

Vorlesung Mensch-Maschine-Interaktion

Models and Users (1)

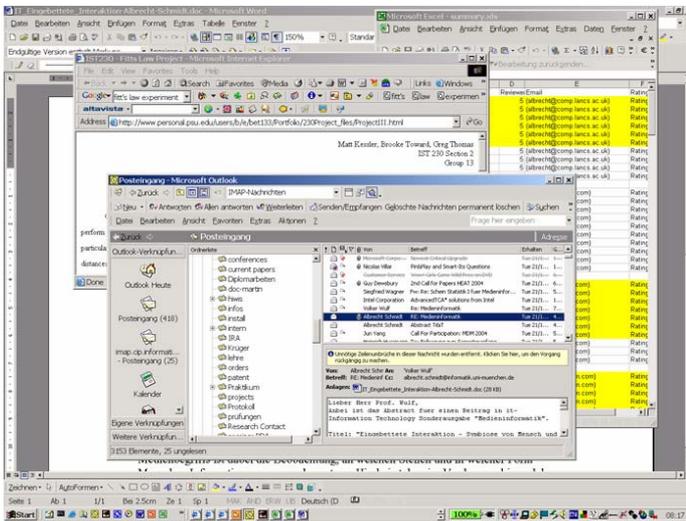
Ludwig-Maximilians-Universität München
LFE Medieninformatik
Heinrich Hußmann & Albrecht Schmidt
WS2003/2004

<http://www.medien.informatik.uni-muenchen.de/>

Table of Content Models and Users (1)

- Why models
- Psychology of everyday things
- Psychology of everyday action
- Seven stages of action
- Models – human and computer

Practical Motivation



- What do we see?
- What is shown?
- What is the meaning?

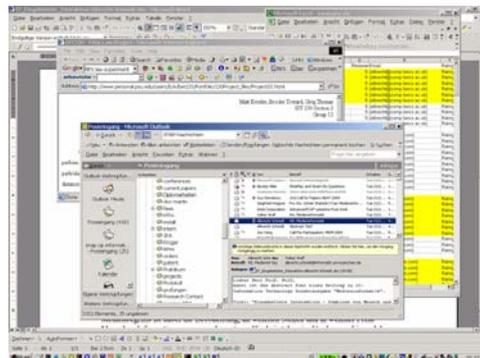
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Skilled Computer Users Answers

- Win2000 desktop
- Text and figures
- Icons and toolbars
- Overlapping windows
- Scroll bars and Menus
- Task bar and status information
- Handles and a pointer
- Representations of documents



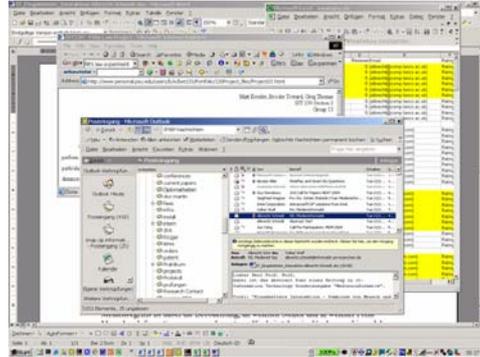
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Basic (Naive) Technical Answers

- 2-D surface
- Controllable pixels



- Image with a resolution of 1400x1050 pixels
- For each pixel the colour can be set
- The change of colour can be controlled rapidly

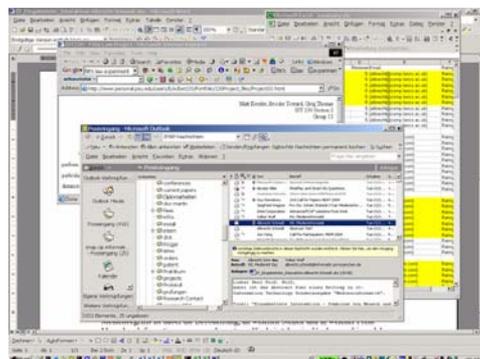
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Perfect Users Answers

- My work environment



- Meeting notes
- Budget for next year
- Request to write a technical article
- Background information on a psychological phenomenon

