

# Current Topics in Media Computing and HCI

Prof. Dr. Jan Borchers  
Media Computing Group  
RWTH Aachen University  
Summer Semester 2014  
<http://hci.rwth-aachen.de/cthci>



## Goals

- Understand **ways to do research in HCI**
- Practice how to **retrieve** and **evaluate** information from the literature  
⇒ Preparation for thesis and future research work
- Learn about **up-to-date developments** in Human–Computer Interaction and interactive multimedia from new books and **recent conference/journal articles**



## Topics for 2014

- Research literacy (3.5 weeks)
  - Understanding HCI research approaches
  - Experimental research and user study protocol (case study: text entry techniques)
  - Statistics in HCI research (case study: midair input techniques)
  - Publication and peer-review process
- Research topics (7.5 weeks)
  - Coding and integrated development environment
  - Interactive surfaces and tangible UIs
  - Crowdsourcing and human computation
  - Augmented reality in HCI
  - Pattern language
  - Interactive television
  - Personal fabrication and personal design

Interleaving



## Current Topics in Media Computing and HCI

- Audience
  - M.Sc. Computer Science
  - M.Sc. Media Informatics
  - M.Sc. Software Systems Engineering
  - B.Sc. Computer Science (extra credit / carry-over)
  - B.Sc. / M.A. Technical Communication (with focus on CS/HCI research)
- Prerequisite: **DIS I**
  - In class, assignments, and exams we assume that you know DIS I



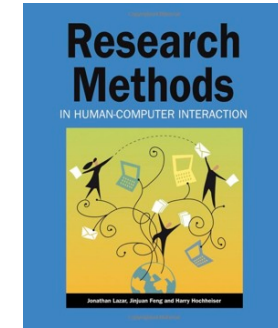
# Literature Sources

- Recent (usually last 2 years) conference papers
  - CHI, UIST, ITS, DIS, Ubicomp,...
  - Older seminal papers included
- Recent journal articles
  - TOCHI,...



# Literature Sources

- Recent books
  - Research Methods in HCI
    - Lazar et al. (2010)
  - **Recommended** reading for more details about evaluation methods — especially if you are going to do your thesis at our chair!



# Administrative

- Format: 6 ECTS
- Lecture: Tuesday, 10:15–11:45
  - Presentation & discussion of research topics
  - Small group in-class exercises
  - Weekly reading assignments (individual)
- Lab: Wednesday, 13:15–14:45 **Attendance is compulsory!**
  - Practice skills learned from the lecture and discuss reading and written assignments
  - 3 Written assignments (in groups)
  - 1 Mini HCI research project (in groups)
  - 1 Mock PC meetings (in groups)
- Extra supervision slots during mini project phase by appointment

# Final Grade

- 30% midterm (June 3)
- 40% final (July 29)
- 5% × 3 written assignments
- 10% mini HCI research project
- 5% mock PC meeting

Lecture date	Lecture topic	Lecture presenter	Lab date	Lab topic	Lab moderator	Written assignment	Assignment logistics				Written feedback	Discussion in the lab
							Release	Deadline for peer submission	Peer feedback deadline	Deadline for final submission		
08.04.	R1: Three approaches to HCI research	Jan	09.04.	Literature searching and reading techniques	Chat	-						
15.04.	R2: Mechanics of experimental research and how to write a user study protocol (Case study, Text-entry techniques)	Chat	16.04.	Identifying contributions and benefits of research articles	Chat	A01: Categorizing research contributions and writing contribution statements	16.04.					
22.04.	T1: Research in coding and IDEs	Jan-Peter	23.04.	Designing experimental user studies	Chat	(A01 peer feedback)		23.04.				
29.04.	(no lecture: CHI 2014)	--	30.04.	(no lab: CHI 2014)	--	A02: Reverse-engineering user study protocol	30.04.		28.04.	30.04.		
06.05.	(no lecture: Fachschaftsvollversammlung)	--	07.05.	Recap from CHI 2014	Florian	(A02 peer feedback)		07.05.				
13.05.	T2: Interactive surfaces and tangibles	Simon	14.05.	A01 discussion Writing a review for research papers	Chat	A03: Writing a review: Interactive surfaces and tangibles	14.05.		12.05.	14.05.	13.05.	14.05.
20.05.	R3: Understanding statistics in HCI research (Case study: mouse input techniques)	Chat	21.05.	Statistics for HCI lab	Chat & Kristina	(A03 peer feedback)		21.05.				
27.05.	T3: Human computation (or sketching)	Leonhard	28.05.	A02 discussion Midterm exam preparation lab	Chat	(Midterm exam preparation)			26.05.	28.05.	27.05.	28.05.
03.06.	Midterm: R1-3, T1-2 (30%)	Chat	04.06.	Midterm exam discussion (not review) A03 discussion	Chat	A04: Mini HCI research project: Midair input techniques	04.06.				03.06.	04.06.
10.06.	(no lecture: Exkursionswoche)	--	11.06.	(no lecture: Exkursionswoche)	--							
17.06.	T4: Augmented reality	Nur	18.06.	Mini project discussion Midterm exam review	Chat	(A04 continued)		27.06.				
24.06.	R4: Peer-review process in HCI T5-1: Pattern language	Jan	25.06.	Mini project interim presentation and feedback	Chat	(A04 peer feedback)			30.06. (in the lab)			
01.07.	T5-2: Pattern language	Jan	02.07.	Mockup PC meeting: Augmented reality UIs	Chat (& Nur?)	(A04 continued)				02.07.		
08.07.	T6: Interactive television UIs Course evaluation	Christian	09.07.	A04 discussion	Chat	(Final exam preparation)					08.07.	09.07.
15.07.	T7: Personal fabrication and personal design Course reflection	Jan	16.07.	Final exam preparation lab	Chat	(Final exam preparation)						

