Desire paths: the illicit trails that defy the urban planners

https://www.theguardian.com/cities/2018/oct/05/desire-paths-the-illicit-trails-that-defy-the-urban-planners

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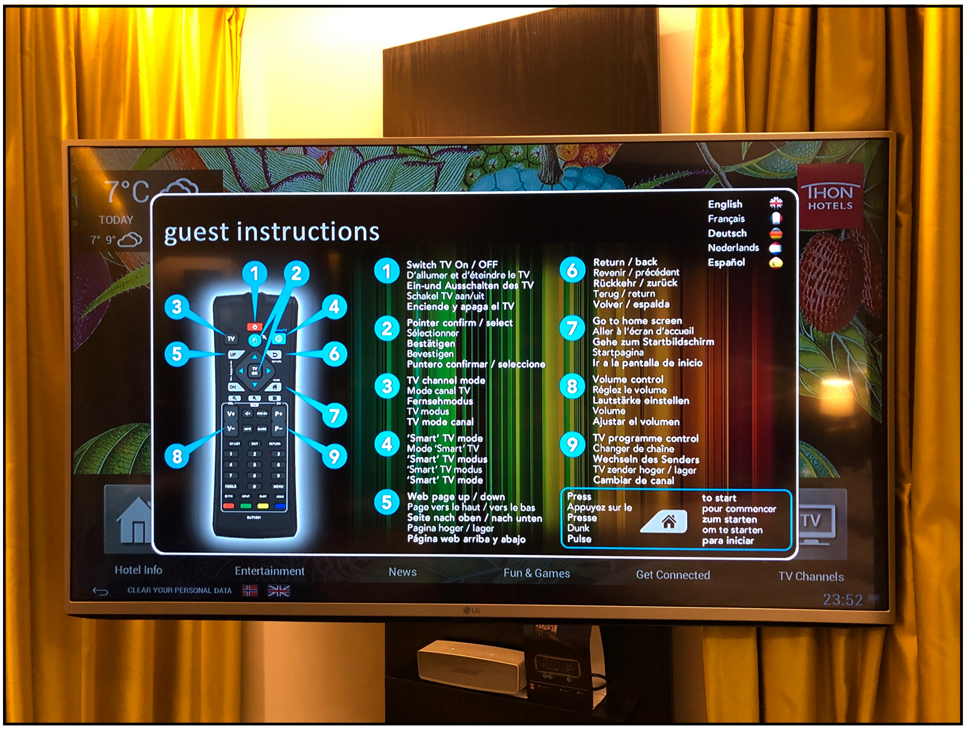
The Psychology of Everyday Things

The Pathology of Everyday Things

- First agricultural tractors:
  - high center of gravity and short width between axles
  - rough terrain → accident!
  - Human error?
  - Probably, design error → modern tractors have low center of gravity and large rear axle.
- Everyday frustrations
  - Are you able (without reading the users manual) to use every function of your:
    - digital clock
    - mobile phone
    - Microwave
    - TVBox...



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The Pathology of Everyday Things

- "Leitz Pravodit" slide projector
  - Only one button to control the presentation
  - During presentation, the slides sometimes go forward and sometimes backwards!
  - If we have access to the user manual:
    - brief push of the button → slides go forward
    - long push of the button → slides reverse
  - What an elegant design!?!
    - 1 button => 2 opposite functions
  - How was a first time user of the projector supposed to know this?!??

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The Pathology of Everyday Things

- Amphitheatre Louis-Laird in Sorbonne
  - Electric projection screen: must be controlled from a separate room.
  - Why can't the person trying to lower or raise the screen see what he is doing?

The Pathology of Everyday Things

- Imagine you are on the seat shown in the figure and you pull the lever pointed by the write arrow. What do you expect to happen?
  - The seat may slide back or forward according to the force you apply.

The Pathology of Everyday Things

- Surprise!, ...the seat ejects, so it can be removed.

- Most people wouldn't expect this result, which can be dangerous.

Design suggestion:

  – Nobody wants to eject the seat while sitting on it. So, the control should be moved to a different position, unreachable by someone sitting on the seat.

The Pathology of Everyday Things

- This tap design is so bad that it requires instructions to be appropriately used:

  – common device
  – uncommon functioning
  – hidden control

- Design tip:
  – often, when a common device requires instructions of use …it means there are design problems.

