Psychology of everyday things

You now know:
- many so-called human errors are actually errors in design
- human factors became important in WWII due to human performance limitations being reached when handling complex machinery

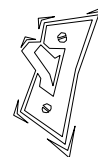**You will soon know these important concepts for designing everyday things**
- affordances
- causality
- visible constraints
- mapping
- transfer effects
- population stereotypes
- conceptual models
- individual differences
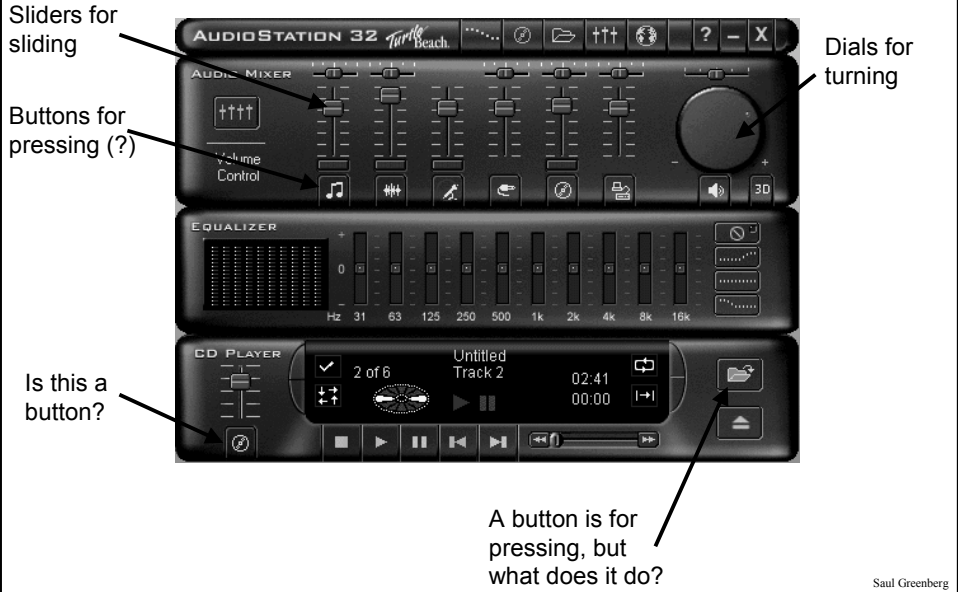- why design is hard

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Making things work: Visual Structure

Visual Affordances
- the perceived and actual fundamental properties of the object that determine how it could possible be used

- appearance indicates how the object should be used
    - chair for sitting
    - table for placing things on
    - knobs for turning
    - slots for inserting things into
    - buttons for pushing
    - computers for ???

