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O2: eModule IT-LIL "IT for a Longer Independent Life"
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This session will present arguments for supporting as wide as possible user populations.

Not only is this an ethically important aim, but also it makes commercial sense.

We will look at differing user populations, their needs and expectations, and how we can design interactive systems to support 'universal usability'.

The session is split into three parts, as shown in the overview.


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O2: eModule IT-LIL "IT for a Longer Independent Life"
Chapter 1. Principles of Human-Computer Interaction - HCI
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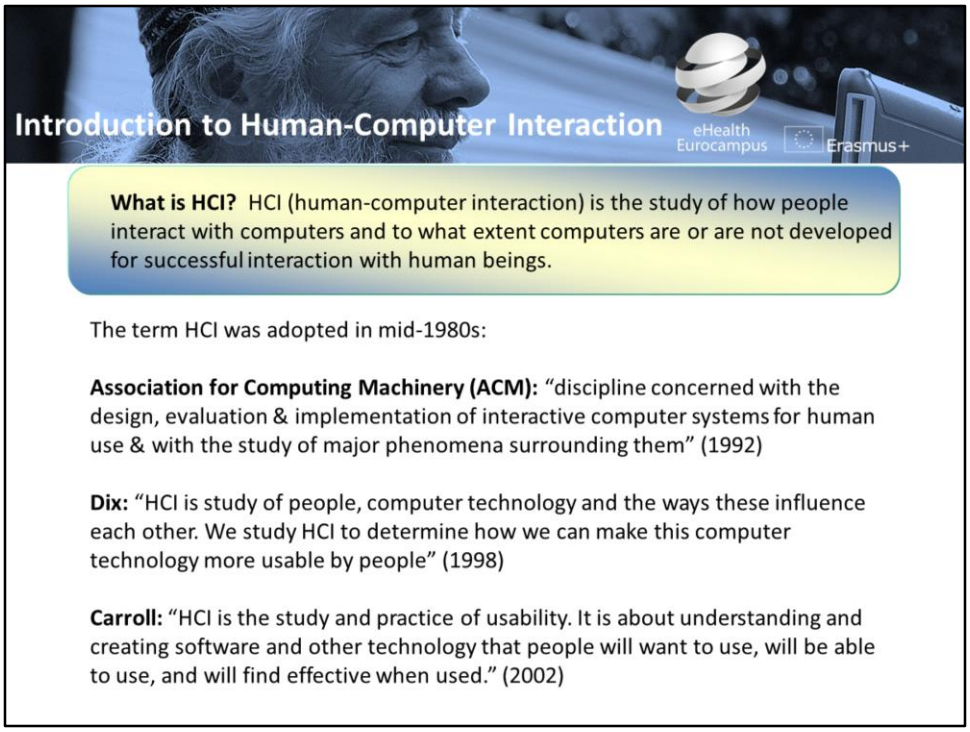
TOPICS

- HCI DEFINITIONS AND HISTORIC EVOLUTION
- USER-CENTERD DESIGN
- INTERACTION
- HCI TRENDS
- HCI JOURNALS

HCI DEFINITIONS AND HISTORIC EVOLUTION



Evolution of the definition of HCI given more weight to the usability concept

Some implied concepts:

Human: an individual user, a group of users working together or a sequence of users in an organization…

Interaction: action involving a dialog with feedback and control throughout performing a task

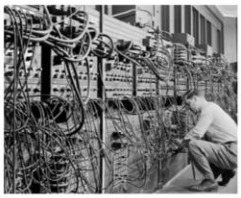
User interface: parts of the computer that the user contacts with

Computer: a computer is a device that accepts information and manipulates it for some result based on a program (a sequence of instructions) on how the data is to be processed.

Different versions: desktop, large-scale computers, pocket PC, embedded system, tablet, Smartphone, IOT…

Why we need HCI understanding and practice?

- Nowadays, computers are cheap and widely used by non-technical people, with very different skills, background, needs..
- Computer manufacturers noticed the importance of making computers "user-friendly" and ease to use.
- Main challenge: **How to achieve "user-friendliness" in computer design?**



ENIAC 1946

Apple co-founder Steve Jobs said in a 1983 speech that the company's strategy is really simple:

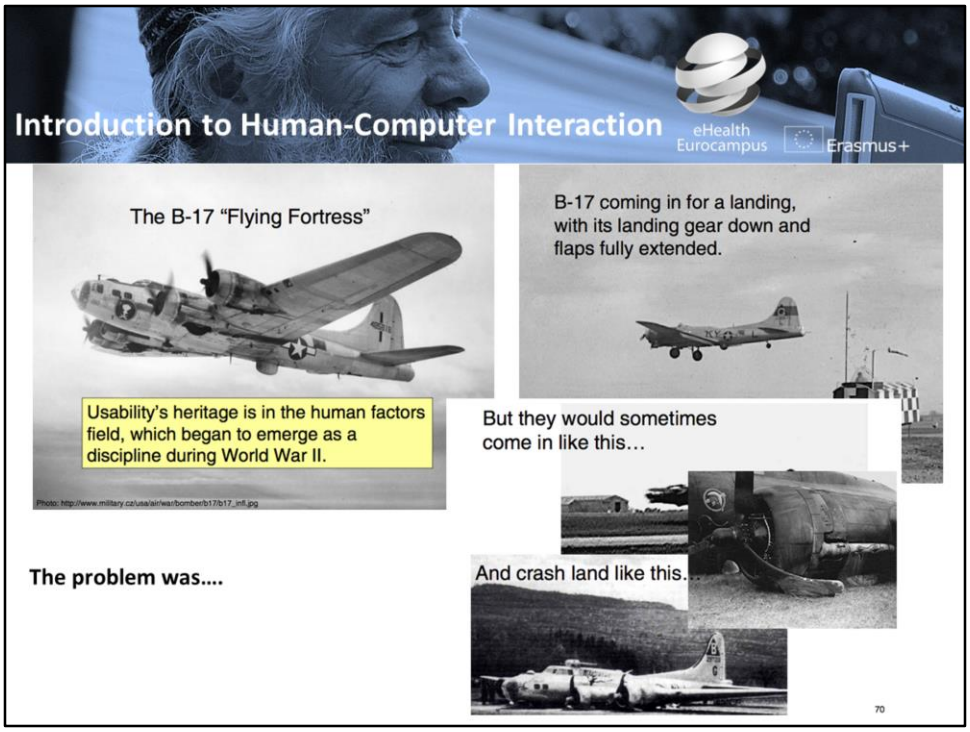
What we want to do is to put an incredibly great computer in a book that you can carry around with you and learn how to use in 20 minutes ... and we really want to do it with a radio link in it so you don't have to hook up to anything and you're in communication with all of these larger databases and other computers

