HUMAN-COMPUTER INTERACTION

THIRD EDITION

DIX
FINLAY
ABOWD
BEALE

chapter 3

the interaction

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

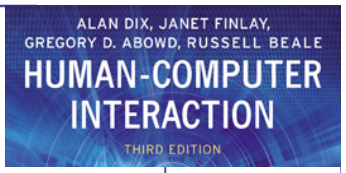
What is interaction?

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 …

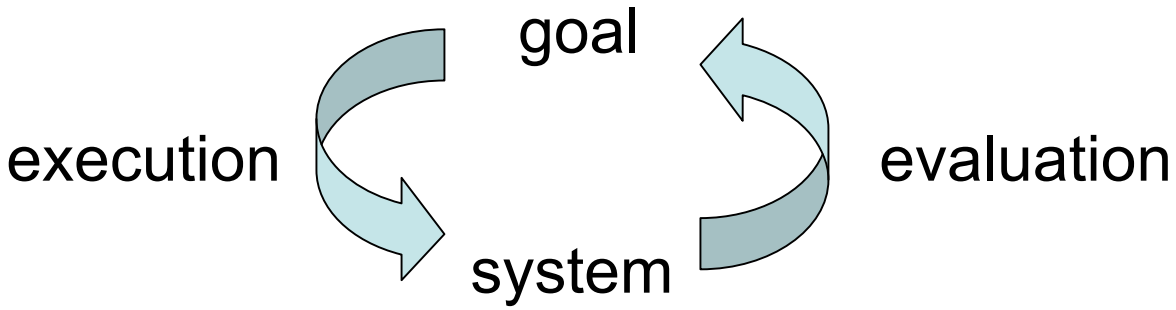
- traditional interaction …
- use of terms differs a lot especially task/goal !!!

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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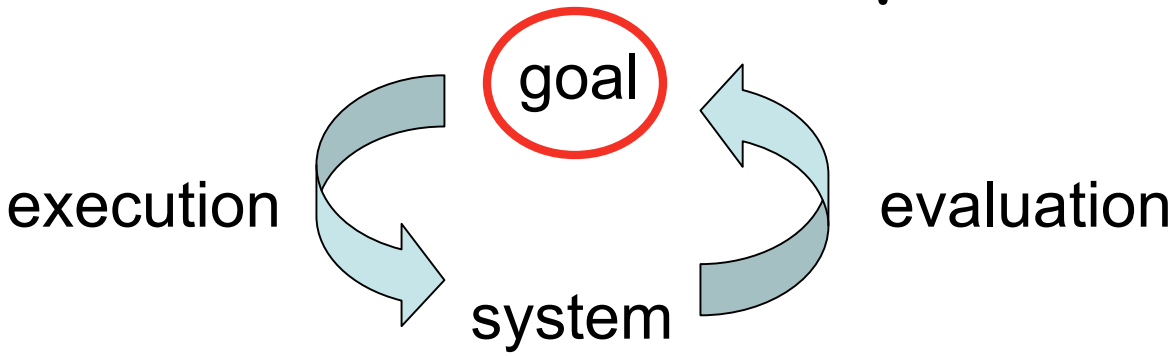

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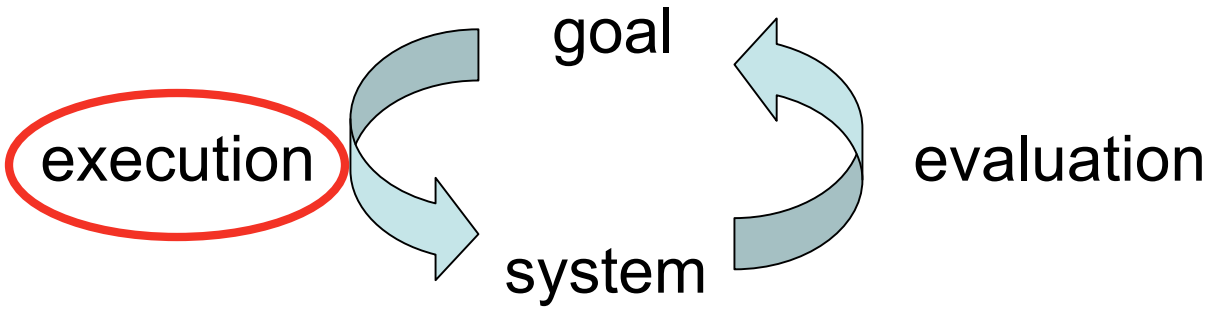

