

Interaction models

Human Factors

The Interaction

- Interaction models
 - Translations between user and system
- Ergonomics
 - Physical characteristics of interaction
- Interaction styles
 - Nature of user/system dialogue
- Context of interaction
 - Social, organisational, motivational

Interaction and experience

- The notion of user experience has become important in interaction design.
- How a product behaves and is used by people in the real world.
- *“every product that is used by someone has a user experience: newspapers, ketchup bottles, reclining armchairs, cardigan sweaters” Garrett, 2003.*
- Can design *for* a user experience, but can’t design the experience.

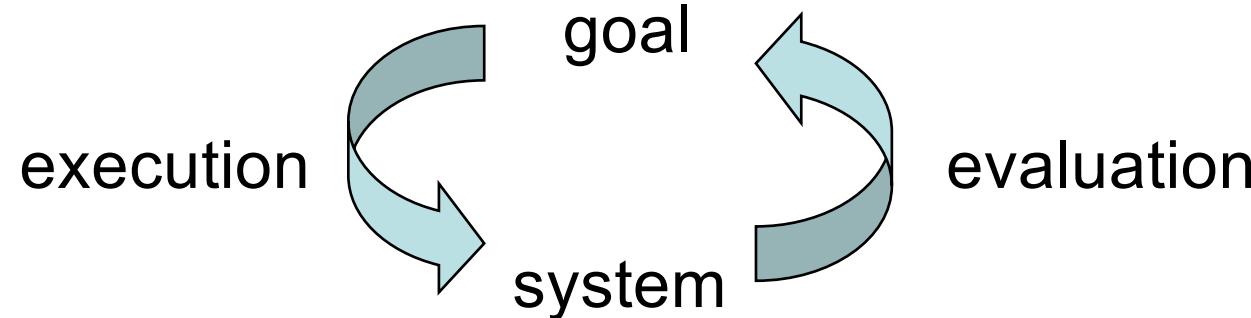
Usability goals

- Effective to use.
- Efficient to use.
- Safe to use.
- Having good utility
- Easy to learn
- Easy to remember how to use.

Interaction Frameworks

- Interaction:
 - communication between the user and the system
- Why have a framework?
 - allows contextualisation
 - presents a global view
- Domain
 - Area of work under study.
 - Tasks - operations to manipulate concepts of the domain.
 - Goal is desired output from performed task.
 - Intention is specific action required to meet the goal.

Norman's (1986) Theory of action



- Proposes 7 stages of an activity
 - Establish a goal
 - Form an intention
 - Specify an action sequence
 - Execute an action
 - Perceive the system state
 - Interpret the state
 - Evaluate the system state with respect to the goals and intentions

Example - Norman's model

- Switching on a light:
 - You are reading, but it's getting dark
 - You decide you need more light (goal: get more light).
 - Form intention to switch on desk lamp.
 - Specify actions required, to reach over and press the lamp switch.
 - After this, you perceive the result (the light is on or it isn't)
 - Interpret this, based on knowledge of the world
 - May result in new goals, evaluation wrt original goal.

An example: reading breaking news on the web

- (i) Set goal to find out about breaking news
 - decide on news website
- (ii) Form an intention
 - check out BBC website
- (iii) Specify what to do
 - move cursor to link on browser
- (iv) Execute action sequence
 - click on mouse button
- (v) Check what happens at the interface
 - see a new page pop up on the screen
- (vi) Interpret it
 - read that it is the BBC website
- (vii) Evaluate it with respect to the goal
 - read breaking news

How realistic?

