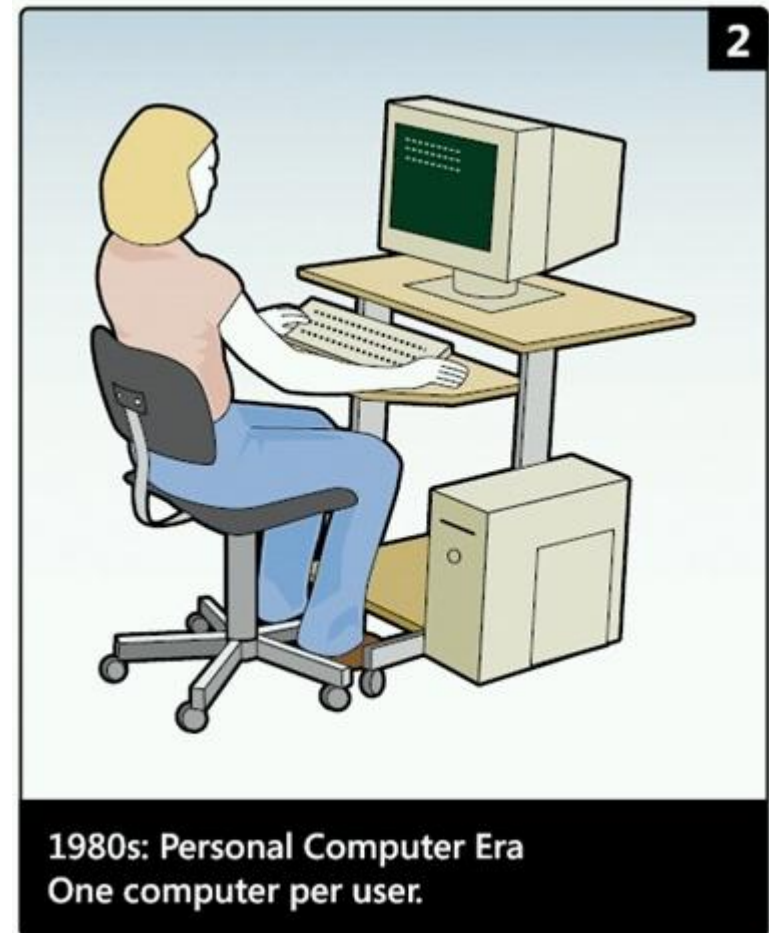


Dr. Sanjay Tripathi, ABB Corporate Research, August 28th, 2010

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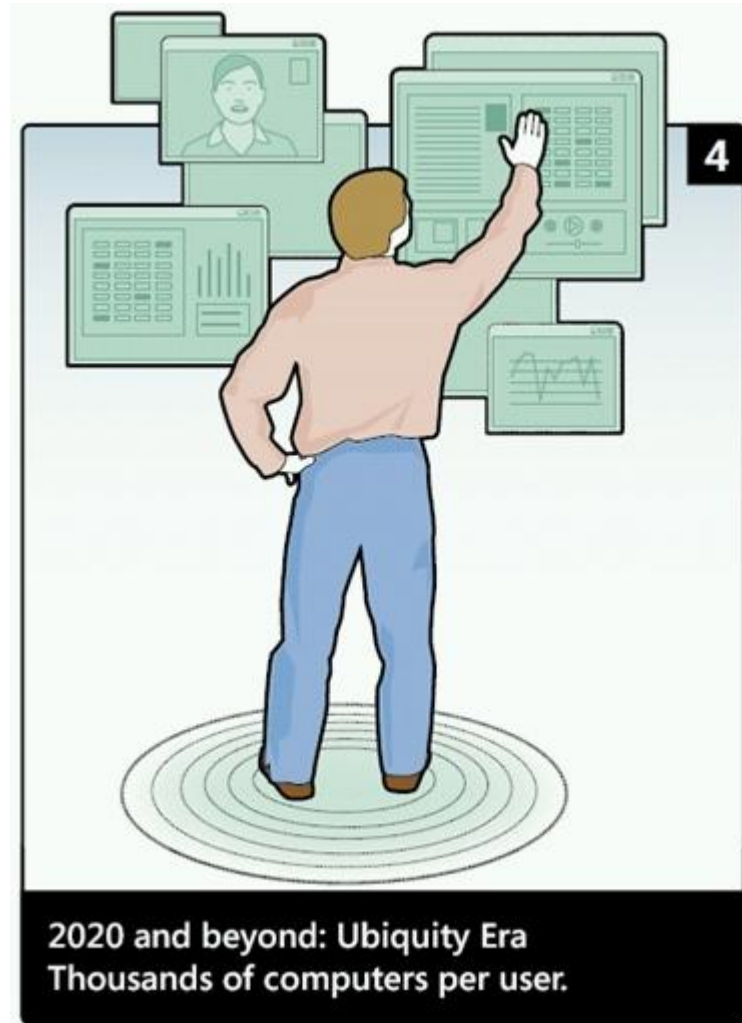
HCI Research /Methods

Computing Era 1960-1980



Source: Being Human: Human Computer Interaction in the year 2020

Computing Era 2000-2020



Source: Being Human: Human Computer Interaction in the year 2020

Interfaces → Gestures



The Reactable

A multi touch interface used for playing music. Interaction is done by moving and rotating physical objects on its surface.