Following 3 slides are from *"Top Ten Myths about Usability"* presentation by Thomas S. Tullis 2009 (http://www.measuringux.com/UsabilityMyths/UsabilityMyths.pdf)

Origins of HCI in the World War II era:

Darn these hooves! I hit the wrong switch again! Who designs these instrument panels, raccoons?

- invention of machines that taxed human sensorimotor abilities, e.g., interface for aircraft control
- even after extensive training, frequent (fatal) errors



The consequences of a bad design

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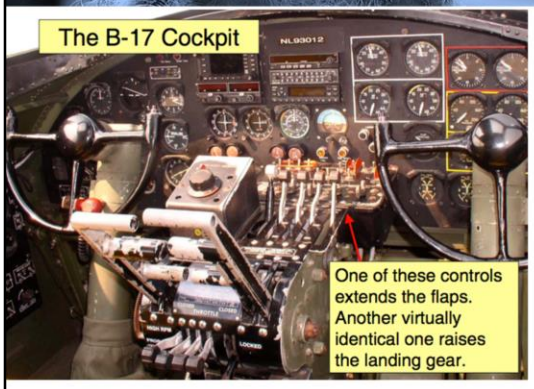
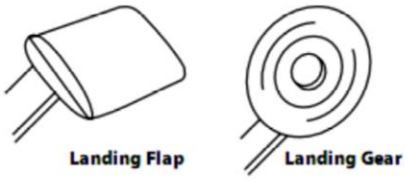


As a result of the work done by the human-factors engineers, shape coded controls were introduced into cockpits



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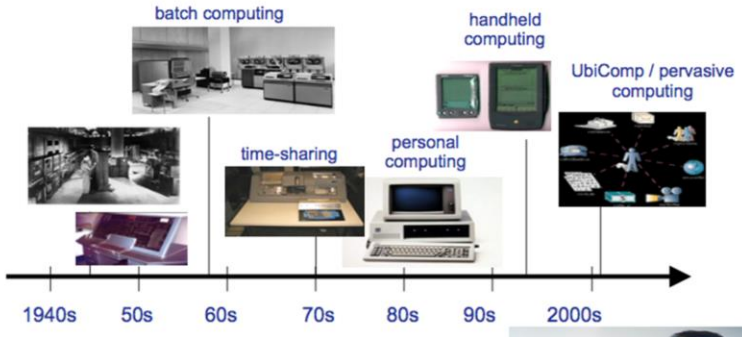
Some historical evolution of the interaction with computers:



From the first mouse by D. Engelbart in 1964....

...to virtual reality glasses (2016)

- At physical level, HCI concerns the selection of the most appropriate **input devices** and **output devices** for a particular interface or task
- Determine the best **style of interaction,** such as direct manipulation, natural language (speech, written input), WIMP (windows, icons, menus, pointers), BCI, etc.
- Develop or improve:
  - **Safety**
  - **Utility**
  - **Effectiveness**
  - **Efficiency**
  - **Usability**
  - **Appeal**

of systems that include computers in a wide sense

Safety: protecting the user from dangerous conditions and undesirable situations

Users: how to prevent user physical security during the utilization of the computer. For example, in a nuclear energy plant or bomb-disposal, the operators should interact with computer-based systems remotely.

Medical equipment in intensive care unit (ICU) are remotely managed and consulted.

Data: how to prevent user from making serious errors by reducing risk of wrong keys/buttons being mistakenly activated.

- Provide user with means of recovering errors
- Ensure **privacy** (protect personal information such as habits and address) and **security** (protect sensitive information such as passwords, VISA card numbers)

Utility: it is the extent of providing the right kind of functionality so that users can do what they need or want to do.

- In computers, a utility is a small program that provides an addition to the capabilities provided by the operating system. In some usages, a utility is a special and nonessential part of the operating system.

Effectiveness: concern a user's ability to accomplish a desired goal or to carry out work (for example, to find a master thesis in our library Web)

- The degree to which objectives are achieved and the extent to which targeted problems are solved. In contrast to efficiency, effectiveness is determined without reference to costs and, whereas efficiency means "doing the thing right," effectiveness means "doing the right thing."

Efficiency: it is a measure of how quickly users can accomplish their goals or finish their work using the system.

Consider the scenario: a shopping Website provides all the information, instruction and server-side support required to perform an on-line purchase. However, the users cannot figure out how to find the items they want to buy. **How efficient is it?**

The Wikipedia definition: **EFFICIENCY** is the (often measurable) ability to avoid wasting materials, energy, efforts, money, and time in doing something or in producing a desired result. In a more general sense, it is the ability to do things well, successfully, and without waste

The concept applied to computing:

- **Algorithmic efficiency**: optimizing the speed and memory requirements of a computer program
- **Storage efficiency**: effectiveness of computer data storage
- **Efficiency factor**: the ratio of the time to transmit a text automatically at a specified modulation rate to the time actually required to receive the same text at a specified maximum error rate.

