



# HUMAN-COMPUTER INTERACTION

THIRD  
EDITION

DIX  
FINLAY  
ABOWD  
BEALE



## chapter 3

### the interaction

- What is saccade and regression?
- Give two example of how we use haptic/ tactile sense for interaction.
- Is sensory memory have any importance while delivering a lecture? if so justify with an example.
- Define slip and mistake? As HCI expert how would you reduce slips in an interface? How would you reduce mistakes?

- Write the equation for Fitts' law.  
Suppose there is an interface which uses a mouse as input device. Will there be any change in movement time if we reduce the distance by a fraction of  $1/2$  between the buttons in the interface while also reducing the size by same fraction of the buttons and change the input from mouse to touch screen? Explain/ justify your answer.

- You are given a task by Sir. Behraj to convert your FAST-NU library into digital library. Sir Behraj ask you to make a list which contains all the features that will be added in library. In this scenario what type of reasoning is required? Justify your answer.

# The Interaction

- interaction models
  - translations between user and system
- ergonomics
  - physical characteristics of interaction
- interaction styles
  - the nature of user/system dialog
- context
  - social, organizational, motivational

# What is interaction?

communication

user ↔ system

but is that all ... ?

– see “language and action” in chapter 4 ...

## models of interaction

## terms of interaction

# Norman model

# interaction framework

# Some terms of interaction

- domain – the area of work under study  
e.g. graphic design
- goal – what you want to achieve  
e.g. create a solid red triangle
- task – how you go about doing it  
– ultimately in terms of operations or actions  
e.g. ... select fill tool, click over triangle

## Note ...

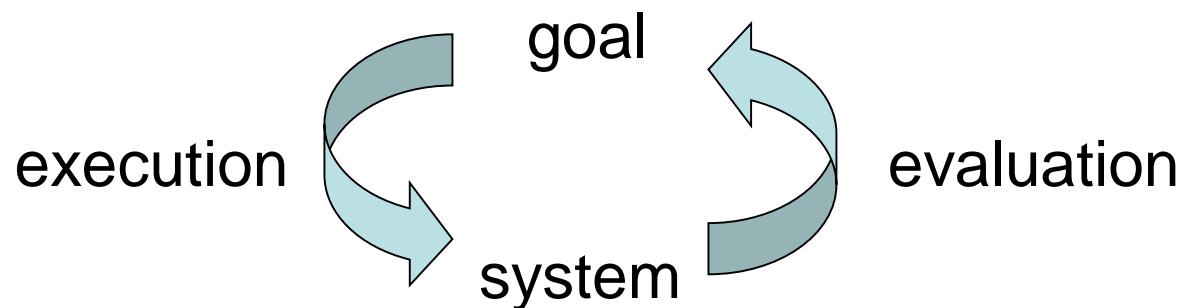
- traditional interaction ...
- use of terms differs a lot especially task/goal !!!



# Donald Norman's model

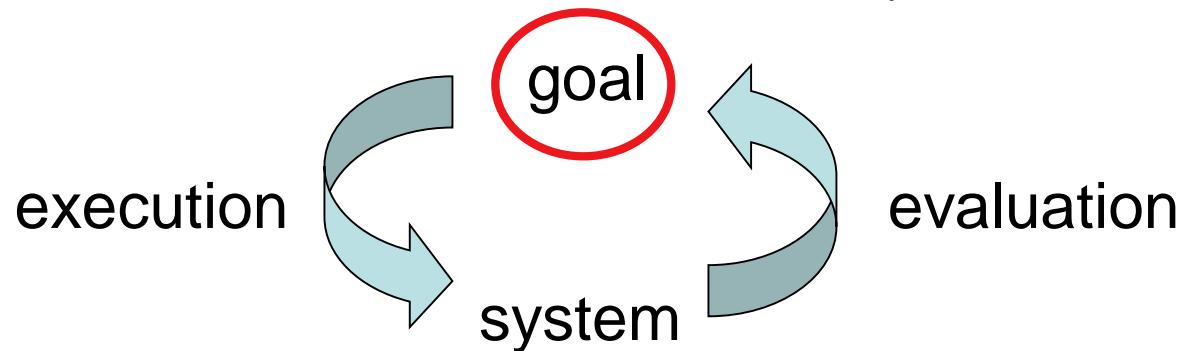
- Seven stages
  - user establishes the goal
  - formulates intention
  - specifies actions at interface
  - executes action
  - perceives system state
  - interprets system state
  - evaluates system state with respect to goal
- Norman's model concentrates on user's view of the interface