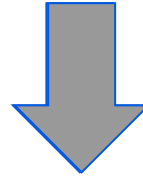
The HotHand Device

A ring worn by electric guitar players that uses motion sensors and a wireless transmitter to create different kinds of sound effects by various hand gestures.

Source: Being Human: Human Computer Interaction in the year 2020

Prediction

**Computing will move to the background,
will extremely merge in our everyday living spaces**



Human user → into the foreground.

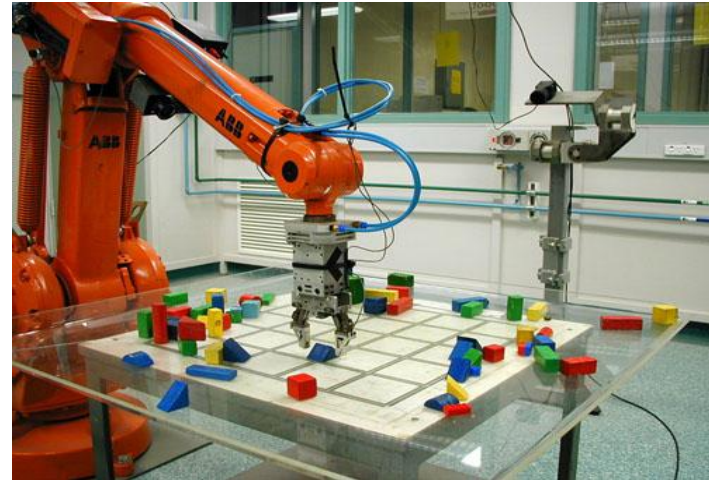


**Interfaces will have the capacity to understand and
emulate human communicative intentions**

Technology Reliant World



Phenomena



Prologue

- Computer has become a mediator between the human operator and the physical system being controlled.
 - This occurred first in aviation
 - Then in process control, manufacturing and military systems
 - More recently it happened in hospitals, trains, automobiles and home appliances

Example: Power and automation

- New form of control is often called supervisory control,
 - Human operator = Manager
 - planning
 - setting goals and constraints
 - diagnosing failures
 - intervening in control as necessary, and
 - learning from experience

The hope has been to relieve the operator of tedious work and make the system both more efficient and more reliable

Introduction to HCI Research

- HCI is a young discipline (about 30 years)
- Has developed from computer science, with influences from cognitive psychology
- Other influences: sociology, anthropology, communication, design, ergonomics
- Related area: Interaction design
- **We will Cover →**
- **Overview of Science and research**
 - Introduction
 - Fundamentals of research (in general)
 - Research approaches and methods
 - Their limitations in application

Introduction to HCI Research

Definition:

- Human-computer interaction is a discipline concerned with **the design, evaluation and implementation** of interactive computing systems **for human use** and with **the study of major phenomena** surrounding them.
- ACM SIGCHI Curricula for HCI (Hewett et al. 1992)
- <http://sigchi.org/cdg/cdg2.html>

Introduction to HCI Research

HCI as a "user science"

- All HCI research includes studies of the *use of technology*
 - Empirical study methods are essential
- But HCI is also closely related to the *design and development of technology*
- Important to discuss the relationship between research and development

Introduction to HCI Research

Is HCI inter- or multidisciplinary?

- One discipline = one research community
 - Shared values, methods and concepts
 - Criteria for "good" and "bad" research
- Disciplines may have difficulties understanding each other (e.g. due to cultural differences)
- HCI demands cooperation among researchers
- How does real interdisciplinary arise?

Introduction to HCI Research

Inter- and multidisciplinary research

- Interdisciplinary research transcends the borders between knowledge areas and organisations ... The goal is an integration, gradually developing into a science of its own
- Multidisciplinary research has a clear division of labour among the sciences involved

Introduction to HCI Research

Research approaches and perspectives

- Experimental psychology
- Cognitive modeling, task analysis
- Situated and distributed cognition
- Ethnography
- Conversation analysis
- Activity theory
- Organizational approaches

Introduction to HCI Research

HCI heritage from Computer Science

- Computer science was itself interdisciplinary
 - Mathematics + engineering
- HCI → Computer Science + Psychology
- A model for all kinds of engineering:
 - Identify requirements
 - Specify a design
 - Build an implementation
- Waterfall model (top-down)
- More realistic: Iterative model!