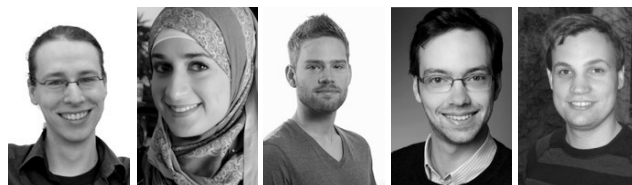
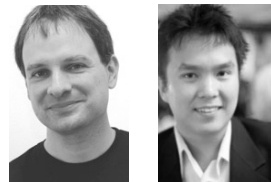
# Learning Resources

- Public website: <http://hci.rwth-aachen.de/cthci>
  - L<sup>2</sup>P course room: slides, literature, assignments
  - Lecture recordings on iTunes U
  - Research papers: [ACM Digital Library](#)
- RSS links available on L2P
- Free access from inside RWTH network

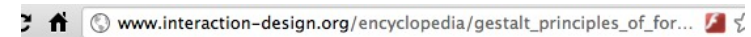


# CTHCI Team

- Prof. Dr. Jan Borchers
- Chat Wacharamanotham, M.Sc.
  - chat@cs.rwth-aachen.de
- Topic presenters



# Plagiarism



The law of similarity captures the idea that elements will be grouped perceptually if they are similar to each other. In the "preferences window" of

## Law of Similarity

The law of similarity captures the idea that elements will be grouped perceptually if they are similar to each other. For instance in the following dialog we tend to divide the given files into two groups:

## Law of Similarity –

The law of similarity states that objects will be grouped perceptually if they are similar to each other. In other words the repetition in the forms persuades the human mind to group it

[1] [http://www.interaction-design.org/encyclopedia/gestalt\\_principles\\_of\\_form\\_perception.html](http://www.interaction-design.org/encyclopedia/gestalt_principles_of_form_perception.html)

Cite and quote instead of plagiarizing!

# Consequences of Plagiarism in this Class

- Plagiarism will result in an immediate 5.0 for this class.
- Repeated plagiarism will also lead to banning from all other i10 classes.
- Sign the declaration of compliance and hand it in after the lab.