# execution/evaluation loop



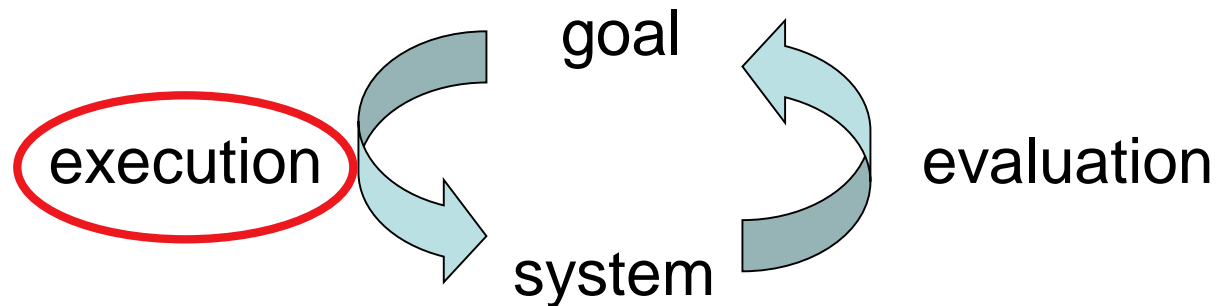
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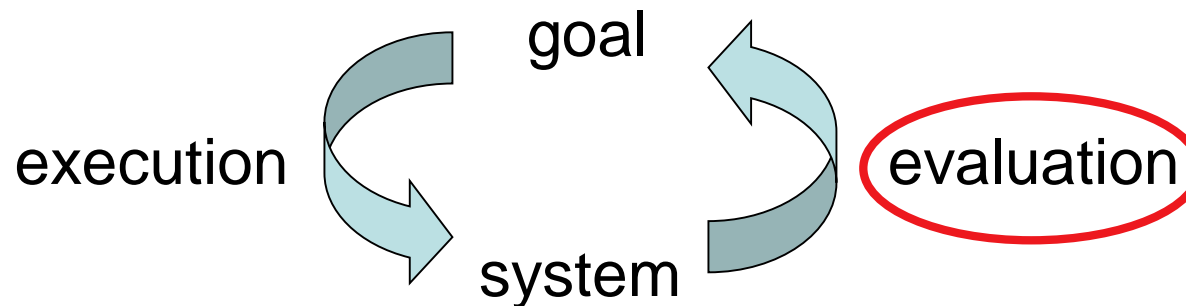
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# execution/evaluation loop



- user establishes the goal
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# Using Norman's model

Some systems are harder to use than others

## Gulf of Execution

user's formulation of actions

≠ actions allowed by the system

## Gulf of Evaluation

user's expectation of changed system state

≠ actual presentation of this state



# Human error - slips and mistakes

## slip

- 😊 understand system and goal
- 😊 correct formulation of action
- 😞 incorrect action

## mistake

- 😞 may not even have right goal!

## Fixing things?

slip – better interface design

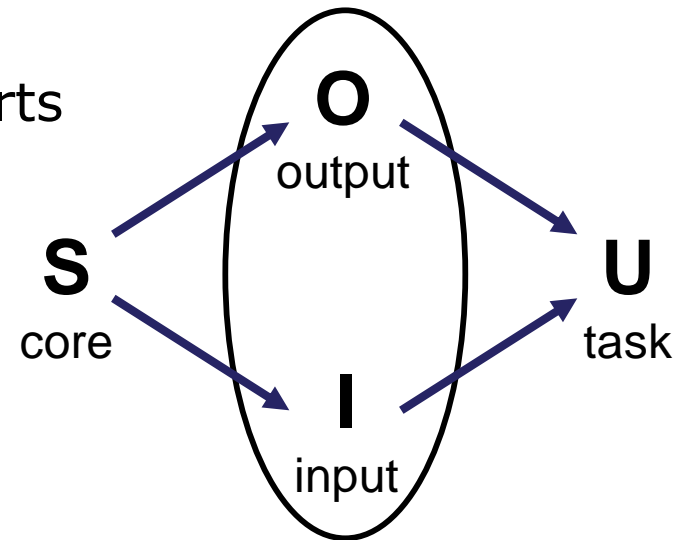
mistake – better understanding of system

# Abowd and Beale framework

extension of Norman...

their interaction framework has 4 parts

- user
- input
- system
- output



each has its own unique language

interaction  $\Rightarrow$  translation between languages

problems in interaction = problems in translation



# Using Abowd & Beale's model

user intentions

- translated into actions at the interface
- translated into alterations of system state
- reflected in the output display
- interpreted by the user

general framework for understanding interaction

- not restricted to electronic computer systems
- identifies all major components involved in interaction
- allows comparative assessment of systems
- an abstraction



*ergonomics*

physical aspects of interfaces  
industrial interfaces

# Ergonomics

- Study of the physical characteristics of interaction
- Also known as human factors – but this can also be used to mean much of HCI!
- Ergonomics good at defining standards and guidelines for constraining the way we design certain aspects of systems

# Ergonomics - examples

- arrangement of controls and displays
  - e.g. controls grouped according to function or frequency of use, or sequentially
- surrounding environment
  - e.g. seating arrangements adaptable to cope with all sizes of user
- health issues
  - e.g. physical position, environmental conditions (temperature, humidity), lighting, noise,
- use of colour
  - e.g. use of red for warning, green for okay, awareness of colour-blindness etc.