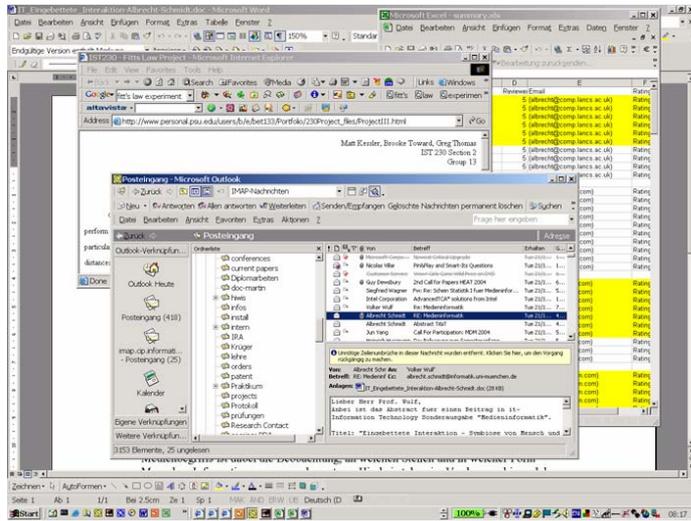
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Example I – Overlaying Windows

- What is the meaning that a window is behind another window?
- What is real? What is illusion?
- What does iconizing do?
- Models? Conceptually Implementation Represented



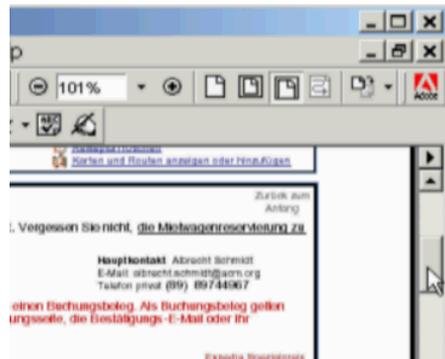
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Example II – Scrolling vs. Hand

- moving up the scroll bar moves down the document
- What happens really? What do we imagine? What is the metaphor?



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Example II – Scrolling vs. Hand

- moving up the hand moves up the document
- What happens really?
What do we imagine?
What is the metaphor?



What the User Sees



- Users see only what is visible!

What the Developer Knows



- Users see only what is visible!
- users have little idea about:
 - architecture,
 - state transitions,
 - dependencies
 - application context
 - system restrictions
 - ...

Guidance for the designer (Shneidermann, 97)

- Systematic approach is needed

- High-level theories and model
- Middle-level principles
- Specific and practical guidelines

Models & Theories

- What are models and theories used for?
 - explanatory
 - predictive
 - descriptive/taxonomy
- Models on different levels
 - keystroke
 - dialog
 - ...
 - concept
 - human action
- What is modelled?
 - user
 - task
 - dialogs
 - transitions
 - software
 - input/output
 - system
 - interaction
 - behaviour
 - ...
 - combination of these

Models and Theories

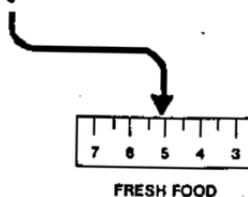
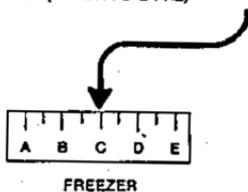
- There are plenty! We will cover some of them...
 - Seven Stages of Action
 - Seeheim Model
 - Conceptual, semantic, syntactic and lexical
 - GOMS and Keystroke
 - Object-Action Interface Model
 - PAC Model
 - Arch Model
 - MVC Concept
 - ...
- Looking at a selection of them to understand
 - What models are used for
 - How models are applied
 - How they help to improve the design/development process

Background: The Psychology of Everyday Things (Norman 2002, Chapter 1)

- Not primarily aimed at computer science problems but with technologies (web, interactive media, embedded computers) moving into everyday life of most people it becomes highly relevant!
- Terms: Perceived and Real Affordances
 - Affordances determine the range of possible - usually physical - actions by a user on an system/object.
 - Perceived Affordances are the actions perceived by a user that appear to be possible.
 - Example: certain materials afford/support certain forms of vandalism (e.g. glass is smash, wood is carved, graffiti appears on stone)
- This is also applicable to digital materials and designs.