# Three Approaches to HCI Research



Test

Empirical science



Look

Ethnography

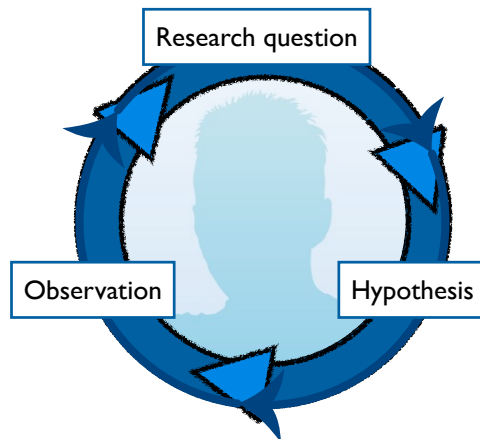


Make

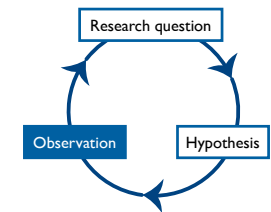
Engineering and design



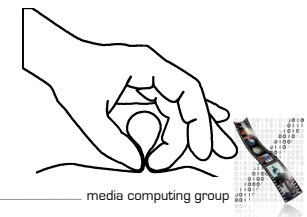
## Empirical Approach



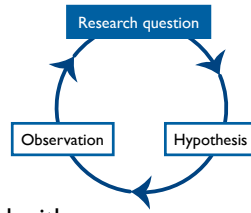
## Initial Observation



- Begin with casual or informal observation
- Usually comes from personal experience that catches your attention or raises questions in your mind
- Example: “Cloth has an affordance of pinching. Could this be useful for interaction design?”

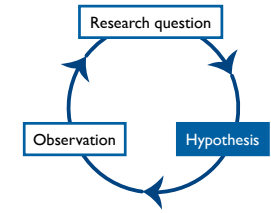


# Research Question



- Identify variables and hypothesis that are associated with your observation
- **Variables:** characteristics or conditions that change or have different values for different individuals
- **Research question:** a statement that describes or explains a relationship between or among variables
  - A proposal to be tested
- Example: “For pinching cloth, different **areas** of the body would differ in **preference** and **the way people pinch**”

# Hypothesis

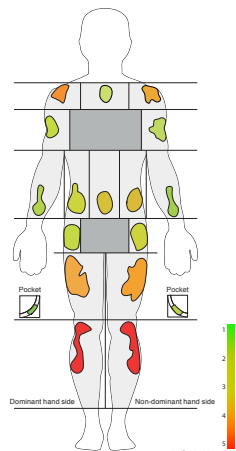


- **Concrete and testable** statements derived from the research question
- **Operational definition:** a specific set of operations for measuring external, observable behavior
- In-class exercise: try giving an operational definition for the variables highlighted below
  - “There would be a difference in **user’s preference** among different **areas** on the body for pinching cloth.”

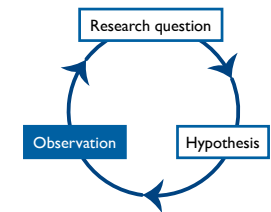


# Research Example: Pinstripe

- Karrer et al., CHI ’11
- Recall the prediction:
  - “There would be a difference in **user’s preference** among different **areas** on the body for cloth pinching.”
- **Method:**
  - Identify 16 different body area
  - Ask the participants to perform the pinching gesture in these areas
  - Collect convenience rating in 5-point Likert scale



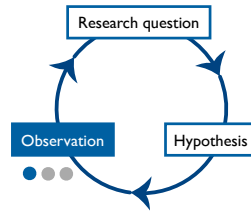
# Planned Observation



- Collect data to support, refute, or refine the original hypothesis
- Three strategies
  - **Descriptive research:** X happens
    - Focus on the current state of each **individual** variable
  - **Relational research:** X and Y happen together
    - Measure **two or more variables** that **exist naturally** from each participant
  - **Experimental research:** X causes Y
    - **Manipulate** one or more variables and observe their **effects** to other variables




# Descriptive Research



- Describe a naturally-occurring phenomenon
- Measure and report individual variables **without claiming relationships**
- Natural phenomena can occur when using a new technology as well
- Methods: observation, survey, case study



# Research Example: Natural Troubles of Driving with GPS

- Brown (Sweden) and Laurier (Edinburgh), Best paper CHI '12 
- Goal: To understand users' interaction with GPS navigation system in non-controlled setting
- 14 drivers, 2 video cameras, field notes
  - 9 hours of video ⇒ 75 clips ⇒ 37 detailed transcriptions
  - Analyzed the data to find common patterns/themes and construct theories that explain them



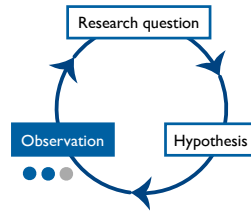
The normal natural troubles of driving with GPS  
Available at: <http://dl.acm.org/citation.cfm?id=2208285>

# Natural Troubles of Driving with GPS

- Contribution & benefits:
  - “Presents a **video analysis study** of driving using GPS navigation systems in **natural settings**. The paper argues for [understanding] driving with [a] GPS as an active process and not as ‘docile driving.’”
- Conclusion
  - Designer should take into account the “intelligent driver”  
E.g., less persistent instructions when the user decided to deviate from them
  - Normal natural trouble: “GPS is used in the way that was not foreseen. The driver must take instructions and the map and fit them with the situation.”



