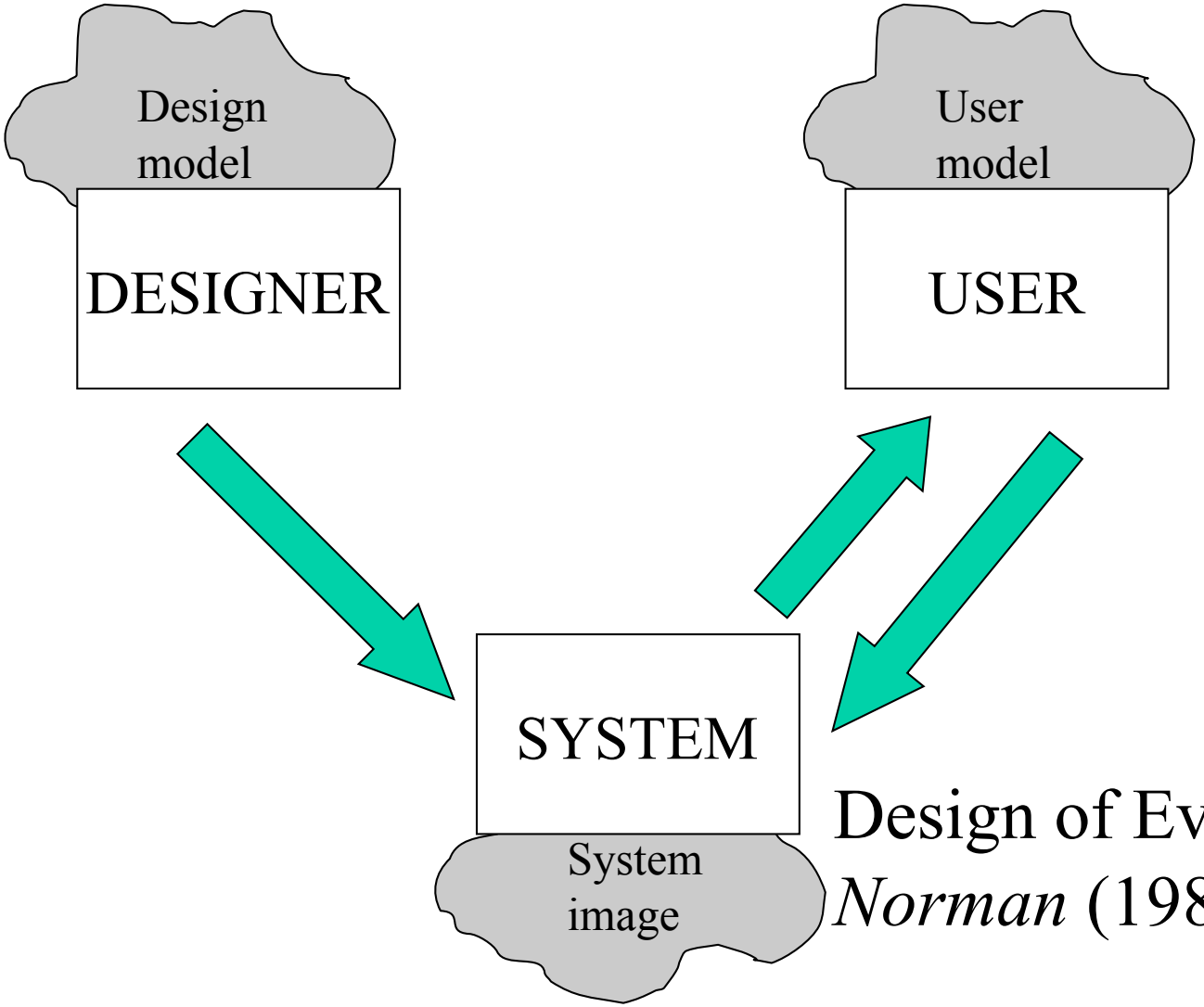
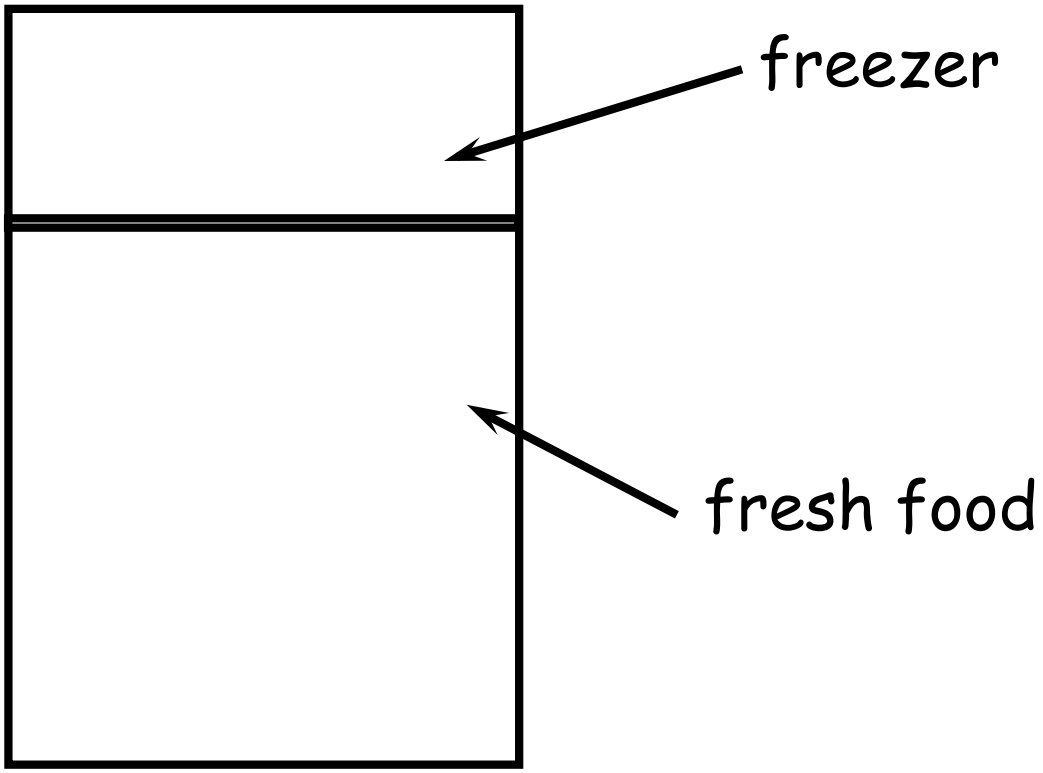


