Design of everyday things

Summary so far:
- many so-called human errors are actually errors in design
- human factors became important as human performance limitations reached when handling complex machinery

You will soon know these important concepts for designing everyday things
- perceived affordances
- causality
- visible constraints
- mapping
- transfer effects
- idioms & population stereotypes
- conceptual models
- individual differences
- why design is hard

Perceived Affordance

The perceived properties of the object that suggest how one could use it

chairs are for sitting
table for placing things on

knobs are for turning

slots are for inserting
handles are for turning

buttons are
for pressing

switch for toggling

computer for…

Many concepts in this section are adapted from Don Norman's book: The Design of Everyday Things

Perceived Affordances

Product design
- perceived affordances:
  - design invites people to take possible actions
- actual affordances:
  - the actual actionable properties of the product

Problems occur when
- these are not the same,
- people's perceptions are not what the designer expects

In-depth discussion available at www.jnd.org/dn.mss/affordances-and-design.html

Perceived Affordances

Saul Greenberg

Perceived Affordance Problems

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Perceived Affordances

GUI design

- perception only through visuals
- designer creates appropriate visual affordances via
  - familiar idioms
  - metaphors

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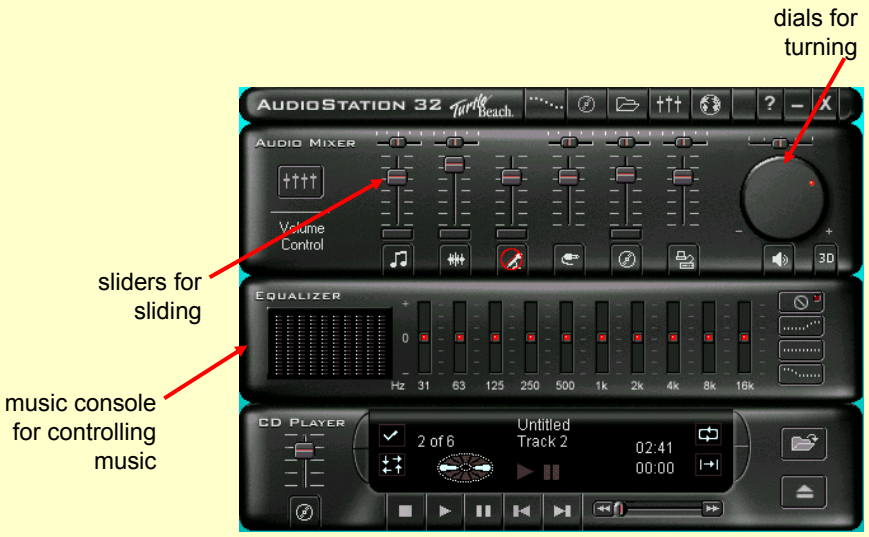
Perceived Affordances



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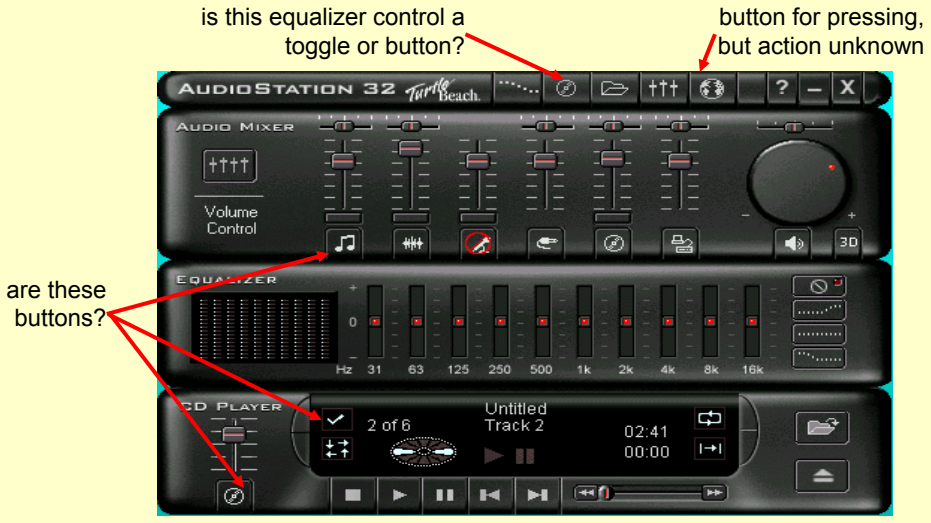
Perceived Affordance Problems



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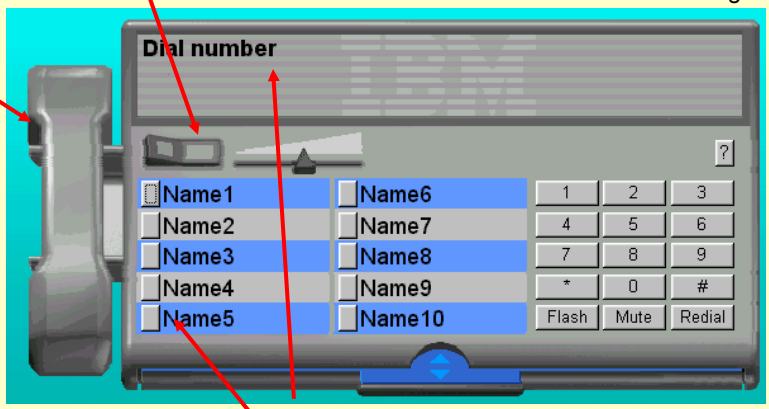
Perceived Affordance Problems

Is this a graphic or a control?