# Industrial interfaces

Office interface vs. industrial interface?

Context matters!

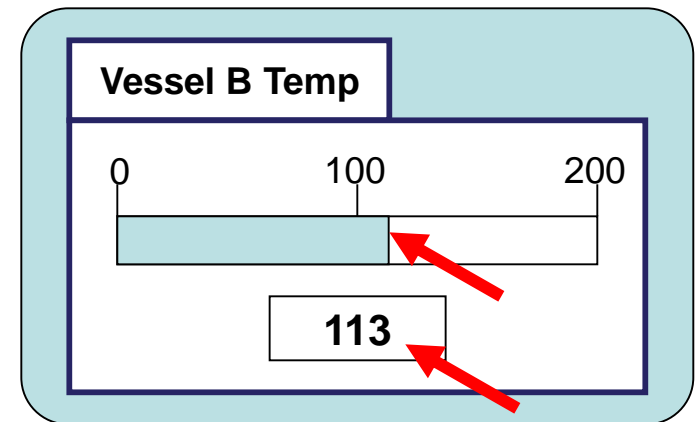
	office	industrial
type of data	textual	numeric
rate of change	slow	fast
environment	clean	dirty

... the oil soaked mouse!



# Glass interfaces ?

- industrial interface:
  - traditional ... dials and knobs
  - now ... screens and keypads
- glass interface
  - + cheaper, more flexible, multiple representations, precise values
  - not physically located, loss of context, complex interfaces
- may need both

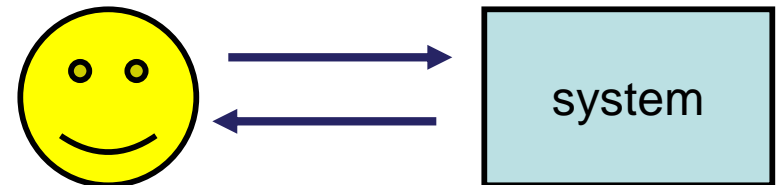


multiple representations  
of same information

# Indirect manipulation

- office – direct manipulation

- user interacts  
with artificial world

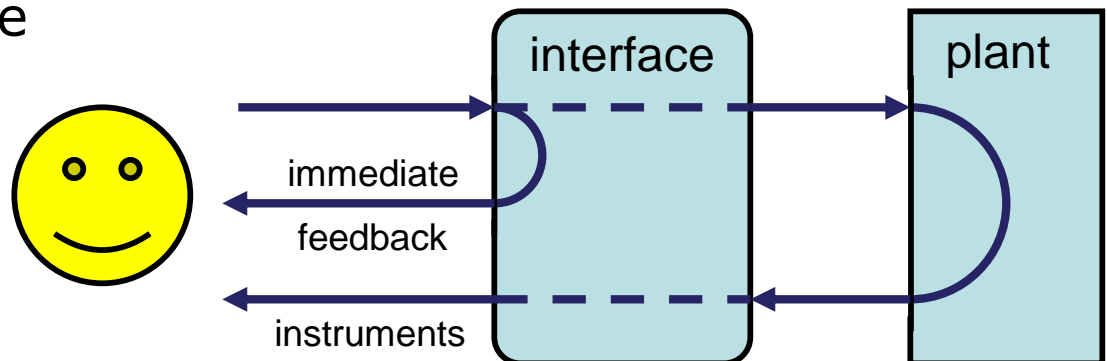


- industrial – indirect manipulation

- user interacts  
*with* real world  
*through* interface

- issues ..

- feedback
- delays





# interaction styles

dialogue ... computer and user

distinct styles of interaction



# Common interaction styles

- command line interface
- menus
- natural language
- question/answer and query dialogue
- form-fills and spreadsheets
- WIMP
- point and click
- three-dimensional interfaces

# Command line interface

- Way of expressing instructions to the computer directly
  - function keys, single characters, short abbreviations, whole words, or a combination
- suitable for repetitive tasks
- better for expert users than novices
- offers direct access to system functionality
- command names/abbreviations should be meaningful!