Design of Everyday Things by *Norman* (1988)

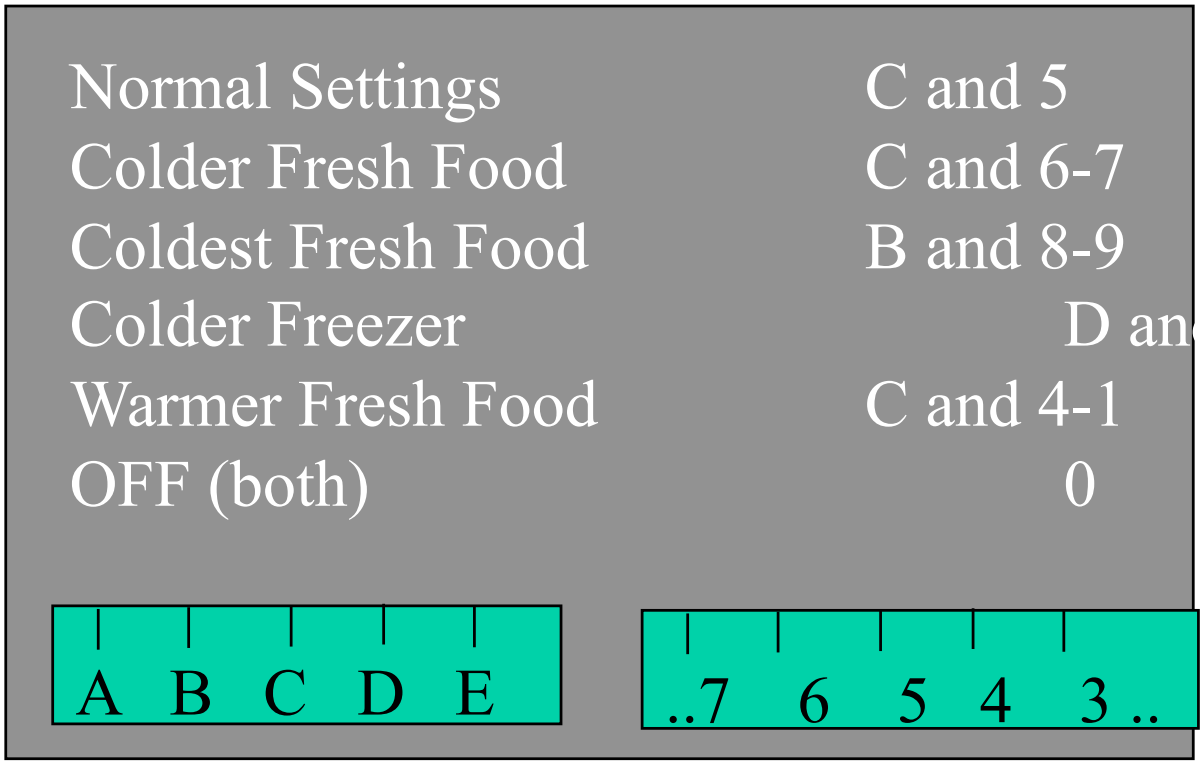
Refrigerator



Problem:

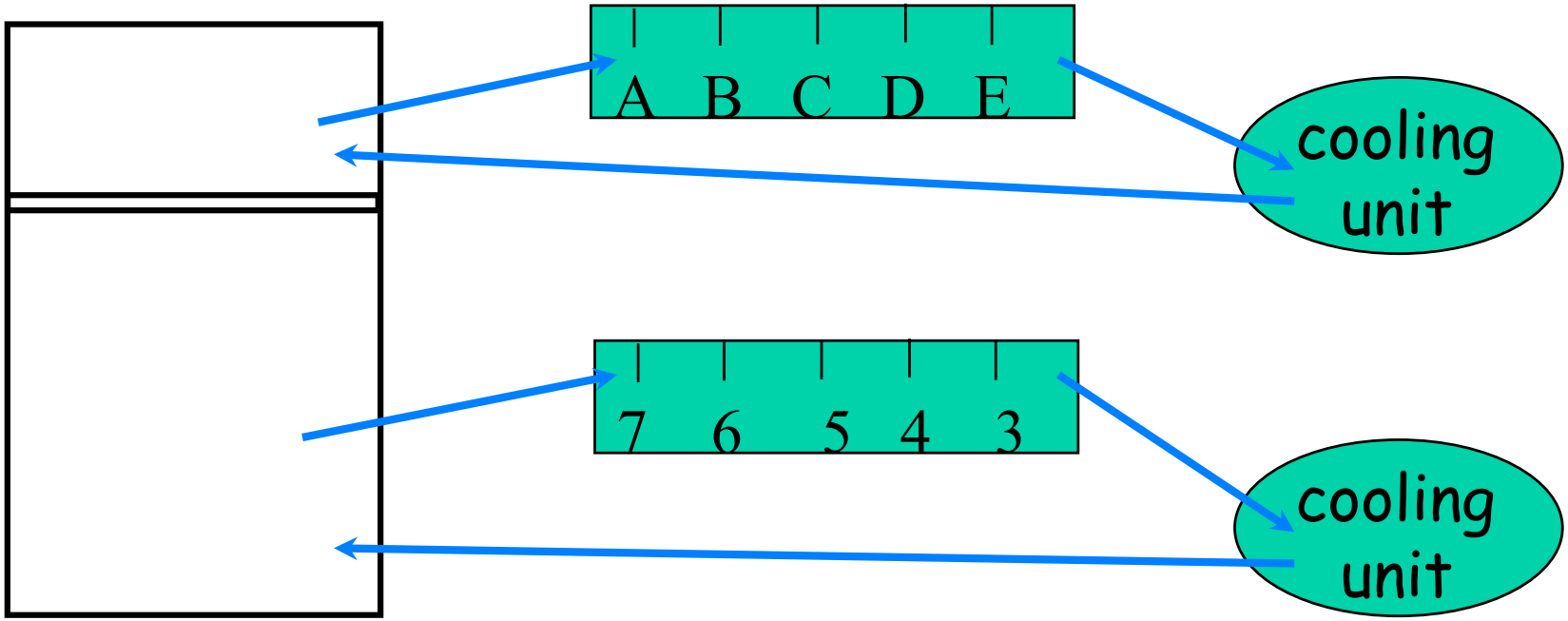
Freezer too cold, but fresh food just right

