

# Current Topics in Media Computing and HCI

*Prof. Dr. Jan Borchers  
Media Computing Group  
RWTH Aachen University*

*Summer Semester 2015*

<http://hci.rwth-aachen.de/cthci>



# Goals

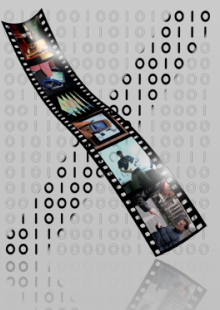
- Understand **ways to do research in HCI**
- Practice how to **retrieve** and **evaluate** information from the literature  
⇒ Preparation for thesis and future research work
- Learn about **up-to-date developments** in Human–Computer Interaction and interactive multimedia from new books and **recent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



# Topics for 2015

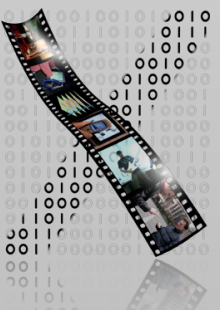
- Research literacy (3.5 weeks)
  - Understanding HCI research approaches
  - Experimental research and user study protocol (case study: text entry techniques)
  - Statistics in HCI research (case study: midair input techniques)
  - Publication and peer-review process
- Research topics (7.5 weeks)
  - Research in coding and IDEs
  - Touch and tangibles on large interactive surfaces
  - Augmented reality in HCI
  - Gestural and stroke input: from touch screens to midair
  - HCI design patterns
  - Interactive e-learning
  - 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 our lectures, 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

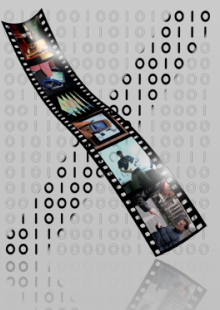
- Recent books
  - Research Methods in HCI (Lazar et al., 2010)  
**Recommended** reading for more details about evaluation methods — especially if you are going to do your thesis at our chair!
  - Research Methods for the Behavioral Sciences (Gravetter and Forzano, 2012)  
**Recommended** reading for more details about experimental research methods



# 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: Thursday, 08:15–09:45
  - Practice skills learned from the lecture and discuss reading and written assignments
  - 3 written assignments (in groups)
  - 1 mini HCI research project (in groups)
- Extra supervision slots during mini project phase by appointment

Active attendance in both  
lecture and lab expected!



# Final Grade

- 30% midterm (June 9)
- 15% 3 written assignments
- 10% mini HCI research project
- 45% final (July 28)





