Chapter 2
UNDERSTANDING AND CONCEPTUALIZING INTERACTION

Chapter 3
COGNITIVE ASPECTS
The lectures

Mission statement of lectures
• Are MEANT to clarify, to deepen, to broaden AND to amplify, point out what’s important, to provide context and, hopefully, to inspire

Furthermore
• The book, the complete INDICATED CHAPTERS and some articles ARE part of the material to be studied

• I follow the order of the book, but do NOT repeat the book ENTIRELY. A lot of what is in the book I talk about, but not about everything, and some I talk about is not in the book.
Chapter 2

UNDERSTANDING AND CONCEPTUALIZING INTERACTION
Understanding the Problem space

• What do you want to create?

• What are your assumptions?  
  (taking something for granted when it needs further investigation)

• What are your claims?  
  (stating something to be true when it is still open to question)

• Will it achieve what you hope it will? If so, how?

Discussing this works best as a team!
Assumptions? Claims?
Everything better with Bluetooth?

1. Download the First Response™ App.
2. Open the App and remove the test stick from the foil.
3. Follow the instructions on screen to connect the Pregnancy PRO test and First Response™ App.
Problem space?
Problem space: Assumptions

Taking something for granted when it needs further investigation

People:
- will want to watch TV while driving
- are willing to share their music
- don’t mind wearing special glasses
- will want to share their location (Foursquare, Facebook etc.)
- will want to trust their pregnancy results with an online app
Problem space: Claims

Stating something to be true when it is still open to question

- A multimodal style of interaction for controlling GPS — one that involves speaking while driving — is safe

- Sharing locations is possible with mobile devices

- Men love Bluetooth

- This pregnancy stick & app will provide me with more or better or more accurate in for than the “pregnant <> not-pregnant” results we had before
Problem space: A framework for analysis

- Are there problems with an existing product or user experience?
- Why do you think there are problems?
- How do you think your proposed design ideas might overcome these?
- When designing for a new user experience how will the proposed design extend or change current ways of doing things?
Problem space > conceptual model > design space

Having a good understanding of the problem space helps to conceptualize the design space. Doing this early has benefits:

**Orientation**
enables design teams to ask specific questions about how the conceptual model will be understood

**Open-minded**
prevents design team from becoming narrowly focused early on

**Common ground**
allows design teams to establish set of commonly agreed terms
Conceptual model

“...a high-level description of how a system is organized and operates” (Johnson and Henderson, 2002, p26)

enables.....

“...designers to straighten out their thinking before they start laying out their widgets” (Johnson and Henderson, 2002, p28)

Not a description of the user interface but a structure outlining the concepts and the relationships between them
Conceptual models: Components

Metaphors and analogies
• understand what a product is for and how to use it for an activity

Concepts that people are exposed to through the product
• task–domain objects, their attributes, and operations (e.g. saving, revisiting, organizing)

• Relationship and mappings between these concepts
Interface metaphors

Metaphor

something \rightarrow \text{identify} \rightarrow \text{some other thing}

(known) \rightarrow \rightarrow (to be illustrated)

Franklin has a heart of gold!

He's a walking encyclopedia

You are my sunshine

Desk Monday, June 17, 1996 Hallway
Interface metaphors

Convention

≠
Interaction types

Instructing

Conversing

Exploring
Interaction types

**Manipulating** > Direct manipulation (Shneiderman, 1983).

- Continuous representation of objects and actions of interest
- Physical actions and button pressing instead of issuing commands with complex syntax
- Rapid reversible actions with immediate feedback on object of interest
Direct manipulation
Manipulating objects…then and now?

Design digital objects so they can be interacted with analogous to how physical objects are manipulated? How analogous?
Paradigms, Visions, Theories, Models, Frameworks

Other sources of inspiration for inspiring and informing design:

• **Paradigms**: General approach adopted by a community for carrying out research (shared assumptions, concepts, values)

• **Theories**: A well-substantiated explanations of some aspect of a phenomenon, e.g. about how memory works (see ch. 3)

• **Models**: Simplification of an (HCI) phenomenon intended to make it easier for designers to predict and evaluate designs (often abstracted from a contributing discipline)

• **Frameworks**: Set of interrelated concepts and/or specific questions for what to look for. Provide advice, e.g. on how to design, steps, questions, challenges, principles, tactics
Visions: Direct manipulation... 😊?
COGNITIVE ASPECTS

Chapter 3
Cognitive processes

- Attention
- Perception
- Memory
- Learning
- Reading, speaking and listening
- Problem-solving, planning, reasoning and decision-making
Attention

• Selecting things to concentrate on at a point in time from the mass of stimuli

• Allows us to focus on information that is relevant

• Involves audio and/or visual senses

• Focussed and divided attention enables us to be selective, but limits our ability to keep track of all events