Typical example: the Unix system

# Menus

- Set of options displayed on the screen
- Options visible
  - less recall - easier to use
  - rely on recognition so names should be meaningful
- Selection by:
  - numbers, letters, arrow keys, mouse
  - combination (e.g. mouse plus accelerators)
- Often options hierarchically grouped
  - sensible grouping is needed
- Restricted form of full WIMP system

# Natural language

- Familiar to user
- speech recognition or typed natural language
- Problems
  - vague
  - ambiguous
  - hard to do well!
- Solutions
  - try to understand a subset
  - pick on key words

# Query interfaces

- Question/answer interfaces
  - user led through interaction via series of questions
  - suitable for novice users but restricted functionality
  - often used in information systems
- Query languages (e.g. SQL)
  - used to retrieve information from database
  - requires understanding of database structure and language syntax, hence requires some expertise

# Form-fills

- Primarily for data entry or data retrieval
- Screen like paper form.
- Data put in relevant place
- Requires
  - good design
  - obvious correction facilities

The screenshot shows a web browser window with the title 'Go-faster Travel Agency Booking'. The page content includes a heading 'Go-faster Travel Agency Booking' and a prompt 'Please enter details of journey:'. Below this are several input fields: 'Start from:' with 'Lancaster', 'Destination:' with 'Atlanta', and 'Via:' with 'Leeds'. There are also radio button options for 'First class / Second class / Bargain' and 'Single / Return', with the 'Return' option selected. A 'Seat number:' field is at the bottom. On the left side of the form, there is a vertical sidebar with icons and labels for 'Favorites', 'History', and 'Search'.

# Spreadsheets

- first spreadsheet VISICALC, followed by Lotus 1-2-3  
MS Excel most common today
- sophisticated variation of form-filling.
  - grid of cells contain a value or a formula
  - formula can involve values of other cells  
e.g. sum of all cells in this column
  - user can enter and alter data spreadsheet maintains consistency

# WIMP Interface

Windows

Icons

Menus

Pointers

... or windows, icons, mice, and pull-down menus!

- default style for majority of interactive computer systems, especially PCs and desktop machines

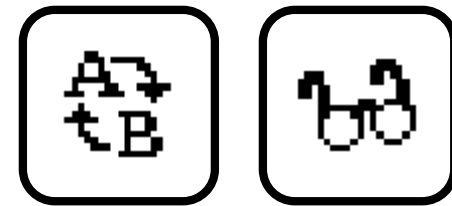


# Point and click interfaces

- used in ..
  - multimedia
  - web browsers
  - hypertext
- just click something!
  - icons, text links or location on map
- minimal typing

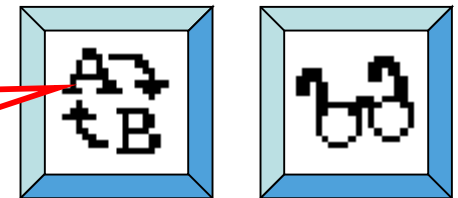
# Three dimensional interfaces

- virtual reality
- 'ordinary' window systems
  - highlighting
  - visual affordance
  - indiscriminate use  
just confusing!
- 3D workspaces
  - use for extra virtual space
  - light and occlusion give depth
  - distance effects



flat buttons ...

click me!



... or sculptured

# elements of the wimp interface

windows, icons, menus, pointers

+++

buttons, toolbars,  
palettes, dialog boxes

also see supplementary material  
on choosing wimp elements

# Windows

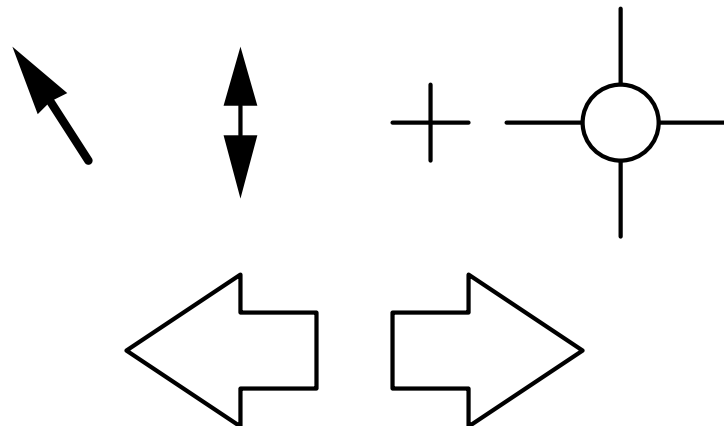
- Areas of the screen that behave as if they were independent
  - can contain text or graphics
  - can be moved or resized
  - can overlap and obscure each other, or can be laid out next to one another (tiled)
- scrollbars
  - allow the user to move the contents of the window up and down or from side to side
- title bars
  - describe the name of the window

# Icons

- small picture or image
- represents some object in the interface
  - often a window or action
- windows can be closed down (iconised)
  - small representation of many accessible windows
- icons can be many and various
  - highly stylized
  - realistic representations.