Lecture date	Lecture topic	Lecture presenter	Lab date	Lab topic	Lab moderator	Reading assignment	Written assignment	Assignment logistics					
								Release	Deadline for peer submission	Peer feedback deadline	Deadline for final submission	Written feedback	Discussion in the lab
07.04.	(no lecture: Orientation)	–	09.04.	(no lab: Orientation)	–	–	–						
14.04.	R1: Three approaches to HCI research	Jan	16.04.	Paper reading and identifying contribution types	Nur	<b>Required:</b> <ul style="list-style-type: none"> <li>(Wobbrock, 2014) Seven Research Contribution Types in Human-Computer Interaction</li> <li>(Griswold, n.d.) How to Read an Engineering Research Paper</li> </ul>	A01: Categorizing research contributions and writing contribution statements	16.04.					
21.04.	R2: Mechanics of experimental research and how to write a user study protocol (Case study: Text-entry techniques)	Nur	23.04.	Literature searching and contributions & benefit statement	Nur	<b>Required:</b> <ul style="list-style-type: none"> <li>(MacKenzie, 2007) Evaluation of Text Entry Techniques</li> </ul> <b>Recommended:</b> TBD	(A01 peer feedback)		23.04.				
28.04.	T1: Research in coding and IDEs	Jan-Peter	30.04.	Designing experimental user studies	Nur	<b>Required:</b> TBD <b>Recommended:</b> TBD	A02: Reverse-engineering user study protocol	30.04.		28.04.	30.04.		
05.05.	(no lecture: Student Representative Council Meetings)	–	07.05.	<ul style="list-style-type: none"> <li>A01 discussion</li> <li>Writing a review for research papers</li> </ul>	Nur	<b>Required:</b> <ul style="list-style-type: none"> <li>(McGrath, 1995) Methodology matters</li> </ul>	(A02 peer feedback)		07.05.			06.05.	07.05.
12.05.	T2: Touch and Tangibles on Large Interactive Surfaces	Simon	14.05.	(no lab: Ascension of Christ)	–	<b>Required:</b> TBD <b>Recommended:</b> TBD	A03: Writing a review: Interactive surfaces and tangibles	14.05.		12.05.	14.05.		
19.05.	T3: Augmented reality HCI	Nur	21.05.	<ul style="list-style-type: none"> <li>A02 discussion</li> <li>Midterm exam preparation lab</li> </ul>	Nur	<b>Required:</b> TBD <b>Recommended:</b> TBD	(A03 peer feedback)		21.05.			20.05.	21.05.
26.05.	(no lecture: Excursion week)	–	28.05.	(no lab: Excursion week)	–	–				26.05.	28.05.		
02.06.	R3: Understanding statistics in HCI research (Case study: midair input techniques)	Krishna	04.06.	(no lab: Corpus Christi)	–	None (exam preparation week)	(Midterm exam preparation)						
09.06.	Midterm: R1–3, T1–2 (30%)	Nur	11.06.	<ul style="list-style-type: none"> <li>Midterm exam discussion (not review)</li> </ul>	Nur	<b>Required:</b> <ul style="list-style-type: none"> <li>(Dragicevic * 8, alt.chi 2014) Running an HCI Experiment in Multiple Parallel Universes</li> </ul> <b>Recommended:</b> <ul style="list-style-type: none"> <li>(Wobbrock, 2011) Practical statistics for HCI</li> </ul>	A04: Mini HCI research project: Midair input techniques	11.06.					
16.06.	T4: Gestural and stroke input: from touch screens to midair	Chat	18.06.	<ul style="list-style-type: none"> <li>A03 discussion</li> <li>Initial discussion for mini project</li> </ul>	Nur	<b>Required:</b> TBD <b>Recommended:</b> TBD	(A04 continued)		27.06.			17.06.	18.06.
23.06.	R4: Peer-review process in HCI T5-1: Pattern language	Jan	25.06.	Mini project interim presentation and feedback	Nur	<b>Required:</b> <ul style="list-style-type: none"> <li>(Dearden and Finlay, 2006) Pattern Languages in HCI: A Critical Review</li> </ul>	(A04 peer feedback)			30.06. (in the lab)			
30.06.	T5-2:Pattern language	Jan	02.07.	Mini project interim presentation and feedback	Nur	<b>Required:</b> TBD <b>Recommended:</b> TBD	(A04 continued)				02.07.		
07.07.	T6: Interactive e-learning • Course evaluation	Krishna	09.07.	Mini project interim presentation and feedback A04 discussion	Nur	<b>Required:</b> TBD <b>Recommended:</b> TBD	(Final exam preparation)					08.07.	09.07.
14.07.	T7: Personal fabrication and personal design • Course reflection	Jan	16.07.	Final exam preparation lab	Nur	<b>Required:</b> TBD <b>Recommended:</b> TBD	(Final exam preparation)						



# Learning Resources

- Public website with all general info:  
<http://hci.rwth-aachen.de/cthci>  
including links to:
    - L<sup>2</sup>P course room (slides, literature, assignments)
    - Lecture recordings on iTunes U
    - Research papers in the ACM Digital Library
- Free access from inside RWTH network



# CTHCI Team

- Prof. Dr. Jan Borchers
- Nur Al-huda Hamdan, M.Sc.
  - [hamdan@cs.rwth-aachen.de](mailto:hamdan@cs.rwth-aachen.de)
- Topic presenters

