# History of HCI

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# Overview

# Sources

- Mackenzie, Chapter 1, **History Context**, Human Computer Interaction: An Empirical Research Perspective, 1st ed. (2013)
- Shneiderman, **Direct Manipulation: A Step Beyond Programming Languages** (1983)
- Macintosh 128K, `https://en.wikipedia.org/wiki/Macintosh_128K`

# Early Days

- In 1940s, computers are too **precious**, too **complicated**
- Only selected scientists/engineers were allowed to access
  - Most **non-user-friendly** tasks like *grep that requires regular expression* or *vi's editor that lack feedback when switching mode* is *NOT* an issue, because these people are the one **who invent themselves**!
- But by 1980s, everything changes. Computers become not only powerful, but **accessible by anyone!** HCI becomes a very important aspect

# Interdisciplinary Nature of HCI

- HCI owes a lot to older disciplines
- The most central is *human factors* or *ergonomics*
  - CHI "human factors" named after
  - Concerns **human capabilities**, **limitations**, and **performance** (but NOT user experience)
- HCI evolves and becomes very broad in scope.
  - Draws interests from many disciplines - psychology, design, engineering, etc.

# Notable events in the history of HCI

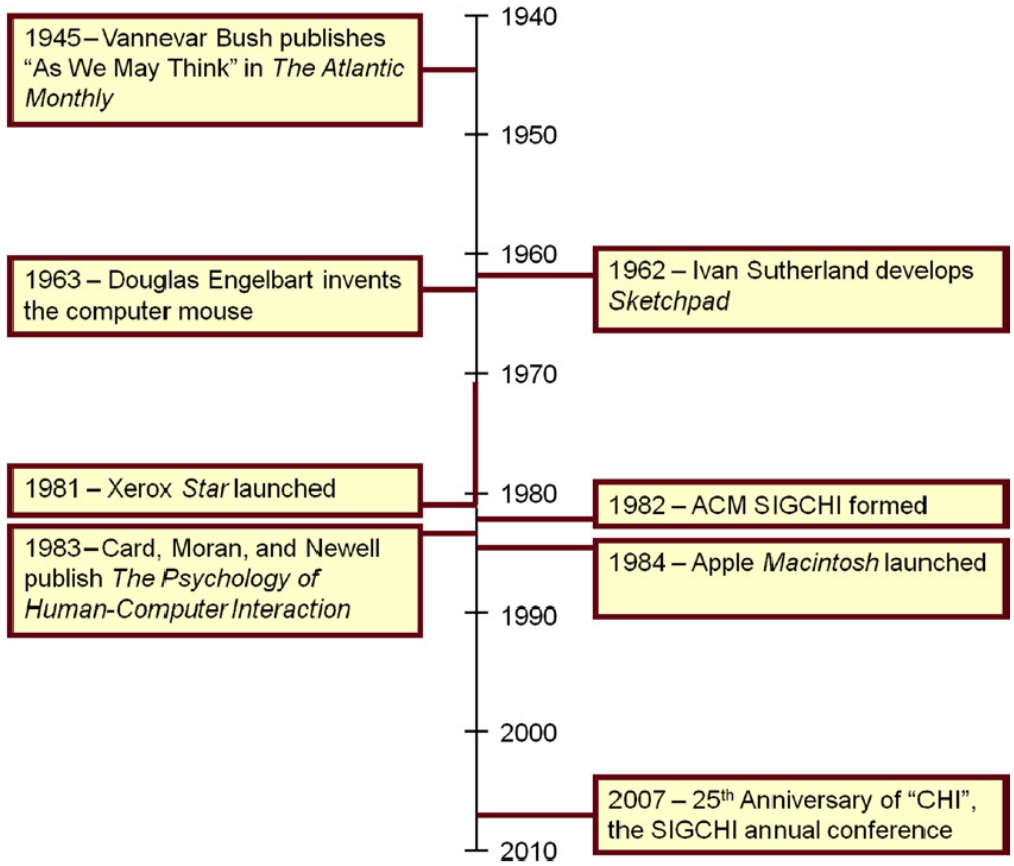


**FIGURE 1.1**

Timeline of notable events in the history of human–computer interaction HCI.