A button is for pressing, but what does it do?

Visual affordances for window controls are missing!



text is for editing, but it doesn't do it.

IBM Real Phone

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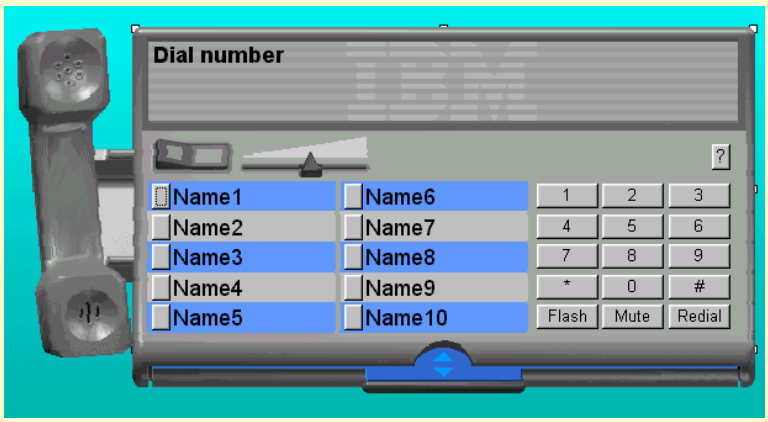
Perceived Affordance Problems



IBM Real Phone

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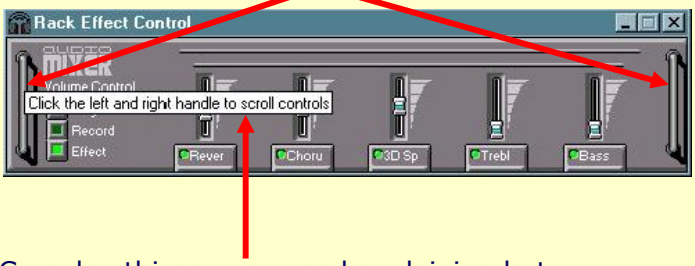
Perceived Affordance Problems

Handles are for lifting,
but these are for scrolling!



Complex things may need explaining but
simple things should not

- when simple things need labels & instructions, then design has failed

AudioRack 32, a multimedia applicaiton

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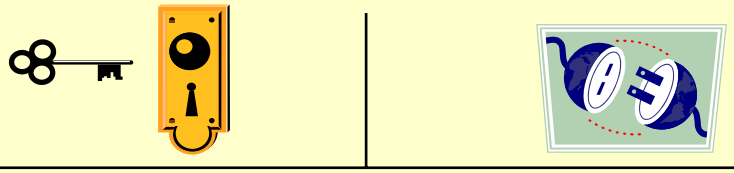
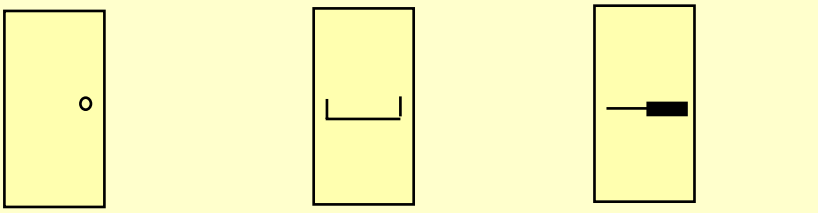
Visible Constraints

Limitations of the actions possible perceived from object's appearance

- provides people with a range of usage possibilities





Push or pull?

Which side?

Can only push,
side to push clearly visible

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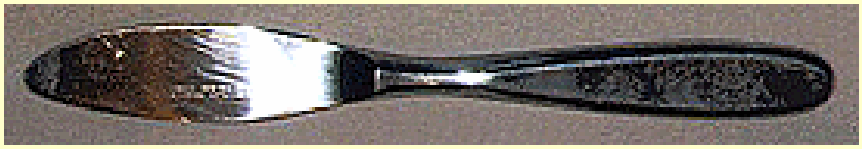
Which side do you use for cutting?