- complex things may need explaining, but simple things should not
    - when simple things need pictures, labels, instructions, then design has failed
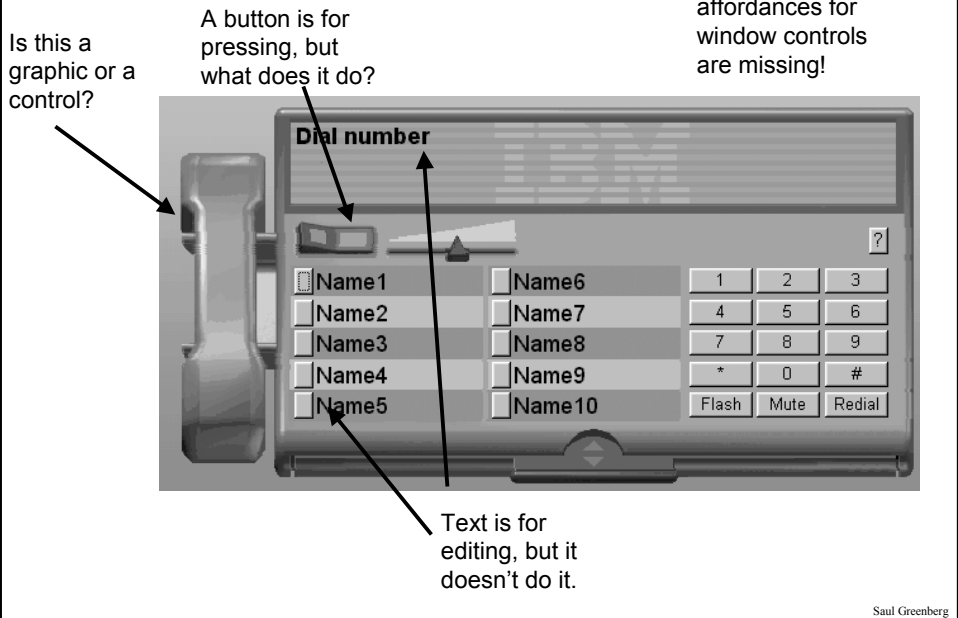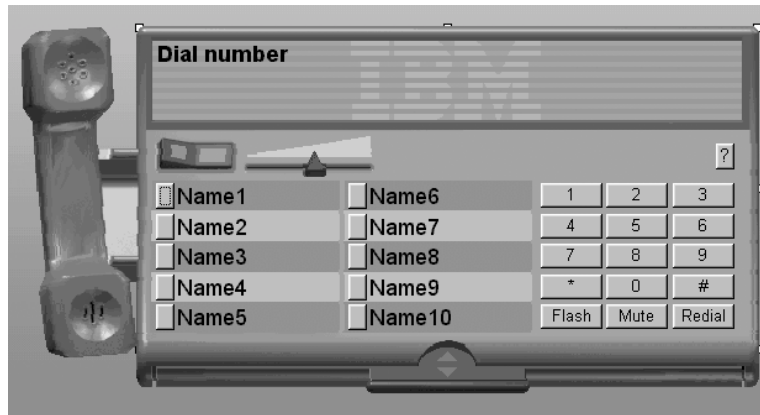
Low level affordances: needs familiar idiom and metaphor to work

Sliders for sliding

Buttons for pressing (?)

Is this a button?

Dials for turning

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

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Some non-obvious visual affordance

Visual affordances for window controls are missing!

Is this a graphic or a control?

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

Dial number

Name1 Name6   1 2 3
Name2 Name7   4 5 6
Name3 Name8   7 8 9
Name4 Name9   * 0 #
Name5 Name10   Flash Mute Redial

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

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A non-obvious visual affordance

Dial number

IBM

Name1	Name6	1 2 3
Name2	Name7	4 5 6
Name3	Name8	7 8 9
Name4	Name9	* 0 #
Name5	Name10	Flash Mute Redial

?

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A bad affordance

Handles are for lifting, but these are for scrolling

Rack Effect Control

MIXER
Volume Control

Click the left and right handle to scroll controls
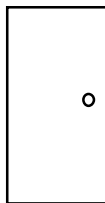
Record
Effect

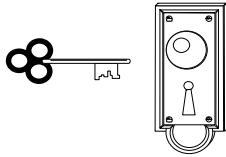Rever   Choru   3D Sp   Trebl   Bass
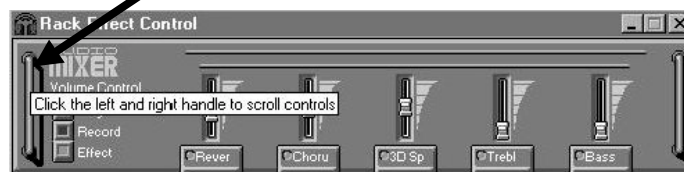
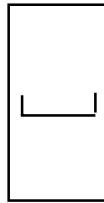from *AudioRack 32*, a multimedia application

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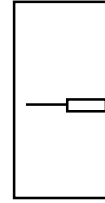## Making things work: Visual Structure (continued)