Usability: how ease of learning and ease of use is a given application or service.

- Can I use the basic functions of a new digital camera without reading the manual?
- Does the software facilitate us to learn new functions easily?

Usability ISO 9241 definition: "it is a measure of the effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in a particular environment."

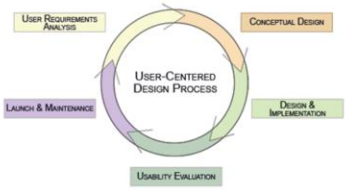
Appeal: how well the user likes the system

- First impression
- Long-term satisfaction

USABILITY can be seen as…

- ***an outcome***: some applications, the websites (and may be the robots?) that are usable.
- ***a process***: it is a methodology or approach (usually called "*user-centered design*")
- ***a set of techniques****:* usability testing, contextual inquiry, heuristic evaluation – there are many techniques whose aim is to improve usability, its implementation and its quantification.
- ***a philosophy***: when *improved usability* is a *value* that motivates the way in which products are developed

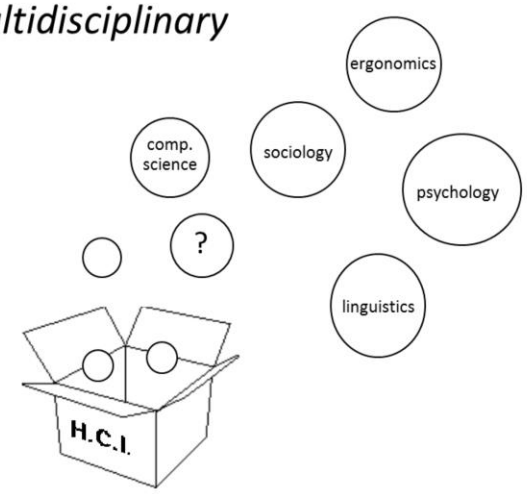
Usability engineering: a practical and systematic methodology to deliver a product that work correctly for the user. It involves several methods:



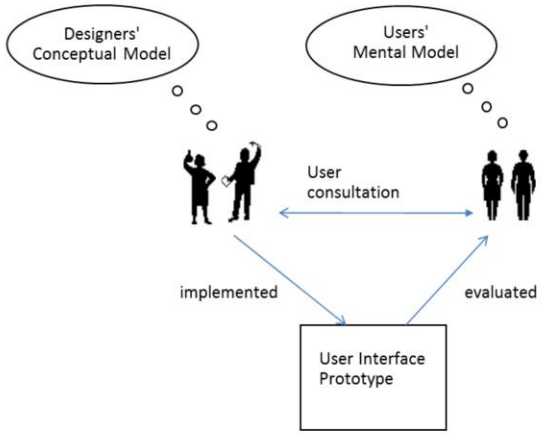
- Gathering requirements
- Designing
- Developing and testing prototypes
- Evaluate design alternatives and analyse usability problems
- Propose solutions and test with the users

USER-CENTERD DESIGN

HCI is *multidisciplinary*



To understand users, we need to involve them!



The user is in the centre: USER-CENTRED design

Reimagining HCI: Toward a More Human-Centered Perspective

Liam Bannon
Université de Technologie de Troyes | liamjbannon@gmail.com

Some years ago, HCI researcher Panu Korhonen of Nokia outlined to me how HCI is changing, as follows:

- In the early days the Nokia HCI people were told "*Please evaluate our user inter- face, and make it easy to use.*" That gave way to "*Please help us design this user interface so that it is easy to use.*" That, in turn, led to a request: "*Please help us find what the users really need so that we know how to design this user interface.*"
- And now, the engineers are pleading with us: "*Look at this area of life, and find us something interesting!*"

This, in a nutshell, tells a story of how HCI has moved from evaluation of interfaces through design of systems and into general sense-making of our world.

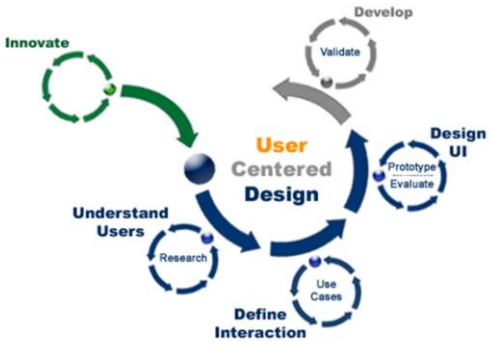
User-Centred Development – How is it Different? What is different in the process?

- **User-centric, not data-centric** (involves users in the entire process as much as possible).
- **Highly interdisciplinary** (draws on knowledge from a multitude of areas: art, psychology, technical writing, computer science…)
- **Highly iterative** (involves as much testing and revision as possible, especially before final implementation)

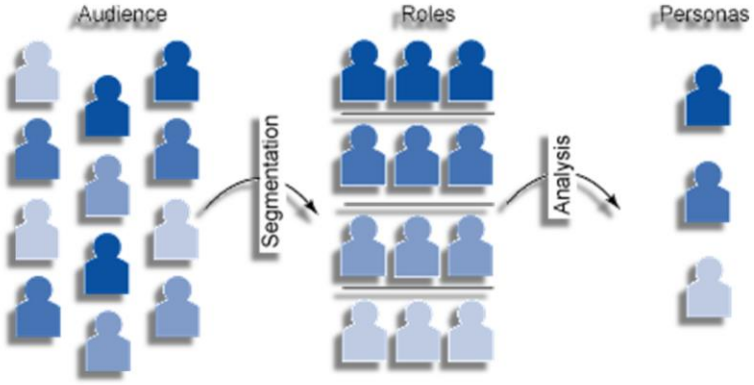
User-centred design cycle:

- Data collection
- Data analysis
- User modelling
- Design
- Prototyping
- Evaluation

User-centred design principles



Access to users is not always easy: introducing ‘personas’



Example persona

<table>
<tr><td rowspan="3">Hanna
  </td><td colspan="2">“I am looking for technologies that can bring me closer to my children and grandchildren…”</td></tr>
<tr><td><u>Age</u>: 67 years old</td><td><u>Work</u>: Retired, ex- secretary in a bank</td></tr>
<tr><td><u>Family situation</u>: Widowed, 1 daughter, 2 grandchildren</td><td><u>Education</u>: less than upper secondary education</td></tr>
<tr><td colspan="2"><u>Approach to technology</u>:
Hanna has a computer at home with Windows XP as an operating system.
She owns a 2G mobile phone, without camera.
She uses Internet to check her emails and for Internet banking.</td><td><u>Barriers</u>:
Mild visual impairment (hyperopia), she has trouble seeing clearly up close.
She suffers from mild-moderate hand osteoarthritis (bone and cartilage degeneration).</td></tr>
</table>

Another one

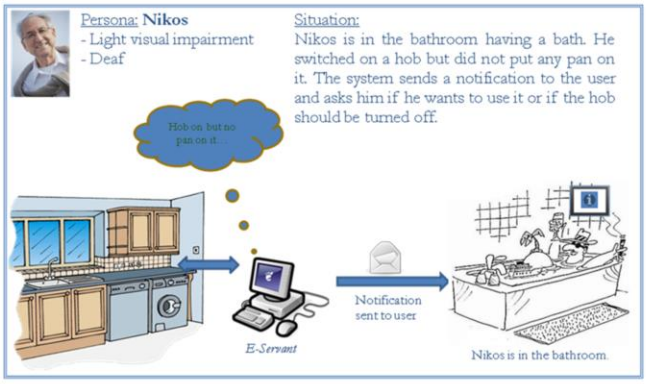
Francesca 	**"My worst fear is to end up alone in a nursing home..."**	
	Age: 63 years old	Work: Retired, ex- art gallery curator
	Family situation: Married, 2 children, 3 grandchildren	Education: upper secondary education
Approach to technology: She owns an old computer at home and uses it mostly to store pictures about her holidays and to let the grandchildren play on it when they come to visit. She owns a 2G mobile phone, with no extra functionality than calling and receiving phone calls.		**Barriers:** **Moderate-severe hearing impairment**, she is using a hearing aid all the time. She suffers from **mild memory loss.**

Scenarios

- How would our personas use an IT system?
- Think of a scenario and work it through
- Identify implications
  - design issues
  - possible errors
  - task sequences
  - goal achievement

Example scenario

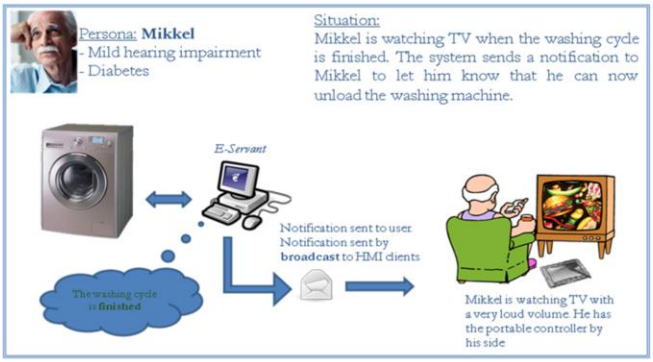
Title: "No Pan On Hot Hob" (NPOHH)



Appliance: Cooker Hob *Case number: 1* *Date: 14/09/2007*

Another one

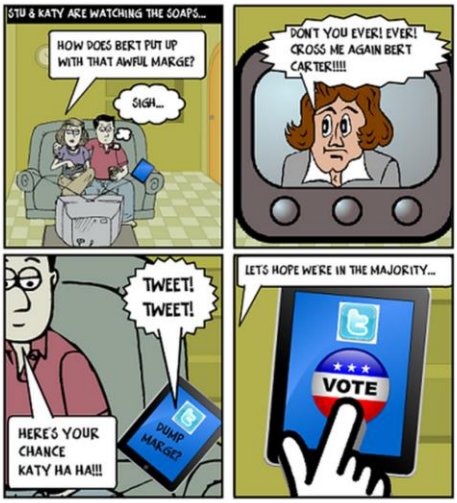
Title: The Washing Cycle Has Finished (TWCHF)



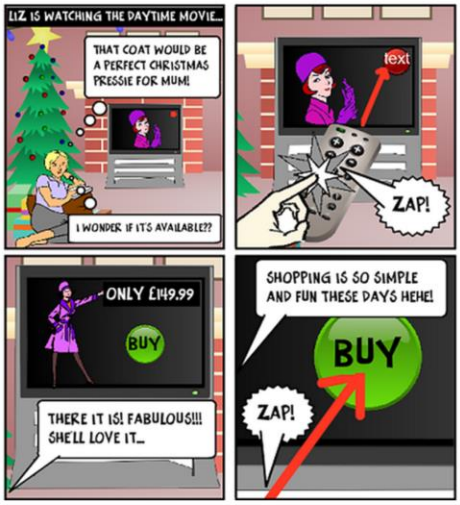
Appliance: Washing Machine *Case number: 1* *Date: 13/09/2007*

Use cases

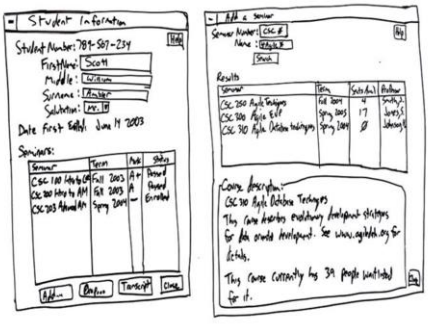
Second screen entertainment.
"Dumped by Twitter"
http://toondoo.com



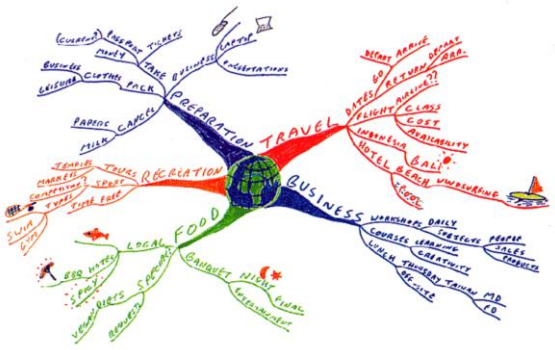
Another one...