Photograph courtesy of www.baddesigns.com

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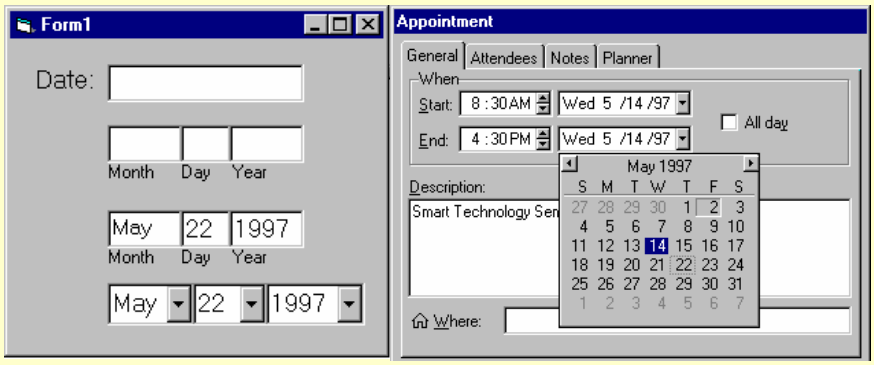
Visible constraints: Entering a Date

The more constraints, the less opportunity for error

- particularly important for managing user input



Controls constructed in Visual Basic

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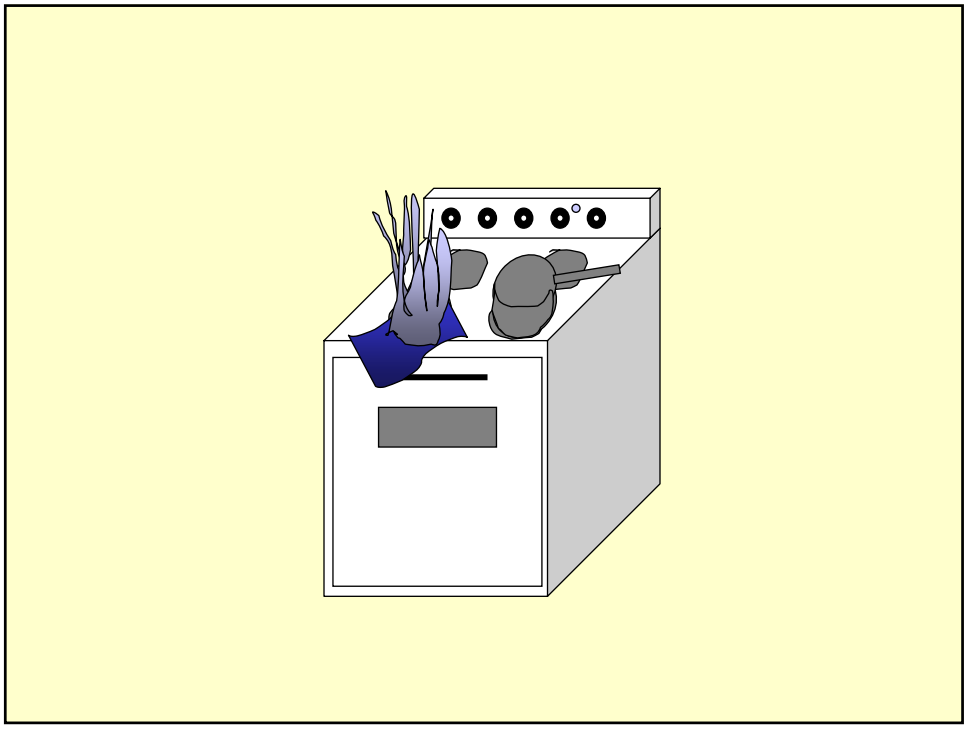


CHEF
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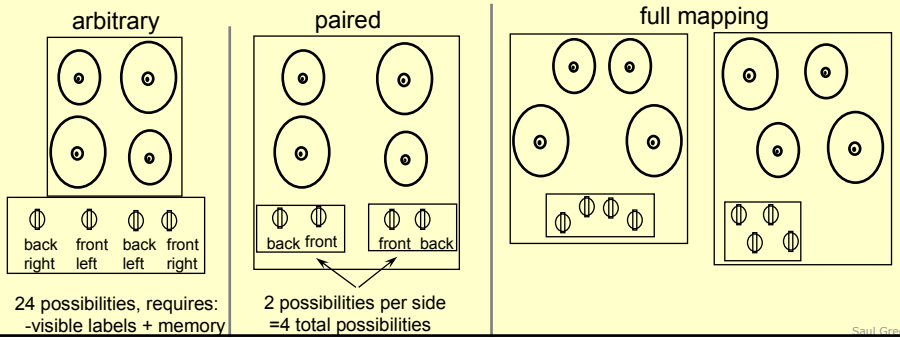
Mapping

The set of possible relations between objects

Control-display compatibility

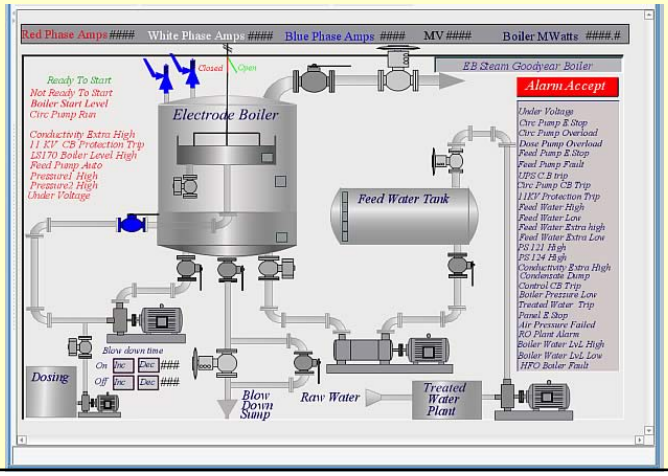
- the natural relationship between controls and displays
- e.g., visual mapping of stove controls to elements