Explaining Conceptual Models Example –Refrigerator

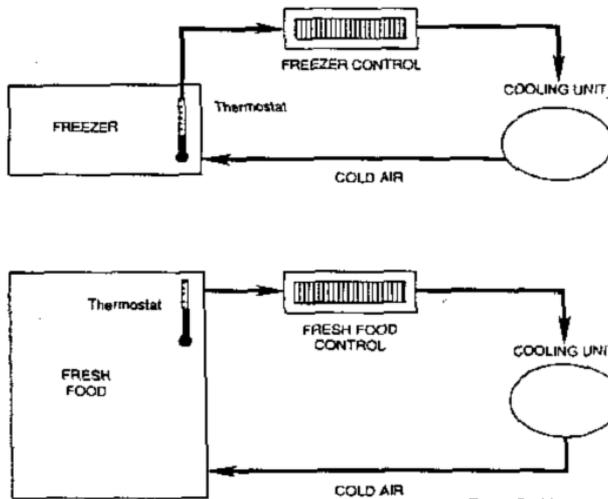
NORMAL SETTINGS	C	AND	5	
COLDER FRESH FOOD	C	AND	6-7	1 SET BOTH CONTROLS
COLDEST FRESH FOOD	B	AND	6-9	2 ALLOW 24 HOURS
COLDER FREEZER	D	AND	7-8	TO STABILIZE
WARMER FRESH FOOD	C	AND	4-1	
OFF (FRESH FD & FRZ)			0	



- 2 controls
- Freezer
- Fridge

From D. Norman, *The Psychology of Everyday Things*.

Example – Refrigerator Conceptual Model 1



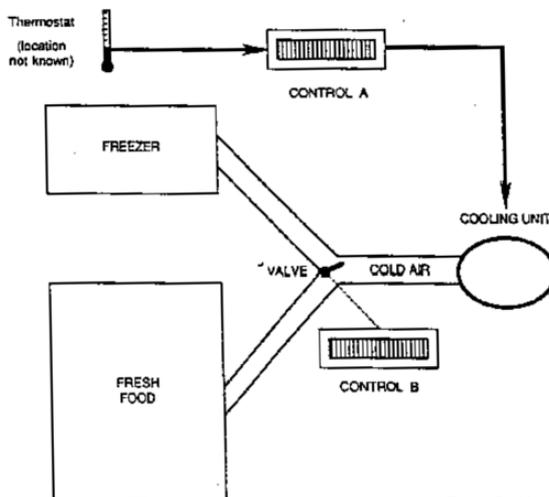
NORMAL SETTINGS C AND 5
 COLDER FRESH FOOD C AND 8-7
 COLDEST FRESH FOOD B AND 8-9
 COLDER FREEZER D AND 7-8
 WARMER FRESH FOOD C AND 4-1
 OFF (FRESH FD & FRZ) C AND 0



- Idea 1:
2 cooling units
- One control each

From D. Norman, *The Psychology of Everyday Things*.

Example – Refrigerator Conceptual Model 2



NORMAL SETTINGS C AND 5
 COLDER FRESH FOOD C AND 8-7
 COLDEST FRESH FOOD B AND 8-9
 COLDER FREEZER D AND 7-8
 WARMER FRESH FOOD C AND 4-1
 OFF (FRESH FD & FRZ) C AND 0



- Actual design –
one cooling unit
- Controls have
different
functions

From D. Norman, *The Psychology of Everyday Things*.

Informal Exercise:

Understand Conceptual Models

- Talk to “non-technical” people and try to understand their conceptual model for the following systems
 - Ordering a book from an online bookshop
 - Finding and reading information on the WWW on a particular topic using a search engine
 - Sending an email to someone who is traveling

- Hints to the conceptual model are often provided by
 - Observing what constraints on usage people apply (e.g. you have to do step x before step y)
 - How people explain errors (e.g. assuming the mental model does not include DNS – it is interesting to find out how people explain errors caused by failure of this component)

Understandability and Usability

- Principles of Design (Norman, 2002)
 1. Provide a good conceptual model
 2. Make things visible

- A conceptual model is used to predict the effect of actions performed. The conceptual model is based on:
 - Affordances
basic properties of the device/system
 - Constraints
possible actions that can be performed
 - Mapping
relationship between controls and outcome
 - Experience
knowledge acquired that is related to the domain

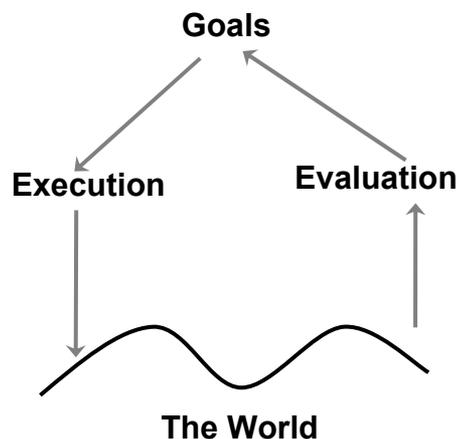
- Visibility relates also to mappings and feedback
 - Provide a control for each function (direct mapping)
 - Make actions and reactions visible (feedback)