• Information at the interface should be structured to capture users’ attention, e.g. use perceptual boundaries, colour, sound and flashing lights
Attention

Find the price of a double room at the Holiday Inn in Columbia

<table>
<thead>
<tr>
<th>City</th>
<th>Motel/Hotel</th>
<th>Area Code</th>
<th>Phone</th>
<th>Single</th>
<th>Double</th>
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Pennsylvania

- Bedford Motel/Hotel: Crinaline Courts
  - (814) 623-9511  S: $118  D: $120
- Bedford Motel/Hotel: Holiday Inn
  - (814) 623-9006  S: $129  D: $136
- Bedford Motel/Hotel: Midway
  - (814) 623-8107  S: $121  D: $126
- Bedford Motel/Hotel: Penn Manor
  - (814) 623-8177  S: $119  D: $125
- Bedford Motel/Hotel: Quality Inn
  - (814) 623-5189  S: $123  D: $128
- Bedford Motel/Hotel: Terrace
  - (814) 623-5111  S: $122  D: $124
- Bradley Motel/Hotel: De Soto
  - (814) 362-3667  S: $120  D: $124
- Bradley Motel/Hotel: Holiday House
  - (814) 362-4511  S: $122  D: $125
- Bradley Motel/Hotel: Holiday Inn
  - (814) 362-4501  S: $132  D: $140
- Breezewood Motel/Hotel: Best Western Plaza
  - (814) 735-4352  S: $120  D: $127
- Breezewood Motel/Hotel: Motel 70
  - (814) 735-4385  S: $116  D: $118
Attention

Tullis (1987) found that the two screens produced quite different results

- 1st screen - took an average of 5.5 seconds to search
- 2nd screen - took 3.2 seconds to search

- Why, since both displays have the same density of information (31%)?

- Spacing
  - In the 1st screen the information is bunched up together, making it hard to search
  - In the 2nd screen the characters are grouped into vertical categories of information making it easier
Multitasking and attention

• Is it possible to perform multiple tasks without one or more of them being detrimentally affected?

• Ophir et al (2009) compared heavy vs light multi-taskers
  • heavy were more prone to being distracted than those who infrequently multitask
  • heavy multi-taskers are easily distracted and find it difficult to filter irrelevant information
Design implications for attention

• Make information salient when it needs attending to

• Use techniques that make things stand out like colour, ordering, spacing, underlining, sequencing and animation

• Avoid cluttering the interface with too much information

• Search engines and form fill-ins that have simple and clean interfaces are easier to use
Perception

• How information is acquired from the world and transformed into experiences

• Obvious implication is to design representations that are readily perceivable, e.g.

  • Text should be legible
  • Icons should be easy to distinguish and read
We lack control....
E.g. color contrast good? Find “Italian”

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<th>Schools and Colleges</th>
<th>Departments and Facilities</th>
<th>Other Locations</th>
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<td>Black Hills Forest</td>
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<td>Fernadino Beach</td>
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<td>Altamonte Springs</td>
<td>Council Bluffs</td>
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<td>Juvenile Justice</td>
<td>Peach Tree City</td>
<td>Classical Lit</td>
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<td>Heskett Center</td>
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<td>Preview Game</td>
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<tr>
<td>Experimental Links</td>
<td>Los Padres Forest</td>
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</tr>
</tbody>
</table>
Which is easiest to read and why?

What is the time?

What is the time?

What is the time?

What is the time?
Design implications

- Icons should enable users to readily *distinguish* meaning
- Bordering/spacing are effective ways of grouping information
- Sounds should be audible and distinguishable
- Speech output should enable users to distinguish between the set of spoken words
- Text should be legible and distinguishable from background
- Tactile feedback should allow users to recognize and distinguish different meanings
Memory

• Involves first encoding and then retrieving knowledge.

• We don’t remember everything - involves filtering and processing what is attended to

• Context is important in affecting our memory (i.e. where, when)

• We recognize things much better than being able to recall things

• we remember less about objects we have photographed than when we observe them with the naked eye (Henkel, 2014)
Memory: Processing

• Encoding is first stage of memory
  • determines which information is attended to in the environment and how it is interpreted

• The more attention paid to something…

• The more it is processed in terms of thinking about it and comparing it with other knowledge…

• The more likely it is to be remembered
  • e.g. when learning about HCI, it is much better to reflect upon it, carry out exercises, have discussions with others about it, and write notes than just passively read a book, listen to a lecture or watch a video about it
Memory: Context is important

• Context affects the extent to which information can be subsequently retrieved

• Sometimes it is difficult to recall information that was encoded in a different context:

  • “You are on a train and someone comes up to you and says hello. You don’t recognize him for a few moments but then realize it is one of your neighbors. You are only used to seeing your neighbor in the hallway of your apartment block and seeing him out of context makes him difficult to recognize initially”
Memory: Recognition versus recall

- Command-based interfaces require users to recall from memory a name from a possible set of 100s.