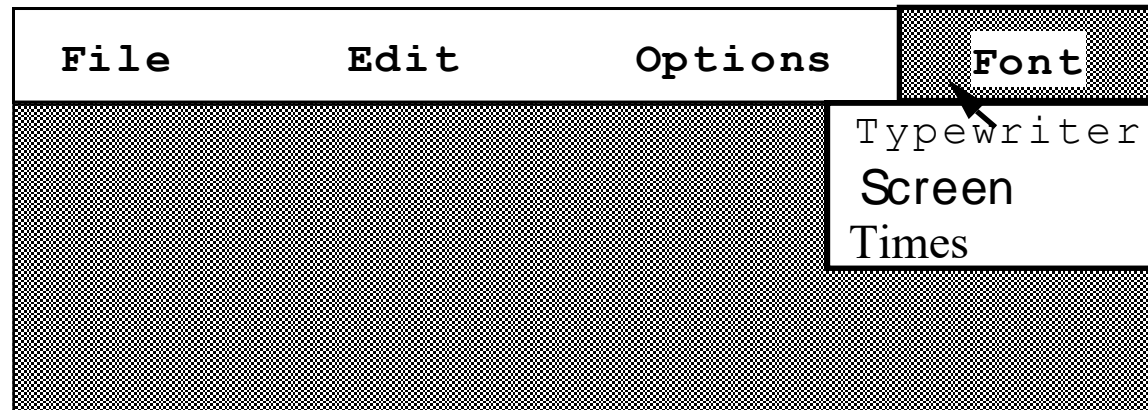
# Pointers

- important component
  - WIMP style relies on pointing and selecting things
- uses mouse, trackpad, joystick, trackball, cursor keys or keyboard shortcuts
- wide variety of graphical images



# Menus

- Choice of operations or services offered on the screen
- Required option selected with pointer



problem – take a lot of screen space

solution – pop-up: menu appears when needed

# Kinds of Menus

- Menu Bar at top of screen (normally), menu drags down
  - pull-down menu - mouse hold and drag down menu
  - drop-down menu - mouse click reveals menu
  - fall-down menus - mouse just moves over bar!
- Contextual menu appears where you are
  - pop-up menus - actions for selected object
  - pie menus - arranged in a circle
    - easier to select item (larger target area)
    - quicker (same distance to any option)  
... but not widely used!



# Menus extras

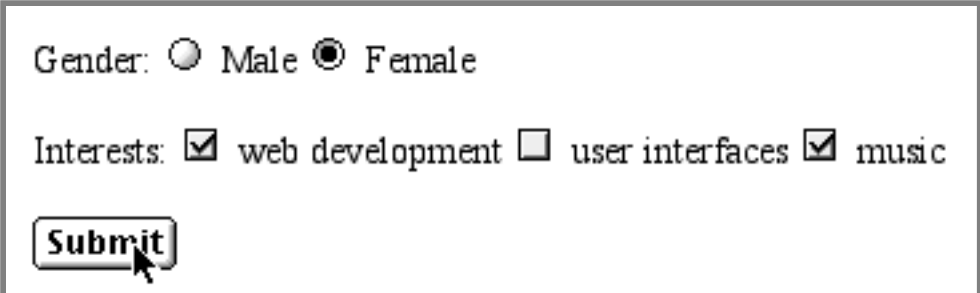
- Cascading menus
    - hierarchical menu structure
    - menu selection opens new menu
    - and so in ad infinitum
  - Keyboard accelerators
    - key combinations - same effect as menu item
    - two kinds
      - active when menu open – usually first letter
      - active when menu closed – usually Ctrl + letter
- usually different !!!

# Menus design issues

- which kind to use
- what to include in menus at all
- words to use (action or description)
- how to group items
- choice of keyboard accelerators

# Buttons

- individual and isolated regions within a display that can be selected to invoke an action



Gender: ☐ Male ☒ Female

Interests: ☒ web development ☐ user interfaces ☒ music

- Special kinds
  - radio buttons
    - set of mutually exclusive choices
  - check boxes
    - set of non-exclusive choices

# Toolbars

- long lines of icons ...  
... but what do they do?
- fast access to common actions
- often customizable:
  - choose *which* toolbars to see
  - choose *what* options are on it

# Palettes and tear-off menus

- Problem
  - menu not there when you want it
- Solution
  - palettes – little windows of actions
    - shown/hidden via menu option
    - e.g. available shapes in drawing package
  - tear-off and pin-up menus
    - menu ‘tears off’ to become palette

# Dialogue boxes

- information windows that pop up to inform of an important event or request information.

e.g: when saving a file, a dialogue box is displayed to allow the user to specify the filename and location. Once the file is saved, the box disappears.

# interactivity

easy to focus on look  
what about feel?

# Speech-driven interfaces

- rapidly improving ...  
... but still inaccurate
- how to have robust dialogue?  
... interaction of course!

e.g. airline reservation:  
reliable “yes” and “no”  
+ system reflects back its understanding  
“you want a ticket from New York to Boston?”