The Pathology of Everyday Things

The Pathology of Everyday Things

- The control buttons for the CD player are next to the cassette player and vice-versa.
- <u>Design suggestion</u>
  - **People expect to find the controls for a certain device next to the device they control. That's how it should be!**

The Pathology of Everyday Things

- The figure shows a control button for a desk lamp.
- The button has 3 positions: low intensity, (I), off (O) and high intensity (II).

- What is wrong?
  – To change the light intensity, one has to turn it off first.
  – It becomes difficult to compare the 2 different states (I) e (II).

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The Psychopathology of computers

- **Intend to type:** `rm *~ to remove Emacs backup files.`

- **Actually type:** `rm * ~ which removes everything!`

- **And there was no undo ...**

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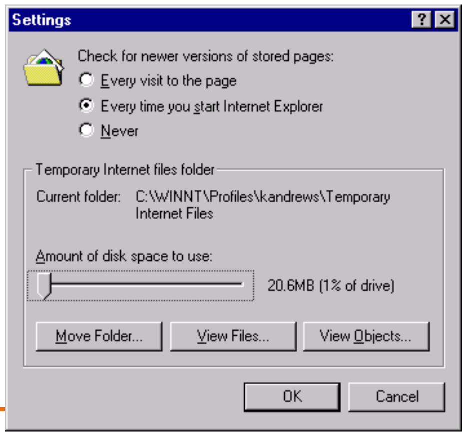
The Psychopathology of computers

- Reported in [Lee, 1992]:
  - In 1988, the USS *Vincennes* shot down an Iran Air A-300 Airbus with 290 people aboard.
  - The Aegis weapons system aboard the *Vincennes* had sophisticated software for identifying and tracking potential targets.
  - However, the large-screen display did not show altitude information - altitude had to be read from separate consoles.
  - The Airbus, which had levelled off at 12500 feet, was taken to be an F-14 fighter descending from 9000 feet.
  - Ironically, an escort ship with older equipment was able to read the plane's altitude quite correctly, but could not intervene in time.

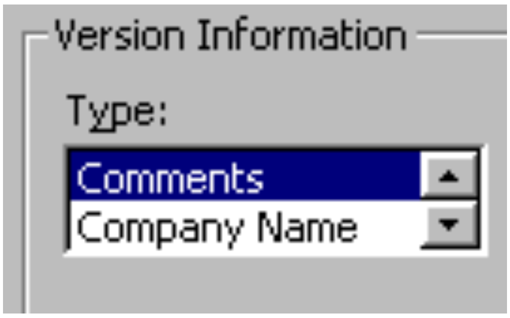
Interface Hall of Shame

- When setting cache size in IE 4.0 the user was only allowed to specify a percentage of their hard drive. The smallest setting was 1%.
- 10GB → 100MB



Interface Hall of Shame

- **Visual Basic 5.0 uses a list box with only 2 items (!)**
- **Radio buttons would be better.**



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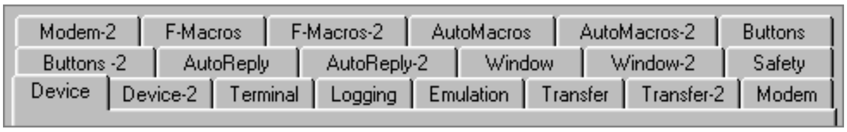
Interface Hall of Shame

- **Single-row property sheets (tab controls) are among the best interface elements.**
- **Multi-row tab controls are maybe the worst interface elements.**
- **Clicking on one of the tabs from other than the front row causes a major reorganization of the entire set of tabs.**



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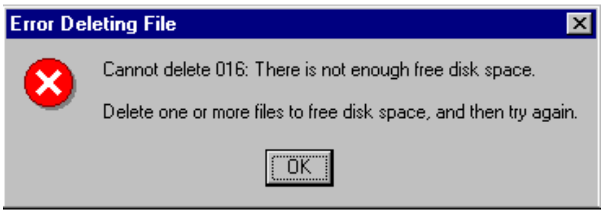
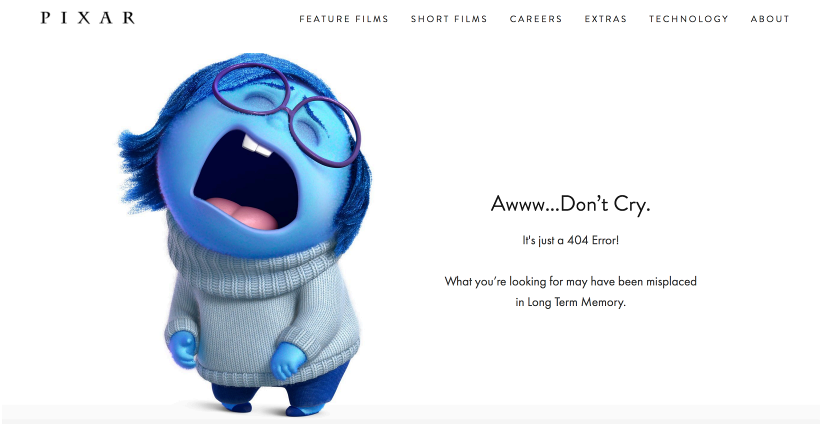
Interface Hall of Shame