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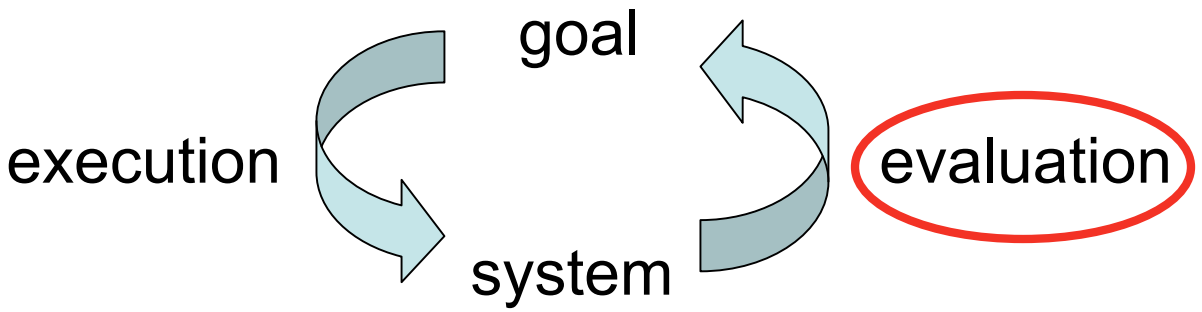

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Using Norman's model

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?

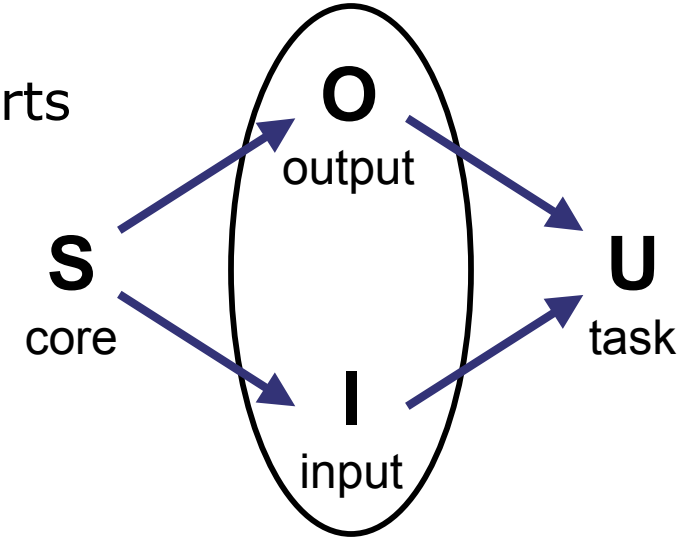
slip – better interface design

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 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?

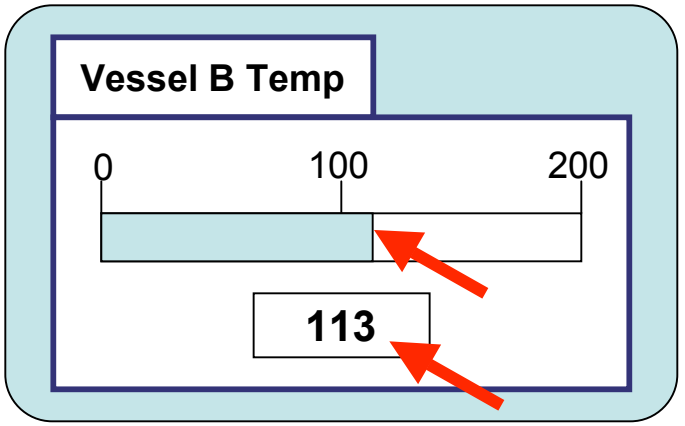
Context matters!

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

… the oil soaked mouse!

Glass interfaces ?