Visible Constraints
- limitations of the actions possible perceived from object's appearance
- provides people with a range of usage possibilities
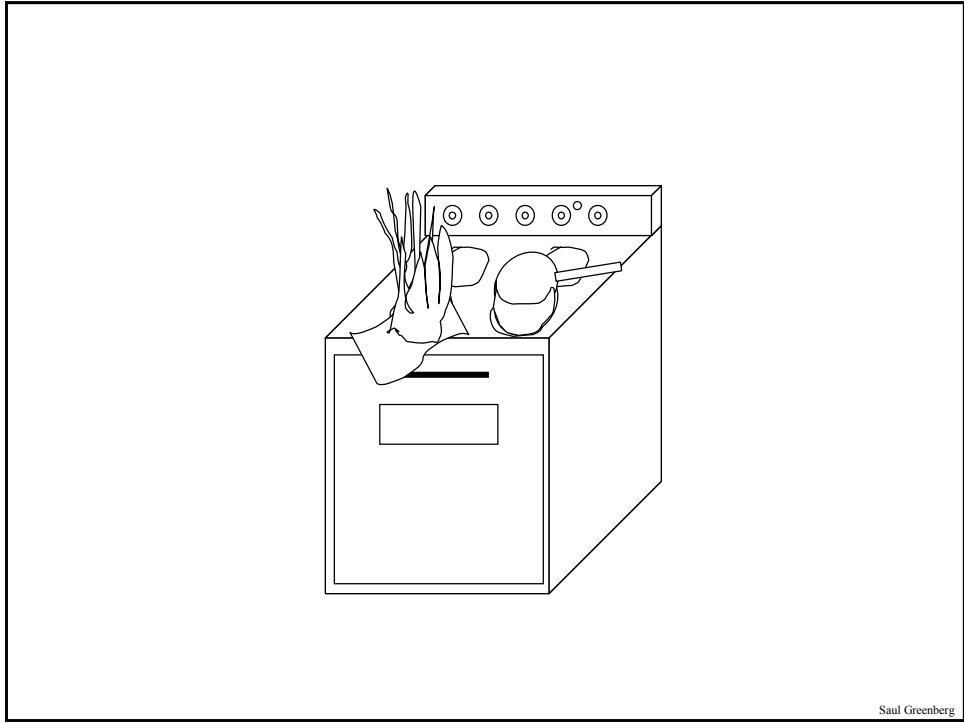
Push or pull?

Which side?

**Can only push,
side to push clearly visible**

A Progression of Visible Constraints to Enter a Date

Form1

Date:

Month   Day   Year

May   22   1997
Month   Day   Year

May   22   1997

Appointment

General | Attendees | Notes | Planner

When

Start: 8 :30AM   Wed 5 /14 /97

End: 4 :30PM   Wed 5 /14 /97

☐ All day

Description:

Smart Technology Sen

May 1997
S M T W T F S
27 28 29 30 1 2 3
 4 5 6 7 8 9 10
11 12 13 **14** 15 16 17
18 19 20 21 22 23 24
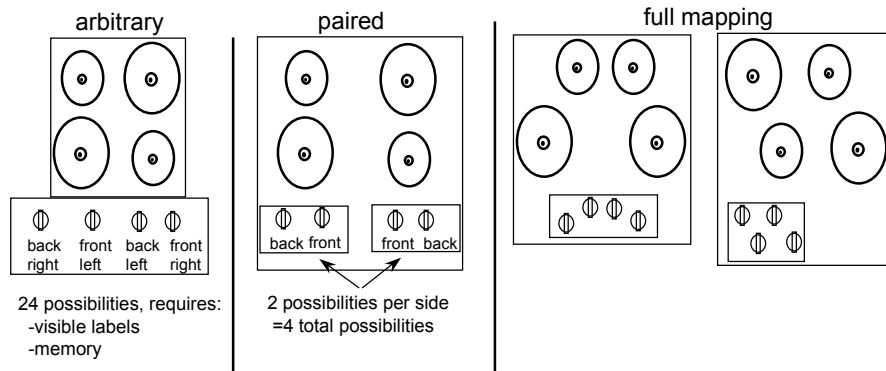25 26 27 28 29 30 31
 1 2 3 4 5 6 7

⌂ Where:

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Making things work: Visual Structure (continued)