Refrigerator Controls



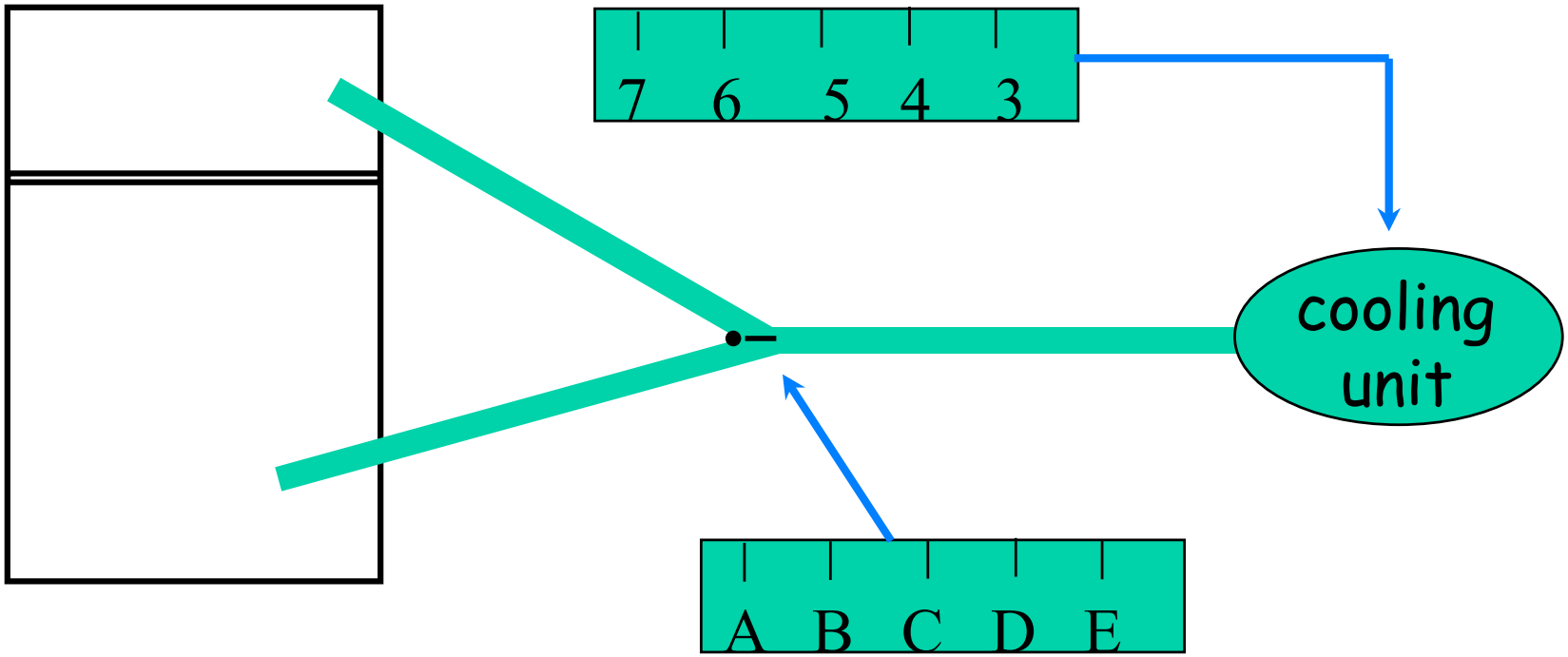
What is your conceptual model?