Background: The Psychology of Everyday Action (Norman 2002, Chapter 2)

- People are blaming themselves for problems caused by design
 - If the system crashes and the user did everything as he is supposed to do the developer/system is blamed
 - If the system crashes and the user operated the system wrongly the user is blamed
- People have misconceptions about their actions
 - The model must not be fully correct – it must explain the phenomenon
- People try to explain actions and results
 - Random coincidence may lead to assumptions about causality

Action Cycle

- The action is goal directed
 - What we want to happened?
 - What is the desired state?
- Human action has two major aspects
 - Execution: what we do to the world
 - Evaluation: compare if what happens is what we want



Action Cycle

Stages of Execution

- Goal
translated into
- An intention to act as to achieve the goal
translated into
- The actual sequence of actions that we plan to do
translated into
- The physical execution of the action sequence

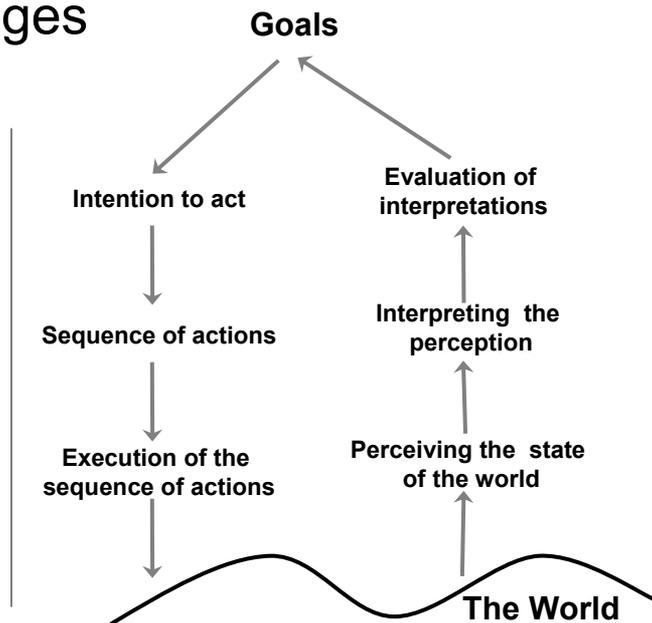
Action Cycle

Stages of Evaluation

- Perceiving the state of the worlds
followed by
- Interpreting the perception according to our expectations
followed by
- Evaluation of the interpretations with what we expected to happen (original intentions)
followed by
- Goal

Seven Stages of Action

1. Forming a goal
2. Forming an intention
3. Specifying an action
4. Executing the action
5. Perceiving the system state
6. Interpreting the system state
7. Evaluating the outcome



Gulf of Execution

- The difference between the intentions and the allowable actions is the Gulf of Execution
 - How directly can the actions be accomplished?
 - Do the actions that can be taken in the system match the actions intended by the person?
- Example in GUI
 - The user wants a document written on the system in paper (the goal)
 - What actions are permitted by the system to achieve this goal?
- Good design minimizes the Gulf of Execution

Gulf of Evaluation

- The Gulf of Evaluation reflects the amount of effort needed to interpret the state of the system how well this can be compared to the intentions
 - Is the information about state of the system easily accessible?
 - Is it represented to ease matching with intentions?
- Example in GUI
 - The user wants a document written on the system in paper (the goal)
 - Is process observable? Are intermediate steps visible?
- Good design minimizes the Gulf of Evaluation

Implications on Design

- Principles of good design (Norman)
 - Stage and action alternatives should be always visible
 - Good conceptual model with a consistent system image
 - Interface should include good mappings that show the relationship between stages
 - Continuous feedback to the user
- Critical points/failures
 - Inadequate goal formed by the user
 - User does not find the correct interface / interaction object
 - User may not be able to specify/execute the desired action
 - Inappropriate / mismatching feedback

About (Human)Errors...

TAIPEI TIMES

Published on [TaipeiTimes](#)

<http://www.taipeitimes.com/News/taiwan/archives/2003/10/18/2003072381>

Fighter pilots find panic button at last

MISTAKE MANAGEMENT: Two crashes blamed on human error have prompted the developers of the IDF to remind the air force about a built-in emergency function

By Brian Hsu

STAFF REPORTER

Saturday, Oct 18, 2003, Page 4

Although Taiwan's Indigenous Defense Fighter (IDF) has an emergency function that minimizes the chance of a plane crash due to human error, pilots have only now found out about it.

The previous two accidents involving IDFs this year were caused by human error, defense sources said yesterday.