Mappings
- the set of possible relations between objects
- the natural relationship between two things
  - eg control-display compatibility
    visible mapping and mimic diagrams: stove and controls
    cause and effect: steering wheel-turn right, car turns right
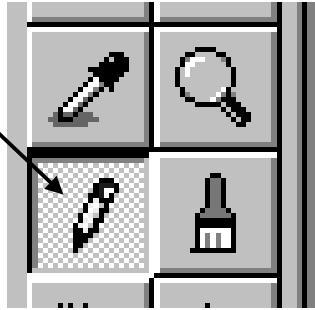
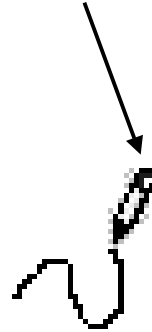| arbitrary	paired	full mapping

back right front left back left front right

back front   front back

24 possibilities, requires:
-visible labels
-memory

2 possibilities per side
=4 total possibilities

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Mapping

Cursor re-enforces
selection of current
item

Only active
pallette items
visible

Depressed
button
indicates
current
mapped item

Making things work: Understandable action

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

- interpretation of "feedback" (more on this later)

- false causality
  - incorrect effect
    starting up an unfamiliar application just as computer crashes
    causes "superstitious" behaviors

  - invisible effect
    command with no apparent result often re-entered repeatedly
    e.g., mouse click to raise menu on unresponsive system

Psychology of everyday things   7

Effects visible only after Exec button is pressed
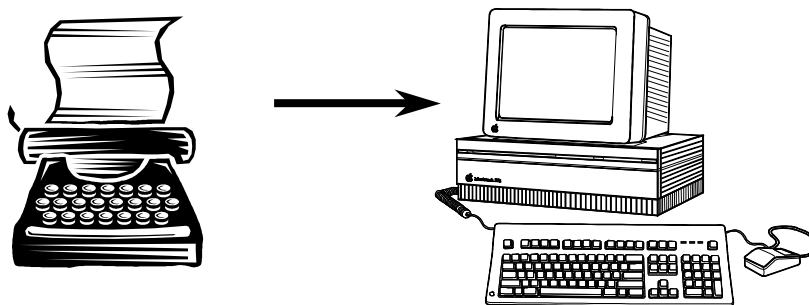•*Ok does nothing!*
•*awkward to find appropriate color level*
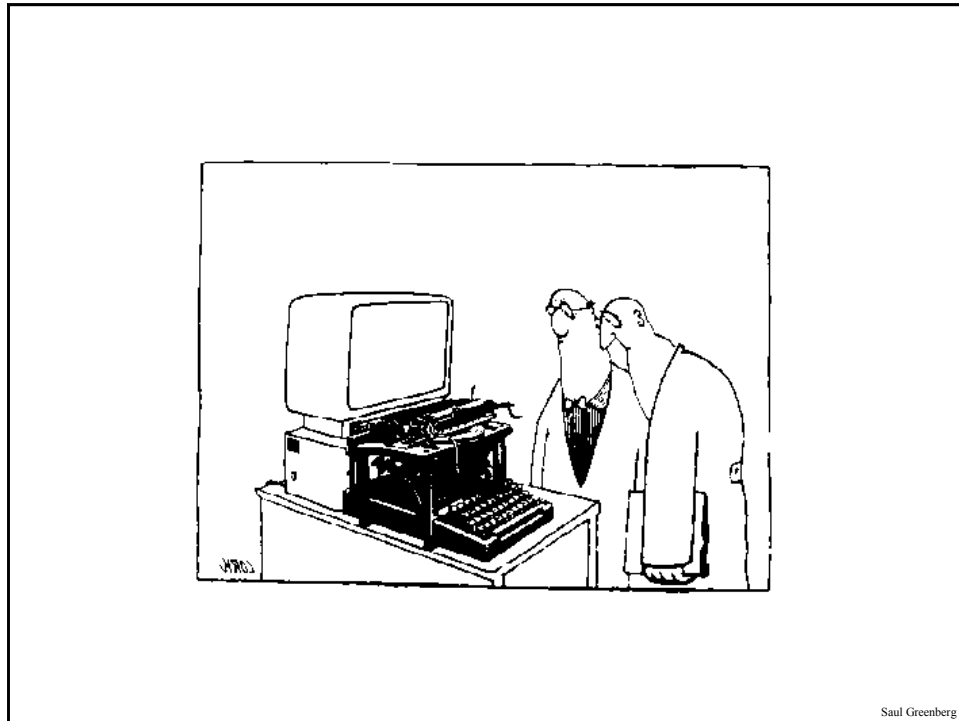
Making things work: Understandable action