Mapping

Control-display compatibility

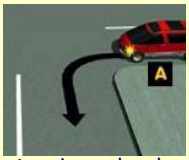
- mimic diagrams for feedback / control imitates physical layout



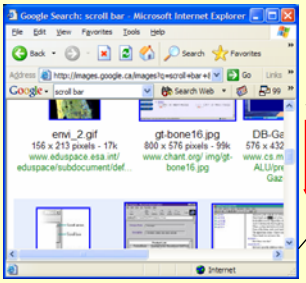
Mapping

Control-display compatibility

- cause and effect



steering wheel-
turn left, car turns left



scroll bar – scroll down
viewport goes down

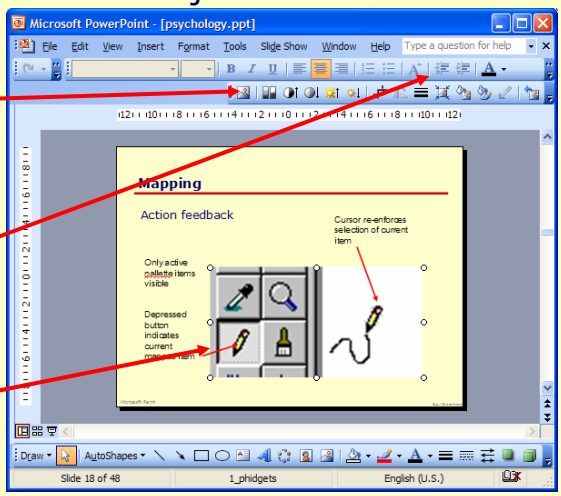
Mapping

Palette controls and active objects

Only controls that can operate on a picture are fully visible

Others are grayed out

Selected picture



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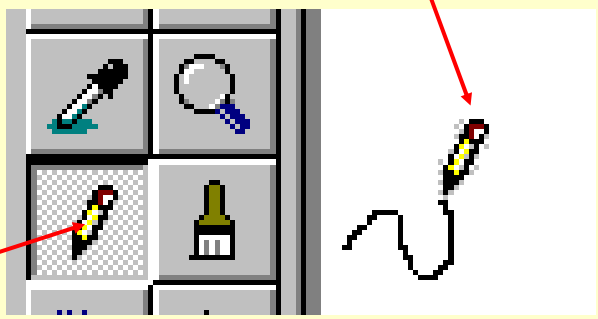
Mapping

Action feedback

Cursor re-enforces selection of current item

Depressed button indicates current mapped item



Microsoft Paint

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Mapping Problems

Quick, open the top drawer

Photograph courtesy of www.baddesigns.com

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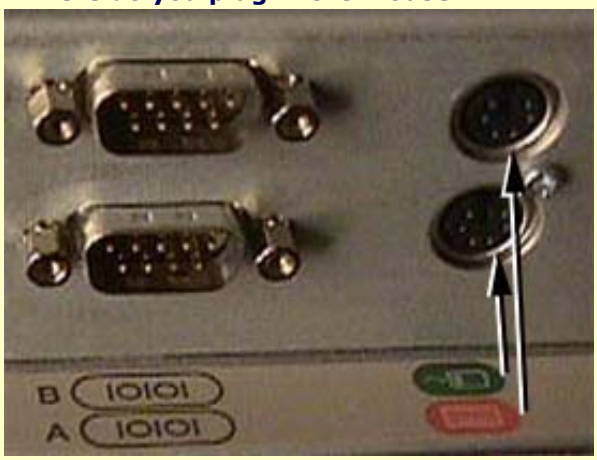
Mapping Problems

Where do you plug in the mouse?



Mapping ambiguous

Photograph courtesy of www.baddesigns.com

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Causality

the thing that happens right after an action is assumed by people to be caused by that action

- interpretation of "feedback"
- false causality
  - incorrect effect
    - invoking unfamiliar function just as computer hangs
    - causes "superstitious" behaviors
  - invisible effect
    - command with no apparent result often re-entered repeatedly
    - e.g., mouse click to raise menu on unresponsive system

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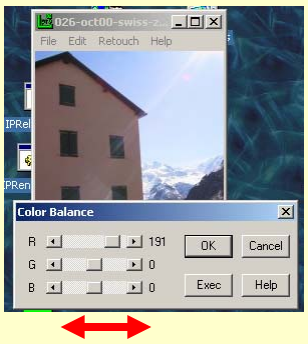
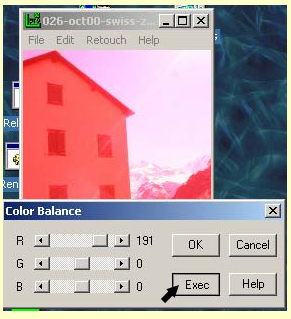
Causality Problems