Most Likely Conceptual Model



In other words, independent controls

Correct Conceptual Model

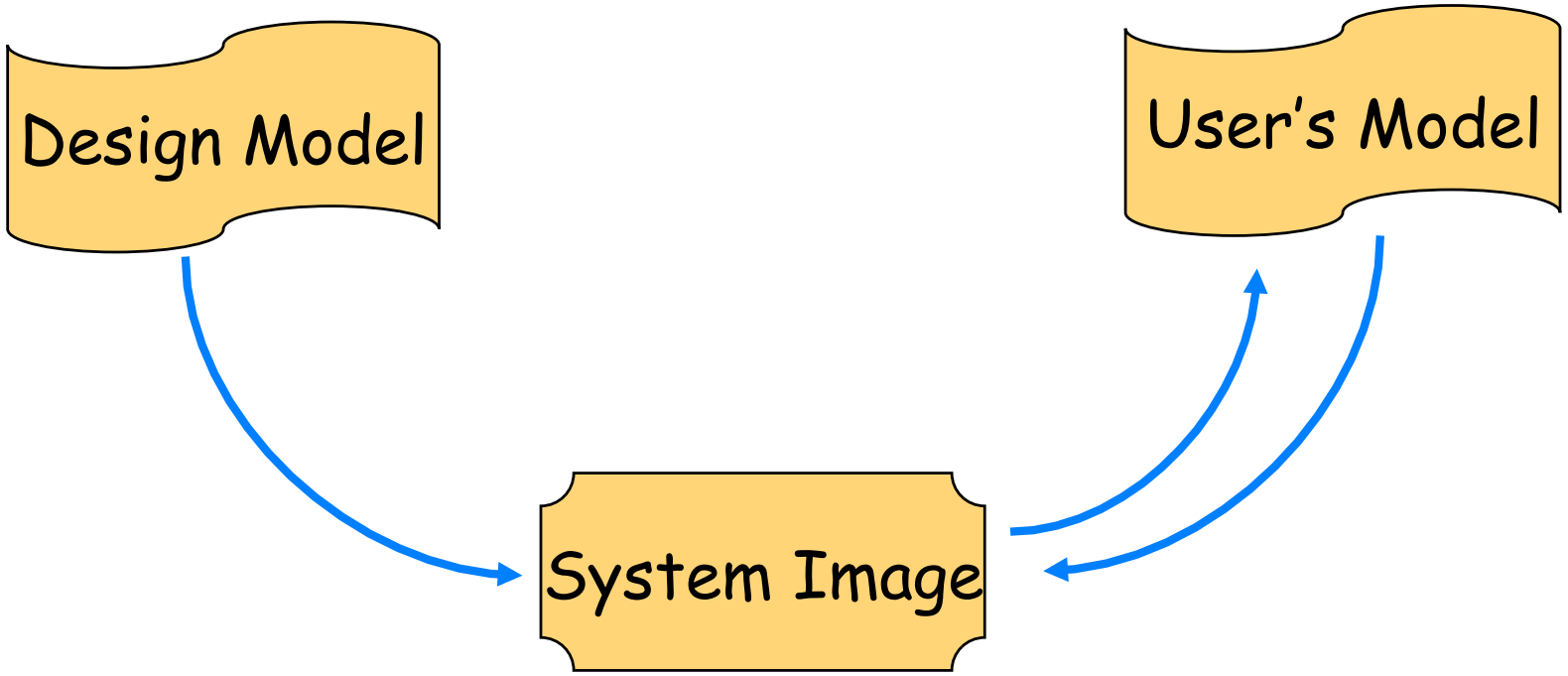


In other words, dependent controls

Can You Fix the Problem?

- Communicate correct model to the user
  - Change the description given on the controls
  - Raise/Lower Cooling
  - Distribute Cooling (20%/80% …)
  - Present drawing of controls

Design Model & User's Model



- Users gets model from experience & usage
- What if the two models don't match?

Mismatch between Designer's & User's Conceptual Models

- Errors
- Slow
- Frustration
- …

Principles and Guidelines

Consider human diversity

- Usage profiles
- Age, gender, physical abilities, education, background, training, motivation, goals, personality
- Novices, intermittent users, experts
- Level-structured interfaces (advanced and simple search example)
- Interaction styles: direct manipulation, menu selection, form fill-in, command language, natural language

Design principles

- Used to make the designer's conceptual model less ambiguous to the user:
  - Visibility
  - Feedback
  - Physical, logical & cultural constraints
  - Mappings
  - Consistency
  - Affordances

Visibility

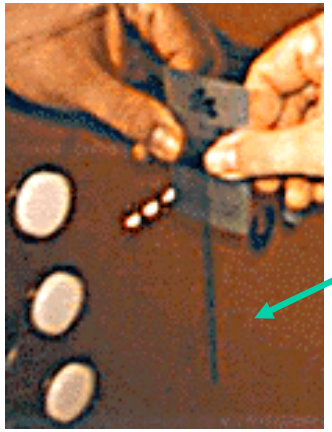
From:
www.baddesigns.com

- This is a control panel for an elevator.
- How does it work?
- Push a button for the floor you want?

- Nothing happens. Push any other button? Still nothing. What do you need to do?

It is not visible as to what to do!

Visibility



…you need to insert your room card in the slot by the buttons to get the elevator to work!

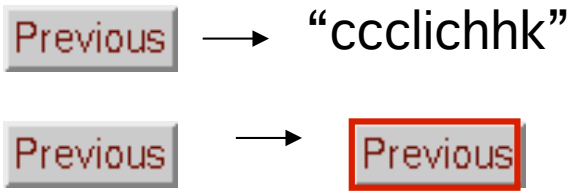
How would you make this action more visible?

- make the card reader more obvious
- provide an auditory message, that says what to do (which language?)
- provide a big label next to the card reader that flashes when someone enters

- make relevant parts visible
- make what has to be done obvious

Feedback

- Sending information back to the user about what has been done
- Includes sound, highlighting, animation and combinations of these
  - e.g. when screen button clicked on provides sound or red highlight feedback:



Constraints

- Restricting the possible actions that can be performed
- Helps prevent user from selecting incorrect options
- Error messages are not constraints; they are reached when constraints fail
- Three main types (Norman, 1999)
  - physical
  - cultural
  - logical

Physical constraints

- Refer to the way physical objects restrict the movement of things
  - E.g. only one way you can insert a key into a lock
- How many ways can you insert a CD or DVD disk into a computer?
- How physically constraining is this action?
- How does it differ from the insertion of a floppy disk into a computer?

Constraints

How (Not) To Open a Door

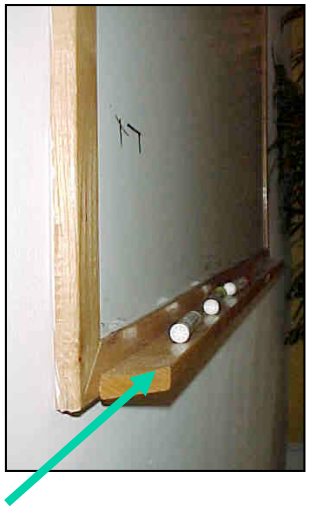
"Emergency Exit Only Push Until Alarm Sounds Door Can Be Opened In 15 Seconds

Furniture illegally blocking exit

Interaction Design

Physical world examples

- automatic transmission gear shift and ignition
- Polarized or 3-prong electrical plugs
- warning signage, e.g. “Dead End”



Lip constrains items from falling

UI examples

- choices that are grayed out
- tailored text entry fields
- drop-down boxes

PREVIOUS | NEXT

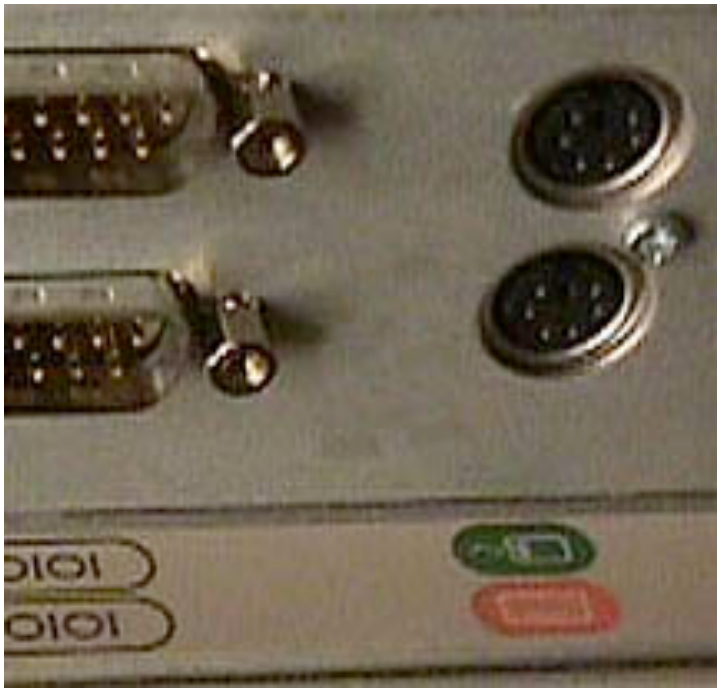
– – ext

no typos here

Logical constraints

- Exploits people's everyday common sense reasoning about the way the world works
- An example is they logical relationship between physical layout of a device and the way it works as the next slide illustrates

Logical or ambiguous design?