- Human activity does not proceed in such an orderly and sequential manner
- More usual for stages to be missed, repeated or out of order
- Do not always have a clear goal in mind but react to the world
- Theory is only approximation of what happens and is greatly simplified
- Help designers think about how to help users monitor their actions

The gulfs

- The ‘gulfs’ explicate the gaps that exist between the user and the interface
- The gulf of execution
 - user’s formulation of actions
≠ actions allowed by the system
 - How hard is it for me to execute actions relevant to my goals?
- The gulf of evaluation
 - user’s expectation of changed system state
≠ actual presentation of this state
 - If the user can easily evaluate the presentation in terms of goal, gulf of evaluation is small.
- Need to bridge the gulfs in order to reduce the cognitive effort required to perform a task

Minimal user effort

- Norman's model lets us consider at a low level, the effort involved in an action.
- Interfaces should usually minimise the amount of effort needed to achieve goals.
- Techniques such as Keystroke-Level-Modelling and critical path analysis are used to help achieve this.

Human Error - Slips and mistakes

Slip

understand system and goal

correct formulation of action

incorrect action

Mistake

may not even have right goal!

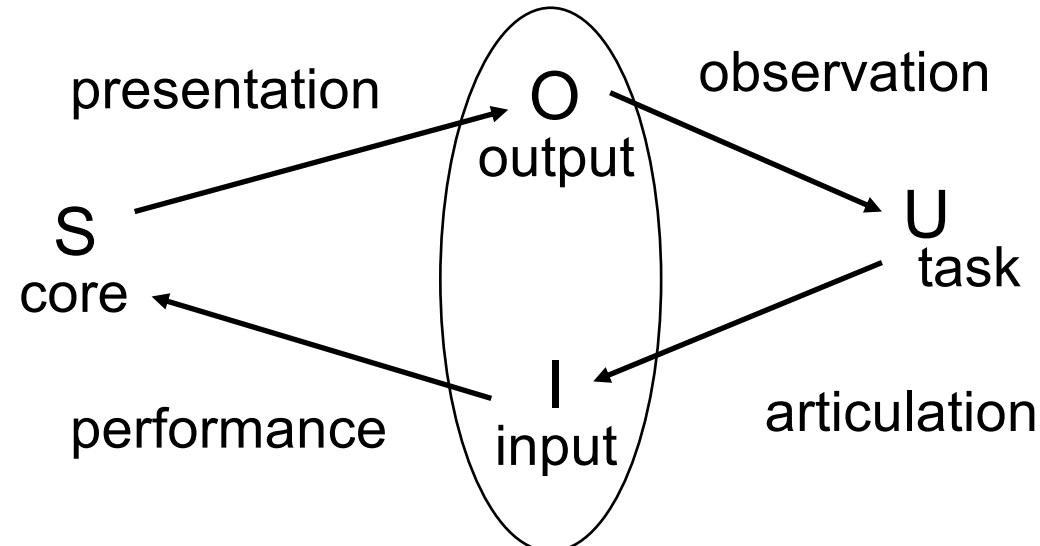
Fixing things?