Error messages



Error messages

We're sorry — something has gone wrong on our end.

What could have caused this?

Well, something technical went wrong on our site.

We might have removed the page when we redesigned our website.

Or the link you clicked might be old and does not work anymore.

Or you might have accidentally typed the wrong URL in the address bar.

What you can do?

You might try retyping the URL and trying again.

Or we could take you back to the **Starbucks home page**.

Or you could use the **site map** to find what you're looking for.

One more thing:
If you want to help us fix this issue, we are here to help. Please contact us and **let us know what went wrong**. Be sure to let us know what Web Browser and Operating System you were using when this occurred.

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Conceptual models

- People form mental models about the way objects work, events take place or people behave – *Conceptual models*.

- Conceptual models come from:
  - Causality
  - Familiarity with similar devices
  - Experience and training
  - Instructions
  - Interaction

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Conceptual models

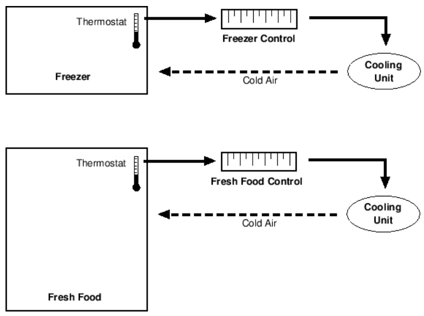
- A **good conceptual model** allows us to
  - understand the relationship between the controls of a device and the outcome.
  - predict the effects of our actions.
- A **poor conceptual model makes it difficult to**
  - figure out what to do in novel situations.
  - understand cause/effect.
  - predict the effects of our actions.

Conceptual models

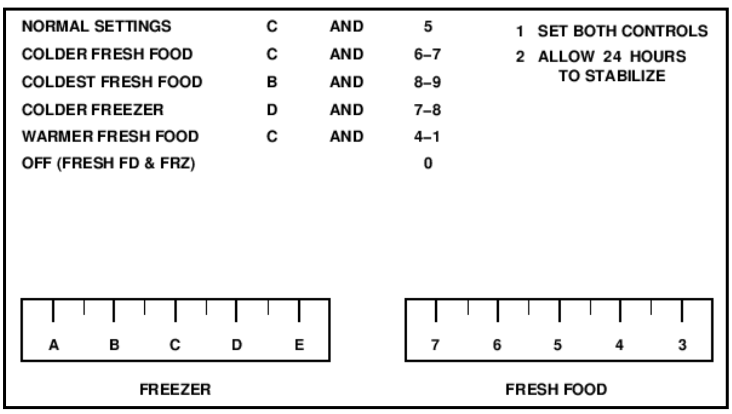
- Example: Refrigerator
  - 2 compartments
    - freezer
    - refrigerator
  - 2 things to do:
    - adjust the temperature of the freezer compartment
    - adjust the temperature for fresh food compartment
  - 2 controls

Conceptual models

- the 2 controls suggests a conceptual model to operate the two-compartment refrigerator.
- the apparent conceptual model, resulting from the controls on the device and instructions, suggests that each control is responsible for the temperature of the compartment that carries its name.



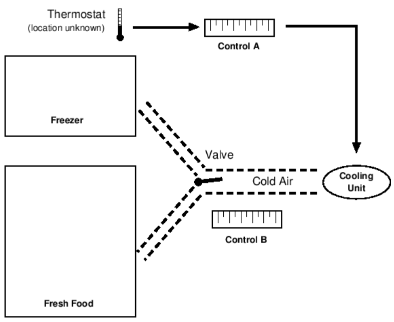
Conceptual models



- The Design of Everyday Things, Donald Norman, 1999.