From: www.baddesigns.com

- Where do you plug the mouse?
- Where do you plug the keyboard?
- top or bottom connector?
- Do the colour coded icons help?

How to design them more logically

From: www.baddesigns.com

(i) A provides direct adjacent mapping between icon and connector

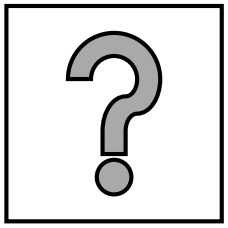
(ii) B provides colour coding to associate the connectors with the labels

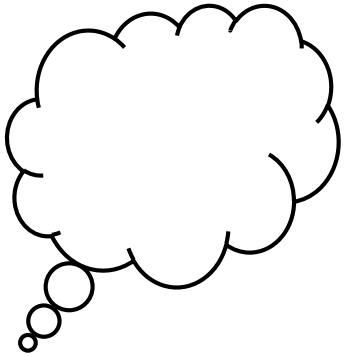
Cultural constraints

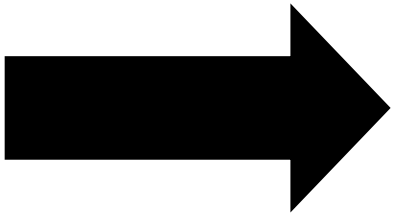
- Learned arbitrary conventions like red triangles for warning

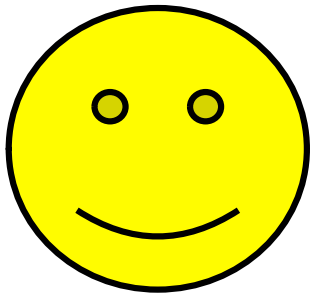
- Can be universal or culturally specific

Which are universal and which are culturally-specific?







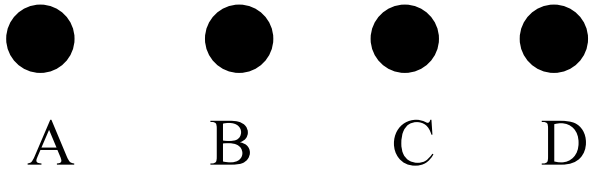


Mapping

- Mapping refers to the similarity between sets of objects where one represents the other, often between tools and their controls
- Mapping can leverage many dimensions: spatial, color, texture, sound
- Mappings are both natural (innate) and cultural (learned)
- Good mapping leverages visual similarity, a powerful cognitive tool

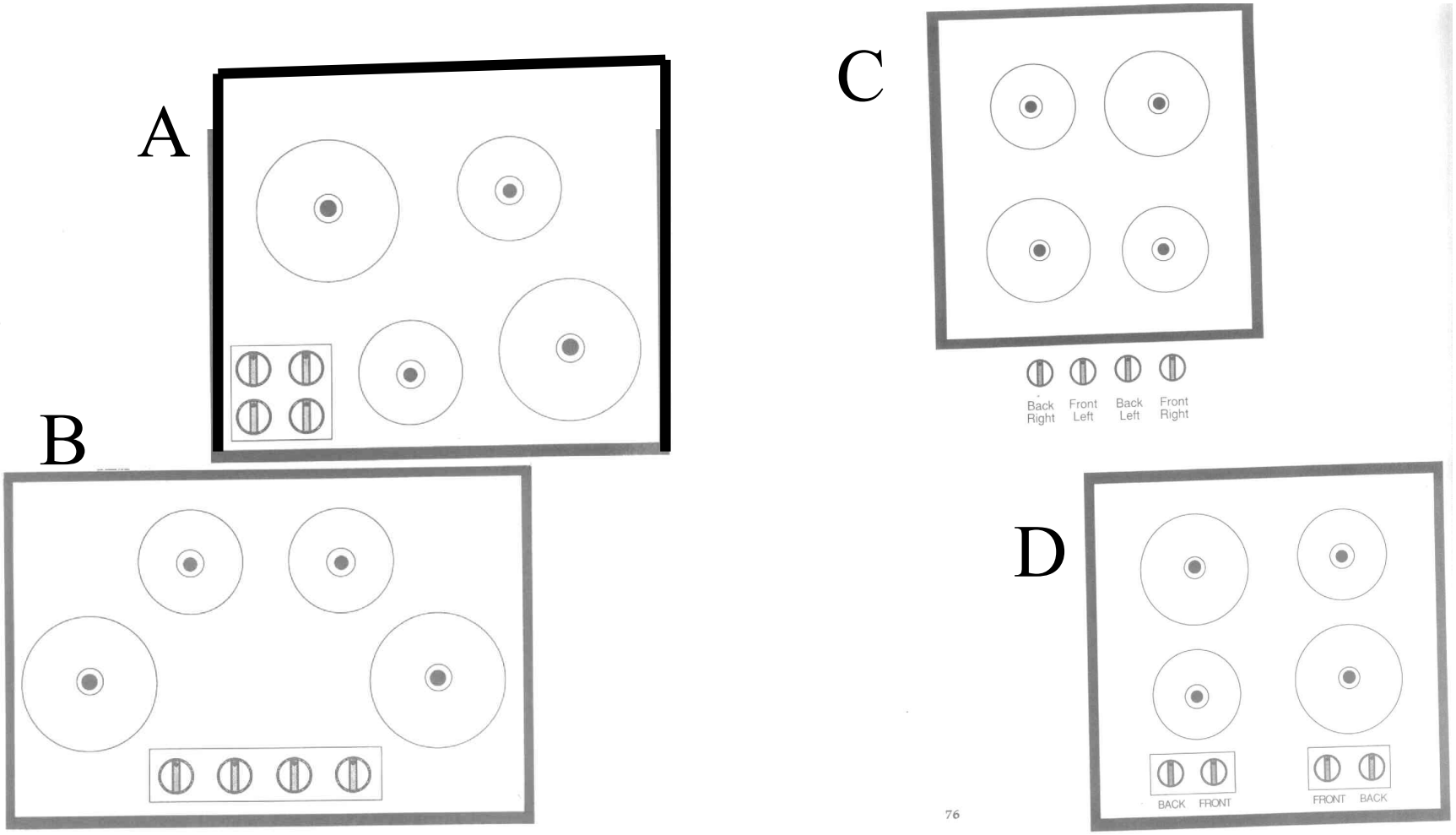
Activity on mappings

– Which controls go with which rings (burners)?