Figure: Source: Fg 1.1 (Mackenzie)

# Who is Vannevar Bush

Figure: Source: Figure 1.2 (Mackenzie)

- Bush published a **prophetic essay** "As We May Think" in Atlantic Monthly in July, 1945 (cited 4000+ times)
- Bush was U.S. government's Director of the Office of Scientific Research and scientific advisor to Roosevelt
- During WWII, he leads 6,000 scientists in the application of science to warfare

# Vannevar Bush's Essay (1945)

- Raises the problem of **information overload** and **difficulty** in accessing knowledge
- Proposes *memex*, which contains a key concept of *associative indexing* - selecting one item retrieves other relevant (sounds a lot like **hyperlink** today!)
- Beginning of many inspirations to follow (just like how *Doraemon* inspires engineering culture in Japan)

# Ivan Sutherland's Sketchpad (1962)

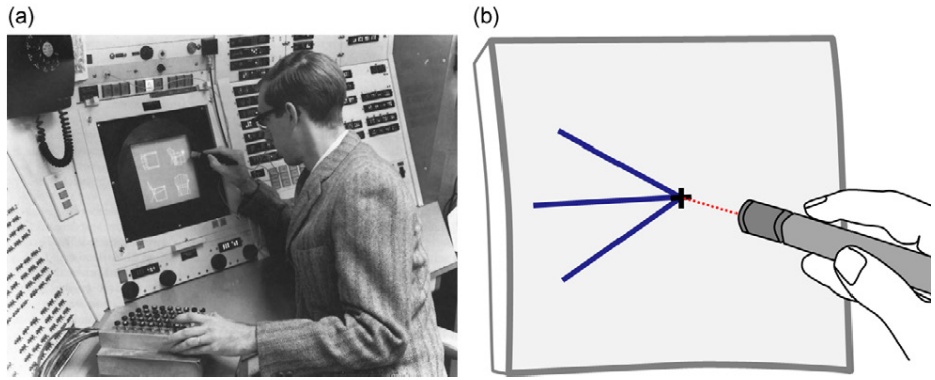


**FIGURE 1.3**

(a) Demo of Ivan Sutherland's Sketchpad. (b) A light pen dragging ("rubber banding") lines, subject to constraints.

Figure: Source: Fg 1.3 (Mackenzie)

- Developed *Sketchpad* as part of his PhD research at MIT
- Sketchpad was a graphic system supported the **drawings** of shapes and lines using a **light pen**
- `https://www.youtube.com/watch?v=YB3saviItTI`

# Direct Manipulation

Sketchpad - the first *direct manipulation* interface

- **Visibility of objects** - continuous representations
- **Incremental action** - action such as mouse selection
- **Rapid feedback** - immediate feedback
- **Reversibility** - can be easily undo
- **Exploration** - permits discovery and learning
- **Syntactic correctness of all actions** - menus and buttons
- **Replacing language with action** - directly manipulating

# Douglas Engelbart's mouse (1963)

- Mouse **symbolizes** the emergence of HCI
- Invented by Douglas Engelbart in 1963
- The light pen was not so usable as **user held the pen in the air which is tiring**.
- Device besides the keyboard makes sense