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

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Population stereotypes

Populations learn idioms that work in a certain way
- red means danger
- green means safe

• But idioms vary in different cultures!
- Light switches
America: down is off
Britain: down is on
- Faucets
America: anti-clockwise on
Britain: anti-clockwise off

• Ignoring/changing stereotypes?
- home handyman: light switches installed upside down
- calculators vs. phone number pads: which should computer keypads follow?

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

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Cultural Associations

Because a trashcan in Thailand may look like this:

a Thai user is likely to be confused by this image popular in Apple interfaces:
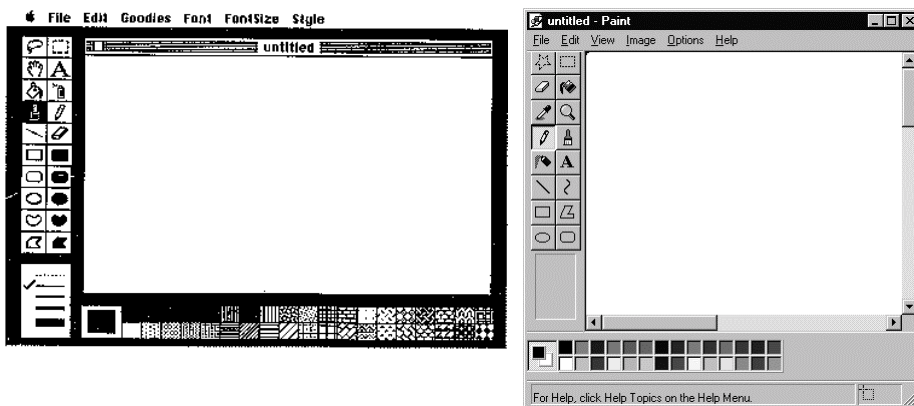
Sun found their email icon problematic for some American urban dwellers who are unfamiliar with rural mail boxes.

Cultural associations

A Mac user finds a Windows system only somewhat familiar

Conceptual model

**People have "mental models" of how things work**

conceptual models built from:
- affordances
- causality
- constraints
- mapping
- positive transfer
- population stereotypes/cultural standards
- instructions
- interactions
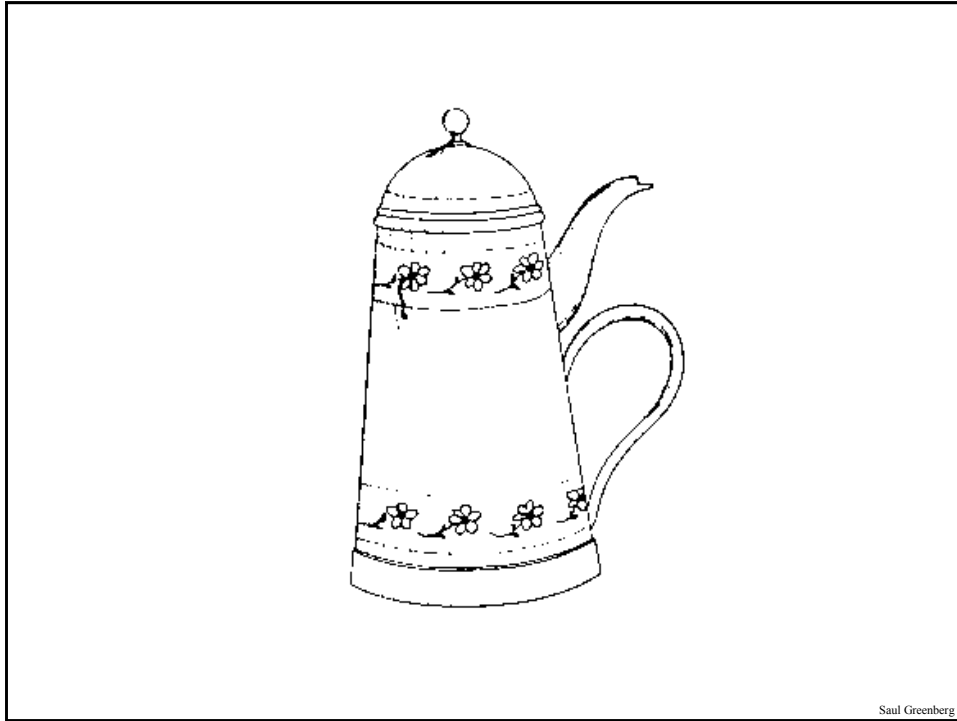- familiarity with similar devices (positive transfer)