Interaction Design (9)

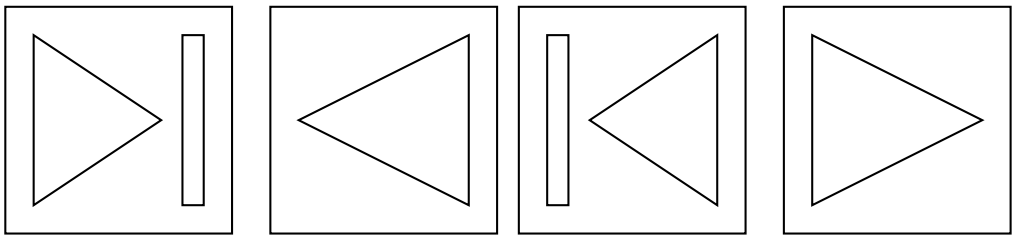
The classic mapping example: stovetops
(from Norman, The Design of Everyday Things)



Why is this a better design?

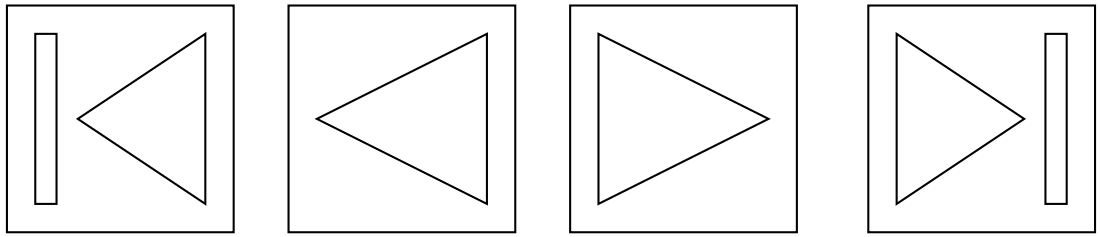
Mapping

- Relationship between controls and their movements and the results in the world
- Why is this a poor mapping of control buttons?



Mapping

- Why is this a better mapping?



- The control buttons are mapped better onto the sequence of actions of fast rewind, rewind, play and fast forward

Consistency

- Design interfaces to have similar operations and use similar elements for similar tasks
- For example:
  - always use ctrl key plus first initial of the command for an operation – ctrl+C, ctrl+S, ctrl+O; Exit or Quit
- Main benefit is consistent interfaces are easier to learn and use

Internal and external consistency

- Internal consistency refers to designing operations to behave the same within an application
  - Difficult to achieve with complex interfaces
- External consistency refers to designing operations, interfaces, etc., to be the same across applications and devices
  - Very rarely the case, based on different designer's preference

Keypad numbers layout

- A case of external inconsistency

(a) phones, remote controls

1	2	3
4	5	6
7	8	9
	0	

(b) calculators, computer keypads

7	8	9
4	5	6
1	2	3
0		

Affordances: to give a clue

- Refers to an attribute of an object that allows people to know how to use it
  - e.g. a mouse button invites pushing, a door handle affords pulling
- Norman (1988) used the term to discuss the design of everyday objects
- Since has been much popularised in interaction design to discuss how to design interface objects
  - e.g. scrollbars to afford moving up and down, icons to afford clicking on

Affordances

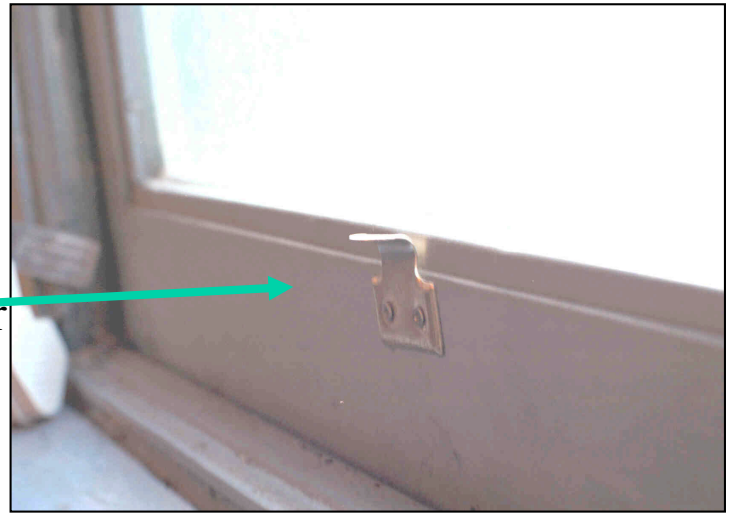
- Physical affordances:

  How do the following physical objects afford? Are they obvious?