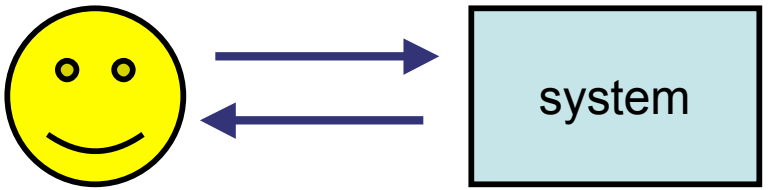
- industrial interface:
  - traditional … dials and knobs
  - now … screens and keypads
- glass interface
  - + cheaper, more flexible, multiple representations, precise values
  - – not physically located, loss of context, complex interfaces
- may need both



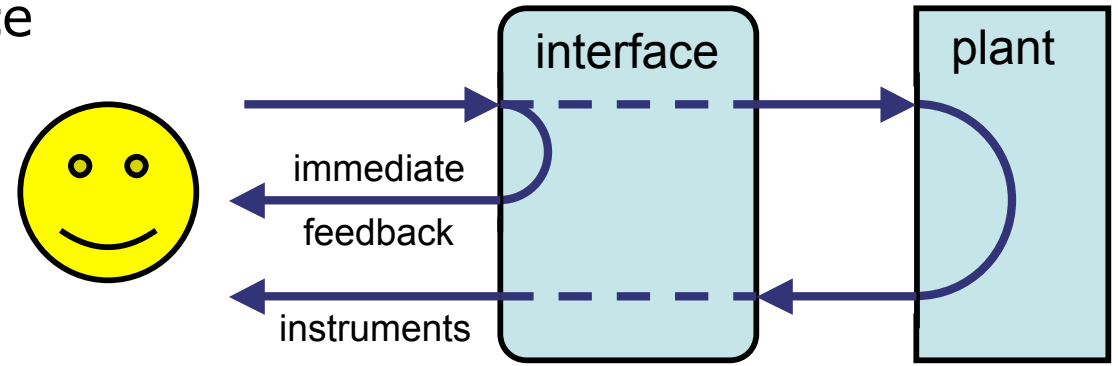
multiple representations of same information

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

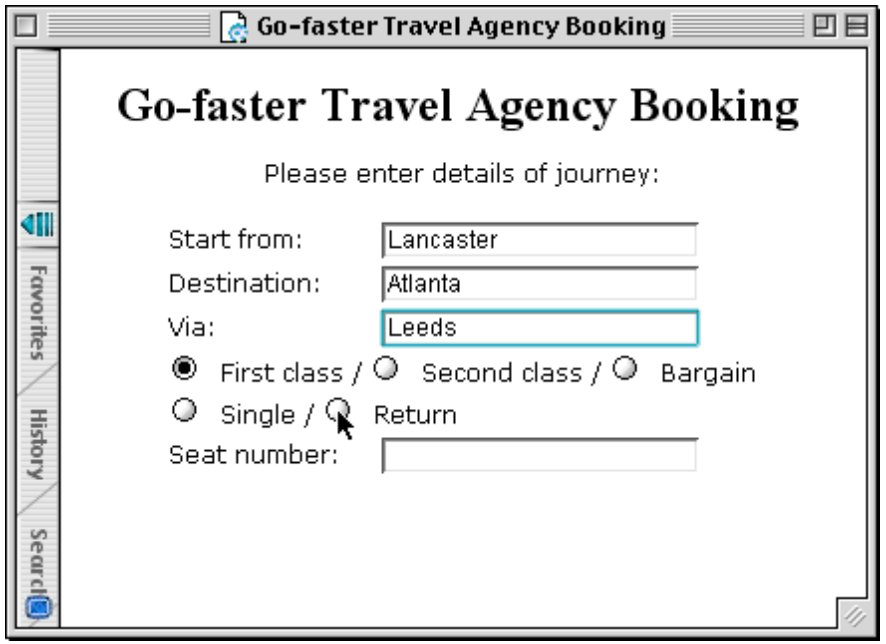
Query interfaces

- 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



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!