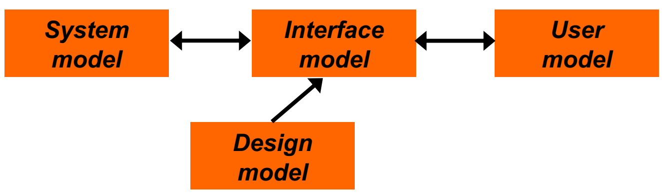
Conceptual models

- …but this conceptual model does not correspond to the way the real device works.
- the real conceptual model: there is only one thermostat and only one cooling mechanism. One control adjusts the thermostat setting, the other the relative proportion of cold air sent to each of the two compartments.



Conceptual models

- *System model* (or implementation model) = how the system works
  - its constituent parts and how they work together to do what the system does
- *Interface model* (system image) is the model that the system presents to the user.
- *User model* (mental model) is how the user thinks the system works.
- *Design model* (conceptual model) is the model that UI designer intended for the interface to convey.



Conceptual models

- The designer expects that the user model would be similar to the design model.
- But,... the design doesn't communicate directly with the user.
- Communication is done through the interface model.
- The interface model should make the design model clear and consistent to the user (avoiding that the user creates a wrong conceptual model).

Conceptual models

- Interface model should be:
  - Simple
  - Appropriate: reflect user's model of the task (learned from task analysis)
  - Well-communicated

Conceptual models

- The interface model might be quite different from the system model.

- System model has radically changed
  - Copper circuit ➔ cells
- Similar simple interface model

Conceptual models

- Designer's tasks:

  1. Choose the apropriate conceptual model.
  2. Correctly communicate it to the user.

How to communicate the model to the user?

- Affordances
- Mapping
- Visibility
- Feedback
- Constrains

Norman's design principles

Affordances

- Affordances - perceived and actual properties of an object that determine how the object could be used.
  - Appearance may suggest the use:
    - chair is for sitting
    - button is for pushing
    - listbox is for selection
    - knob is for turning

Affordances

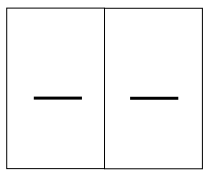
– Appearance should be used to tell the user what to do.

– The parts of a user interface should agree in perceived and actual affordances.

– When simple things need instruction, the design has failed!

Affordances

- Door
  - Can be opened and closed
  - How?
    - Pushing?
    - Pulling?
    - Sliding? Which direction?



  - The answers should given by the design, with no need for words or symbols, with no need to try.

Affordances

- Good design... the vertical bar suggests pulling; the horizontal bar suggests pushing.

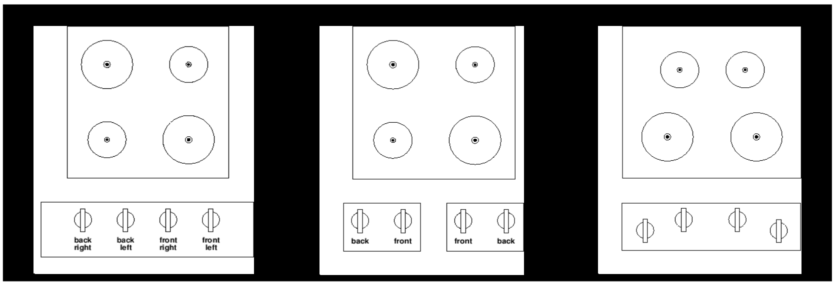
Affordances

- British Rail shelters with glass walls were vandalized routinely
  - Glass suggests ("affords") being broken
- Glass was replaced by strong plywood or concrete, and demolishing stopped
  - Wood and concrete suggests/affords stability and support
- Now, they are being scribbled
  - Smooth, even surfaces "afford" drawing

Mapping

- Mappings – relationship between the controls and their effects on the system.
- Natural Mappings – uses physical analogies and cultural conventions.
- Principle of natural mapping: the relationship between the controls and actions should be clear to the user.
- Ex:
  - to turn the car to the right, ones turns the steering wheel clockwise (its top moves to the right)
    - which control affects the direction
    - which direction to turn the steering wheel
  - Move the control up to move an object up.
  - A louder sound to represent a bigger quantity.

Mapping



- Arbitrary mapping: several possible arrangements; need for labels or memory.
- Partial mapping: only(!) 4 possible arrangements, but confusion is still possible.
- Natural mapping: no ambiguity, no need for labels, learning time or remembering.