# Engineering of the Mouse

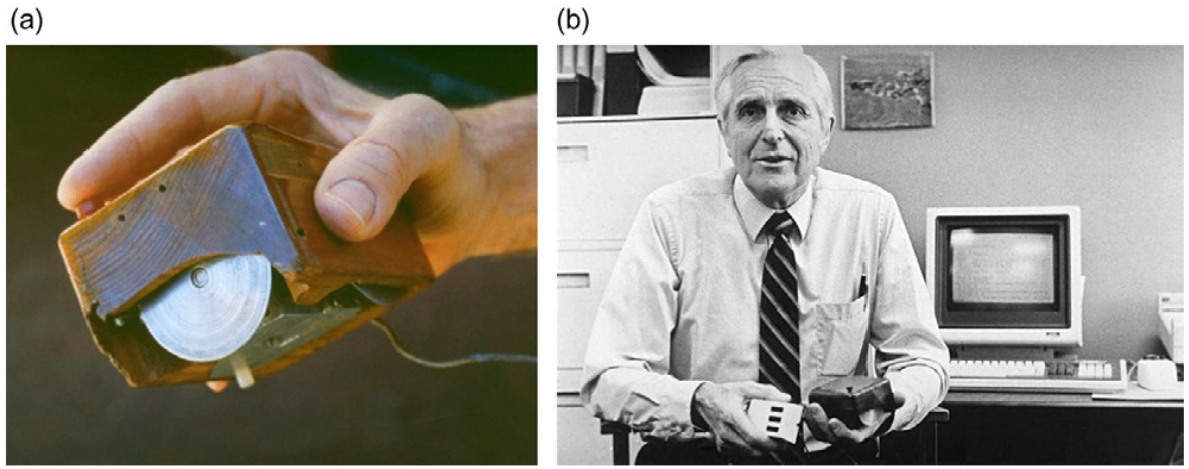


**FIGURE 1.4**

(a) The first mouse. (b) Inventor Douglas Engelbart holding his invention in his left hand and an early three-button variation in his right hand.

Figure: Source: Fg 1.4 (Mackenzie)

- The first prototype included **one button** and **two wheels** positioned at right angles to each other, marking xy
- A selection button at the user's index finger.
- Later, Engelbart developed a three-button version

# HCI First User Study

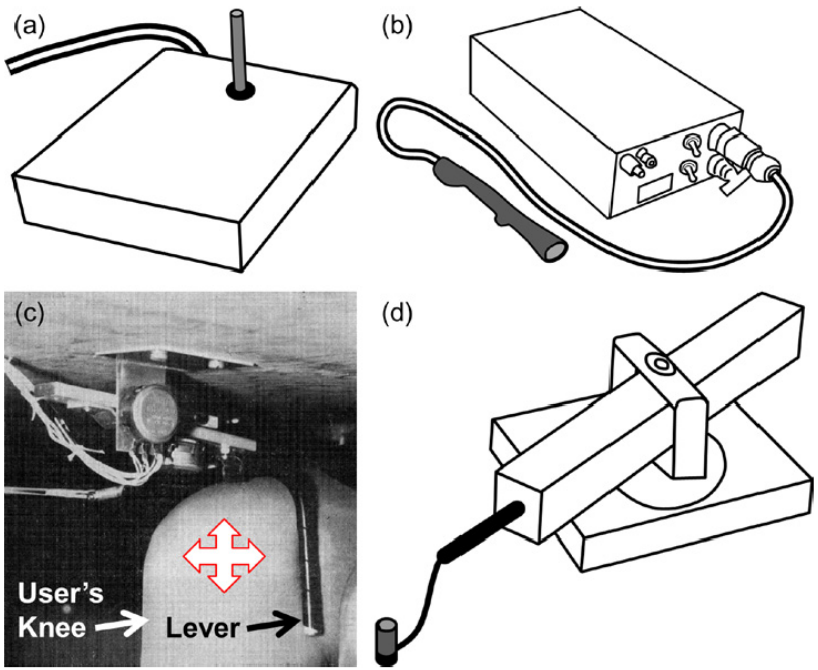


**FIGURE 1.5**

Additional devices used in the first comparative evaluation of a mouse: (a) Joystick. (b) Lightpen. (c) Knee-controlled lever. (d) *Grafacon*.

*(Source: a, b, d, adapted from English et al., 1967; c, 1967 IEEE. Reprinted with permission)*

Figure: Source: Fg 1.5 (Mackenzie)

# HCI First User Study

- First ever "user study"
- **Selecting** and **manipulating** text
- Compared **mouse** with
  - **Light pen**
  - **Joystick**
  - **Knee-controlled lever**
  - **Grafacon**
- Three metrics
  - **Access time** - hand from keyboard to device
  - **Motion time** - onset of cursor to the final selection
  - **Errors** - distance between center of target and center of cursor