Effects visible only after Exec button is pressed

- Ok does nothing!
- awkward to find appropriate color level





LViewPro

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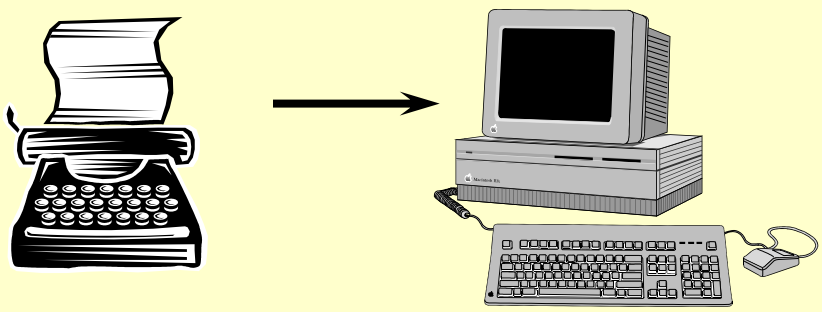
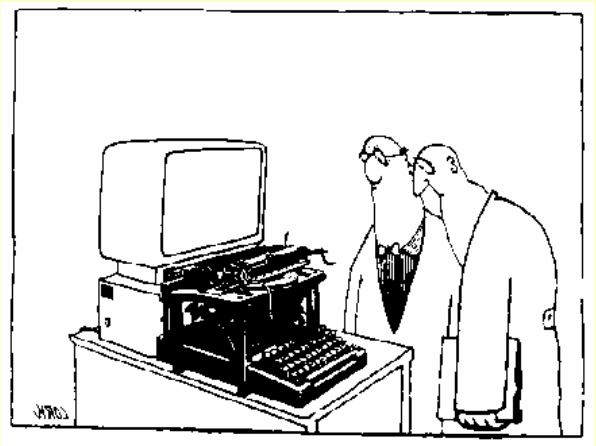
Transfer Effects

People transfer their learning/expectations of similar objects to the current objects

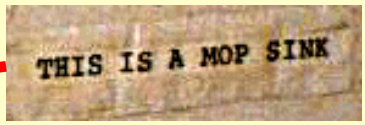
- positive transfer: previous learning's also apply to new situation
- negative transfer: previous learning's conflict with the new situation





Transfer Effect Problems

A Restaurant in Santa Barbara



Photograph courtesy of www.baddesigns.com

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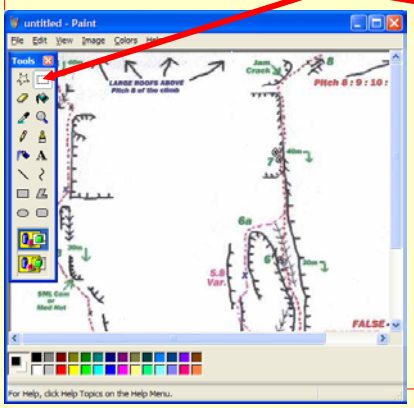
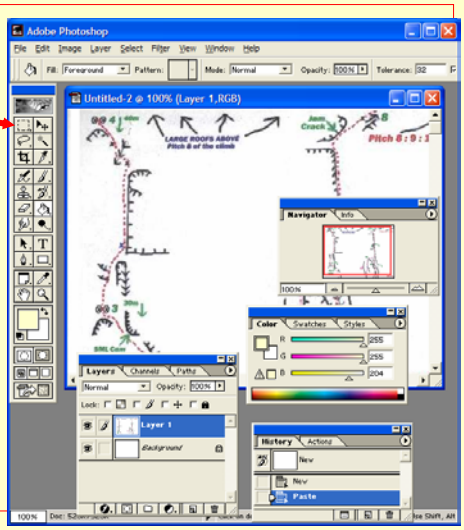
Transfer Effect Problems

How does knowing MSPaint help you in Photoshop?

- e.g. rectangular control...





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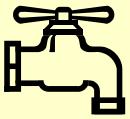
Idioms and Population Stereotypes

Interface idioms:
- 'standard' interface features we learnt, use and remember

Idioms may define arbitrary behaviours
- red means danger
- green means safe

Population stereotypes: Idioms vary in different cultures
- Light switches
  - America: down is off
  - Britain: down is on

- Faucets
  - America: anti-clockwise on
  - Britain: anti-clockwise off



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Idioms and Population Stereotypes

Ignoring/changing idioms?
- home handyman
  - light switches installed upside down
- calculators vs. phone number pads
  - which did computer keypads follow and why?