Physical world examples: natural affordances

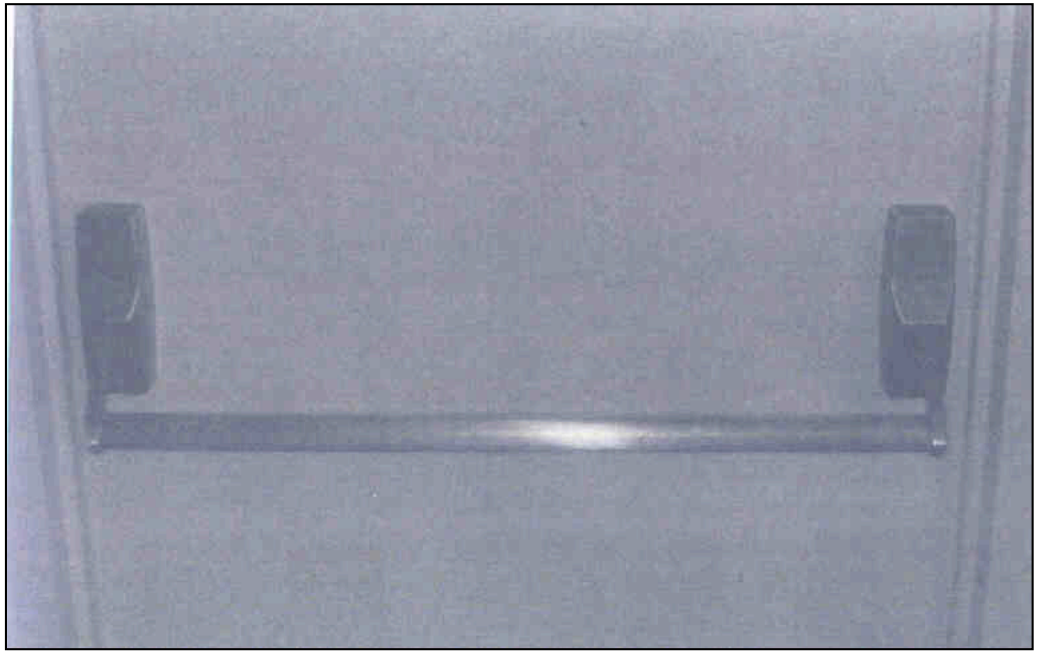
For the foot

For the finger



Real world examples: misleading affordances

Ambiguity at its worst:

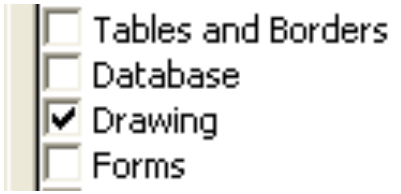


(From Norman, Design of Everyday Things)

Recognising Virtual affordances

- An affordance is an aspect of an object that makes it obvious how the object is to be used
- Recognising an affordance is an immediate consequence of perception
- Examples:
  - a button affords pushing

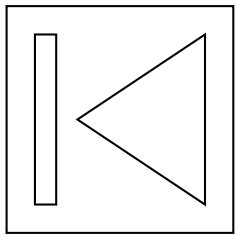
  - a checkbox affords checking

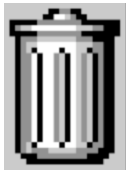


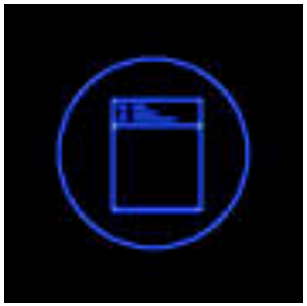
- Affordances are sometimes tightly coupled with actions, for example:
  - hyperlink: blue underlined text plus the pointer changes shape when passes over it

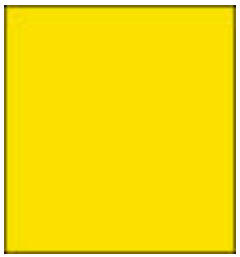
Affordances

- Virtual affordances
  - How do the following screen objects afford?
  - What if you were a novice user?
  - Would you know what to do with them?









Top Ten Mistakes in Web Design

From Jakob Nielsen “Heuristic Evaluation”

- http://www.useit.com/alertbox/

Should be controversial (some is outdated) - feel free to disagree

10. Overly Long Download Times

- 10 second rule
  - amount of wait time before users lose interest
    - traditional human factors studies back this up
- 15 seconds may be acceptable on web
  - people are getting trained to endure
  - but only for a few key pages
- Web is getting slower, not faster

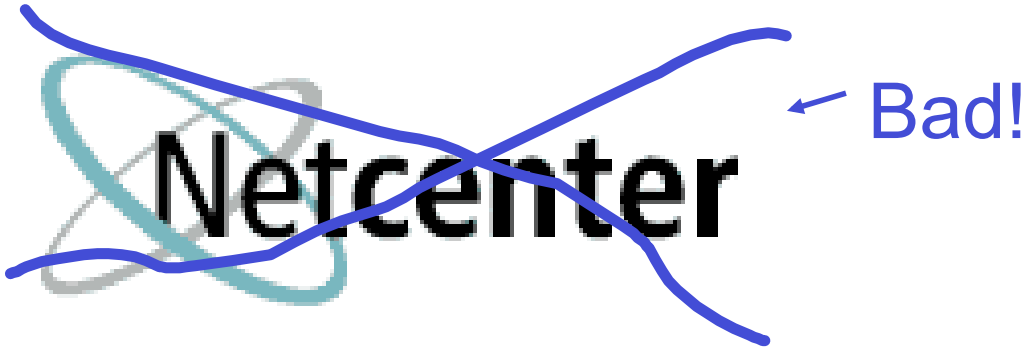
9. Outdated Information

- Most people rather create content than do maintenance
- Hire a Web master for your team
  - "root out the weeds and replant the flowers"

8. Non-standard Link Colors

- Links to
  - pages that haven’t been seen are blue
  - previously seen pages are purple/red
- Don't mess with these colors
  - one of the few navigational aides that is standard in most browsers
- Consistency is important for learning
  - don’t underline other objects with blue/red!