# HCI First User Study

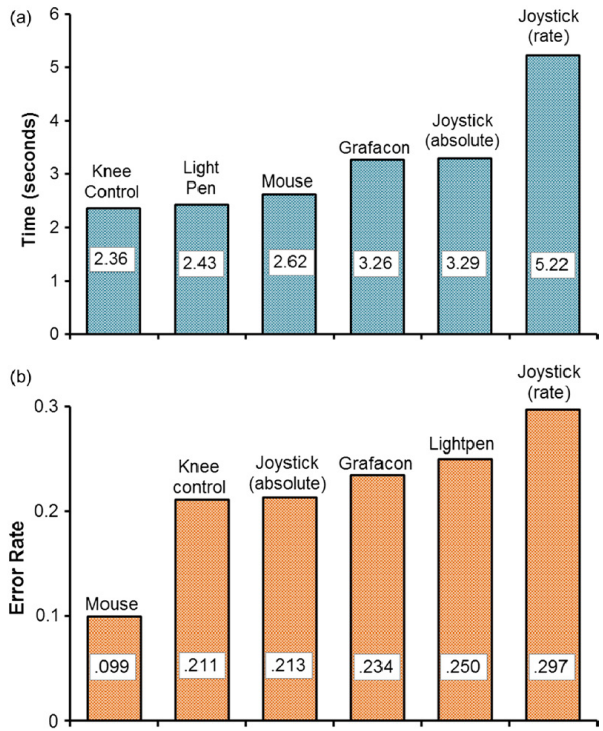


**FIGURE 1.6**

Results of first comparative evaluation of a computer mouse: (a) Task completion time in seconds. (b) Error rate as the ratio of missed selections to all selections.

*(Adapted from English et al., 1967)*

Figure: Source: Fg 1.6 (Mackenzie) - Access time + Motion time = Task Completion time

- 11 participants (8 experienced and 3 inexperienced)
- **A character target at random X and Y pos with varied size appeared**, with surrounding distractors
- The trial begin with a spacebar hit, a cursor will appear, and participant move his or her hand to the input device and move the cursor to the target, and make selection
- Ten trials / device

# HCI First User Study

- Although **Knee-controlled lever** is best in terms of time, since Knee-controlled has zero access time, the authors argued that considering only motion time, Knee control does not perform well
- **Light pen** performs slightly better than **mouse**, but because of possible fatigue, mouse will be better in the long run
- **Mouse** is the clear winner in terms of accuracy

# Discussion

- Why require **distractors**?
- Why require a **spacebar hit**?
- Why require **10 trials** and not 1 or 2? How to determine 10?
- Why not only measure **time**, but also **errors**?
- Why a mix of **experienced** and **inexperienced**? and why 11 participants?
- How do you choose your **comparison tools**? Why light pen or joystick, for example? Why command line is not being compared?
- Do you think the **order of factor** matters? For example, always do light pen first.

# At the NCC (1981)

Figure: Source: Fg 1.7 (Mackenzie)

- **National Computer Conference (NCC)** was the yearly conference for computing. Gathered major players like IBM. The attendance exceeded 100,000
- In May 1981 at NCC, **Xerox** attracted a lot of buzz regarding their **Xerox 8100 Star Information System** that supports
  - Windows, icons, menus and a pointing device (WIMP)
  - Direct manipulation and what-you-see-is-what-you-get (WYSIWYG) interaction

# Star

https://www.youtube.com/watch?v=w0Am7EiFNu8

# Star's Desktop Metaphor

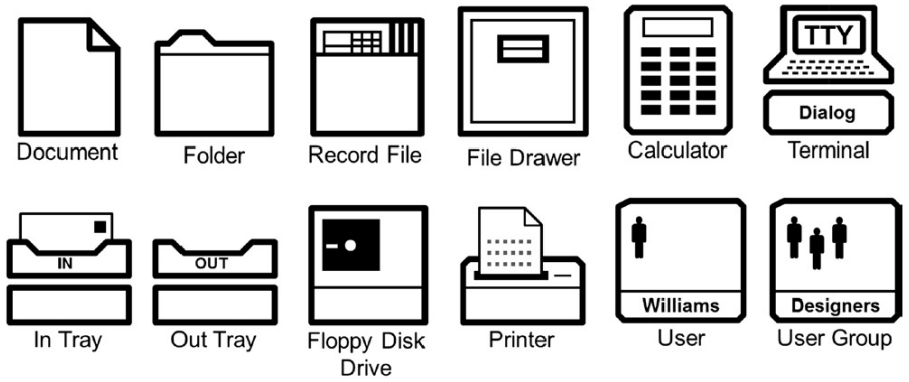


**FIGURE 1.8**

Examples of icons appearing on the Xerox Star desktop.