LIZ IS WATCHING THE DAYTIME MOVIE...
THAT COAT WOULD BE A PERFECT CHRISTMAS PRESSIE FOR MUM!
I WONDER IF IT'S AVAILABLE??
text
ZAP!
ONLY £149.99
BUY
THERE IT IS! FABULOUS!!! SHE'LL LOVE IT...
SHOPPING IS SO SIMPLE AND FUN THESE DAYS HEHE!
BUY
ZAP!

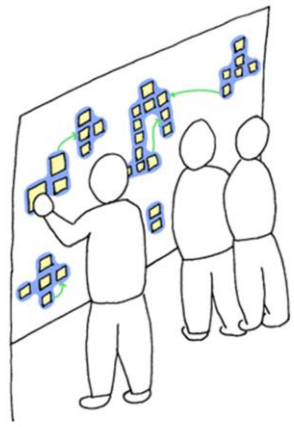
Storyboarding/wireframing (e.g. draw.io)



Brainstorming (mind mapping techniques)



Affinity diagramming



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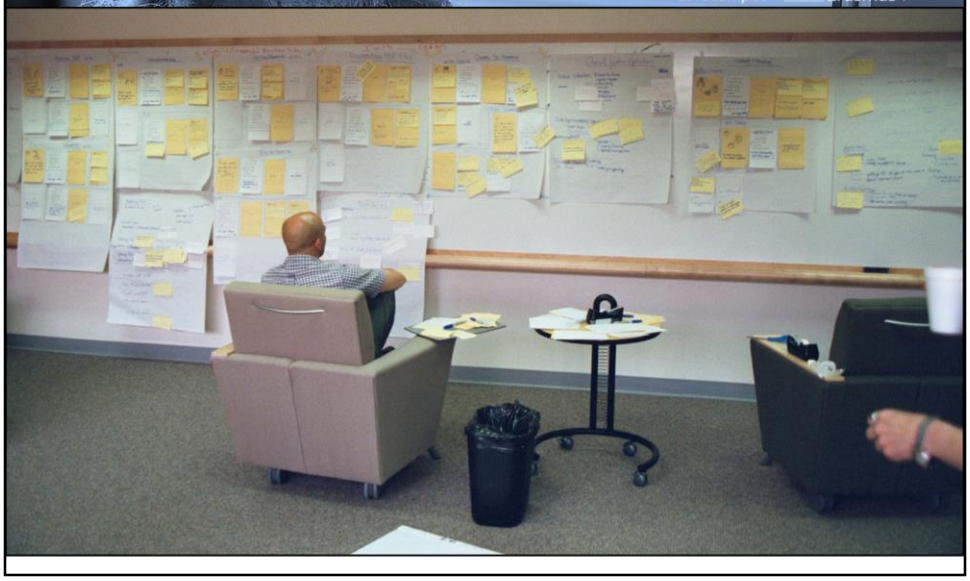


The Wizard of Oz technique

http://www.youtube.com/watch?v=NZR64EF3OpA

Wizard of Oz in a lab setting

INTERACTION

Human-computer interfaces

The design of effective human-computer interfaces has been, and continues to be, a significant challenge that demands an appreciation of the entire **human perceptual-motor system**.

"Technological advances have undoubtedly served to improve the HCI experience. For example, we have progressed beyond the use of computer punch cards and command-line interfaces to more complex tools such as graphical user interfaces, speech recognition, eye-gaze control systems and BCI. As HCI has become not only more effective, but by the same token more elaborate, **the importance of the interaction between the various perceptual, cognitive, and motor constraints of the human system has come to the forefront.**"

Human Computer Interaction fundamentals. A. Sears 2009

Examples of new interaction schemes

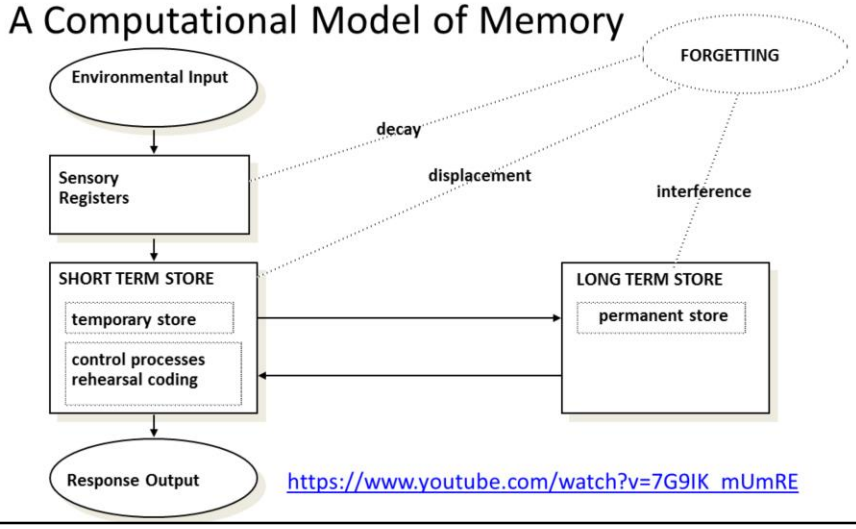
Human information processing

Human **information processing theory** deals with how people receive, store, integrate, retrieve, and use information