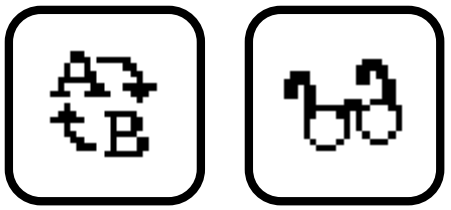
- default style for majority of interactive computer systems, especially PCs and desktop machines

Point and click interfaces

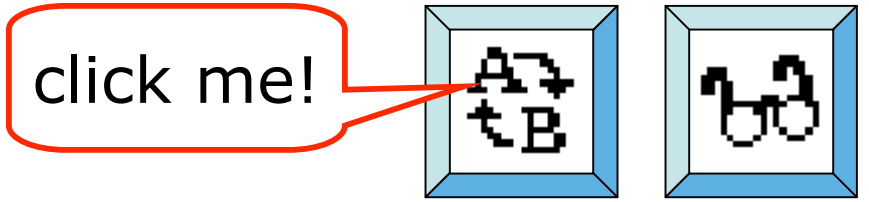
- used in ..
  - multimedia
  - web browsers
  - hypertext
- just click something!
  - icons, text links or location on map
- minimal typing

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 …



… 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

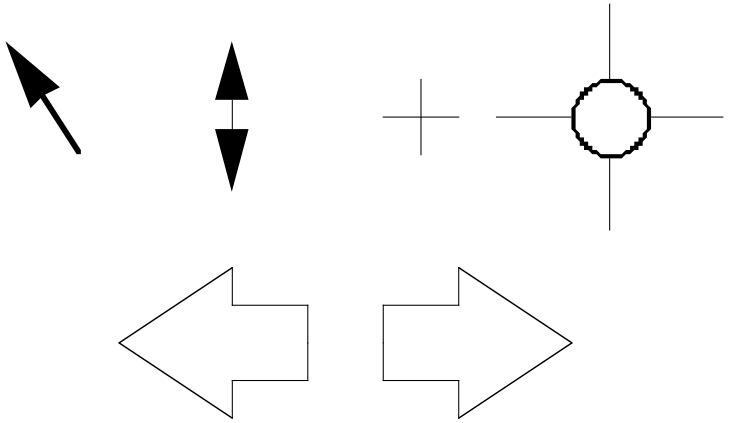
- Areas of the screen that behave as if they were independent
  - can contain text or graphics
  - can be moved or resized
  - can overlap and obscure each other, or can be laid out next to one another (tiled)
- scrollbars
  - allow the user to move the contents of the window up and down or from side 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 fi many accessible windows
- icons can be many and various
  - highly stylized
  - realistic representations.