Visibility

- Visibility is all about how clearly the user sees the state of the interface and all the possible actions.
- Relevant parts of the system must be visible.

Visibility

- Possible actions: things the user can do in the interface
- State: current configuration of the interface and its backend (ex: which objects are selected).

Hiding certain action can be advantageous. Certain functions can be kept invisible until needed
(ex: Google search)

Feedback

- Causality exists when something that happens after an action appears to be caused by that action.
- Two types of false causality:
  - Coincidences
    - Touch the keyboard just when the computer fails makes us feel guilty.
    - Run a new application just before the computer crashes.
  - Invisible effects generate confusion
    - When an action has no visible effect, we may conclude that it was ignored and we repeat it.
    - Repeatedly clicking a button with no noticeable system change.
  - Need for FEEDBACK!!!

Feedback

- Actions should have an immediate visible feedback.
- Synchronized with the user action

Feedback

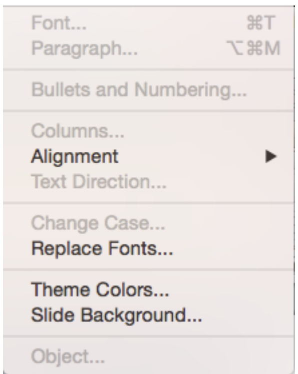
- Imagine:
  - trying to talk without hearing your own voice
  - trying to draw with a pencil that leaves no mark
- Types of feedback:
  - Visual
  - Audio
  - Haptic
- EX:
  - Scrollbar thumbs move.
  - Dragged objects follow the cursor.

Feedback

Constraints

- + possibilities => + difficulty to manage new situations.
- Constraints restrict the number of possibilities.
- Types:
  - Physical: based on object shape; limit possible operations; more effective when visible.
  - Semantic: rely upon our knowledge of the situation and of the world.
  - Cultural: rely upon accepted cultural conventions.
  - Logical: explore logical relationships. Natural mapping provides logical constraints. Affordances suggest possibilities.
- Constraints: reduce the alternatives.

Constraints



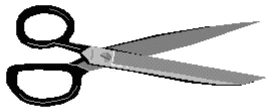
Constraints

Constraints

- Cultural conventions may vary:
  - Light switches:
    - USA: down - off
    - UK: down - on
  - Taps:
    - USA: turn left - open
    - UK: turn left - close
  - Red:
    - USA: danger
    - Egypt: dead
    - India: life
    - China: happiness
  - ...

Conceptual models

- Scissors provide a good conceptual model:
  - Affordances
    - holes to put the fingers
  - Constraints
    - Big hole suggests several fingers and small hole for the thumb.
  - Mapping
    - between fingers and holes
- Conceptual model
  - operating parts are visible and the implications are clear. The conceptual model is made clear.



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Conceptual models

- A digital clock with several buttons doesn’t provide a good conceptual model.
  - Affordances
    - buttons suggest pushing,...but what do they do?
  - Mapping
    - no evident relationship between the buttons and their functions
  - No constraints
  - Former Knowledge
    - not similar with mechanical clocks.
- Conceptual model
  - Must be formed from instructions.

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Metaphor

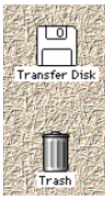
- A Metaphor
  - Another way to address the conceptual model problem
  - Relating computing to other real-world activity is an effective teaching technique
    - Desktop
    - Trashcan
  - Several good interfaces are not based on metaphors
    - Hyperlink
    - Resizeable windows

Metaphor

- Advantages
  - Help users to perceive the conceptual model
  - Help to understand the “unfamiliar”
  - Simplify the description of the system to novice users
  - Facilitate users access to computers
- You’re borrowing a conceptual model that the user already knows.

Metaphor

- Problems
  - Hard to find
  - Constraining
  - Some tasks do not fit into a given metaphor
  - Cultural differences
- Not such a good example!



- Trash bin over the desk?
- Drag to trash $\Rightarrow$ Delete
- Disk eject $\Rightarrow$ drag to trash !!