# Relational Research



- Measure a set of variables for each participant
- Examine to identify **patterns** of relationship
  - Changes in one variable are consistently and predictably accompanied by changes in another variable
- Measure the **strength** of the relationship

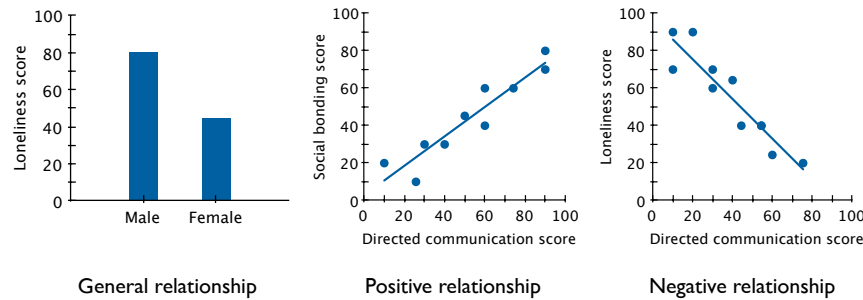
# Research Example: Social Network Activity and Social Well-Being



- Burke (CMU), Marlow, and Lento (Facebook). Best paper CHI '10
  - “An empirical analysis of the **relationship** between **direct** and **passive communication** on Facebook and social well-being, including loneliness, bridging, and bonding social capital.”
- Survey in Likert scale (N=1193)
- Analyze the past two months Facebook activity data, e.g.,
  - Friend count (actual)
  - Directed communication: comments, likes
  - Passive consumption of broadcasted items, e.g., status update



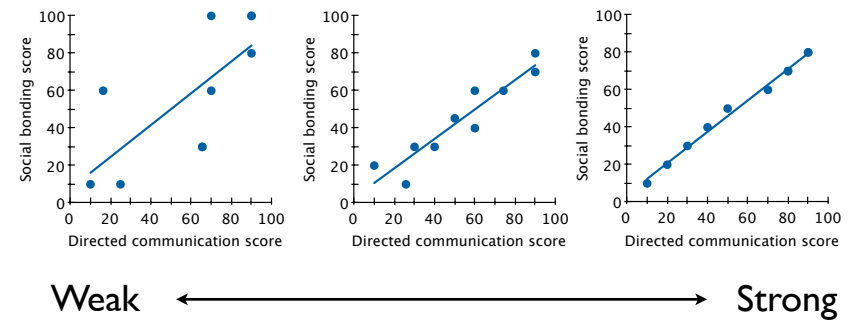
## Patterns in the Relationship between Variables



Simulated data for instructional purpose, based on the result from [Burke et al., CHI '10]



## Strength of the Relationship between Variables

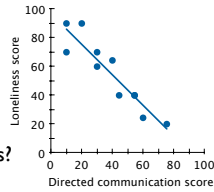


Simulated data for instructional purpose

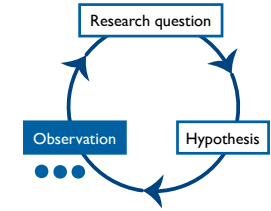


# Limitations of Relational Research

- Correlation does not imply causation
  - E.g., loneliness  $\Rightarrow$  less direct communication?
  - or less direct communication  $\Rightarrow$  loneliness?
  - or third variable  $\Rightarrow$  direct communication and loneliness?
- **Third variable problem:** unidentified variable controls the correlated variables
- **Shallow** data from large number of people instead of **deep** data
  - Can be improved by follow-up interviews, follow-up surveys
- Participant sampling method limits the conclusion
  - Method: advertisement on Facebook
  - Participants: only English-speaking users, but compensated by many countries of origin