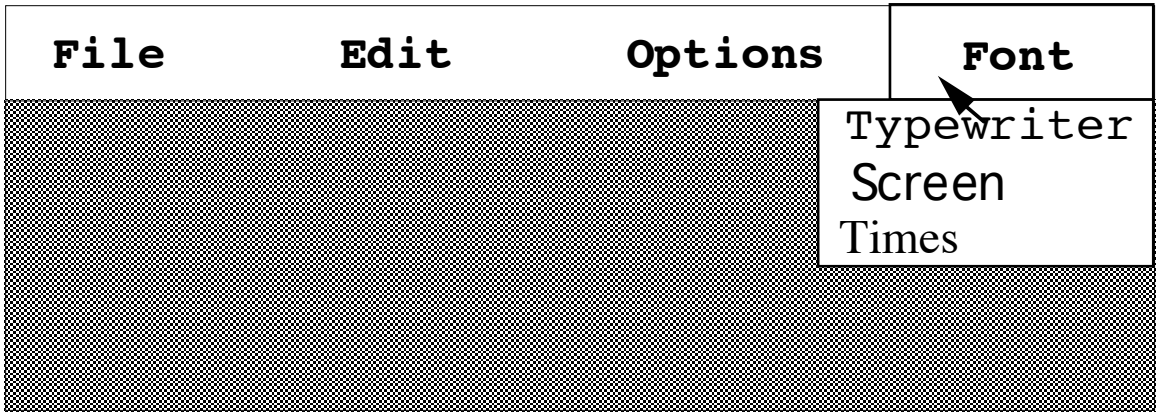
Pointers

- 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

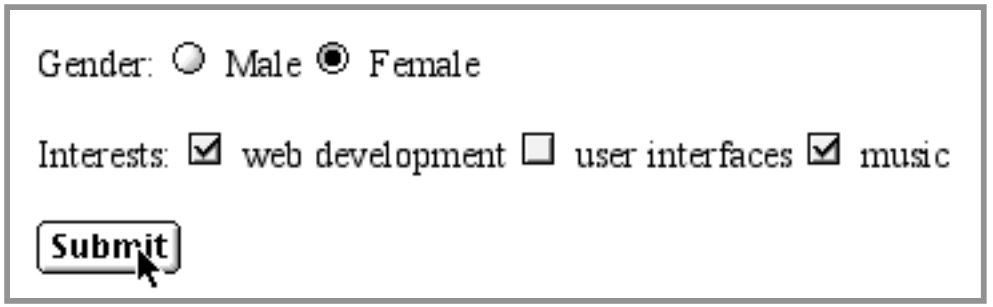
  usually different !!!

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



- 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

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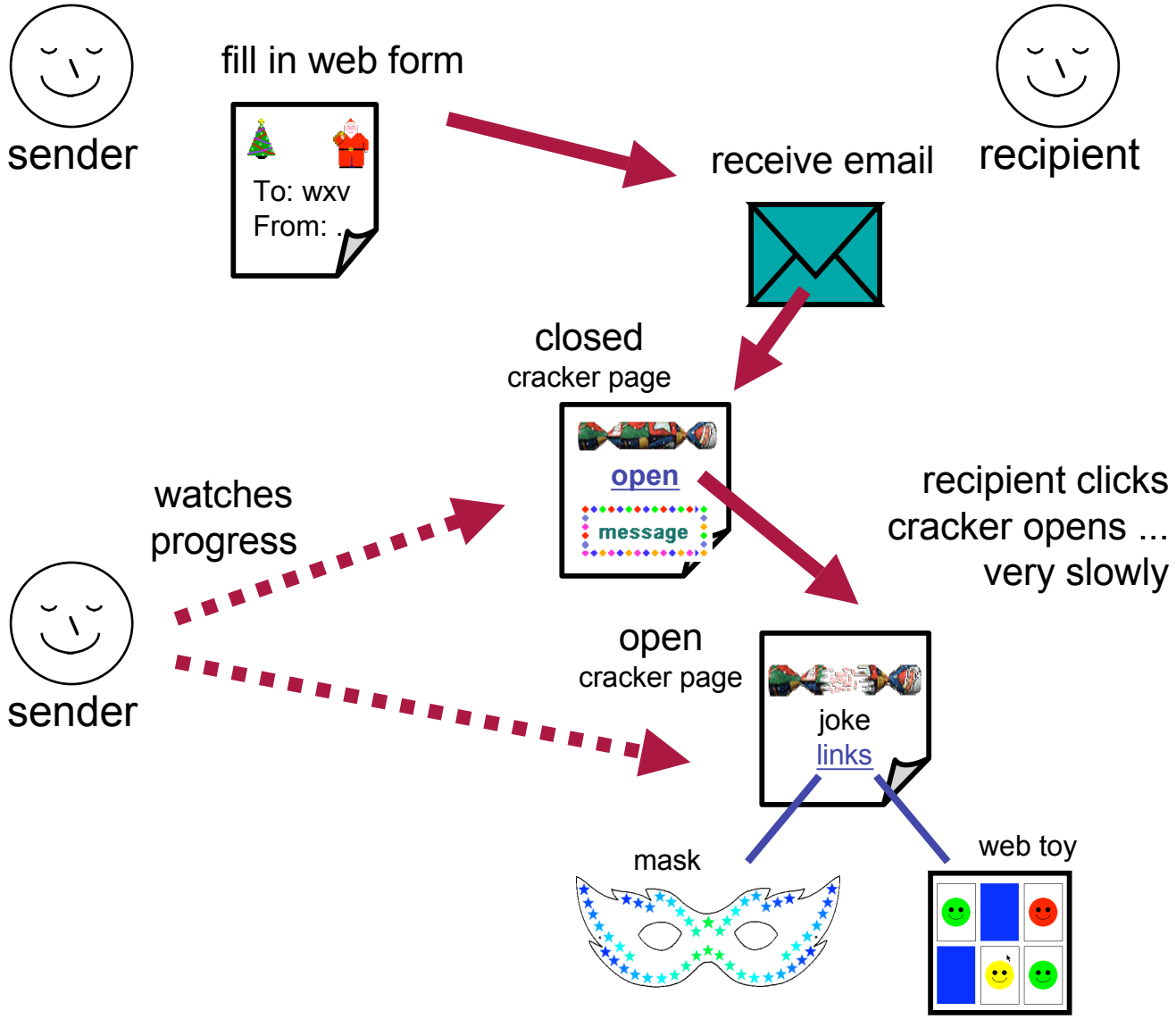
how crackers work