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Metaphor

- The basic rule for metaphors is: use it if you have one, but don't stretch for one if you don't.
- Use of a metaphor is no guarantee for a good communication of the conceptual model:
  - RealCD: bad affordances, visibility

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Metaphor

Interface Hall of Shame

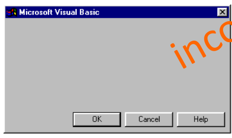
Metaphor

Consistency

- When people lack the knowledge about how to operate a certain system, they tend to derive the operation by analogy with other similar system.
- Principle of least surprise
- Similar things should look and act in similar ways.
- Different things should be visibly different

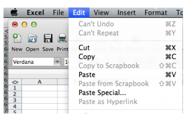
Consistency

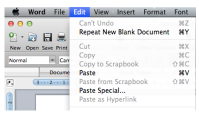
- Internal – within itself



inconsistency

•External – with other application of the same platform





•Metaphorical – with the interface metaphor or similar real-world objects

inconsistency

Knowledge distribution

- Knowledge in the head and in the world
  - partially in the head
  - partially in the world
  - partially in constraints
- Knowledge in the world
  - reduces the need for learning and mental effort.
  - Ex:
    - the interface can show the input format:
      - >Please enter the date (yyyy/mm/dd):_
      - The slots' format only allows for the correct object.

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Interface Hall of Shame

- **Suggestions to correct the interface problems?**

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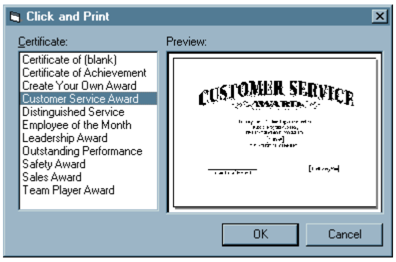
Interface Hall of Shame

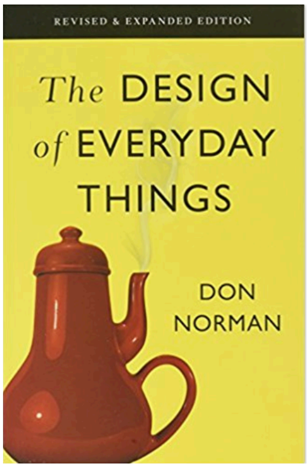


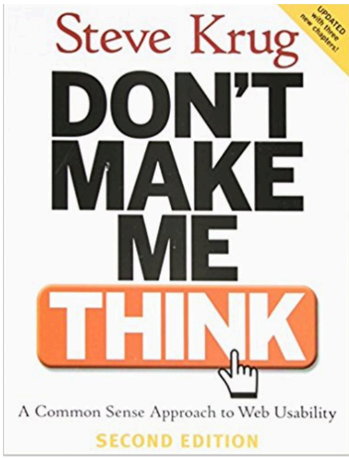
- **Affordance: a list box suggests the selection of an item.**
- **Random access to available templates is trivial.**
- **No need for help messages.**

Previously correcting errors

- **A paper prototype of this interface in an initial iteration would have detected several problems. In that iteration, modifications would have cost just one more “sketch”.**

Further reading





Interaction models

Interaction - Concepts

- *What is Interaction?*
  - A process of information transfer.
  - Communication between the user and the system
    - two complex entities
    - ≠ ways of communication and view of the domain
  - The interface must effectively translate between them
    - the translation may fail for several reasons.
- *Models*
  - Interaction models help to understand what is going on in the interaction and to identify the roots of difficulties.
  - Provide a framework to compare different interaction styles.

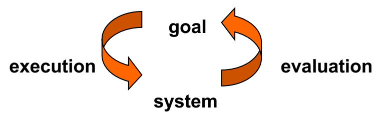
Interaction – Norman's model

"*The basic idea is simple. To get something done, you have to start with some notion of **what is wanted**—the **goal** that is to be achieved. Then, you have to do something to the world, that is, **take action** to move yourself or manipulate someone or something. Finally, you **check** to see that your goal was made. So there are four different things to consider: the goal, what is done to the world, the world itself, and the check of the world. The action itself has two major aspects: doing something and checking. Call these **execution** and **evaluation**.*"

[Norman]

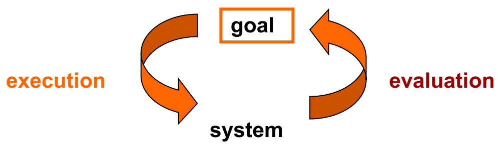
Interaction – Norman’s model

- Donald Norman’s model of interaction is the most influential in HCI, possibly because of it's closeness to our intuitive understanding of the interaction between human users and computers. It comprises 7 stages:
  - establishing the goal
  - forming intention
  - specifying the action sequence
  - executing the action
  - perceiving the system state
  - interpreting the system state
  - evaluating the system state with respect to the goals and intentions.