- GUIs provide MP3 players visually-based options that users need only browse through until they recognize one.

- Web browsers, etc., provide lists of visited URLs, song titles etc., that support recognition memory.
Memory: The problem with the classic ‘7 ± 2’

• George Miller’s (1956) theory of how much information people can remember, our memory capacity is limited. Many designers think this is useful finding for interaction design. It sometimes is, but…

• Present only 7 options on a menu…
• Display only 7 icons on a tool bar…
• Have no more than 7 bullets in a list…
• Place only 7 items on a pull down menu…
• Place only 7 tabs on the top of a website page…
Unnecessary. Why?

- Inappropriate application of the theory

- People can scan lists of bullets, tabs, menu items for the one they want

- They don’t have to recall them from memory having only briefly heard or seen them

- Sometimes a small number of items is good

- But depends on task and available screen estate
Memory aids

SenseCam, by Microsoft Research Labs (now Autographer)
• a wearable device that intermittently takes photos without user intervention while worn
• images taken stored and revisited using special software
• improved people’s memory, suffering from Alzheimers
Design implications

• Don’t overload users’ memories with complicated procedures for carrying out tasks

• Design interfaces that promote recognition rather than recall

• Provide users with various ways of encoding information to help them remember
  • e.g. categories, color, flagging, time stamping
Hey…wait a minute!
aren’t….humans are good at certain things?!

Case: The Netsuky project:

Software as an aid in conversational memory

• Context: call centers

• In Europe 1% works in them (in USA 3%).

• Collaboration UU – Startup in Ireland

(deze case is geen tentamenstof)
High turnover
Only (phone) auditory contact
Very anonymous
Often “grumpy” conversations
Routine tasks, many customers per day
Monotonous
Too few “sincere” commitments
It must improve, change the tools!
Context: call centres & their software

- Diminish distance between human operator and the case he/she is working on by taking away some parts of task back to HUMANS, away from the system or machine. Make it such that an operator becomes more “owner” of a case.

- This part is generated by the operator him/herself! This part costs time, creativity and effort

- **Rationale behind it**: if something is self-generated it will leave stronger, more lasting and more meaningful memory traces. Exploit multimodality: text & images
Standard flow

1. Pickup phone, converse

2. Data entry, during and after (semi automated)

3. Send to backoffice

4. Next customer
Netsuky flow

1. Pickup phone, converse

2. Data entry, during and after

3. System demands 2 effortful creative episodes from user

4. Send to backoffice

5. Next customer
Netsuky flow
Netsuky vs. standard flow
Netsuky vs. standard flow: Experiment

Session 1
- N=46
- 24 x netsuky version, 22 control version
- 27 x listening, do data entry task

Session 2 (3 days later)
- N=46
- Netsuky: see name and (self chosen) image
- Control: see only the name
- Reproduce: facts, details, moods and rate confidence
## Experiment session 2: recall

<table>
<thead>
<tr>
<th>Request</th>
<th>All facts</th>
<th>Mood etc. Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Netsuky</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mr. Scotland</td>
<td>door handle be fixed in home.</td>
<td>Scotish man, in his 30s. Was anxious and a little worried as to when it would be fixed. Insisted +</td>
</tr>
<tr>
<td>Woman wanted to check balance.</td>
<td>Needed to be resolved fast, for his elderly father. Customer tried to fix it himself, but +</td>
<td>American. Customer and Representative were both chaty, happy young women. +</td>
</tr>
<tr>
<td><strong>Standard</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mr. Scotland</td>
<td>Something to do with banks.</td>
<td>Male, Scottish, 40ish years old, seemed generally fine.</td>
</tr>
<tr>
<td>Karen</td>
<td>Both Scottish on the telephone.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Standard</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Karen</td>
<td>Transfer money</td>
<td>Female, 30ish, English,</td>
</tr>
<tr>
<td></td>
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</table>
How an interface behaves has a huge influence on our cognitive processes.

In certain situations, designers could take care that systems don’t do TOO much for the user (depending on task, context). Sometimes it is good to, counterintuitively, making a process a bit more effortful or demanding and less assisted.

Multimedia/ICT are everywhere. These findings could apply in a range of other applications, including educative software, or systems in which making mistakes has huge consequences.