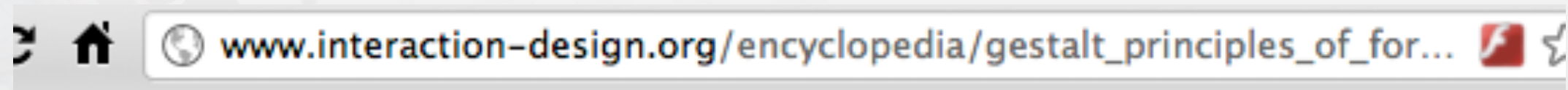


# Limited Seats

- 30 seats available
- Register in CAMPUS or email Nur for registration before Friday
- You will know if you're in by next lecture (Tue)
- First assignment in the first lab (this Thu)



# 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:

[1]

## 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]

[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.



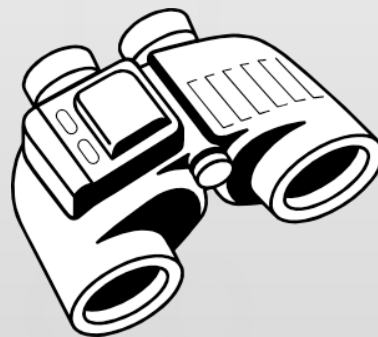


# Three Approaches to HCI Research



Test

Empirical science



Look

Ethnography



Make

Engineering  
and design