Difficulty of changing stereotypes
- Qwerty keyboard: designed to prevent jamming of keyboard
- Dvorak keyboard ('30s): provably faster to use

Images from www.atarimagazines.com/v5n11/dvorakkeyboard.html

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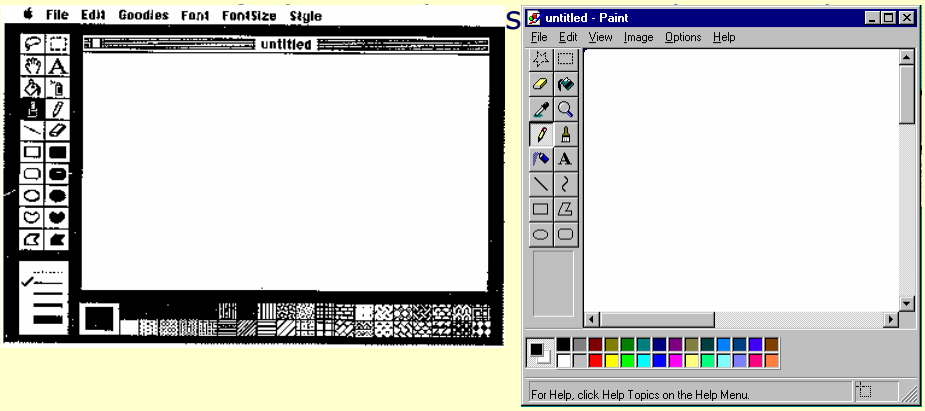
Cultural associations



Apple MacPaint and Microsoft Paint

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Conceptual model

People have "mental models" of how things work, built from

- affordances
- causality
- constraints
- mapping
- positive transfer
- population stereotypes/cultural standards
- instructions
- interactions

models allow people to mentally simulate operation of device

models may be wrong

- particularly if above attributes are misleading

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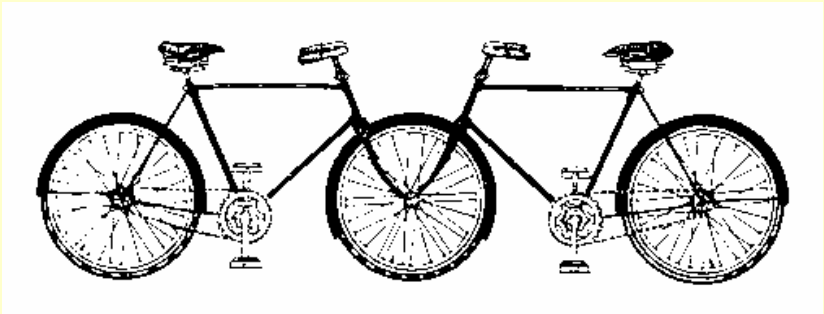
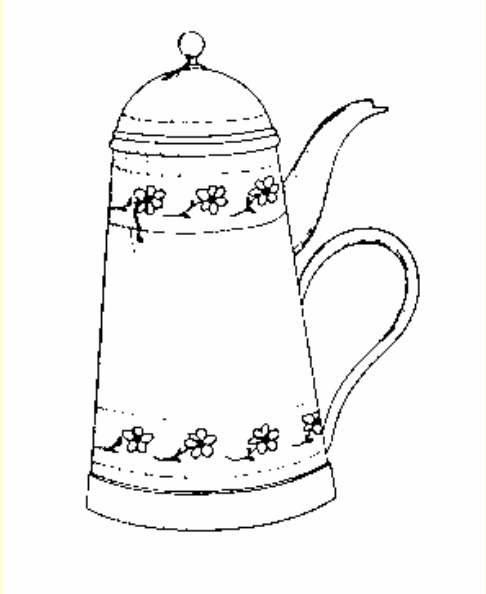
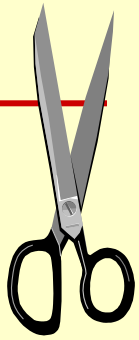


Donald Norman Design of Everyday Things, Basic Books



Donald Norman Design of Everyday Things, Basic Books

Good example: Scissors



affordances:
- holes for something to be inserted

constraints:
- big hole for several fingers, small hole for thumb

mapping:
- between holes and fingers suggested and constrained by appearance

positive transfer and cultural idioms
- learnt when young
- constant mechanism

conceptual model:
- implications clear of how the operating parts work

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Bad example: Digital watch

affordances:
- four push buttons to push, but not clear what they will do

constraints and mapping unknown
- no visible relation between buttons, possible actions and end result

transfer of training
- little relation to analog watches

cultural idiom
- somewhat standardized core controls and functions
- but still highly variable

conceptual model:
- must be learnt

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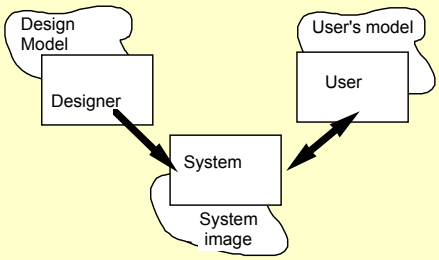
Designing a good conceptual model

communicate model through visual image
- visible affordances, mappings, and constraints
- visible causality of interactions
- cultural idioms, transfer
- instructions augments visuals

all work together to remind a person of what can be done and how to do it



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Who do you design for?

