H C I

Human-Computer Interaction

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The Goals of Human-Computer Interaction

- *To develop or improve the:*
  - **safety**
  - **utility**
  - **effectiveness**
  - **efficiency**
  - **usability**

  of systems that include computers.

I(Interacting with Computers, 1989, p. 3)

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Main Concern of HCI

- *The system should be designed to match the user requirements.*
- *The system design should be user-centered.*
- *The needs, capabilities and preferences of the users should be taken in consideration.*

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The Disciplines of HCI

(ACM SIGCHI, 1992, p. 16)

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Disciplines Contributing to HCI

- ***Computer Science***
- ***Cognitive Psychology***
- ***Social and Organizational Psychology***
- ***Ergonomics or Human Factors***
- ***Linguistics***
- ***Artificial Intelligence***
- ***Engineering***
- ***Design***
- ***Philosophy***
- ***Sociology***
- ***Anthropology***

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Computer Science- A Definition

The discipline of computing is the systematic study of algorithmic processes that describe and transform information: their theory, analysis, design, efficiency, implementation and application. The fundamental question underlying all of computing is: "what can be (efficiently) automated?"

*(Denning, P.J.,et. al., "Computing as a Discipline". Communications of the ACM, **22**(1), 9-23)*

Contributions of Computer Science to HCI

- *Knowledge about the capability of Technology*
- *Techniques to support software design, development and maintenance*
  - **object-oriented languages**
  - **user interface design environments**
  - **prototyping tools**
- *System architectures, abstractions and notations*
- *Reuse and reverse engineering concepts*

Cognitive Psychology

- ***Deals with:***
  - **perception**
  - **attention**
  - **memory**
  - **learning**
  - **thinking**
  - **problem solving**
- ***Contributions to HCI***
  - **Development of guidelines**
  - **Models to predict human performance**
  - **Empirical methods for testing computer systems**

Social and Organizational Psychology

- ***Suggest how the introduction of computers will influence working practices***
- ***Tries to understand the structures and function of organizations in terms of:***
  - **authority and power**
  - **size and complexity**
  - **efficiency and effectiveness**
  - **information flow**
  - **technology**
  - **working practices**
  - **work environment**
  - **social context**

Ergonomics or Human Factors

- *The objective is to:*
  - **maximize an operator's safety, efficiency and reliability of performance**
  - **make tasks easier**
  - **increase feelings of comfort and satisfaction**

Linguistics

- *Is the scientific study of language*
- *Contributions to HCI*
  - **natural language interfaces**
  - **conversational analysis** **(how individuals and groups interact with computers in natural environments)**

Artificial Intelligence

- *Is concerned with the users' needs when interacting with an intelligent interface.*

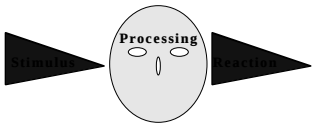
Philosophy, Sociology and Anthropology

The application of these disciplines to HCI contributes to obtain a more accurate description of the interaction between users, their work, the technology and the environment.

Engineering and Design

- *Needs no introduction to engineers*
- *Is the production of, with ingenious*

The Human Processing System



Input and Output Channels

Identify human input and output channels.

Input and Output Channels

Input

- **vision**
- **hearing**
- **touch**
- **taste**
- **smell**

Output

- **limbs**
- **fingers**
- **eyes**
- **head**
- **vocal system**
- mind

Vision: The Human Eye

Vision: Eye Sensors

- ***Photoreceptors***
  - **rods** –*highly sensitive to light*
    –*concentrated on the edges of retina*
    –*dominate peripheral vision*
  - **cones** –*sensitive to three light wavelength (color)*
    –*concentrated in fovea*
- ***Ganglion cells (nerve)***
  - **X-cells** –*early detection of pattern*
    –*concentrated in fovea*
  - **Y-cells** –*early detection of movement*
    –*widely distributed in the retina*

Visual Perception of Size and Depth

- *Size*
  - **visual angle**
  - **perception of depth**
- *Depth*
  - **visual angle**
  - **object overlapping**
  - **sizes of familiar objects**
  - **contrast and brightness**
  - **shadow**
  - **motion parallax**

Visual Angle

Visual Perception of Brightness

Brightness- subjective perception to levels of light

- **luminance - amount of light emitted by an object**
- **contrast - relative brightness of an object an its background**

An increase in luminance causes:

- **an increase in visual acuity**
- **flickering to be noticed on computer displays**

Visual Perception of Color

Color is a combination of:

- **hue - determine by the spectral wavelength of light (remember the prism)**
- **intensity - brightness**
- **saturation - the amount of whiteness**

Facts:

- **eyes are sensitive to red, green, blue (RGB)**
- **blue acuity is lower (3-4% cones in fovea)**
- **8% of males and 1% of females are color blind (mostly unable to distinguish between red and green)**

Tips for Using Colors at the Interface

- *Do not use too many colors*
- *Use same color for areas belonging together*
- *Use colors to make features prominent*
- *Use dark colors for the background and bright colors for the foreground*

High Level Visual Perception

- *resolution of ambiguity*
- *image construction*
- *distortion (illusions)*
- *elimination of redundant information*

The Gestalt Laws of Perceptual Organization

- **Proximity - close objects belong together**
- **Similarity - similar objects belong together**
- **Closure - fill in missing parts**
- **Continuity - objects forming a known pattern belong together**
- **Symmetry - close mirror images make a coherent figure**

Visual Perception and Reading

- **adults read approximately 250 words per minute**
- **font sizes between 9 and 12 with proportional spacing between lines are equally legible**
- **line lengths of between 2.3” to 5.2” are equally legible**
- **paper reading is faster than monitor reading**
- **words in capital letters are read slower**

The Human Memory

Sensory Memories

- ***Act as buffers for stimuli received through senses***
- ***There is one for each sense***
  - **Iconic - visual stimuli**
  - **Echotic - aural stimuli**
  - **Haptic - touch**
- ***Are constantly overwritten by new information***
- ***Information is passed to short-term memory by attention***

Attention

- *Is the concentration of the mind on one out of a number of competing stimuli*
- *The choice is governed by our level of interest or need*

Short-term Memory

- *Acts like a scratch-pad of information*
- *Decays rapidly*
- *Has limited capacity (7+/-2 chunks of information)*
- *It can be improved by:*
  - **chunking information**
  - **using well known patterns**
- *It can be affected by interference*

Long-term Memory

- *very large capacity*
- *short access time (~.1 second)*
- *decays slowly (apparently)*

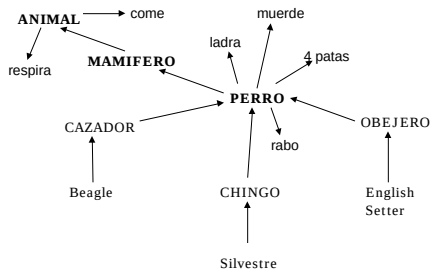
Types of Long-term Memory

- *semantic memory- structured record of facts, concepts and skills that we have acquired*
- *episodic memory- memory of events and experiences in a serial form*

Long-term Memory Structure

- *semantic networks*
- *frames*
- *scripts*

Semantic Networks



Frame Structure

DOG

- *Fixed*
  - **legs: 4**
- *Default*
  - **diet: carnivorous**
  - **sound: bark**
- *Variable*
  - **size:**
  - **color:**

Script Structure

- **Entry conditions** - *conditions that must be satisfied for the script to be activated*
- **Result** - *conditions that will be true after the script is terminated*
- **Props** - *objects involved in the events described in the script*
- **Roles** - *actions performed by particular participants*
- **Scenes** - *the sequence of events that occur*
- **Tracks** - *a variation on the general pattern representing an alternative scenario*

Exercise

Una persona entra a un salón de belleza y luego de media hora sale de este lugar.

Prepara un "script" de esta situación.

Long-term Memory Process

- *storage or remembering information*
- *forgetting information*
- *information retrieval*

Storage of Information in Long-term Memory

- **Rehearsal (or refreshing?)**
- ***Total Time Hypothesis* - the amount of information learned is directly proportional to the amount of time spent learning**
- ***Distribution of Practice Effect* - learning time is most effective if it is distributed over time**
- **It's easier to remember objects than concepts**

Forgetting Information

- ***retroactive interference* - new information causes the loss of old information**
- ***proactive inhibition* - old information interferes with new information**
- **emotional factors**
  - **positive information is remembered better**
- **not being able to retrieve information**
  - **tip of the tongue**

Information Retrieval

- *Recall - the information is reproduced from memory*
- *Recognition - the presentation of information provides cues for retrieving additional information*

Computer-Supported Cooperative Work

- *Face-to-face communication*
- *Conversation*
- *Text Based Communication*
- *Group Working and Communication*
- *Organizational Issues*