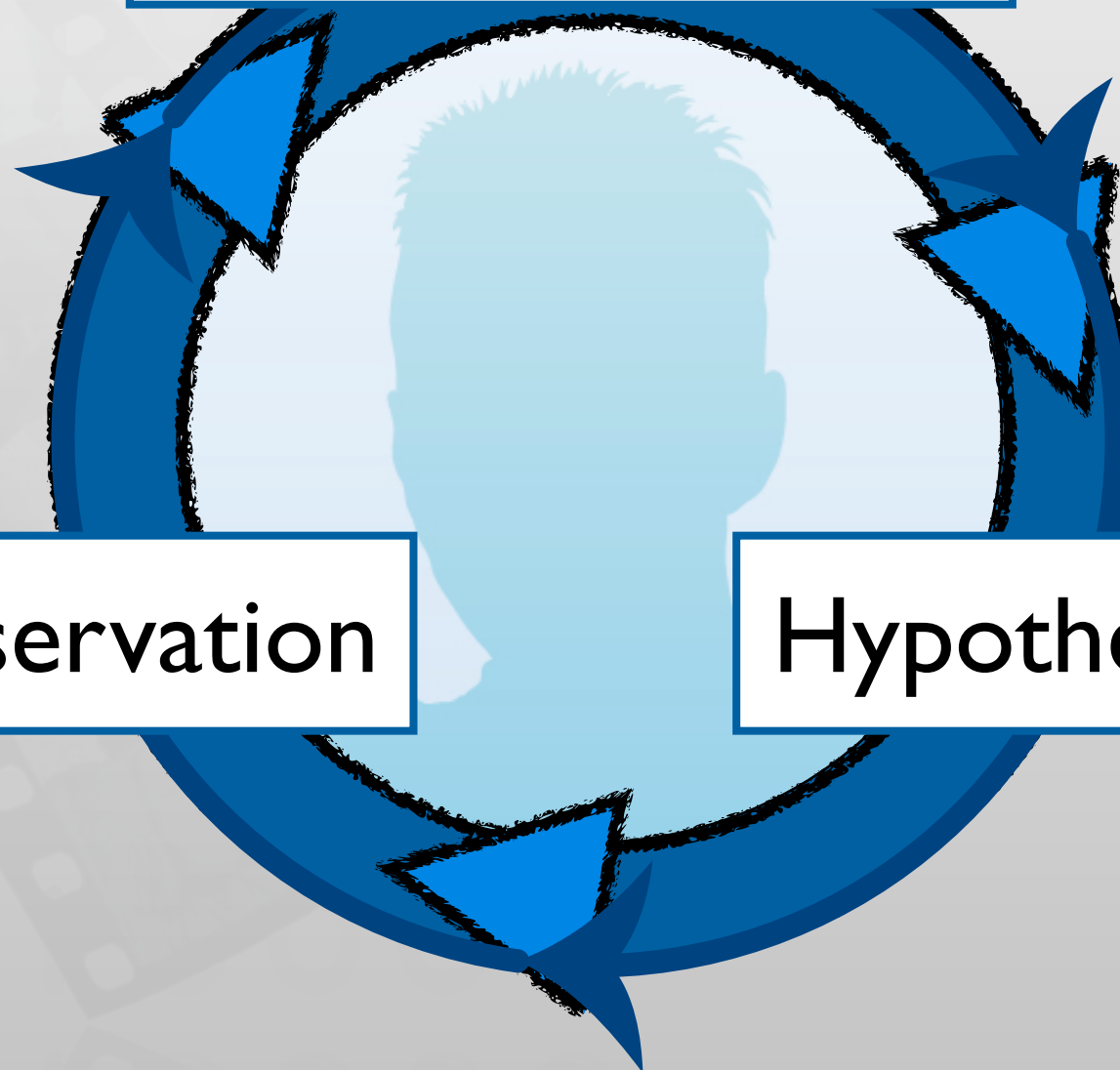
# Empirical Approach



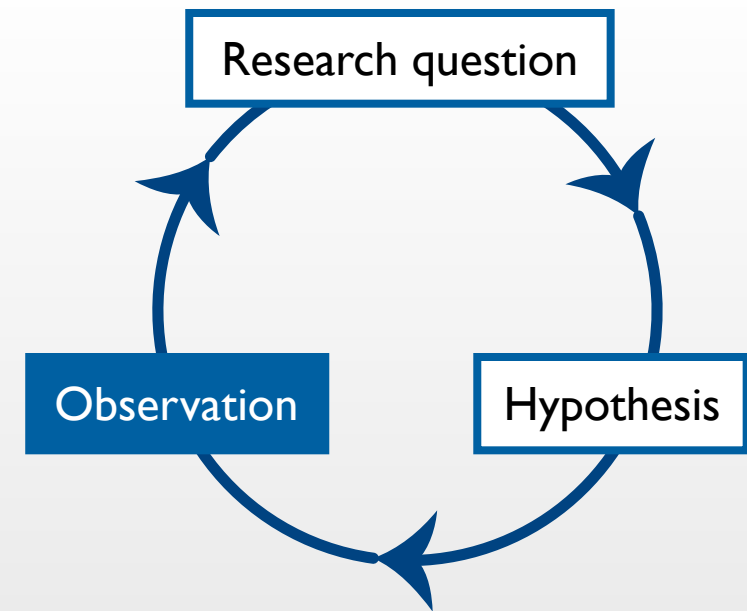
Research question

Observation

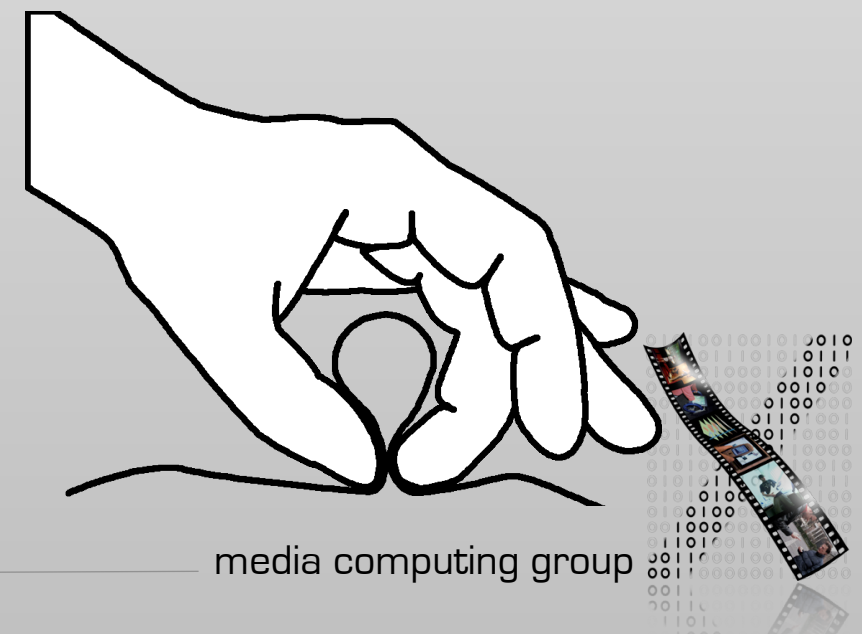
Hypothesis



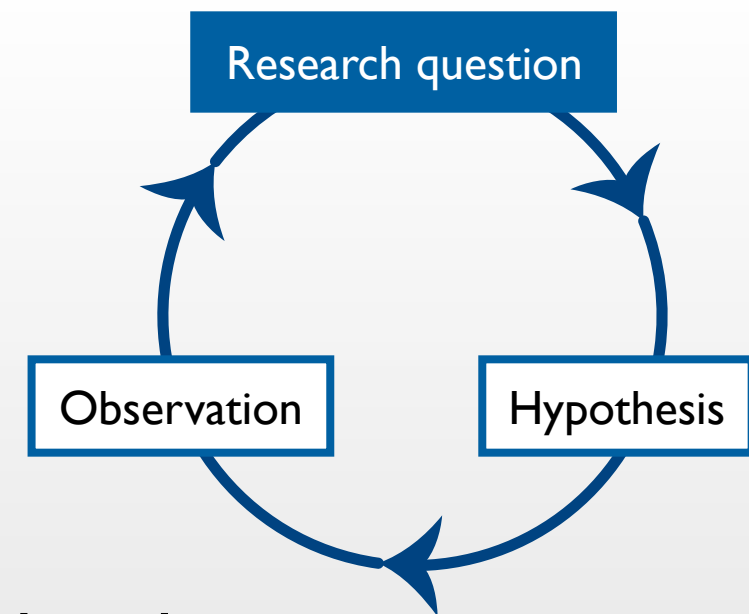
# Initial Observation



- 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?”