slip - better interface design

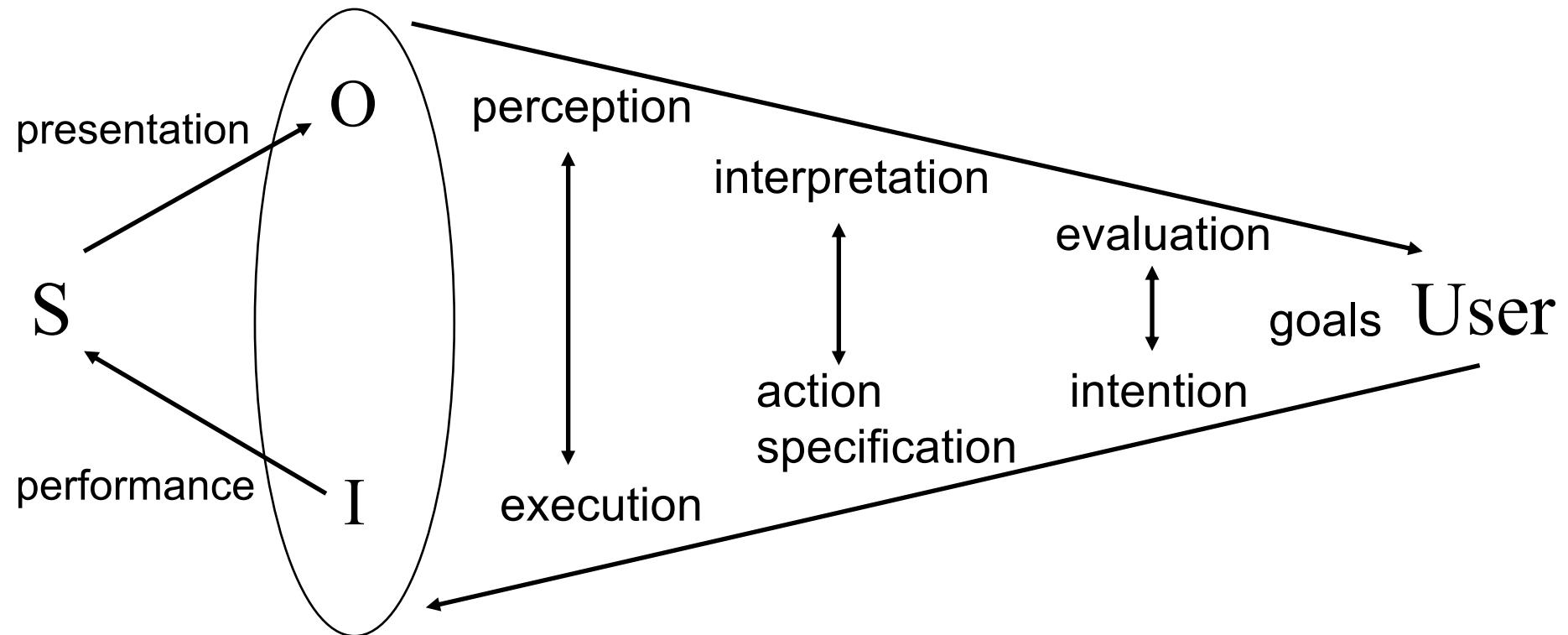
mistake - better understanding of system

Interaction Frameworks

- Extended by Abowd and Beale: their interaction framework has 4 parts
 - user
 - input
 - system
 - output



Interaction Framework



Greater ability to reason about system aspects, eg. expressiveness, reachability.

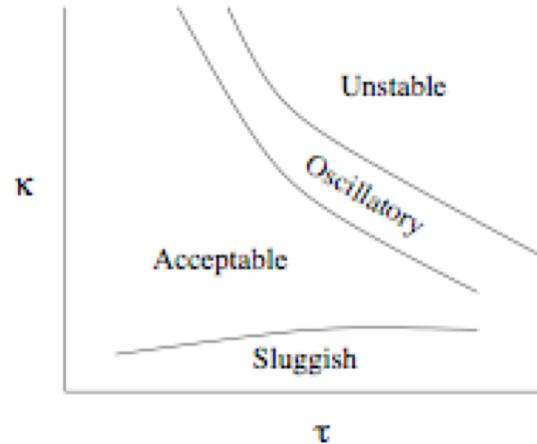
Ergonomics

- Study of the physical characteristics of interaction
- Also known as human factors.
- Background of industrial systems.
- Ergonomics good at defining standards and guidelines for constraining the way we design certain aspects of systems.

Ergonomics in design - 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, lighting, noise, environmental conditions (temperature, humidity)
- Use of colour
 - e.g. additional encoding, avoid blue for critical information, use of red for warning, green for okay (cultural issues), awareness of colour-blindness etc.