models may be wrong, particularly if above attributes are misleading

models allows people to mentally simulate operation of device
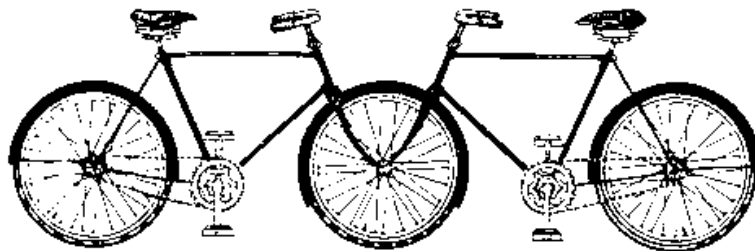
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__Example__

Good: 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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Examples

Bad: Digital watch

12:00

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

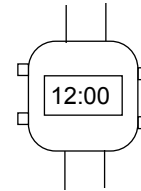transfer of training
    little relation to analog watches

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

conceptual model:
    must be taught

Two guidelines for design

1. Provide a good conceptual model
• allows user to predict the effects of our actions
• problem:

  - designer's conceptual model communicated to user through system image:
    appearance, written instructions, system behaviour through interaction,
    transfer, idioms and stereotypes

  - if system image does not make model clear and
    consistent, user will develop wrong conceptual model
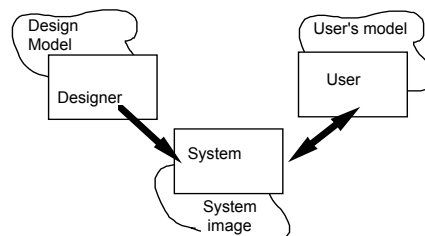
Two guidelines for design (continued)

2. Make things visible

• relations between user's intentions, required actions, and results are
  - sensible
  - non arbitrary
  - meaningful

• visible affordances, mappings, and constraints

• use visible cultural idioms

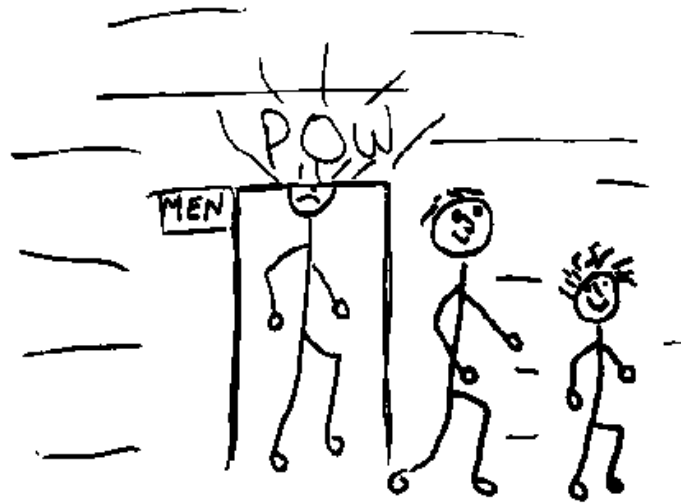• reminds person of what can be done and how to do it