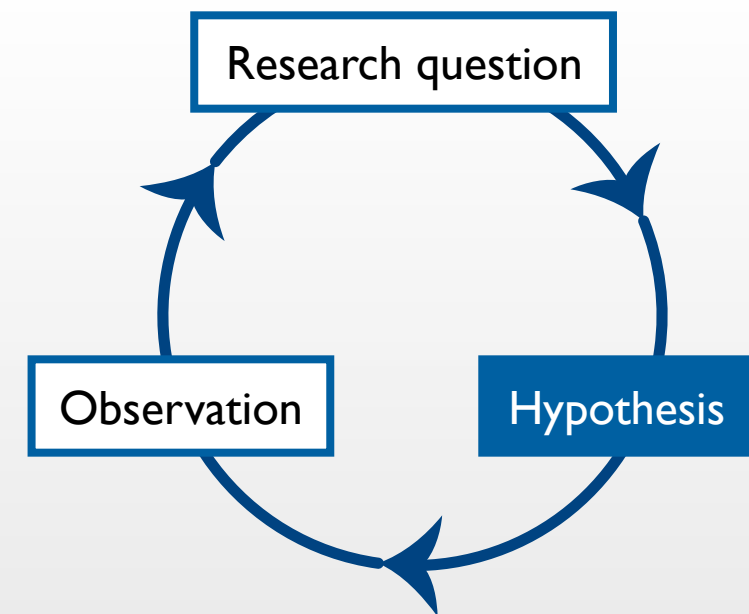
# Research Question



- 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



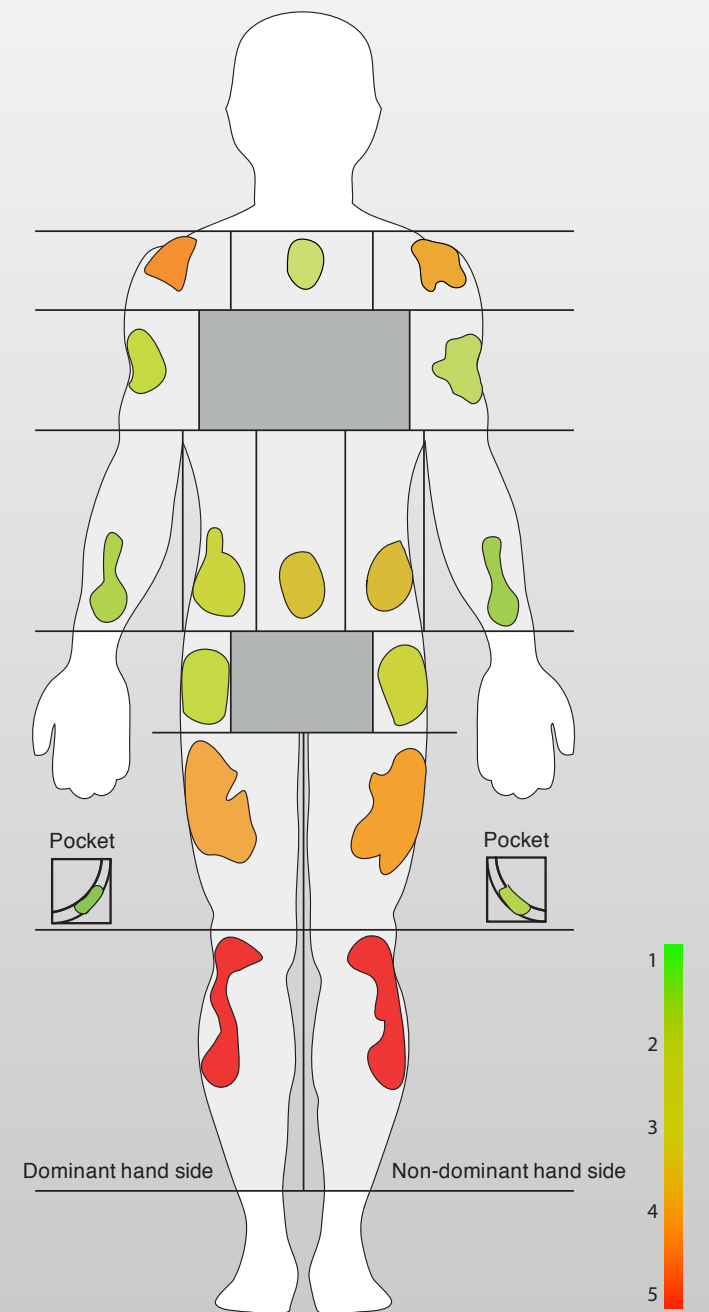
- **Concrete and testable** statements derived from the research question
- **Operational definition:** a specific set of operations for measuring external, observable behavior
- In-class exercise: try giving an operational definition for the variables highlighted below
  - “There would be a difference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