"The crash was also caused by the negative G-force which the flight instructor created .."

About (Human)Errors...

- "If an error is possible someone will make it" (Norman)
- Human Error may also be a starting point to look for design problems.
- Design implications
 - Assume all possible errors will be made
 - Minimize the chance to make errors (constraints)
 - Minimize the effect that errors have (that is difficult!)
 - Include mechanism to detect errors
 - Attempt to make actions reversible

Constraints

- Physical constraints
 - basic physical limitations
- Semantic constraints
 - Assumption that create something meaningful
- Cultural constraints
 - Borders provided by cultural conventions
- Logical constraints
 - Restrictions due to reasoning
- Applying constraints is a design decision!



(example from Norman)

GUI Example

Date unconstrained

Flüge online buchen

von: bitte auswählen

nach:

Hinflug am: Rückflug am:

Erw.: Kinder bis 11: unter 2:

1 0 0

Date constrained

1. Schritt 2. Schritt

Angebote suchen für Abflug von

Alle Linien- & Charterflüge

Hinreise am Reiseziel

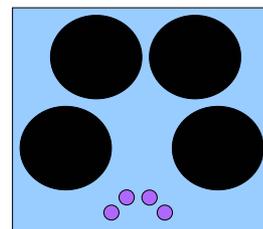
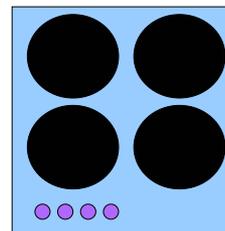
Mi 12 Nov.2003

Rückreise am Klasse

Mi 19 Nov.2003 Economy

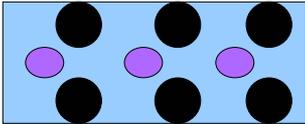
Mapping

- Relationship between controls and action
- Mappings should be
 - Understandable (e.g. moving the mouse up move the slider up)
 - Consistent
 - Recognizable or at least quickly learnable and easy to recall
 - Natural, meaning to be consistent with knowledge the user already has
- Example: cooker
(more on these issues in Gestalt theory)



Mapping & Human Error

- Labels are correct
- However full context is needed
- Build-it source for potential frustration
- Missing context



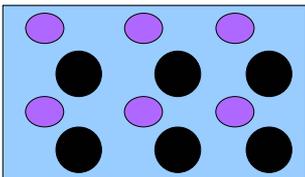
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Mapping & Human Error

- Labels are correct
- However full context is needed
- Build-it source for potential frustration
- Full view



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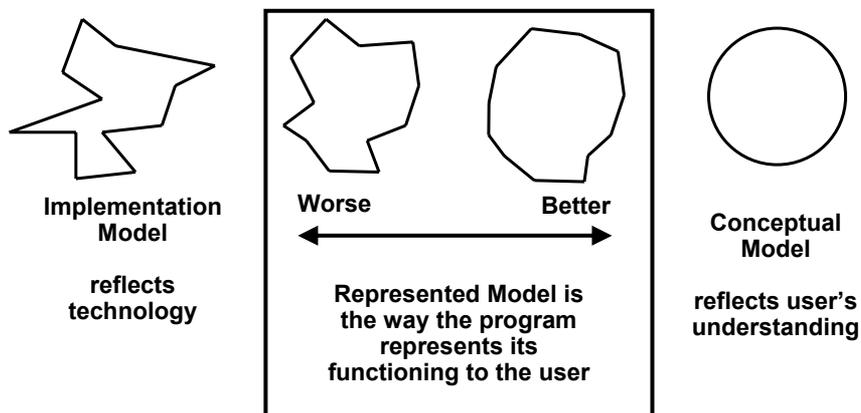
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Models – Human and Computer

- Applications are based on an Implementation Model
- User operate on their Conceptual Model/Mental Model
- The user interfaces translates between models
- Provocative Statement from A. Cooper
“Computer literacy is nothing more than a euphemism for making the user stretch to understand an alien logic rather than having software-enabled products stretch to meet the user’s way of thinking”

Implementation, Represented, Conceptual Model



From A. Cooper, About Face 2.0

References

- D. A. Norman. The Design of Everyday Things. Basic Books 2002. ISBN: 0465067107
- B. Shneiderman. Designing the User Interface: Strategies for Effective Human-Computer Interaction , Third Edition. 1997. ISBN: 0201694972
- A. Cooper. About Face 2.0: Chapter 1 - Goal-Directed Design
http://media.wiley.com/product_data/excerpt/13/07645264/0764526413.pdf