Side Note: Consistency

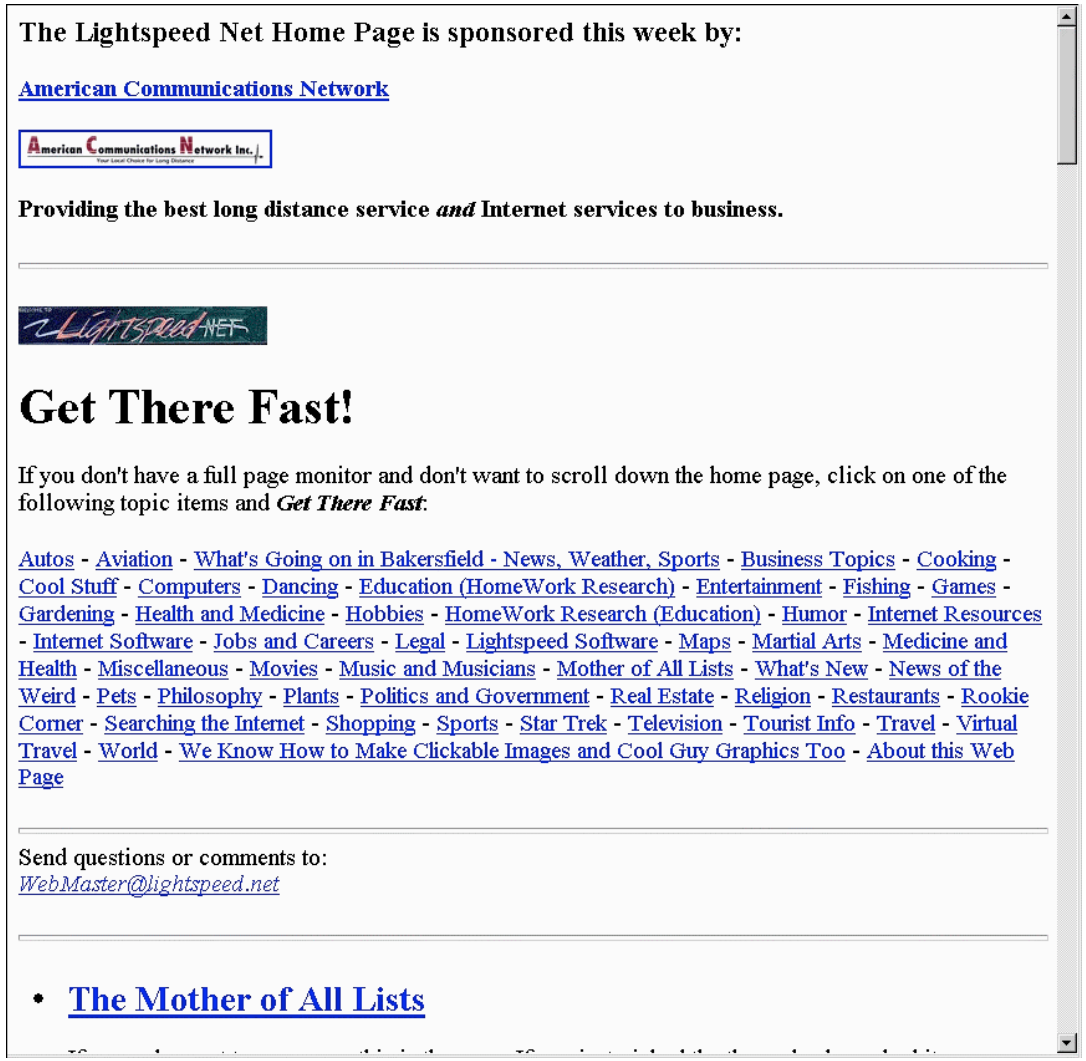


Don’t make things that look like buttons unless they act like buttons (or opposite)

7. Lack of Navigation Support

- Users don’t know much about your site
  - they always have difficulty finding information
  - give a strong sense of structure and place
- Communicate site structure
  - provide a site map
  - provide a good search feature
    - the best navigation support will never be enough

What Might be Wrong Here?



The Lightspeed Net Home Page is sponsored this week by:

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Get There Fast!

If you don't have a full page monitor and don't want to scroll down the home page, click on one of the following topic items and ***Get There Fast***:

Autos - Aviation - What's Going on in Bakersfield - News, Weather, Sports - Business Topics - Cooking - Cool Stuff - Computers - Dancing - Education (HomeWork Research) - Entertainment - Fishing - Games - Gardening - Health and Medicine - Hobbies - HomeWork Research (Education) - Humor - Internet Resources - Internet Software - Jobs and Careers - Legal - Lightspeed Software - Maps - Martial Arts - Medicine and Health - Miscellaneous - Movies - Music and Musicians - Mother of All Lists - What's New - News of the Weird - Pets - Philosophy - Plants - Politics and Government - Real Estate - Religion - Restaurants - Rookie Corner - Searching the Internet - Shopping - Sports - Star Trek - Television - Tourist Info - Travel - Virtual Travel - World - We Know How to Make Clickable Images and Cool Guy Graphics Too - About this Web Page

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Send questions or comments to:
WebMaster@lightspeed.net

- **The Mother of All Lists**

6. Long Scrolling Pages

- Only 10% of users scroll beyond visible section when page comes up!
- All critical content & navigation should be on the top part of the page
- Leaf nodes can be longer
  - people who have that interest will be reading it
  - still good to be brief

What Might be Wrong Here?

Courses Taught in the Past and Future Plans

Past Courses

Spring 1997 - CS 160: User Interface Design, Implementation, & Evaluation

Future Plans

Spring 1998 - CS 260: Research Topics in Human-Computer Interaction, WF, 11-12:30, 405 Soda

Back to my home page

5. Orphan Pages

- All pages should have a clear indication of what web site they belong to
  - users may not come in through your home page
- Every page should have
  - a link up to your home page
  - some indication of where they fit within the structure of your information space

4. Complex URLs

- Users try to decode URLs of pages
  - to infer the structure of web sites
    - lack of support for navigation & sense of location
- URL should be human-readable
  - names should reflect nature of the info. space
  - sometimes need to type in URL->minimize typos
    - use lower-case, short names with no special chars
      - many people don't know how to type a ~

3. Constantly Running Animations

- Don’t have elements that move incessantly
  - moving images have an overpowering effect on the human peripheral vision
    - -> no animations, scrolling text, marquees
- Give your user some peace and quiet to actually read the text!
- <BLINK> is simply evil

2. Unjustified use of Bleeding Edge Technology

- Don’t try to attract people using it
  - you’ll get the nerd crowd, but mainstream users care about content and service
- If their system crashes
  - they will never come back

1. Using Frame Related Techniques

- Confusing for users
  - breaks the user model of the web page
  - lose predictability of user actions
    - who knows what information will appear where when you click on a link?
      - can’t bookmark the current page and return to it
      - URLs stop working
      - can’t share with others (lose social filtering)

Frames (cont.)

- Search engines have problems w/ frames
  - what part of frames do you include in indexes?
- Early surveys found most users preferred frame-less sites
- Caveat: very experienced designers can sometimes use frames to good effect, but should use as sparingly as possible

Further Learning: **Heuristic Evaluation** :

http://www.useit.com

- **Visibility of system status**
- **Match between system and the real world**
- **User control and freedom**
- **Consistency and standards**
- **Error prevention**
- **Recognition rather than recall**
- **Flexibility and efficiency of use**
- **Aesthetic and minimalist design**
- **Help users recognize, diagnose, and recover from errors**
- **Help and documentation**