According to Huitt (2003), there are a few **basic principles** that most cognitive psychologists agree with:

- The mental system has **limited capacities**, i.e. bottlenecks in the flow and processing of information.
- A **control mechanism** is required to oversee the encoding, transformation, processing, storage, retrieval and utilization of information.
- There is a **two-way flow** of information. Sensory input is combined with information stored in memory in order to construct meaning.
- The human organism has been **genetically prepared** to process and organize information in specific ways

A Computational Model of Memory



https://www.youtube.com/watch?v=7G9IK_mUmRE

Cognitive Processes

- Cognitive processes include perception, recognition, imagining, remembering, thinking, judging, reasoning, problem solving, conceptualizing, and planning. These cognitive processes can emerge from human language, thought, imagery, and symbols.
- In addition to these specific cognitive processes, many cognitive psychologists study language-acquisition, altered states of mind and consciousness, visual perception, auditory perception, short-term memory, long-term memory, storage, retrieval, perceptions of thought,...

Information-processing framework

Attention is the collection of processes that allow us to dedicate our limited information processing capacity to the purposeful (cognitive) manipulation of a subset of available information.

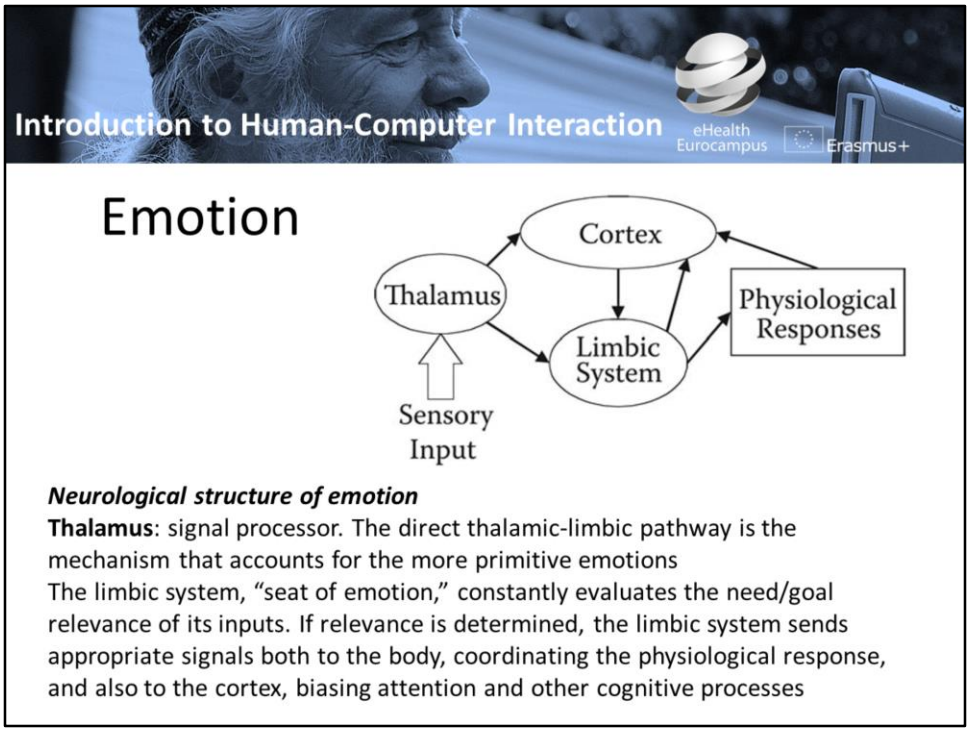
Stated another way, attention is the process through which information enters into working memory and achieves the level of consciousness.

There are three important characteristics of attention:

(a) attention is selective and allows only a specific subset of information to enter the limited processing system;

(b) the focus of attention can be shifted from one source of information to another;

(c) attention can be divided such that, within certain limitations, one may selectively attend to more that one source of information at a time



The limbic system,1 often called the "seat of emotion," constantly evaluates the need/goal relevance of its inputs. If relevance is determined, the limbic system sends appropriate signals both to the body, coordinating the physiological response, and also to the cortex, biasing attention and other cognitive processes

EMOTION

- One of the most important effects of emotion lies in its ability to **capture attention**. Emotion-relevant thoughts then tend to dominate conscious processing—the more important the situation, the higher the arousal, and the more forceful the focus (Clore & Gasper, 2000).
- Emotion's effect on attention also has implications for **memory**. Because emotion focuses thought on the evoking stimulus, emotional stimuli are generally remembered better than unemotional events (Thorson & Friestad, 1985).
- Mood has also been found to affect cognitive style and **performance**
- Mood has also been shown to influence **judgment and decision making.**

MEASURING AFFECT/EMOTIONS

Measuring user affect can be valuable both as a component of usability testing and as an interface technique. When evaluating interfaces, affective information provides insight into **what a user is feeling**—the fundamental basis of liking and other sentiments.