Physical interaction



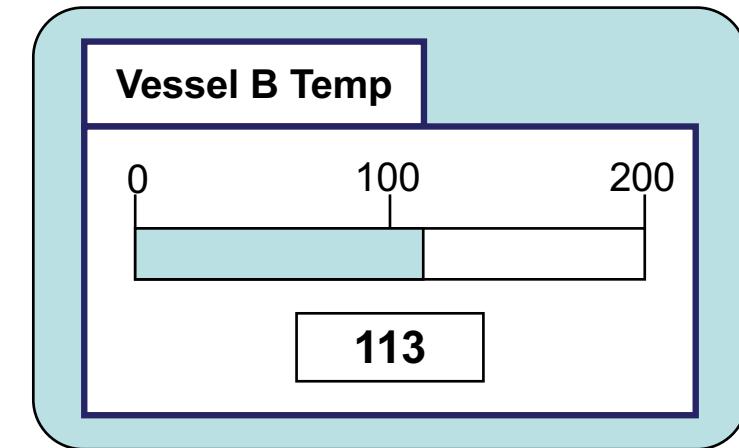
- Consider manually controlled system with gain κ and time delay from user input of τ
- High gain and long delay yields systems that are difficult or impossible to control.

Order of control

- Zero order - mouse.
- First order - car accelerator.
- Second order - steering wheel, power plants, chemical plants.
- Third order - submarines, aviation.
- Lower order control is easier.

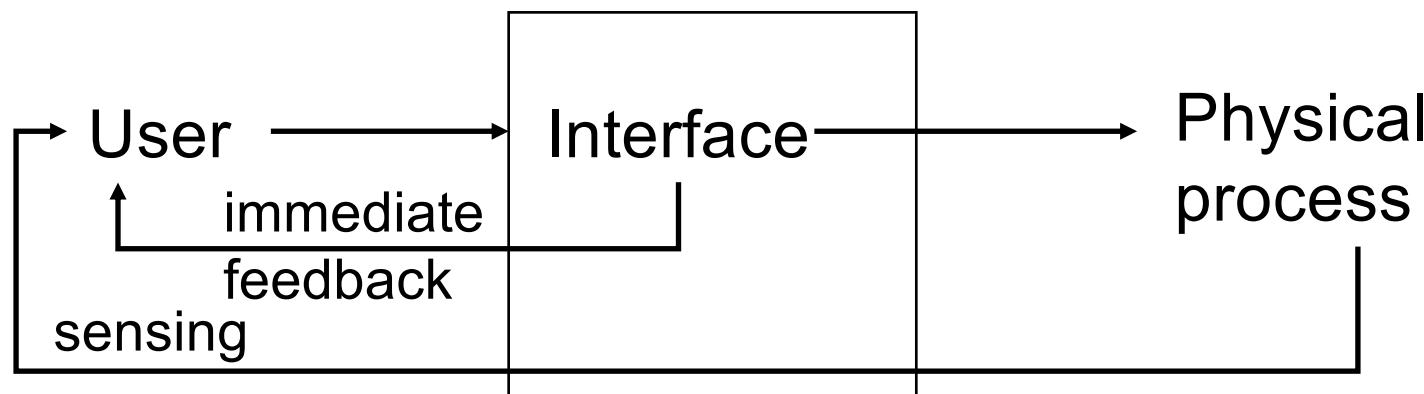
Glass interfaces

- 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



Indirect manipulation

- Sometimes system is intermediary between user and real world.
- Indirect interaction requires two levels of feedback - e.g. recognition of commands vs. final effect on world.
- Problems associated with periodic sampling -e.g. Data of different timeliness.



Arrangement of controls

- Functional controls and displays are organised so that those that are functionally related are placed together
- Sequential controls reflect the order of their use in a typical interaction (e.g. In domain where task sequence is enforced).
- Frequency controls organised according to how frequently they are used, with the most commonly used controls being the most easily accessible.

Physical design

- Ergonomic - cannot physically push buttons if they are too small or too close.
- Physical - the form factor may force certain positions or of style of control.
- Legal and safety - e.g. cooker controls, far from rings, out of reach of children.
- Context and environment - smooth microwave controls easy to clean.
- Aesthetic, Economic.

Interaction styles

- Interaction: dialogue between computer and user
- Some applications have very distinct styles of interaction.
- We can identify some common styles
 - command line interface
 - menus
 - natural language
 - question/answer and query dialogue
 - form-fills and spreadsheets
 - WIMP

Interaction styles

- We can see these types of interface as forming categories:
- Linguistic Styles:
 - Command line
 - Natural language (incl. Speech)
- Key-Modal Styles
 - Function keys
 - Q&A interaction
 - Menu driven
- Direct manipulation
 - WIMP/GUI
 - forms?