Introduction to HCI Research

HCI heritage from psychology

- Research object in cognitive psychology: mental processes (memory, thinking, learning)
- **Approach**
 - modeling mental processes
 - influences from information processing in computers
 - oriented towards experimental methods and controlled data management
 - testing of hypotheses
- **Limitations for HCI**
 - great individual variations; many variables interact
 - de-contextualization
 - strong focus on causal relations

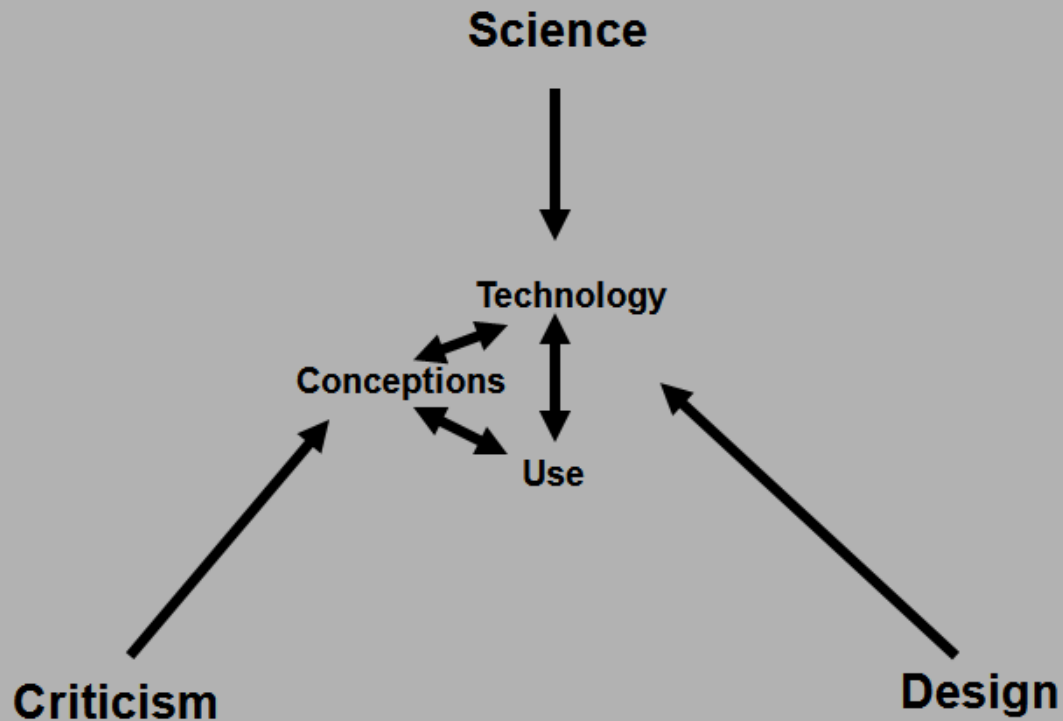
Introduction to HCI Research

HCI heritage from psychology

- Work psychology: originates from ergonomics
- Task analysis
 - Informal description of tasks (e.g. as a scenario)
 - Systems for formal description of work tasks
 - **Purpose:** to match the system design to users' tasks
 - **Problem:** many tasks are open-ended and cannot be described in a simple way with rules or tree structures
- Situated action: more recent approach
 - Socially oriented psychological theory
 - Individuals' cognitive processes interacting with a social context
 - Method: interpretative, more field studies

Introduction to HCI Research

Human-Environment Interaction Research



Presentation at the IU Informatics Conference, Fall 04, Interaction Design Research, by Professor Erik Stolterman, Department of Informatics, Umeå University, Sweden

Perspectives on Human-Computer Interaction

- By John Kammersgaard
 - **The Systems perspective**
 - The system is looked upon from a bird's eye view
 - The relevance of a task can only be expressed on the organisational level
 - All interaction is seen as transmission of data between human and automatic components
 - The goal is to make transmission as fast and correct as possible.
 - The dialogue partner perspective
 - The tool perspective
 - The media perspective

Perspectives on Human-Computer Interaction

- By John Kammersgaard
 - **The Systems perspective**
 - **The dialogue partner perspective**
 - brought to attention through the artificial intelligence research
 - focuses the use of computers within an individual context
 - the computer always be seen as acting like a human being in a communication process
 - The goal: to make communication as similar as possible to human-human interaction
 - Caution: only be used for certain special purposes and always in combination with other perspectives
 - **The tool perspective**
 - **The media perspective**