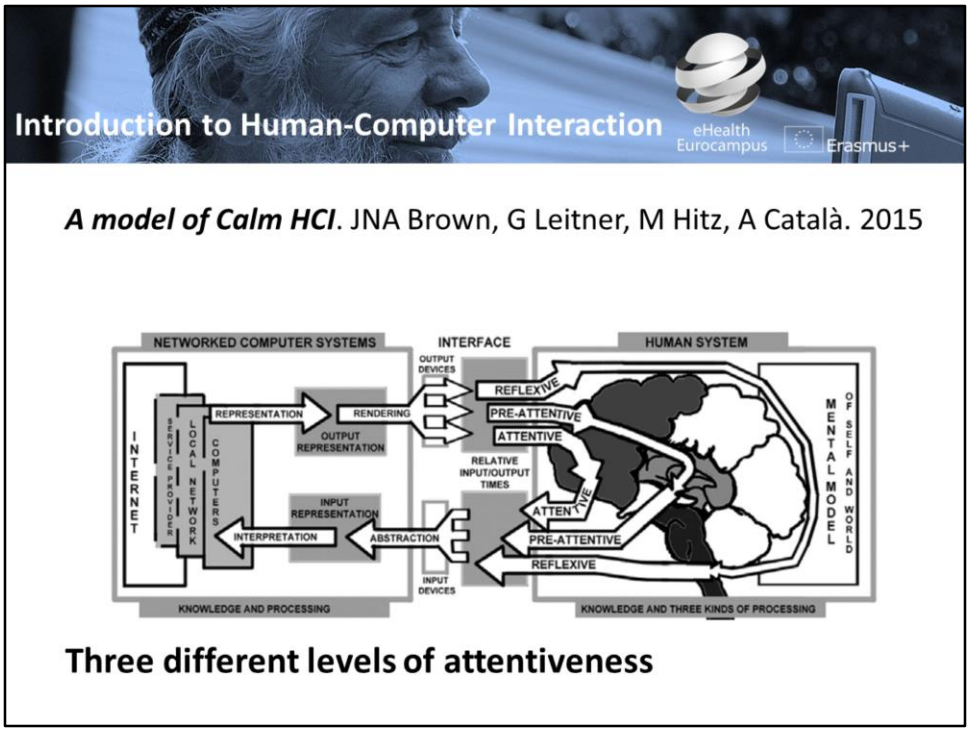
Neurological responses:

The brain is the most fundamental source of emotion. In a relaxed state, the human brain exhibits an alpha rhythm, which can be detected by EEG recordings. Disruption of this signal (alpha blocking) occurs in response to novelty, complexity, and unexpectedness, as well as during emotional excitement and anxiety.

MEASURING AFFECT/EMOTIONS cont.

Autonomic Activity

- Heart rate, blood pressure, blood-pulse volume, respiration, temperature, pupil dilation, skin conductivity, and muscle tension measured by electromyography EMG. Combined measures of multiple autonomic signals show promise as components of an emotion recognition system. Picard, Vyzas, and Healey, for example, achieved 81% percent recognition accuracy on eight emotions through combined measures of respiration, blood pressure volume, and skin conductance, as well as facial muscle tension.



Signals designed to trigger only the pre- attentive portion the sensory system in order to perceive subtle signals and recognise familiar patterns without interrupting attentive focus

Affective computing: computing that relates to, arises from or deliberately influences emotions

Founding member of the first IEEE Technical Committee on Wearable Information Technology, which was the precursor to the *quantified-self movement* that promotes self-monitoring using wearable sensors and other technologies. ***Rosalind Picard.*** *MIT Affective Computing Lab MIT*

MULTIMODAL INTERACTION

People naturally interact with the world multimodally, through both parallel and sequential use of multiple perceptual modalities. Multimodal human–computer interaction has sought for decades to endow computers with similar capabilities, in order to provide more natural, powerful, and compelling interactive experiences. (*speech, touch, vision, and gesture*) *Matthew Turk. Pattern Recognition Letters*

While the multimodal interaction community has focused more on input technologies such as speech and gesture recognition and haptic input, and multimodal output has been a key element of multimedia and visualization research communities, ***the overall goal of multimodal interaction is to fully support both directions of communication between human and machine*** as well as to empower computer-supported human–human multimodal interaction.

MULTIMODAL INTERACTION EXAMPLE

Augmented Reality-based Remote Collaboration

Steffen Gauglitz, Benjamin Nuernberger, Kuo-Chin Lien, Cha Lee Matthew Turk, Tobias Höllerer

We describe a framework and several prototype implementations for unobtrusive mobile remote collaboration on tasks that involve the physical environment. Our system uses the Augmented Reality paradigm and model-free, markerless visual tracking to facilitate decoupled, live updated views of the environment and world-stabilized annotations while supporting a moving camera and unknown, unprepared environments.

https://www.youtube.com/watch?v=tlJU0Gi6hfg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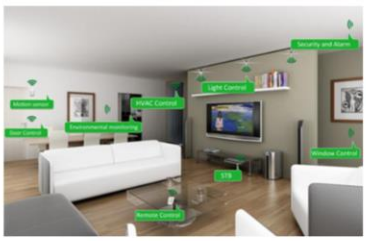
HCI TRENDS

On Pervasive computing, also called ubiquitous computing, is the growing trend of embedding computational capability (generally in the form of microprocessors) into everyday objects to make them effectively communicate and perform useful tasks in a way that minimizes the end user's need to interact with computers as computers. Pervasive computing devices are network-connected and constantly available.



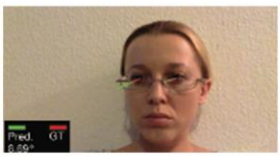
To consider: technology trends, users' profile, users' abilities…

On new ideas for Person-centred design.

Virtual reality: A computer simulation of a real or imaginary system that enables a user to perform operations on the simulated system and shows the effects in real time.

Augmented reality is the integration of digital information with the user's environment in real time. Unlike virtual reality, which creates a totally artificial environment, augmented reality uses the existing environment and overlays new information on top of it.