Face-to-Face Communication

- *Personal space*
- *Eye contact and gaze*
- *Gestures and body language*
- *Back channels*
- *Turn-taking*

Personal Space

- ***People tend to get close to each other in a conversation***
- ***The comfortable distance depends on:***
  - **relative positioning of people (longer distance when face-to-face)**
  - **culture**
- ***Distance is less important when conversation is mediated through technology such as video conferencing***

Eye Contact and Gaze

- **Long gazing between two humans is usually reserved for lovers**
- **Sporadic direct eye contact provides a sense of engagement**
- **The frequency of eye contact and the action of avoiding it is directly related to authority and power (remember the boxers)**
- **Eye gaze is useful in establishing the focus of the conversation**
- **Its not easy to achieve eye contact through technology such as video conferencing**

Gestures and Body Language

- **We use gestures and body movements as a complementary language**
  - **head turning**
  - **hand movement**
  - **facial expressions**
- **Technology such as video conference does not allow a clear reading of our body language (the scene capture by a camera is not realistic)**

Back Channels

- *Is feedback from the listener confirming understanding*
  aja, si si, quick head movement
- *Allow the speakers to be slightly vague*
- *Can be lost with the use of technology*
  - **telephone**

Turn-taking

- **Is the process by which the roles of the speaker and listener are exchanged**
- **Back channels play a crucial part - they can be used to claim the turn**
- **The speaker can explicitly offer the floor to the listener**
- **The speaker may implicitly offer the floor to the listener by leaving a small gap**
- **A lack of response could be interpreted as if the listener:**
  - **is in agreement with the speaker (el que calla otorga)**
  - **did not understand the speaker**
- **Satellite communication introduces communication delays that could cause misinterpretation in a conversation**

Issues in Conversation

- *Structure*
  - **utterances**
  - **adjacency pairs**
- *Context*
- *Focus*
- *Breakdown and repair*
- *Common ground*

Basic Conversational Structure

- **turn-taking**
- **utterance - *speech within each turn***
- **adjacency pairs - *question/statement-answer/response utterance pairs***

Juan: ¿Quiéres helado?
Sara: si gracias
Juan: ¿de vasito o barquilla?
Sara: barquilla

(J-1, S-1, J-2, S-2) i.e. J-1 (Juan-adjacency pair 1)

Broken Adjacency Pairs

Juan: ¿Quiéres helado?
Sara : ¿de qué que sabor es?
Juan: de chocolate
Sara: ¿de dieta?
Juan: si
Sara: no gracias

(J-1, S-2, J-2, S-3, J-3, S-1)

Incomplete and Threaded Adjacency Pairs

Juan: ¿Quiéres helado?
Sara : ¿De qué que sabor es?
Juan: de chocolate. Tengo flan también.
Sara: Si es de queso dame un pedazito que estoy a dieta.

(J-1, S-2, J-23, S-3)

Context

- *Utterances are usually highly ambiguous*
- *Ambiguous utterances depend on context for resolving ambiguity*
- *There are two types of context within a conversation:*
  - **internal context - dependence on earlier utterances**
  - **external context - dependence on the environment**

Internal and External Context

Juan: ¿Te gusta el helado?
Sara : mucho
Juan: ¿De cuál quieres?
Sara: de ese (apuntando hacia la mesa)

Focus of Conversation

Juan: Que bonitas están tus flores.
Sara : Si, pero estoy teniendo problemas con las abejas
Juan: Ellas simbolizan la primavera.
Sara: ¿las abejas?
Juan: no las flores

Breakdown and Repair

- *Breakdown can be caused by:*
  - **divergence of topic focus**
  - **incorrectly read gestures or eye gaze**
  - **missed or inappropriate back channel responses**
- *Humans are very efficient at repairing breakdowns*
- *Breakdown detection and repair is facilitated by:*
  - **redundancy**
  - **frequency of turn-taking**
  - **back channels**
- *Technology missing these elements difficults repair*

Common Ground

- ***People involved in a conversation come from different backgrounds and knowledge***
- ***Participants of a conversation know that their partners***
  - **do not share the same knowledge of the world**
  - **will attempt to interpret each other's utterances**
- ***Participants of a conversation seek to obtain a shared understanding for the task at hand (a common ground)***

Conversation- A Definition

"Conversation is an inherently social activity, based on a constructed shared understanding, and relaying on the participant's models of one another. In addition, it depends on continuous interaction to correct misinterpretations and to confirm understanding."

Dix, Alan, et. al., "Human-Computer Interaction", Prentice Hall, New York, 1993.