

CSC 3461

Toward an interaction model

- What we would like:
 - a model that explains how human users interact with computer interfaces
 - even better: a model that explains how humans interact with computational media more generally
- Why?
 - explanatory power; diagnosis
 - predictive; design
- Our starting place:
 - models of how people interact with everyday objects
 - models of how people “understand” or “explain” everyday phenomenon

2

The Paradox of Technology

- What is the paradox of technology?
- Consider the “U”-shaped curve of complexity:
 - radios
 - watches
 - ...

3

The Paradox of Technology

- What is the paradox of technology?
 - Potential is to make life easier and more enjoyable
 - To realize this potential, technology undergoes development
 - Development often leads to complexity which leads to difficulty and frustration
- The same technology that makes life easier and more enjoyable also complicates life by making things harder to learn and harder to use.

4

Basic terminology

- 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, specified in terms of operations or actions
 - e.g. ... select fill tool, click over triangle
- terminology can differ in different communities
- terminology affected by the shift from work-based HCI design to social, qualitative interaction design

5

The Design of Everyday Things Donald A. Norman



6

Overview of Concepts

- relevant concept: mental models
- relevant concept: folk theory

- relevant concept: affordance
- relevant concept: feedback

- relevant concept: mapping

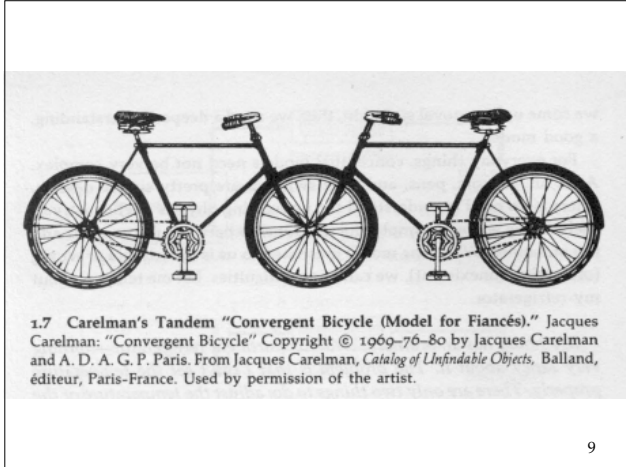
- relevant concept: false blame

7

Motivation for Concepts

- Design principles:
 - Provide a good conceptual model
 - relevant concept: mental models
 - relevant concept: folk theory
 - Make things visible
 - relevant concept: affordance
 - relevant concept: feedback
 - Make relationships between controls and things controlled as “natural” as possible
 - relevant concept: mapping
 - Mitigate the effects of errors
 - relevant concept: false blame
 - reduce occurrence, reduce consequences (in that order, e.g., “reduce, reuse, recycle”)

8



9

Mental Models

- People are explanatory beings
 - they attempt to form mental models that they use to understand what they observe/sense
 - what is the nature of these mental models
- When faced with something novel:
 - People may use already-formed models to explain/describe novel but similar phenomenon
 - People often attempt to "generalize" the application of such models
- A designer can influence the interaction via the mental model suggested to the user

10

Mental Models

- What goes into the formation of the mental models?
- What factors affect the assessment of which mental model is to be applied?

11

Everyday things

- Doors
- Light switches
- Taps
-
- Telephones
- Microwaves
- VCR's

psychology vs psychopathology

12

Everyday things

- exercise: count the objects in your immediate surroundings
- even if an object is simple:
 - each may require its own method of operation, has to be learned, does its own specialized task, etc
- conclusion: there is a vast numbers of things to learn
- how people cope with everyday objects is instructive with respect to how users cope with interfaces

13

Affordances

- “the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used”

14

Affordances

- Plates are for pushing
- Knobs are for turning
- Buttons are for pressing

- No picture, label or instruction is required

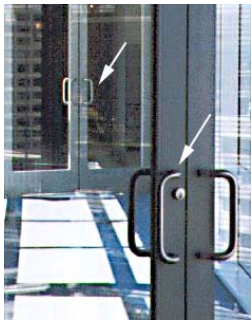
15

Affordances

- perceived and actual properties of a thing
- “is for”, *ability
- provide clues to the operation of things
 - plates are for pushing, knobs are for turning/ pulling ...etc

16

Doors are for opening



17

Affordances

- Prevalent definition in cognitive psychology due to Gibson, *The Theory of Affordances*, 1977; *The Ecological Approach to Visual Perception*, 1979
 - all "action possibilities" latent in the environment, objectively measurable and independent of the individual's ability to recognize them, but always in relation to the actor and therefore dependent on their capabilities.
- Affordance is dependent on the physical capabilities of the actor;
 - the term is subjective
 - E.g., a set of steps which rises four feet high does not afford the act of climbing if the actor is a crawling infant.
- Norman appropriated this notion; made it dependent on the actor's goals, plans, etc
 - the term is subjective and relational
- to afford: to provide/make available -vs- to suggest/invite

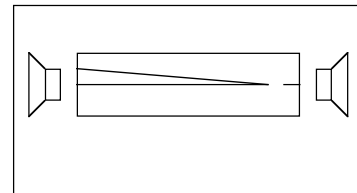
18

The Principle of Mappings

- The relationship between two things
- Natural mapping
 - Physical analogies
 - Cultural standards

19

Car speaker control



20

Good mappings

- It is possible to determine the relationships between:
 - Actions and results
 - Controls and their effects
 - The system state and what is visible

21

Natural mapping



22

Explanation of Everyday Phenomenon

- People often:
 - attribute cause incorrectly
 - attribute cause instead of correlation
 - e.g., two closely occurring events are related as “cause-effect” occurrences
 - e.g. library catalog example
 - attribute blame to themselves instead of elsewhere
 - use “cues” incorrectly when constructing explanations of phenomenon