- Norman’s model concentrates on the user’s view of the interface.

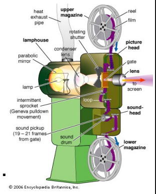
Interaction – Norman’s model



- Seven stages of action:
  - establishing the goal
  - forming intention
  - specifying the action sequence
  - executing the action
  - perceiving the system state
  - interpreting the system state
  - evaluating the system state with respect to the goals and intentions.

Interaction – Norman's model

- Norman uses his model of interaction to show why some interfaces causes problems to their users.



- Some systems are harder to use than others.

- **Gulf of execution**
  - the difference between the intentions and the allowable actions.
  - user's formulation of actions $\neq$ actions allowed by the system

- **Gulf of evaluation**
  - reflects the amount of effort the user must exert to interpret the physical state of the system and to determine how well the expectations and intentions have been met.
  - user's expectation of changed system state $\neq$ actual presentation of this state

Interaction – Norman's model

- The seven stages of action prompt the following design questions:

How easily can one:

1. determine the function of the device?
2. tell what actions are possible?
3. determine mapping from intention to physical movement?
4. perform the action?
5. tell what state the system is in?
6. determine mapping from system state to interpretation?
7. tell if system is in the desired state?

Interaction – Norman's model

- **Principles of Good Design**
  The significance of these questions can be summed up as the following principles of good design:
  - *Visibility*: By looking, the user can tell the state of the device and the alternatives for action.
  - Affordances: Objects' appearance determine how the object could be used.
  - *Feedback*: The user receives full and continuous feedback about the results of actions.
  - *Good mappings*: It is possible to determine the relationship between actions and results, between the controls and their effects, and between the system state and what is visible.
  - *A good conceptual model*: The designer provides a good conceptual model for the user, with consistency in the presentation of operations and results and a coherent, consistent system image.

Norman, 1998

Dificulties in interaction

- Gulf of execution
  - Difficulty of choosing actions and performing them
  - Affordances, constraints, mappings are helpful
- Gulf of evaluation
  - Difficulty of determining the effects of your actions
  - Feedback is essential here

To err is human

Norman’s thoughts about Errors

– If an error is possible, someone will make it.
  Assume: All possible errors will be made!

– **Design for error**

– Design exploratory systems, with the possibility to undo actions.

To err is human

Norman’s thoughts about Errors

– Designers should:
  - assume all possible errors will occur
  - minimize the chance of errors
  - minimize the effects of errors when they do occur
  - make it easy for users to detect errors
  - make it possible to reverse the effects of an error

To err is human

- Mistake
  - form the wrong intention
  - often caused by a wrong conceptual model
- Slip
  - error in carrying out the intention (wrong execution)
    - Description errors
    - Capture errors
    - Mode errors
  - fix: better interface design

To err is human

- Description error
  - Intended action is replaced by another action with much in common
    - Pouring orange juice into your cereal
    - Throwing shirt into toilet instead of laundry basket
      - "throwing the shirt at the top of the container"
  - the internal description of the intention was not sufficiently precise.
  - Avoid actions with very similar descriptions
    - Long rows of identical switches

To err is human

- Capture error
  - A sequence of actions is replaced by another sequence that starts the same way. Usually the first is unfamiliar and the second is well practiced.
    - Leave your house and find yourself walking to school instead of where you meant to go
    - Vi :wq! command
  - Avoid usual action sequences with common prefixes.

To err is human

- Mode error
  - Occurs when devices have different modes of operation and the same action has different meanings depending on the selected mode
    - Vi's insert mode vs. command mode
    - Caps Lock
  - Avoiding mode errors
    - Eliminate modes
    - Visibility of mode
    - Spring-loaded or temporary modes
    - Disjoint action sets in different modes

To err is human

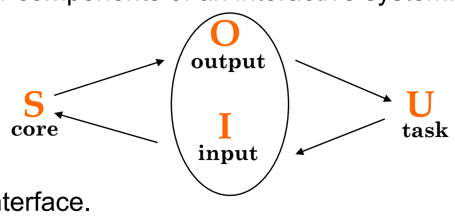
- Lack of consistency
  - When people lack the knowledge about how to operate a certain system, they tend to derive the operation by analogy with other similar system.
  - It is a powerful method of human though,…
  - … it can lead to errors if the mapping is not consistent.