The crackers experience

	real cracker	**virtual cracker**
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

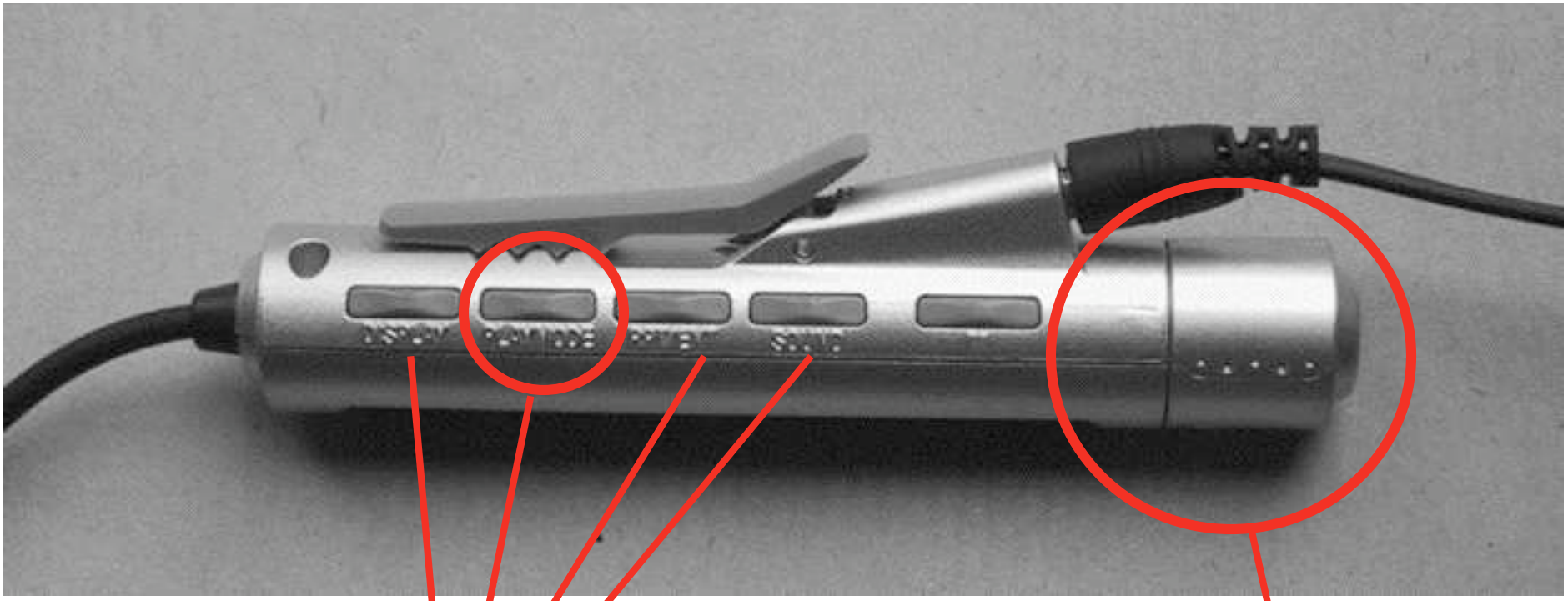
- yes/no buttons
  - well sort of
- 'joystick'
- also left side control