# Look and ... feel

- WIMP systems have the same elements:  
windows, icons., menus, pointers, buttons, etc.
- but different window systems  
... *behave* differently  
  
e.g. MacOS vs Windows menus

appearance + behaviour = look and feel

# Initiative

- who has the initiative?
  - old question-answer – computer
  - WIMP interface – user
- WIMP exceptions ...
  - pre-emptive* parts of the interface
- modal dialog boxes
  - come and won't go away!
  - good for errors, essential steps
  - but use with care

# Error and repair

can't always avoid errors ...  
... but we can put them right

make it easy to *detect* errors  
... then the user can *repair* them

hello, this is the Go Faster booking system  
what would you like?  
(user) *I want to fly from New York to London*  
you want a ticket from New York to Boston  
(user) *no*  
sorry, please confirm one at a time  
do you want to fly from New York  
(user) *yes*  
... ..

# Context

Interaction affected by social and organizational context

- other people
  - desire to impress, competition, fear of failure
- motivation
  - fear, allegiance, ambition, self-satisfaction
- inadequate systems
  - cause frustration and lack of motivation

# Experience, engagement and fun



designing experience  
physical engagement  
managing value

# Experience?

- home, entertainment, shopping
  - not enough that people can use a system
  - they must want to use it!
- psychology of experience
  - flow (Csikszentimihalyi)
  - balance between anxiety and boredom
- education
  - zone of proximal development
  - things you can just do with help
- wider ...
  - literary analysis, film studies, drama

# Designing experience



- real crackers
  - cheap and cheerful!
  - bad joke, plastic toy, paper hat
  - pull and bang

# Designing experience



- virtual crackers
  - cheap and cheerful
  - bad joke, web toy, cut-out mask
  - click and bang

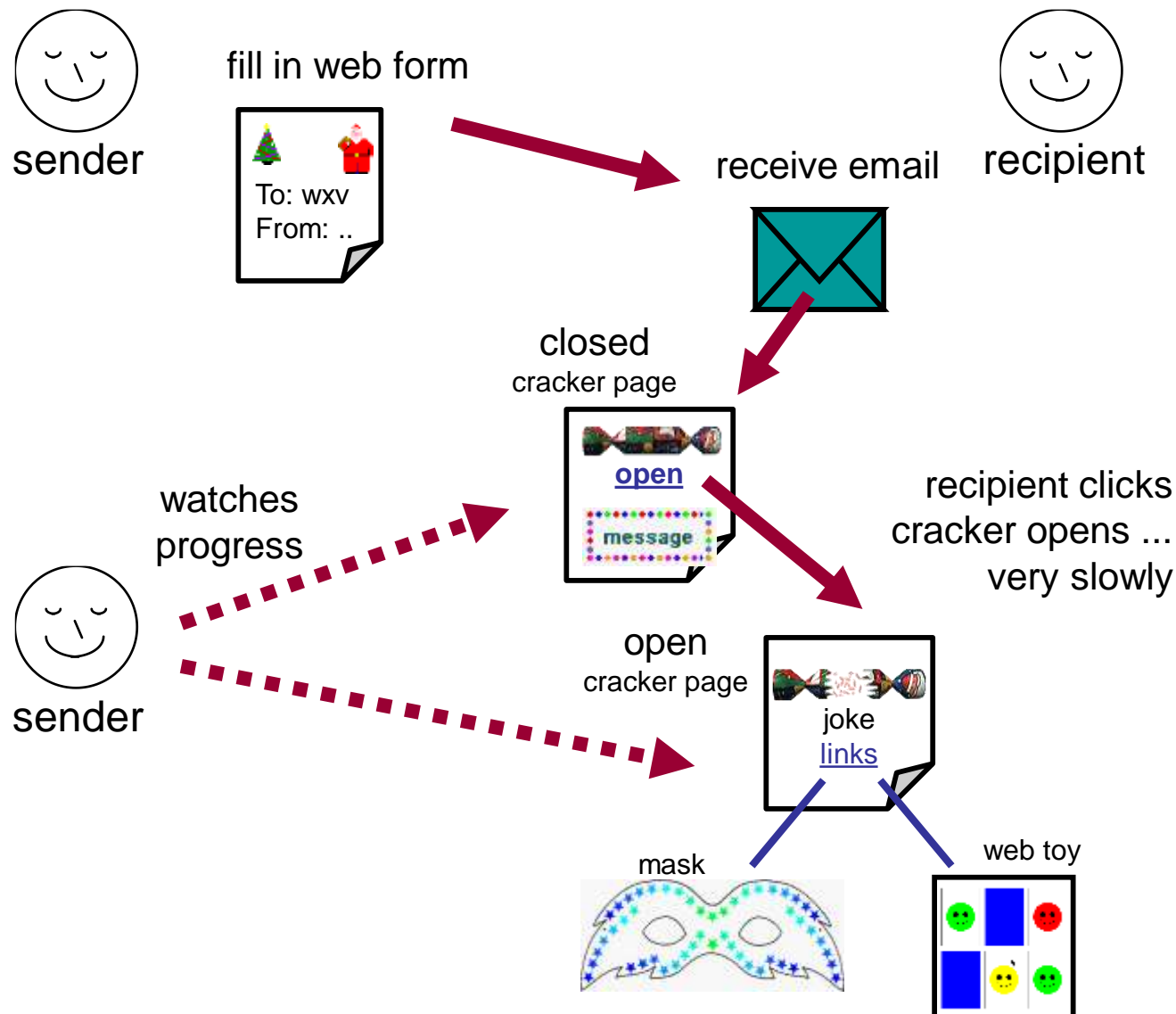


# Designing experience



- virtual crackers
  - cheap and cheerful
  - bad joke, web toy, cut-out mask
  - click and bang