To err is human

- Minimize error occurrence
  - actions with serious consequences and irreversible actions should be difficult to perform and require confirmation
- Minimize the effect of errors
- Support recovering

Interaction – Interactive cycle

- Interaction Framework from Abowd and Beale is an extension of Norman's model. It attempts a more realistic description of interaction by including the system explicitly.
- Nodes represent the 4 major components of an interactive system:
  - System
  - User
  - Input
  - Output



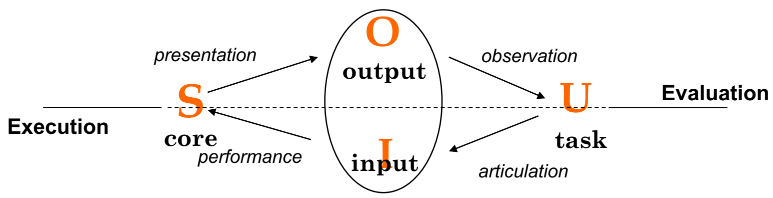
- Input and Output form the interface.
- Each component has its own language: core, task, input, output.

interaction $\Rightarrow$ translation between languages

problems in interaction = problems in translation

Interaction – Interactive cycle

- 4 main steps, each corresponding to a translation from one component to another:



- 2 phases: Execution and evaluation.

Interaction – Interactive cycle

- **Execution phase**
  – User starts the interaction cycle
    - formulation of the goal
    - formulation of the task to achieve the goal

  – the only way the user can manipulate the machine is through the *Input*.
    → a task must be articulated within the *Input* language.
  – the *input* language is translated into the *Core* language as operations to be performed by the system.
  – the system transforms itself and get into a new state.

- **Evaluation phase**
  – the new system state must be communicated to the user.
  – the current values of the system attributes are translated to the Output language.
  – the user observes the Output and evaluates the results of the interaction in respect to the goal.

Interaction – Interactive cycle

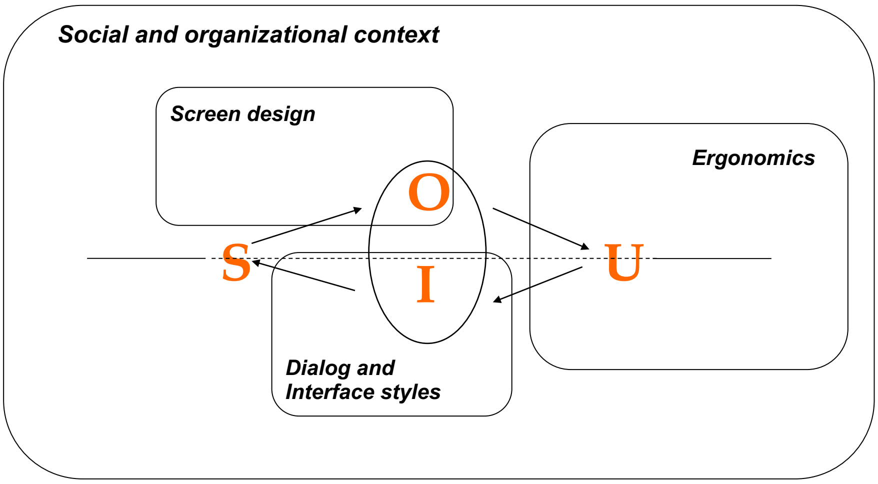
- Summary of Abowd & Beale´s model:

  – user intentions
    → translated into actions at the interface
      → translated into changes in system state
        → reflected in the output display
          → interpreted by the user

- general framework for understanding interaction

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

Interaction – Interactive cycle



Interaction - Ergonomics

- Ergonomics - study of the physical characteristics of the interaction, which includes:
  - Control's arrangement
    - controls should be grouped logically (keeping opposing controls separate); according to function, frequency of use or sequentially.
    - the whole system interface must be appropriately arranged in relation with the user's position; the user should able to reach all controls and see all displays without excessive body movement.
    - critical information should be displayed at the eye level.
    - appropriate light should be used, not distorting the display.
    - space between controls should be adequate, in order to facilitate the user manipulation.
  - Physical surrounding environment
    - Ex: adaptable seats for all sizes of users, comfortable positions.
  - Health issues
    - physical position, temperature, lighting, noise,...
  - Use of colour
    - colour characteristics and interpretation by users; be aware of human psychological and physical characteristics, as well as cultural differences.

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