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, consistent.
- Typical example: linux/unix shell

CLI's Advantages + Disadvantages

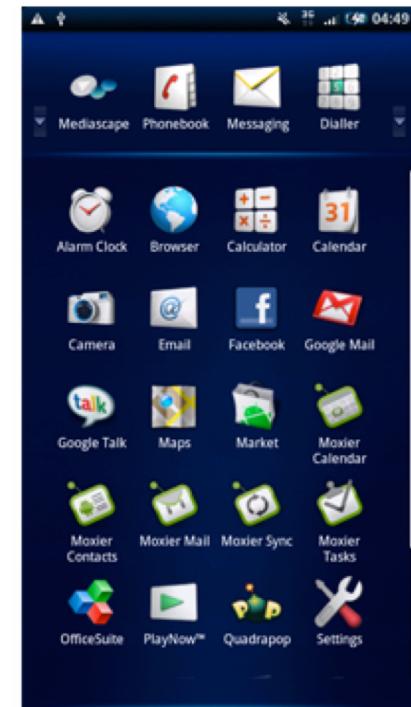
- Flexible
- Appeals to “power” users
- Allows user initiative
- Allows convenient creation of macros
- Cheap
- Low visibility
- Requires substantial training and memorization
- Not useful for “novice” users
- Poor error handling

Menus

- Set of options displayed on the screen
- Options visible
 - less recall - easier to use
 - rely on recognition so names should be meaningful
- Selected by using mouse, keys, buttons
- Often options hierarchically grouped:
sensible grouping is needed
- Restricted form of full WIMP system
- Not suitable for complex actions

Menus Advantages + Disadvantages

- reduces learning time
 - reduces keystrokes
 - structures decision making
 - easy to support error handling
-
- too many menus for complex tasks
 - can be slow for frequent users
 - consumes screen space



What about non-graphical menus?

Natural language

- Familiar to user
- Use speech recognition or typed natural language
- Problems
 - Vague
 - Ambiguous (“The boy hit the dog with the stick”).
 - Hard to do well - generally restricted domains.
- Solutions
 - try to understand a subset
 - pick on key words



Natural Language Interfaces



- natural to specify (no need to learn syntax)
- less intimidating for novices
- access over telephone
- hands-free interaction if spoken
- can not be applied generally yet
- requires clarification dialog
- may require more keystrokes (unless spoken)
- unpredictable results when errors occur

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
 - limited variation in sequence
 - little training needed
- Query interfaces
 - Many systems essentially allow the user to construct a complex query to an underlying database with varying degrees of help.
- Search is now a major interaction style in itself

Form-fills

- Primarily for data entry or data retrieval
- Screen like paper form.
- Simplifies data entry - menu style for parameter fill-in
- Modest training, convenient assistance
- Recognition vs. recall
- Web based applications led to proliferation of form-based interfaces
- Recent developments have enabled move back towards more varied interaction styles