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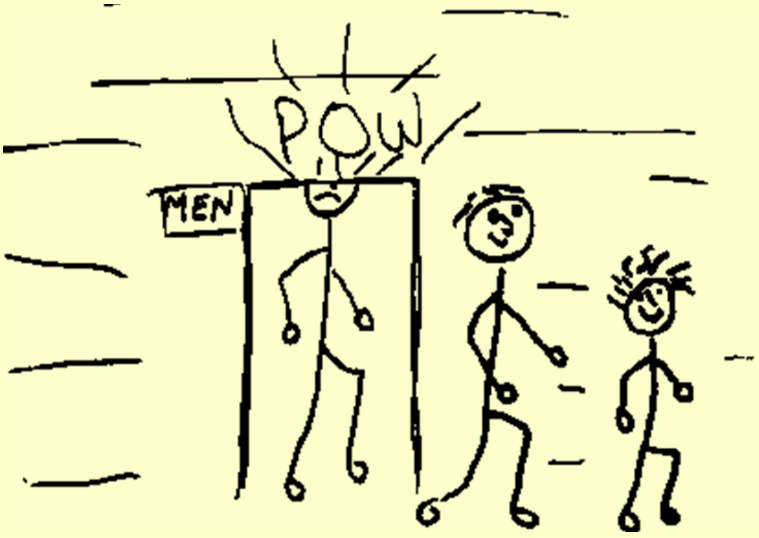
Who do you design for?



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Who do you design for?

People are different

It is rarely possible to accommodate all people perfectly

- design often a compromise
  - ceiling height: 8‘
  - but tallest man: 8' 11"!

Rule of thumb:

- cater to 95% of audience (5th or 95th percentile)
  - but means 5% of population may be (seriously!) compromised
- designing for the average a mistake
  - may exclude half the audience

Examples:

- cars and height: headroom, seat size
- computers and visibility:
  - font size, line thickness, color for color-blind people?

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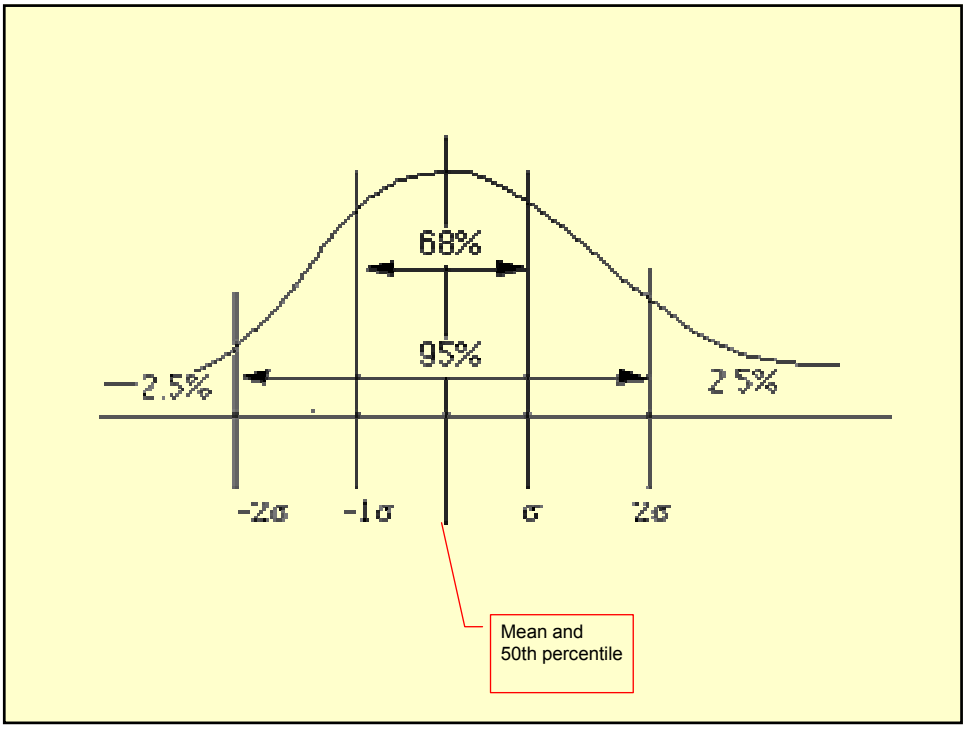

Proverbs on individual differences

You do **not** necessarily represent a good average user of equipment or systems you design

Do not expect others to think and behave as you do, or as you might like them to.

People vary in thought and behaviour just as they do physically

Who do you design for?

- novices — *walk up and use systems*; *interface affords restricted set of tasks*; *introductory tutorials to more complex uses*
- casual — *standard idioms*; *recognition (visual affordances) over recall*; *reference guides*; *interface affords basic task structure*
- intermediate — *advanced idioms*; *complex controls*; *reminders and tips*; *interface affords advanced tasks*
- expert — *shortcuts for power use*; *interface affords full task + task customization*

most kiosk + internet systems

most shrink-wrapped systems

custom software

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Why design is hard

Over the last century

- the number of things to control has increased dramatically
  - car radio: AM, FM1, FM2, 5 pre-sets, station selection, balance, fader, bass, treble, distance, mono/stereo, dolby, tape eject, fast forward and reverse, etc (while driving at night!)
- display is increasingly artificial
  - red lights in car indicate problems vs flames for fire
- feedback more complex, subtle, and less natural
  - is your digital watch alarm on and set correctly?
- errors increasing serious and/or costly
  - airplane crashes, losing days of work...