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

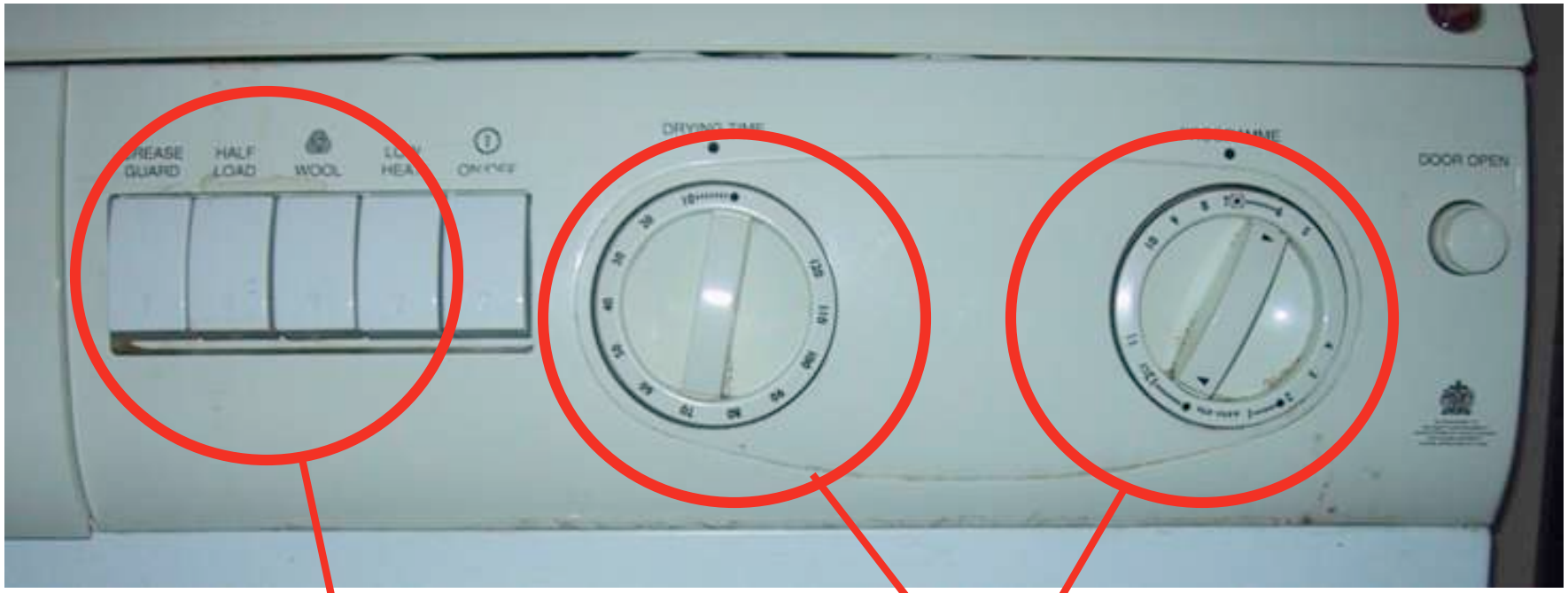
physical layout

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

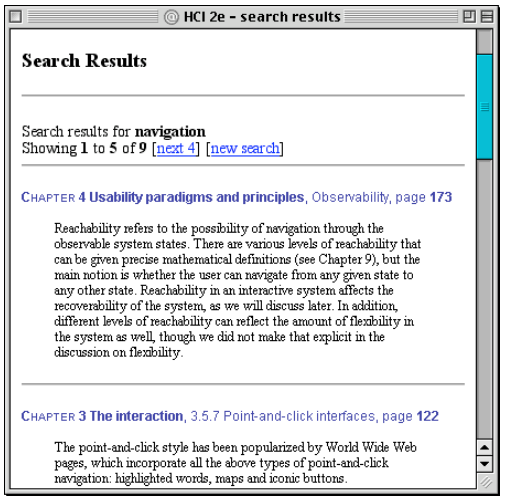
- in economics Net Present Value:
  - discount by $(1+\text{rate})^{\text{years to wait}}$
- in life people heavily discount
  - future value and future cost
  - hence resistance to learning
  - need low barriers
    and high perceived present value

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"!!



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