# Experimental Research

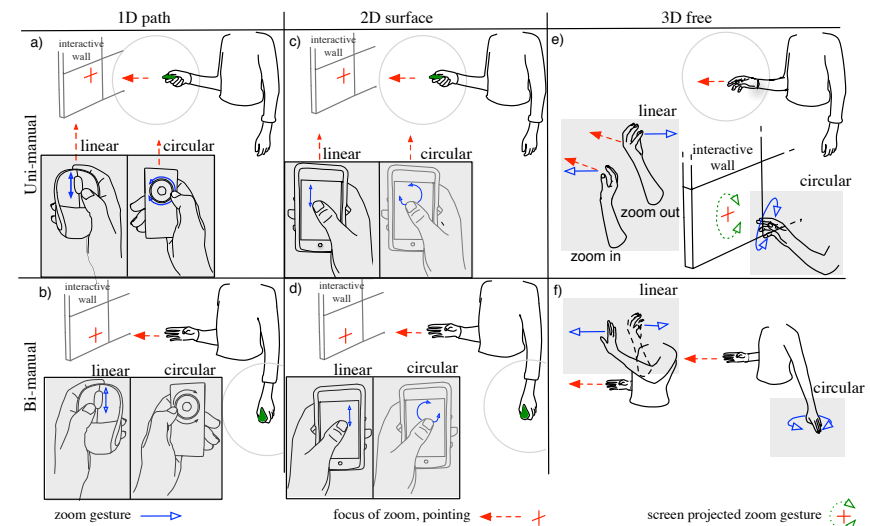


- Purpose: To infer cause-and-effect relationship
- Controlling **independent variable**
- Observe the change in the **dependent variables**
- In-class exercise: recall the following experimental designs
  - Between-group vs. within-group
  - Benefits and drawbacks
- More details in next lecture



# Research Example: Mid-air Pan-and-Zoom on Wall-sized Displays

- Nancel et al. (Paris), Best paper CHI '11 
- Contributions & Benefits:
  - “Design and evaluation of multiscale navigation techniques for very large displays based on **three key factors**: number of hands involved, type of movement, type of feedback.”





# Three Approaches to HCI Research

Mid-air pan-and-zoom on wall-sized displays  
 Available at: <http://dl.acm.org/citation.cfm?id=1978969>



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Ethnography

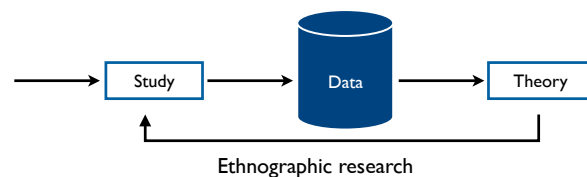
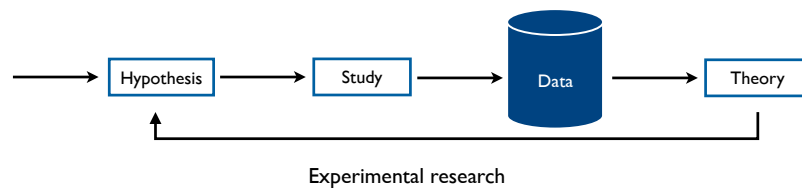


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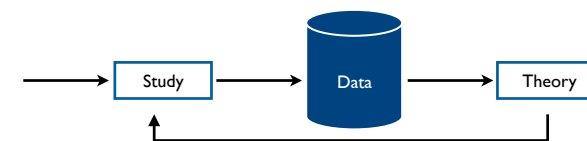
Engineering and design



## Ethnography



## Ethnography



- Collect the data
- Code the data and find patterns that occur in the data
- Create theories that explain the data
- Try to attack the theories by gathering more data
  - Leads to stronger theories



# Data Collection

- Methods: Observation, interview, participation, logging
  - Format: Field notes, video, audio, log files
- **Triangulation:** use multiple data sources to support an interpretation to increase the confidence of the conclusion
  - From different participants
  - From different types of data, e.g., observation, interview, logs



# Research Example: Vlogging in Dentist Training

- Becvar and Hollan (UCSD), GROUP '07
- Field site: dental hygiene training program in San Diego, CA, USA
- Goals
  - To gain understand the teaching and learning practices, media and representations
  - To implement and evaluate a design prototype based on the finding of the first goal
- Method
  - Ethnographic study of the current practice
  - Implement and deploy the prototype, then do another ethnographic study



# Vlogging in Dentist Training: Understanding Current Practice

- Method (2004, **one year in the field**)
  - Observation
  - Video recording
  - Contextual interview
- 18 students, 4 instructors participated
- Sample finding: strategies used by clinical instructors
  - Molding: laying their hands over students' hands as they work with instruments
  - Directing: verbally talking a student through a new procedure: "Do this"
  - Demonstration: using hand gestures to show correct/incorrect ways to handle instruments