# how crackers work



# The crackers experience

	<b>real cracker</b>	<b>virtual cracker</b>
Surface elements		
design	cheap and cheerful	simple page/graphics
play	plastic toy and joke	web toy and joke
dressing up	paper hat	mask to cut out
Experienced effects		
shared	offered to another	sent by email message
co-experience	pulled together	sender can't see content until opened by recipient
excitement	cultural connotations	recruited expectation
hiddenness	contents inside	first page - no contents
suspense	pulling cracker	slow ... page change
surprise	bang (when it works)	WAV file (when it works)

# Physical design

- many constraints:
  - ergonomic – minimum button size
  - physical – high-voltage switches are big
  - legal and safety – high cooker controls
  - context and environment – easy to clean
  - aesthetic – must look good
  - economic – ... and not cost too much!

# Design trade-offs

constraints are contradictory ... need trade-offs

within categories:

- e.g. safety – cooker controls
  - front panel – safer for adult
  - rear panel – safer for child

between categories

- e.g. ergonomics vs. physical – MiniDisc remote
  - ergonomics – controls need to be bigger
  - physical – no room!
  - solution – multifunction controls & reduced functionality

# Fluidity

- do external physical aspects reflect logical effect?
  - related to affordance (chap 5)

logical state revealed in physical state?  
e.g. on/off buttons

inverse actions inverse effects?  
e.g. arrow buttons, twist controls

# inverse actions

- yes/no buttons
  - well sort of
- 'joystick'
- also left side control



# spring back controls

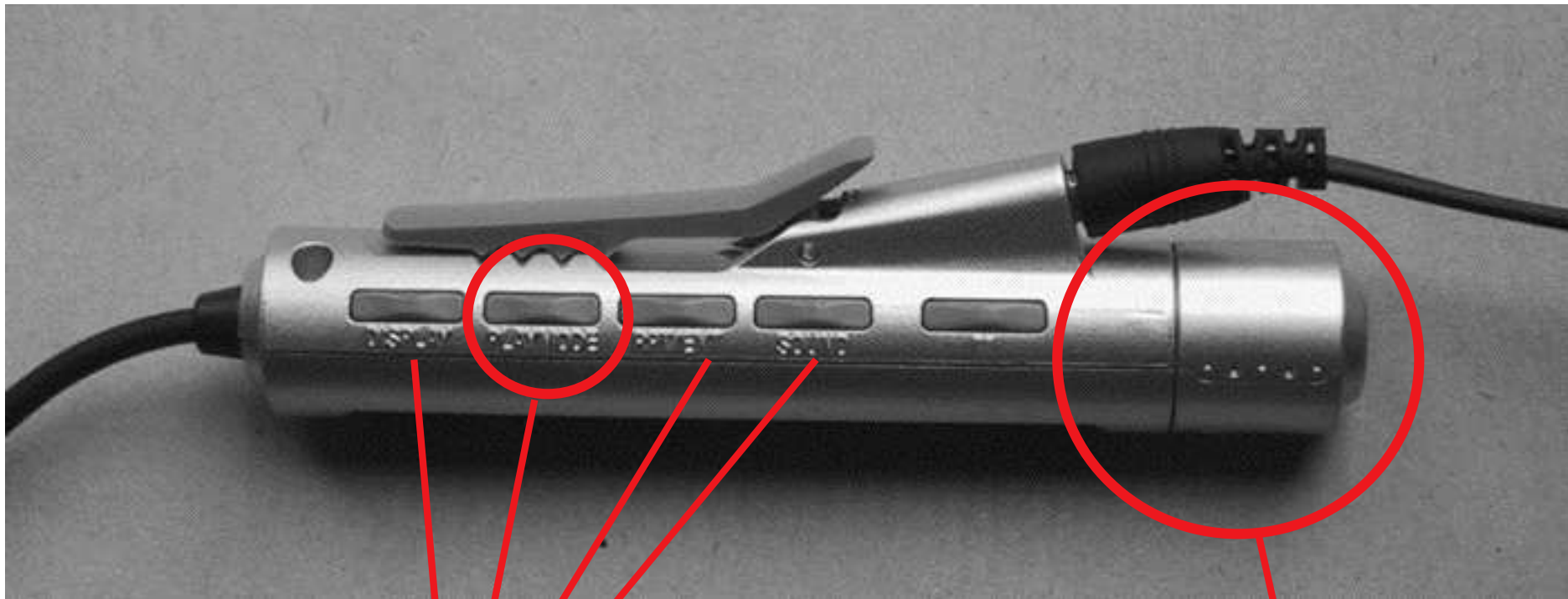
- one-shot buttons
- joystick
- some sliders

good – large selection sets  
bad – hidden state





# a minidisk controller



series of spring-back controls  
each cycle through some options  
-natural inverse back/forward

twist for track movement  
pull and twist for volume  
- spring back  
- natural inverse for twist