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
  - eg ceiling height: 8'
      but tallest man: 8' 11"!
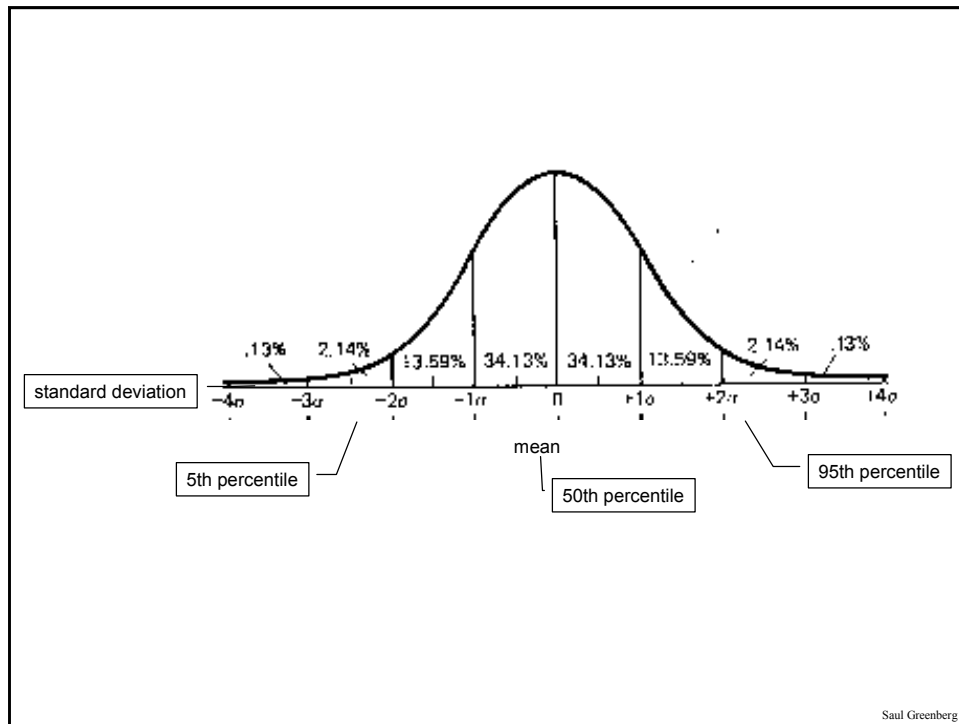
Rule of thumb:
- design should cater for 95% of audience (ie for 5th or 95th percentile)
  - but means 5% of population may be (seriously!) compromised
- Designing for the average a mistake
  - may exclude half the audience

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

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standard deviation

.13% 2.14% !3.59% 34.13% 34.13% 13.59% 2.14% .13%

−4σ −3σ −2σ −1σ Π +1σ +2σ +3σ +4σ

mean

5th percentile

50th percentile

95th percentile

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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

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Who do you design for?

Computer users:

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

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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

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Why design is hard

People often consider cost and appearance over human factors 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)

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What you now know

Human factors comes of age in WWII
• human control of complex machinery could not be maintained even after high degree of training

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

Designers help things work by providing a good conceptual model
• affordances
• causality
• constraints
• mapping
• positive transfer
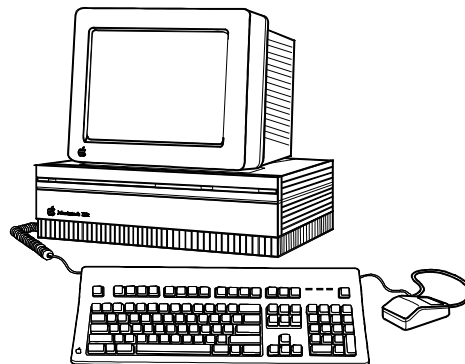• population stereotypes

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

Design is difficult for a variety of reasons that go beyond design

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Preview: Human factors in computing systems

What does this do?

• computers far more complex to control than most physical devices
• general purpose computer contains no natural conceptual model
• completely up to the designer to present a good model to the user

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