# Three Approaches to HCI Research



Test

Empirical science



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Ethnography



Make

Engineering and design



# Engineering & Design




- Objective: solve a problem with a solution that works
- Key attributes\*:
  - Compelling target
    - Solve a **concrete, compelling problem** with demonstrated need
    - Solve a set of problems using a **unifying set of principles**
    - Explore** how people will interact with computers in the future
  - Technical challenge
    - Requires novel, non-trivial algorithms, or configuration of components
  - Deployed when possible
    - System is deployed and intended benefits and unexpected outcomes documented

\* from James Landay Slides: James & Friends' Systems How To



# Research Example: Skinput

- Harrison et al., Best paper CHI '10 
- Contributions & Benefits
  - “Skinput is a **technology** that appropriates the human body for acoustic transmission, allowing the skin to be used as a finger input surface.”



## Three Approaches to HCI Research

Skinput: appropriating the body as an input surface  
Available at: <http://dl.acm.org/citation.cfm?id=1753394>



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Ethnography

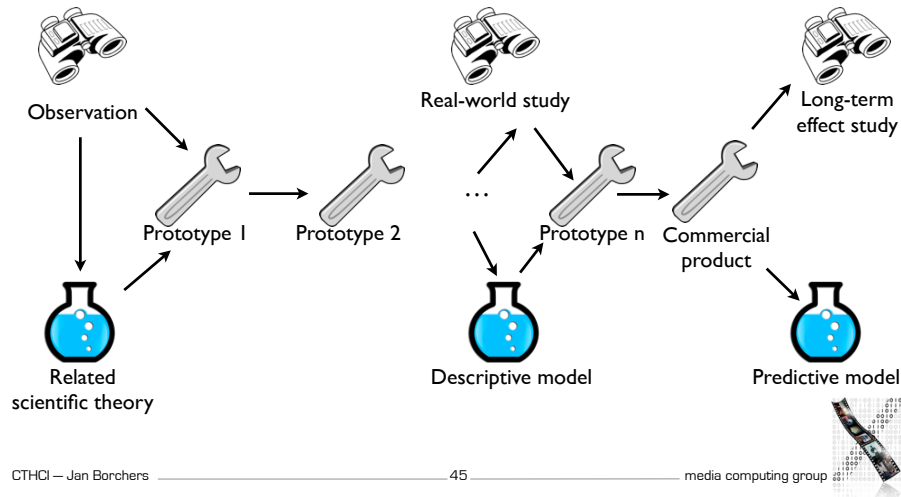


Make


Engineering and design



# The Messy Truth



# Research Example: CommandMaps

- Scarr et al., Best paper CHI '12 
- Improve toolbar (specifically Microsoft's Ribbon interface)
- In-class exercise:
  - Contributions?
  - Benefits?
  - Which part uses empirical science, ethnography, and engineering/design approach?

# CommandMaps

CommandMaps, CHI '13  
Available at: <http://dl.acm.org/citation.cfm?id=2207713>

- Contributions & Benefits:
  - “Introduces [CommandMap interfaces for mouse-based command invocation](#). Theoretically and empirically demonstrates that their defining properties — spatially stable command locations and a flat command hierarchy — [improve user performance](#).”  
[Scarr et al., CHI '12]

# Closing Remarks: Design Meets Science

“This was my ideal model of how the supporting science could work. It required good designers to actually do design, but what we could do was help structure the design space so that the movement through that design space was much more rapid. The science didn’t design the mouse, but it provided the constraints to do it.”

— Stu Card, **Designing Interactions** (2007)



# Next Week: Experimental Research

- How can we be sure that X causes Y? — Experimental methods
- How to measure that? — Measures and metrics
- How good is a piece of knowledge? — Validity and generalizability
- How to design a user study? — User study protocol
- Illustrated by a contemporary topic: Text entry UIs



# What You Need To Do Now

- Sign up for this class in CAMPUS
- Read this paper today:
  - [Seven Research Contribution Types in Human-Computer Interaction](#)  
— Jacob Wobbrock, 2014
- Come to the lab tomorrow!
  - Literature searching and reading techniques
  - Help with CAMPUS/L2P problems
- Read this paper before next lecture:
  - [How to Read an Engineering Research Paper](#) — William G. Griswold

Links to articles:  
[hci.rwth-aachen.de/cthci](http://hci.rwth-aachen.de/cthci)