*(Adapted from Smith, Irby, Kimball, and Harslem, 1982)*

Figure: Source: Fg 1.8 (Mackenzie)

- One novel feature of the Star was the use of *desktop metaphor*
- **Metaphors** are important in HCI. It allows almost no learning in understanding how to use systems

# Star's File Systems

- To make the system usable, Star focus on i**nteractions with files, rather than program**. Thus, when user clicked a file, the file should automatically open the associated program
- All these programs are hidden from the users, thus users are not burdened with lots of programs, but instead, work with the more familiar "file-system"

# Star's Direct Manipulation

- Supports point-select interaction
- Direct manipulation in Star supports **multiple input channels**, and each channel has a direct correspondent of the task - **display brightness** or **sound** use *slider*, **font size** or **family** use *menu item*
- These direct manipulation channels can be done **in any order** - giving users the sense of **control**
- To implement direct manipulation, systems shifted from *sequential programming* to *event-driven programming*

# Star's GUI

- To design GUI, PARC lead by Alan Kay developed a new object-oriented programming language known as *Smalltalk* and a software architecture known as Model-View-Controller
- This GUI takes almost 10 years to develop, where a lot of the time was spent on inventing the architecture

# Star's commercial failure and Apple II

- In the end, Star was not so successful
- 3 reasons were identified
  1. Star was not really a *personal* computer. PARC viewed Star as a beefed up version of a terminal connected to a central server.
  2. Star architecture was "closed" - could only run Xerox applications
  3. Expensive - $16,000
- Anyhow, the *Apple II*, introduced in 1977, was hugely successful. The original retail price was $1,298 featuring the same components as Star and supports 4KB of ram (but without mouse) thus require typing to launch programs
  - the platform for VisiCalc, the first spreadsheet application which sells over 700,000 copies and become known as the first "killer app"

# Birth of HCI (1983)

- 1983 was possibly among the most notable milestone of HCI and were defined by three important feats:
  1. the first **ACM SIGCHI conference**
  2. publication of Card, Moran, and Newell's *The Psychology of Human Computer Interaction (1983)*
  3. arrival of **Apple Macintosh** in January 1984

# (1) First ACM SIGCHI Conference (1983)

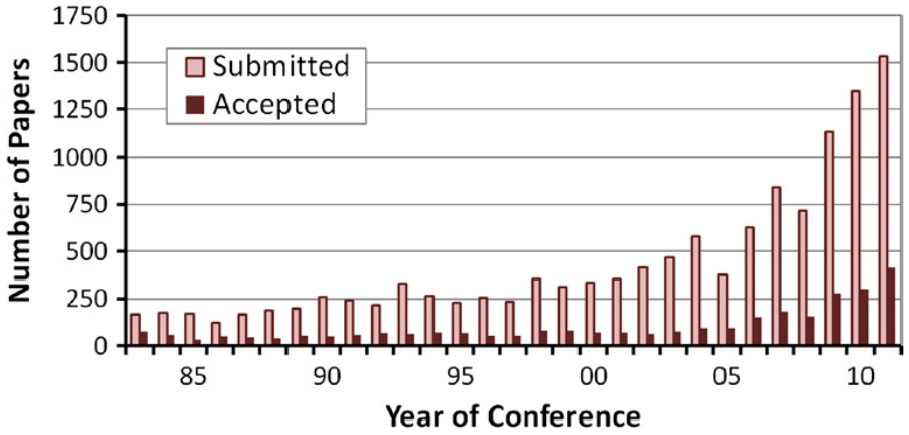


Figure: Source: Fg 1.9 (Mackenzie)

- The **first SIGCHI conference** was held in Boston with 59 technical papers presentations.
- Since then, SIGCHI is widely known as CHI (k sound) and has attendance of about 4,000
- CHI publication has since becomes the standard of HCI academia

# (2) The Psychology of Human-Computer Interaction (1983)

- Card and Moran arrived at PARC in 1974 and seek to **apply the knowledge of human sensory, cognitive and motor systems to HCI**.
- This knowledge was eye-opening where *Model Human Processor* (MHP) was proposed
- The MHP had an **eye** and a **ear** (for sensory input to a perceptual processor), a **brain** (with a cognitive processor, short-term memory, and long-term memory), and an **arm**, **hand**, and **finger** (for motor responses)
- MHP is the first to show that **human can be modeled**