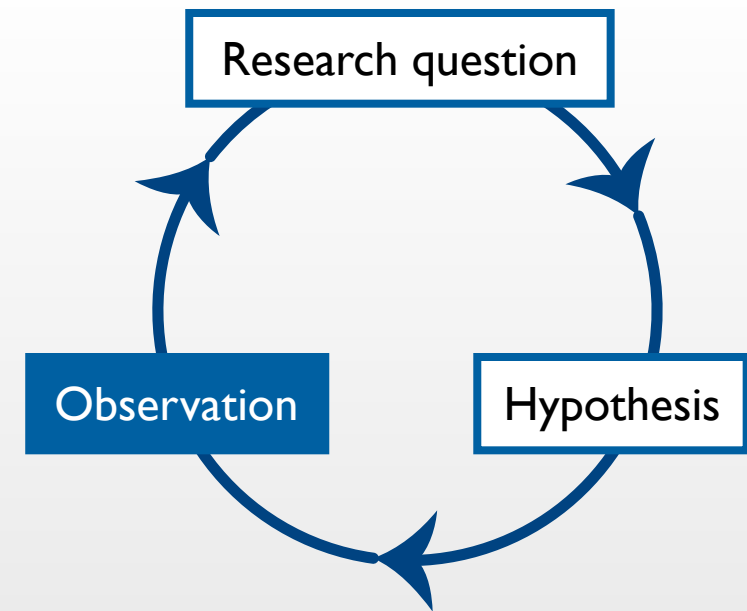


# Research Example: Pinstripe

- 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



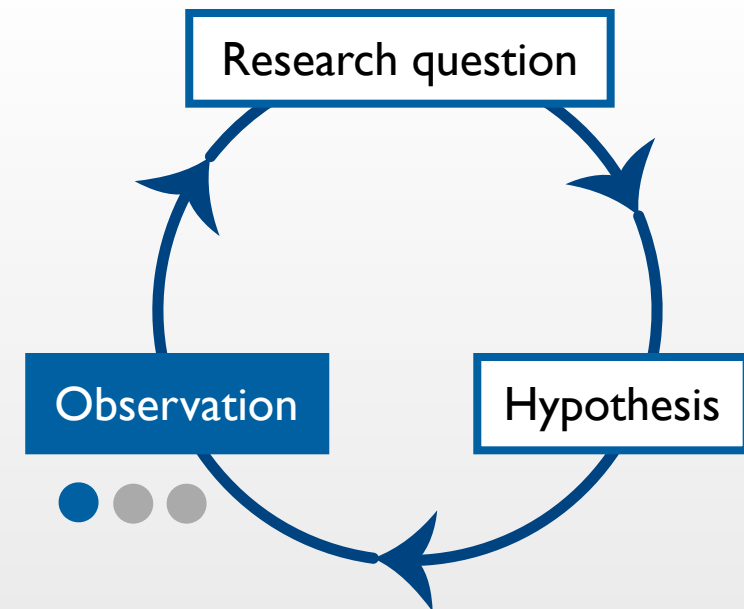
# Planned Observation



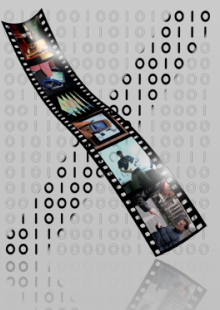
- Collect data to support, refute, or refine the original hypothesis
- Three strategies
  - **Descriptive research:** X happens  
Focus on the current state of each **individual** variable
  - **Relational research:** X and Y happen together  
Measure **two or more variables** that **exist naturally** 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  $\Rightarrow$  75 clips  $\Rightarrow$  37 detailed transcriptions
  - Analyzed the data to find common patterns/themes and construct theories that explain them





# **Figure 1: Following GPS instructions**

**While the driver 'follows' what the GPS recommends the driver still needs skill to read what the GPS says and even to ignore GPS instructions.**