Perspectives on Human-Computer Interaction

- By John Kammersgaard
 - **The Systems perspective**
 - **The dialogue partner perspective**
 - **The tool perspective**
 - the computer becomes a tool box providing utensils that can help the user in accomplishing a task
 - The user possesses all the knowledge and have full control over the tools
 - The user knows which tools are needed and the designer knows how to make them → the user leads the development process with the designer as an expert resource
 - The purpose of the system is not to take over some part of work but to function as a powerful tool for the user
 - The tool ideally disappear from the user's conscience in the same way a hammer is used without conscious reflection by a carpenter.
 - strength: the knowledge of the user is properly utilized
 - Weakness: no generalized conclusions
 - **The media perspective**

Perspectives on Human-Computer Interaction

- By John Kammersgaard
 - **The Systems perspective**
 - **The dialogue partner perspective**
 - **The tool perspective**
 - **The media perspective**
 - the computer is seen as a medium through which humans communicate with each other
 - The focus is on use within a collective context
 - Two types of communication is of interest
 - The communication within groups of users
 - the one-way communication from the designer to the users

Science ? Research?

- Scientific knowledge is different from everyday knowledge in that
“ **the conditions, methods and reliability of the knowledge are reviewed systematically** “ (Wallèn)
 - What is NOT science?
 - Knowledge acquired through intuition, or skills (?)
 - Is an enquiry a kind of science?
 - Is construction of computer systems a science?
- Research is a systematic and methodical search for new knowledge and new ideas

Science ? Critique? Design?

Science	Criticism	Design
Explain & predict	Emancipate & challenge	Create & change
Knowledge	Meaning	Competence
The True	The Ideal	The Practical

Presentation at the IU Informatics Conference, Fall 04, Interaction Design Research, by Professor Erik Stolterman, Department of Informatics, Umeå University, Sweden

Scientific traditions

- **Positivism**

- Empirically verifiable knowledge
- Measurement and measurement methods
- Replicating results by repeated experiments
- Explanations by cause and effect
- Looking for general facts
- The researcher should be objective

- **Critique of positivism**

- The human is viewed as an object
- Interpretation cannot be avoided when investigating
- human and social affairs!

Theories and Models

- **Theory**

- A conceptual description of a phenomenon
- Basic concepts and their internal structure

- **Model**

- A simplified description of how different entities are related
- Example: Norman's model of the interaction process

1. establishing the goal
2. forming the intention
3. specifying the action sequence
4. executing the action
5. perceiving the system state
6. interpreting the system state
7. evaluating the system state with respect to the goals and intentions

Measurements

- How can variations in a phenomenon be measured?
- Subjective measures
 - Ratings, question-answer studies
- Objective measures
 - Direct observation
 - E.g. Time measurements, or process logs
- Validity: do you measure what you intended to measure?
- Reliability: do different measurements give the same result?

Scientific studies

- **Explorative study**
 - May initiate new research in a field
 - Contributes to discovery and understanding of problems
 - Identify typical cases and relevant variables
- **Descriptive study**
 - Characterization of a research object and its properties
 - Can be rather free from theoretical assumptions
- **Explanatory study**
 - Causal connections are looked for
 - Identifying the basic mechanisms behind a certain effect

Induction and deduction

- **Induction**

- going from collected data, trying to reach general conclusions
- E.g. In Grounded theory: collection of data, analysis and classification, conceptual analysis

- **Deduction**

- empirical testing of a hypothesis, generated from a theory
- Usually in experimental study Different factors (variables) are varied systematically and the effects are measured

In HCI Research

- What we do:
 - **Systematic study** of users in relevant tasks
 - **Construction** of a prototype (“hypothesis”)
 - **Evaluation** with users (“testing the hypothesis”)
 - Usually an **iterative process!**

Is this science?

Popular HCI Research Methods

	Method	Strengths	Weaknesses	Use
Natural setting	Case studies	Natural settings Rich data	Time demanding Limited generalizability	Descriptions, explanations, developing hypothesis
	Field studies	Natural Settings Replicable	Difficult data collection Unknown sample bias	Studying current practice Evaluating new practices
	Action research	First hand experience Applying theory to practice	Ethics, bias, time Unknown generalizability	Generate hypothesis/theory Testing theories/hypothesis
Artificial setting	Laboratory experiments	Control of variables Replicable	Limited realism Unknown generalizability	Controlled experiments Theory/product testing
Environment independent setting	Survey research	Easy, low cost Can reduce sample bias	Context insensitive No variable manipulation	Collecting descriptive data from large samples
	Applied research	The goal is a product which may be evaluated	May need further design to make product general	Product development, testing hypothesis/concepts
	Basic research	No restrictions on solutions Solve new problems	Costly, time demanding May produce no solution	Theory building
	Normative writings	Insight into firsthand experience	Opinions may influence outcome	Descriptions of practice, building frameworks

Source: Wynekoop and Conger

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Thank You

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