Please complete the form below. Mandatory fields marked *

Delivery Details

Name *

Address *

Town/City

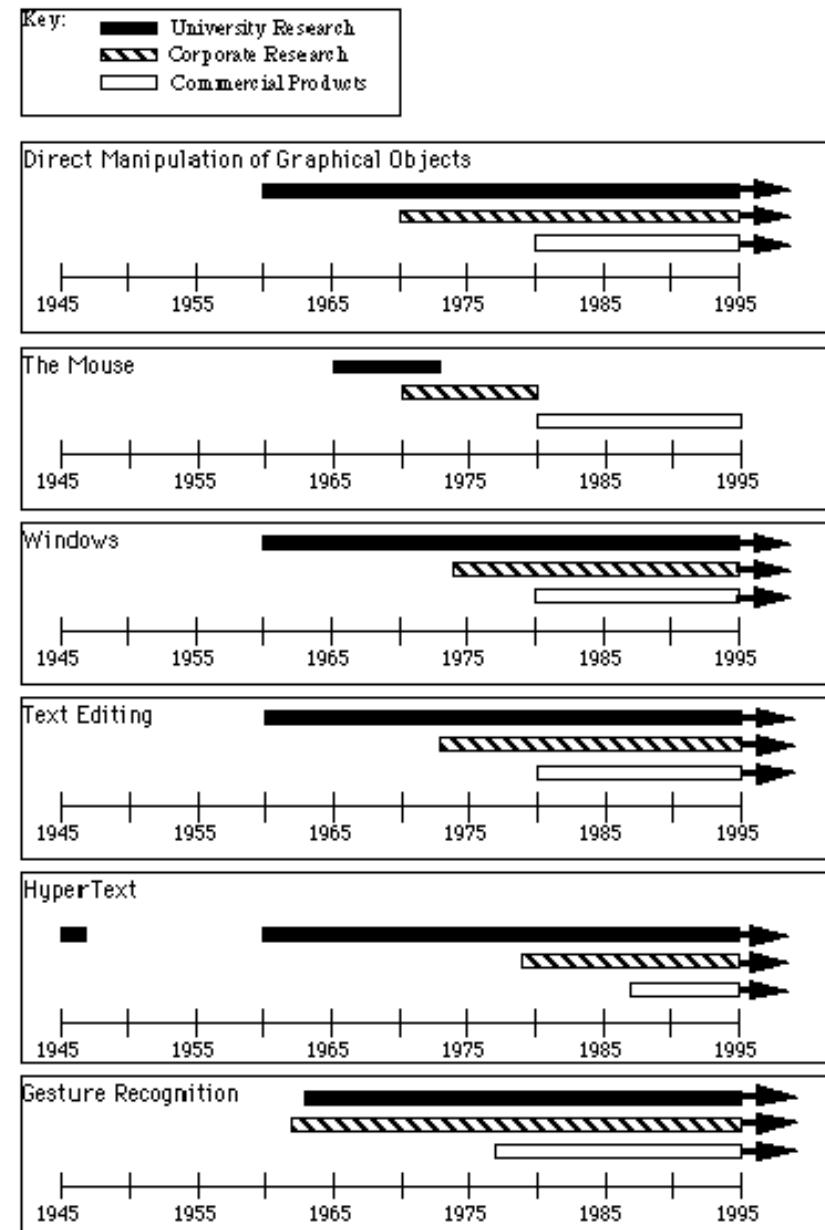
County *

Postcode *

Is this address also your invoice address? *

- Yes
 No

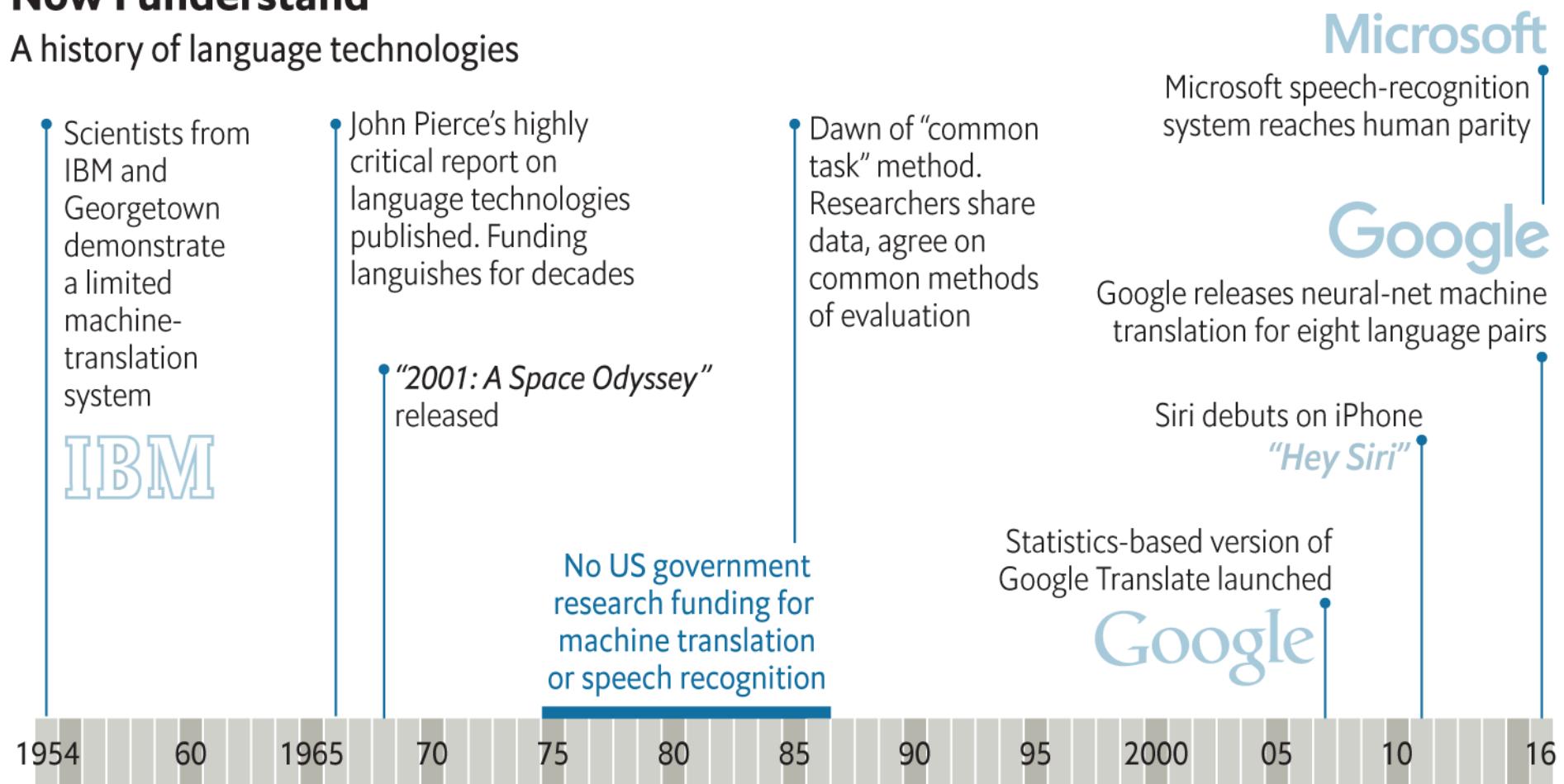
History of input methods - Myers, 1998



Speech input

Now I understand

A history of language technologies



Source: *The Economist*

WIMP Interface

- Windows, Icons, Menus, Pointers
- Default style for majority of interactive computer systems, especially PCs and desktop machines
- Style does not directly translate to devices with small displays.
- What's it all for?

Direct Manipulation

- Objects of interest are visible in interface
- Incremental action at the interface with rapid feedback on all actions
- Reversibility of all actions, so that users are encouraged to explore without severe penalties.
- Syntactic correctness of all actions so that every user action is a legal operation.
- Replacement of complex command languages with actions to manipulate directly the visible objects (and hence the name direct manipulation).

Direct Manipulation

- visually presents task concepts
- learnability
- retention
- error avoidance
- encourages exploration
- high subjective satisfaction
- more difficult to program (especially error handling)
- non-sighted users

Exercise

- What kinds of interaction style can map well to handheld devices?
 - CLI
 - Menus
 - Natural language
 - Question/Answer and query dialogue
 - Form fills and spreadsheets
 - WIMP
- What elements of WIMP systems would you expect to have problems with on handheld devices?

Social and Organizational Context

- Interaction affected by social and organisational context
- Other people
 - desire to impress, competition, fear of failure
- Motivation
 - fear, allegiance, ambition, self-satisfaction
- Inadequate systems (do not match requirements of work to be done)
 - cause frustration and lack of motivation