This is a manifest for ourselves: there are things that we humans are best at 😊! And it makes it more fun too!
Reading, speaking, and listening

- The ease with which people can read, listen, or speak differs
  - Many prefer listening to reading
  - Reading can be quicker than speaking or listening
  - Listening requires less cognitive effort than reading or speaking (and is more automated)
  - Dyslexics have difficulties understanding and recognizing written words
Applications

• Speech-recognition systems allow users to interact with them by asking questions
  • e.g. Google Voice, Siri

• Speech-output systems use artificially generated speech
  • e.g. written-text-to-speech systems for the blind

• Natural-language systems enable users to type in questions and give text-based responses
  • e.g. Ask search engine
Design implications

• Speech-based menus and instructions should be short

• Accentuate the intonation of artificially generated speech voices
  • they are harder to understand than human voices

• Provide opportunities for making text large on a screen
Problem-solving, planning, reasoning and decision-making

• All involves reflective cognition
  • e.g. thinking about what to do, what the options are, and the consequences
• Often involves conscious processes, discussion with others (or oneself), and the use of artefacts
  • e.g. maps, books, pen and paper
• May involve working through different scenarios and deciding which is best option
Design implications

• Provide additional information/functions for users who wish to understand more about how to carry out an activity more effectively

• Use simple computational aids to support rapid decision-making and planning for users on the move
Cognitive frameworks

Internal
• Mental models
• Gulfs of execution and evaluation
• Information processing

External
• Distributed cognition
• External cognition
• Embodied interaction
Mental models

- Users develop an understanding of a system through learning about and using it:
  - How to use the system (what to do next)
  - What to do with unfamiliar systems or unexpected situations (how the system works)

- Craik (1943) described mental models as:
  - Internal constructions of some aspect of the external world enabling predictions to be made

- Deep versus shallow models
  - E.g. how to drive a car and how it works
Everyday reasoning and mental models

Many people have erroneous mental models (Kempton, 1996). You arrive home on a cold winter’s night to a cold house. How do you get the house to warm up as quickly as possible? Set the thermostat to be at its highest or to the desired temperature?

≠

the ‘more is more’ principle is (erroneously) generalised to a different setting
Gulfs of execution and evaluation

- The ‘gulfs’ explicate the gaps that exist between the user and the interface

- The gulf of execution
  - the distance from the user to the physical system

- The gulf of evaluation
  - the distance from the physical system to the user

- Bridging the gulfs can reduce cognitive effort required to perform tasks
Bridging the gulfs
Information processing

Conceptualizes human performance in metaphorical terms of information processing stages
Information processing - Model Human processor (Card et al, 1983)

• Models the information processes of a user interacting with a computer

• Predicts which cognitive processes are involved when a user interacts with a computer

• Enables calculations to be made of how long a user will take to carry out a task
Information processing: The human processor model
Distributed cognition

- Concerned with the nature of cognitive phenomena across individuals, artefacts, and internal and external representations (Hutchins, 1995)

- Information is transformed through different media (computers, displays, paper, heads)
Distributed cognition: What’s involved

- The distributed problem-solving that takes place
- The role of verbal and non-verbal behaviour
- The various coordinating mechanisms that are used (e.g. rules, procedures)
- The communication that takes place as the collaborative activity progresses
- How knowledge is shared and accessed
External cognition

• Concerned with explaining how we interact with external representations (e.g. maps, notes, diagrams)

• What are the cognitive benefits and what processes involved

• How they extend our cognition

• What computer-based representations can we develop to help even more?
External cognition- Externalizing to reduce memory load

- Diaries, reminders, calendars, notes, shopping lists, to-do lists
  - written to remind us of what to do

- Post-its, piles, marked emails
  - where placed indicates priority of what to do

- External representations:
  - Remind us that we need to do something (e.g. to buy something for mother’s day)
  - Remind us of what to do (e.g. buy a card)
  - Remind us when to do something (e.g. send card by date)
External cognition - Computational offloading

• When a tool is used in conjunction with an external representation to carry out a computation (e.g. pen and paper)

• Try doing the two sums below (a) in your head, (b) on a piece of paper and c) with a calculator.
  
  • 234 x 456 = ??
  • CCXXXIII x CCCCCXXXXXVI = ???

• Which is easiest and why? Both are identical sums
Design implications

• Provide external representations at the interface that reduce memory load and facilitate computational offloading

  • e.g. Information visualizations have been designed to allow people to make sense and rapid decisions about masses of data
Lekker hoor!
Je hebt de eerste stap naar een doordachte carrière gemaakt.

90% van je carrière wordt in de eerste jaren bepaald. Oriënteer je daarom bij mogelijke werkgevers en leg de beste basis voor jouw loopbaan. Tijdens de Meat 'n Greet krijg je de kans om te kijken wat Info Support jou te bieden heeft.

KOM OOK 18 MEI

18 MEI 2016
17.00 UUR

Info Support
Kruisboog 42, Veenendaal

http://meatngreet.nl/
Vrijdag 13 mei

Gast college Ellen Schuurink & Maartje de Vries

In WG: Begin opdracht 2
Vragen?