# Model Human Processor

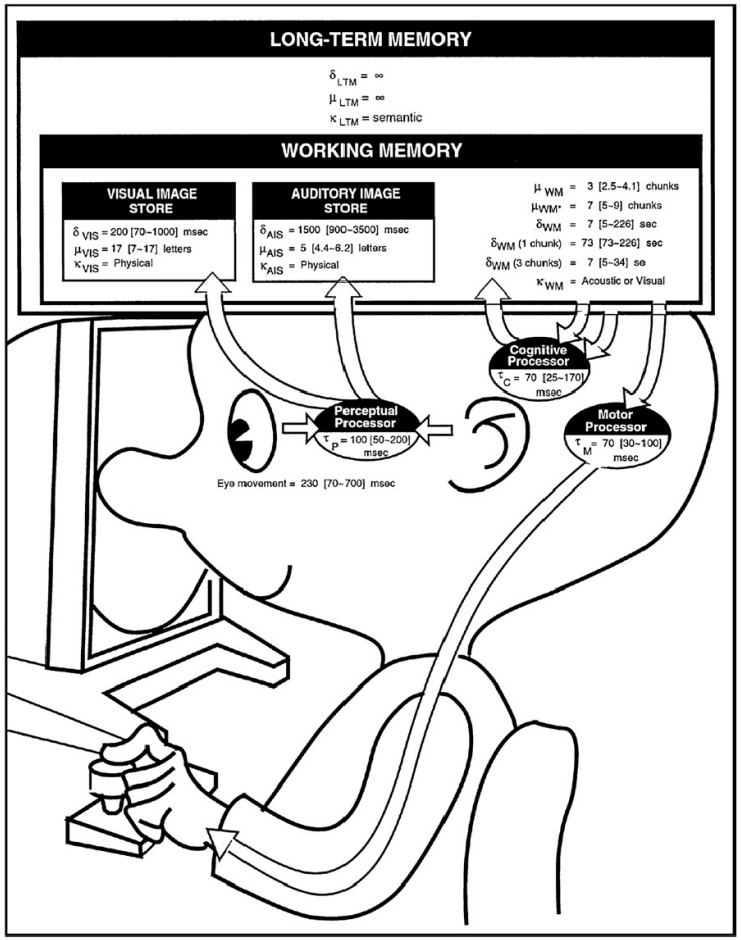


Figure: Source: Fg 1.11 (Mackenzie)

# (3) Launch of the Apple Macintosh (1984)

Figure: Source: Fg 1.12 (Mackenzie)

https://www.youtube.com/watch?v=3vq9p00T08I

# Launch of the Apple Macintosh (1984)

- Apple Macintosh was launched in January 22, 1984, selling at $2,495. Sold 70,000 unit by May 3, 1984
- Introducing **one-button mouse**
- Used MacOS - **icons-based**
- Featured 128KB Ram, and for storage, it introduced **3.5 inch disks** that stored 400K (later 800K then 1.44MB), enough to store application
- Bundled with System, Finder, MacPaint, MacWrite, MacProject, MacTerminal, and Microsoft Word

# Growth of HCI and GUIs

- Microsoft was a latecomer in GUIs. Early version of Microsoft *Windows* appeared in 1985, but it was not until *Windows 3.0* (1990) and *Windows 3.1* (1992) that Microsoft became a real threat to Mac
- Major **universities** offered courses in HCI
- **Companies** also paid great effort in their HCI departments
- **SIGCHI conferences** remain the main driver

# Early Days HCI research

- A classic example of early days is on the **design of menus.**
  - **Speed**: *Marking menus* - `https://www.youtube.com/watch?v=dtH9GdFSQaw`
  - **Order**: How menu items should be ordered? Alphabetically or by function?
  - **Metaphor**: Is access improve if an icon is added to the label?
  - **Depth vs. Breadth**: Go deeper or wider?
  - **Organization**: Which menu to put "Indent Text"?
- **Spirit of HCI research** is similar to above questions

# Online Resources

- ACM Digital Library - `http://dl.acm.org`
- HCI pioneers - `https://hcipioneers.wordpress.com/`
- ACM Interactions - `http://interactions.acm.org/`
- HCI Bibliography - `http://www.hcibib.org/`
- Textbook - `http://www.yorku.ca/mack/HCIbook/`
- Human Computer Interaction - **Brief Intro by John Caroll**, `https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/human-computer-interaction-brief-intro`

# What's next

Read my slide on **Empirical** and these textbook resources:

- Mackenzie, Chapter 4-5, **Scientific Foundations, Designing HCI Experiments**, Human Computer Interaction: An Empirical Research Perspective, 1st ed. (2013)
- Zhao, **How to Design Controlled Experiments in HCI?** `https://www.slideshare.net/shilman/controlled-experiments-shengdong-zhao`

# Questions