23

Psychology of Causation

- Causation: a directional relationship between one event and another event which is the consequence of the first.
 - cause/effect
- Causation vs Correlation, Coincidence
- False causality

24

Explanation of Everyday Phenomenon

- People often form an understanding based on “surface level” observation as opposed to deep knowledge of an event
 - e.g. two bullets scenario
- People often make judgments based on past experiences instead of facts-at-hand
 - e.g., airplane o-ring example

25

Seven-Stage Interaction Model

- Goal – the state that is to be achieved
- Action cycle
 - Intention – actual determination to act
 - Set of actions
 - Physical execution of actions
- Evaluation cycle
 - Perceiving state
 - Interpreting state
 - Evaluating state – comparing with intention and goal

26

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

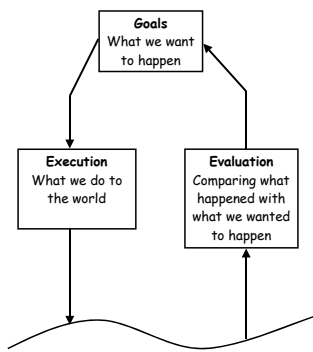
27

Basis of model formation

- How do people do things? How do they interact?
- Norman’s seven stages: goal (1), action (3), and evaluation (3)

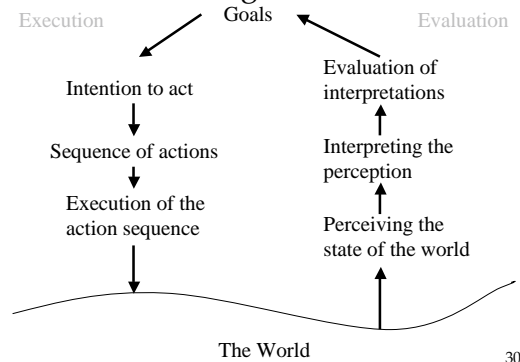
28

Norman's Action Cycle



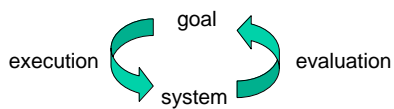
29

Norman's Seven Stages of Action



30

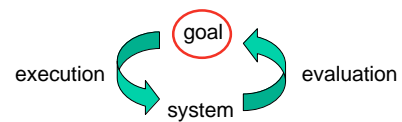
execution/evaluation loop



- 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

31

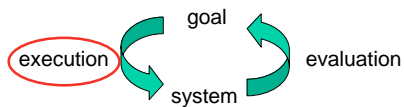
execution/evaluation loop



- 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

32

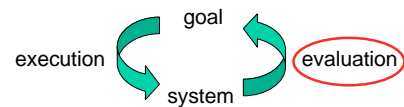
execution/evaluation loop



- 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

33

execution/evaluation loop



- 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

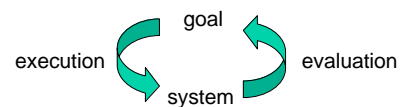
34

What the user faces:

- user must:
 - interpret the physical state of the system
 - determine how well the the expectations and intentions have been met.
 - if the system provides information that is easy to interpret and matches the way the person thinks of the system
 - user expends relatively little effort
 - > small "gulf of evaluation"
- user must also:
 - determine which system actions to perform in order to realize intention
 - if the system provides desired actions
 - > small "gulf of execution"

35

execution/evaluation loop



At this point:
What do I want to do?
What can I do?

At this point:
What is the state of the system?
What do I want to do next?

36

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

37

The Gulf of Evaluation

- The difference between the system's state and what the user's perception of the system's state
- Issues:
 - where is the knowledge derived about the system's state?
- people find it difficult to interpret the system response and match it with their goals

38

The Gulf of Execution

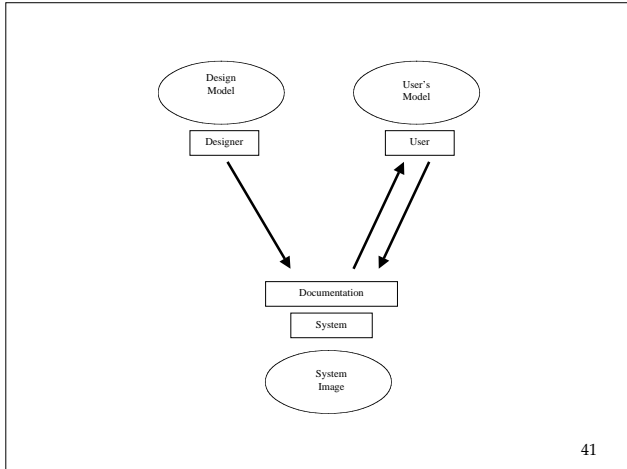
- The difference between the intentions and the allowable actions
- Issues:
 - where is the knowledge derived about what actions are allowable?
 - on what basis are intentions derived?
- people may find it difficult to transform their intentions to actions and ultimately execute those actions

39

The Norman Interaction Model

- Not a complete model
- Does not account for opportunistic or data-driven behavior
- Also, not all interactions require that all steps as specified in the model be followed
 - an event in the world may trigger an interpretation and a subsequent action

40



41

Design Principles

- Make things visible: the system's state, the alternatives for actions
 - relevant concept: affordance, feedback
- Provide a coherent, consistent system image
 - relevant concept: mental models, folk theory
- Make it possible to determine the relationships between controls and things controlled; actions and results
 - relevant concept: mapping
- Provide full and continuous feedback about the results of actions
- Mitigate the effects of errors
 - relevant concept: false blame
 - reduce occurrence, reduce consequences
 - (in that order, e.g., "reduce, reuse, recycle")

42