Attentive Interfaces: The computer should attend to the user's needs through anticipating what the user wants to do; i.e., interfaces respond to the user's expressions and gestures

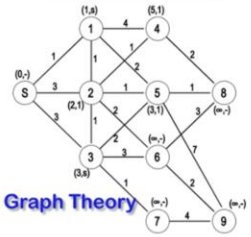


COGNITIVE ENGINEERING

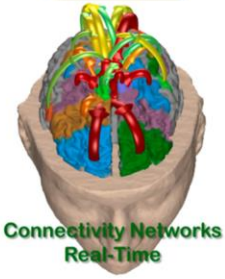
Motivation
Improve quality of life
Help people live longer and healthier

Our method

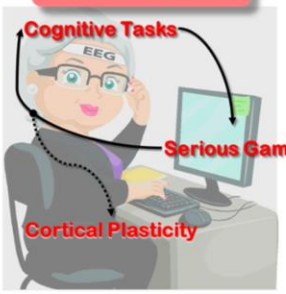
Mathematical Formulation



Product

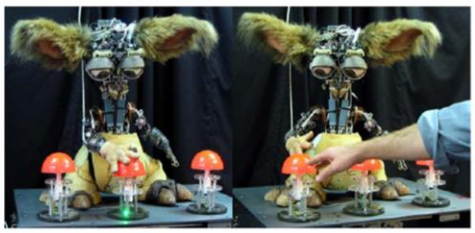


Experimental Model



SINAPSE. Cognitive rehabilitation project

Human-Robot Interaction (HRI) is a field of study dedicated to understanding, designing, and evaluating robotic systems for use by or with humans.



Social Robots

On Social aspects of HCI

E-inclusion is a social movement whose goal is to end the ***digital divide***, a term used to describe the fact that the world can be divided into people who do and people who don't have access to - and the capability to use - modern information technology (IT). According to advocates, e-inclusion has the power to: close the gap between developed and less developed countries; promote democracy and mutual understanding.

Ethical issues: HCI researchers are now designing and evaluating technologies in increasingly sensitive and challenging settings. It is crucial to consider and plan for ethical issues when conducting **any** research involving people, but this becomes even more important when the research is conducted in sensitive settings. Research that involves **vulnerable or marginalized participants**, or that is **emotionally challenging for researchers**, can produce complex ethical dilemmas where there are no clear "right" or "wrong" answers.

Recent HCI significant journal papers

*How Can **Affect** Be Detected and Represented in Technological Support for **Physical Rehabilitation?*** *Temitayo A. Olugbade* *University College London, United Kingdom* *2019* Although clinical best practice suggests that affect awareness could enable more effective technological support for physical rehabilitation through personalisation to psychological needs, designers need to consider what affective states matter, and how they should be tracked and addressed.

*Understanding the Role of Interactive Machine Learning in **Movement Interaction Design.*** *Marco Gillies.2019.* Interaction based on human movement has the potential to become an important new paradigm of human-computer interaction. However, high quality, mainstream movement interaction requires effective tools and techniques to support designers

*Subjective **sleep quality monitoring** with the Hypnos digital sleep diary: evaluation of usability and user experience* *T. Vacaretu*, *N. Batalas*, *B. Erten - Uyumaz*, *M. van Gilst*, *S. Overeem*, *Panos Markopoulos* *2019* Sleep diaries are often used to support the diagnosis and treatment of sleep disorders though the emergence of self-tracking technologies also makes them interesting for intrinsically motivated individuals who wish to gain insight into their sleep patterns and related influences. This paper introduces Hypnos, a digital sleep diary, and a user study aimed to its usability and the resulting user experience

Key Note

End-User Development for the Internet of Things *Panos Marcopoulos TU/e 2109.*
The Internet of Things promises to put within arm's reach a vast network of connected computerized devices, from sensors and actuators to more traditional devices, such as phones and tablets. Research in this field has been primarily focused on technical considerations, such as how devices will connect with other devices and how those connections will be kept secure. Relatively, less attention has gone into improving the usability of these constellations of devices for people using them who live and act within the dynamic technological habitat they provide. We do not yet know how best to help users to harness the potential power of these large collections of devices to accomplish their tasks. The Internet of Things is likely to transform these tasks by enhancing our physical environment and the objects that surround us with sensing and computational capabilities, which, in turn, is likely to result in new activities and needs for people.

HCI JOURNALS

HCI Journals

ACM Computing Surveys [SJR]
ACM interactions [MAS] [SJR]
ACM Transactions on Computer Human Interaction [SJR]
ACM Transactions on Interactive Intelligent Systems [SJR]
Advances in Human-Computer Interaction [SJR]
Behaviour and Information Technology [SJR]
Cognitive Computation [SJR]
Computers in Human Behavior [SJR] [SD]
Foundations and Trends in Human-Computer Interaction [SJR]
Human-Computer Interaction [SJR] [WoS]
IEEE Systems Man and Cybernetics, Part A: Systems and Humans [SJR]
IEEE Transactions on Affective Computing [SJR]
IEEE Transactions on Human-Machine Systems [SJR]
Interacting with Computers [SJR]
International Journal of Ambient Computing and Intelligence [SJR]
International Journal of Human-Computer Interaction [SJR]
International Journal of Mobile Human Computer Interaction [SJR]

HCI Journals cont.

- International Journal of UbiComp [MAS]
- International Journal of Virtual Reality [---]
- Journal of Ambient Intelligence and Humanized Computing [SJR]
- Journal of Ambient Intelligence and Smart Environments [SJR]
- Journal of Organizational and End User Computing [SJR]
- Journal of Usability Studies [---]
- Multimodal Technologies and Interaction [---]
- Personal and Ubiquitous Computing [SJR]
- Pervasive and Mobile Computing [SJR] [WoS]
- Proceedings of the ACM on Human-Computer Interaction [---]
- User Modeling and User-Adapted Interaction [SJR]
- Virtual Reality [SJR]

A memory game

- http://www.freegames.ws/games/kidsgames/simon/mysimon.htm

Some light entertainment…

- Thorndike's Law of Effect (1898)
- A more complex problem
- An example of insight problem-solving