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Why design is hard

Marketplace pressures

- adding functionality (complexity) now easy and cheap
  - computers
- adding controls/feedback expensive
  - physical buttons on calculator, microwave oven
  - widgets consume screen real estate
- design usually requires several iterations before success
  - product pulled if not immediately successful

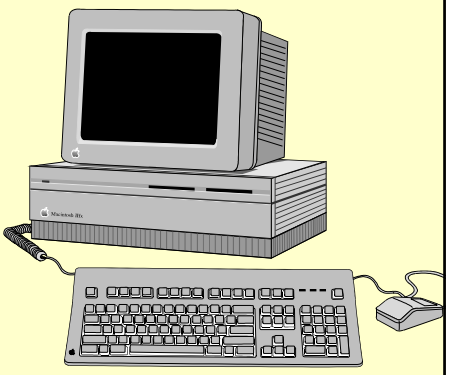
Why design is hard

People consider cost and appearance over design

- bad design not always visible
- people tend to blame themselves when errors occur
  - "I was never very good with machines"
  - "I knew I should have read the manual!"
  - "Look at what I did! Do I feel stupid!"
- eg the new wave of cheap telephones:
  - accidentally hangs up when button hit with chin
  - bad audio feedback
  - cheap pushbuttons—mis-dials common
  - trendy designs that are uncomfortable to hold
  - hangs up when dropped
  - functionality that can't be accessed (redial, mute, hold)

Human factors in computing systems

What does this do?



- computers far more complex to control than everyday devices
- general purpose computer contains no natural conceptual model
- completely up to the designer to craft a conceptual model

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What you now know

Many human errors are actually errors in design
- don't blame the user!

Designers help by providing a good conceptual model
- affordances
- causality
- constraints
- mapping
- positive transfer
- population stereotypes and idioms

Design to accommodate individual differences
- decide on the range of users

Design is difficult for reasons that go beyond design

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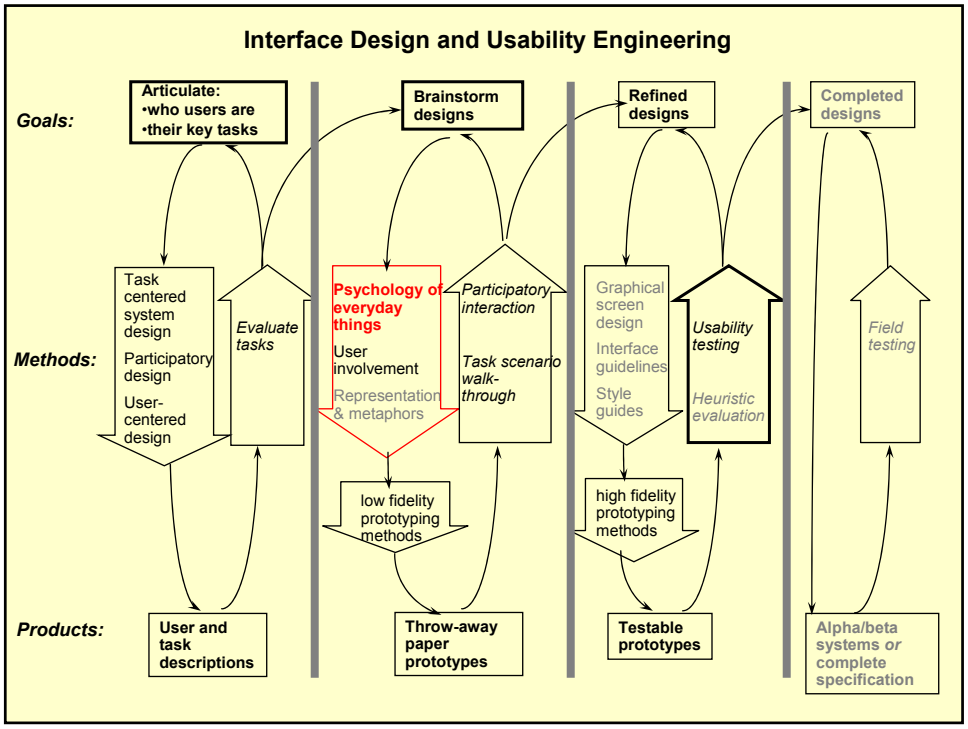
Interface Design and Usability Engineering
Goals:
Articulate:
•who users are
•their key tasks
Brainstorm designs
Refined designs
Completed designs
Methods:
Task centered system design
Participatory design
User-centered design
Evaluate tasks
Psychology of everyday things
User involvement
Representation & metaphors
Participatory interaction
Task scenario walk-through
Graphical screen design
Interface guidelines
Style guides
Usability testing
Heuristic evaluation
Field testing
low fidelity prototyping methods
high fidelity prototyping methods
Products:
User and task descriptions
Throw-away paper prototypes
Testable prototypes
Alpha/beta systems or complete specification