# physical layout

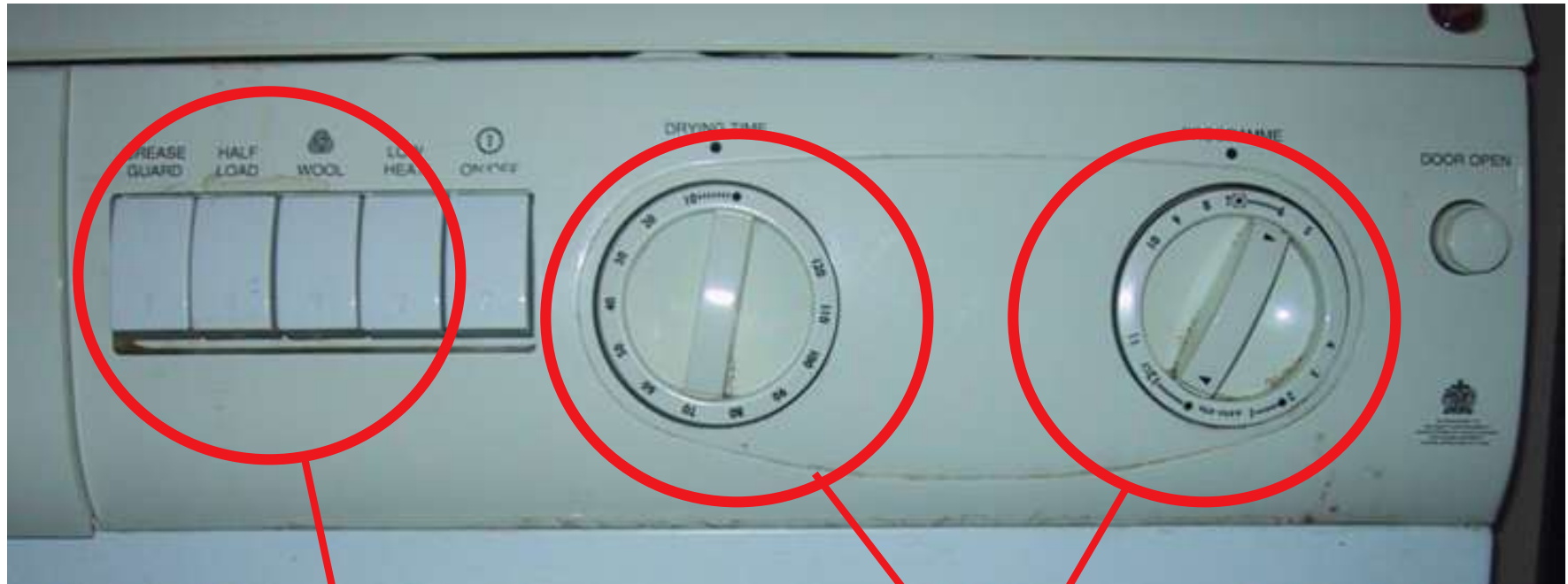
controls:

logical relationship

~ spatial grouping



# compliant interaction



state evident in  
mechanical buttons

rotary knobs reveal internal state  
and can be controlled by both user  
and machine

# Managing value

people use something

**ONLY IF**

it has perceived value

**AND**

value exceeds cost

## **BUT NOTE**

- exceptions (e.g. habit)
- value **NOT** necessarily personal gain or money

# Weighing up value

## value

- helps me get my work done
- fun
- good for others

## cost

- download time
- money £, \$, €
- learning effort

# Discounted future

- in economics Net Present Value:
  - discount by  $(1 + \text{rate})^{\text{years to wait}}$
- in life people heavily discount
  - future value and future cost
  - hence resistance to learning
  - need low barriers  
and high perceived present value

# example - HCI book search

- value for people *who have* the book helps you to look up things
  - chapter and page number
- value for those *who don't* ... sort of online mini-encyclopaedia
  - full paragraph of context

... but also says "buy me"!!



engagement  
search the book!





# Value and organisational design

- coercion
  - tell people what to do!
  - value = keep your job
- enculturation
  - explain corporate values
  - establish support (e.g share options)
- emergence
  - design process so that  
individuals value → organisational value



# General lesson ...

if you want someone to do something ...

- make it easy for them!
- understand their values