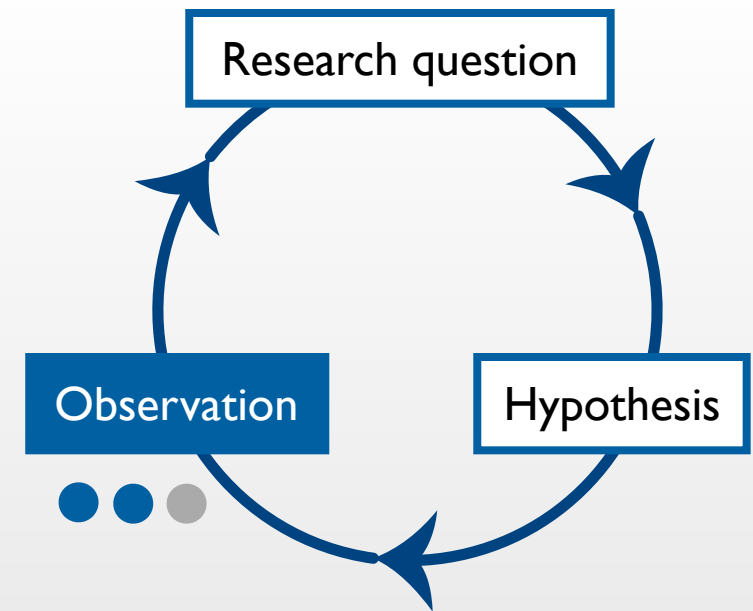


# Natural Troubles of Driving with GPS

- 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



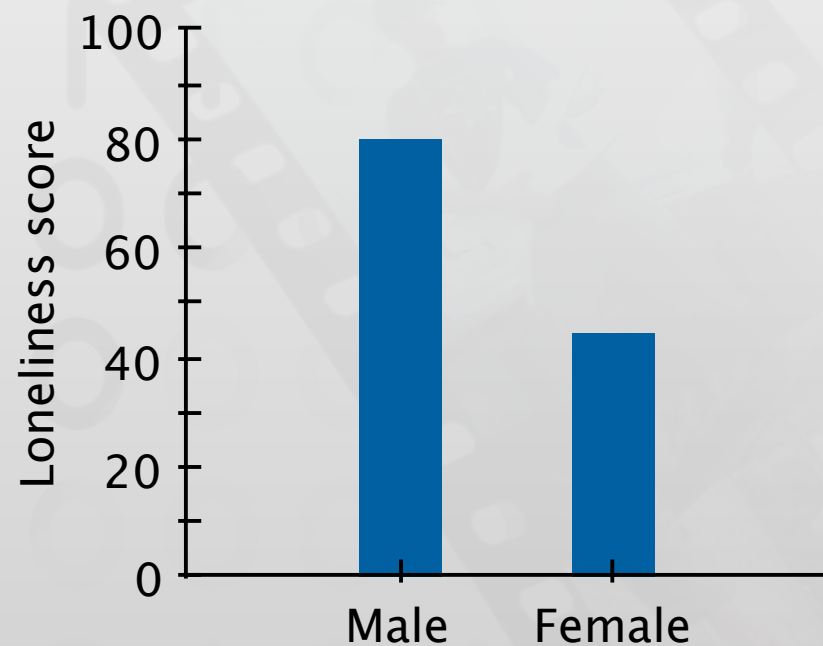
# Research Example: Social Network Activity and Social Well-Being



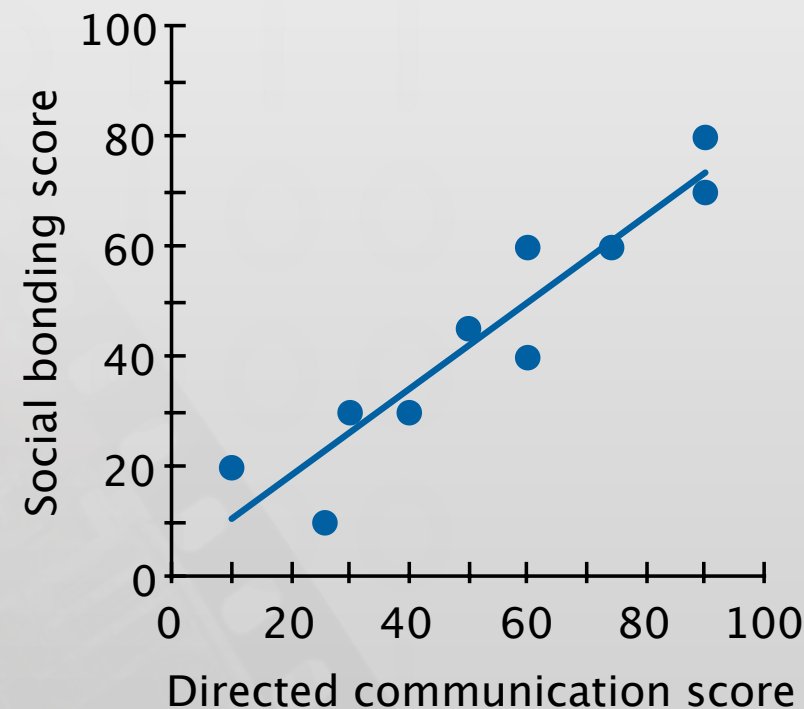
- Burke (CMU), Marlow, and Lento (Facebook), Best paper CHI '10
  - “An empirical analysis of the **relationship** between **direct** and **passive communication** on Facebook and social well-being, including loneliness, bridging, and bonding social capital.”
- Survey in Likert scale (N=**1193**)
- Analyze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



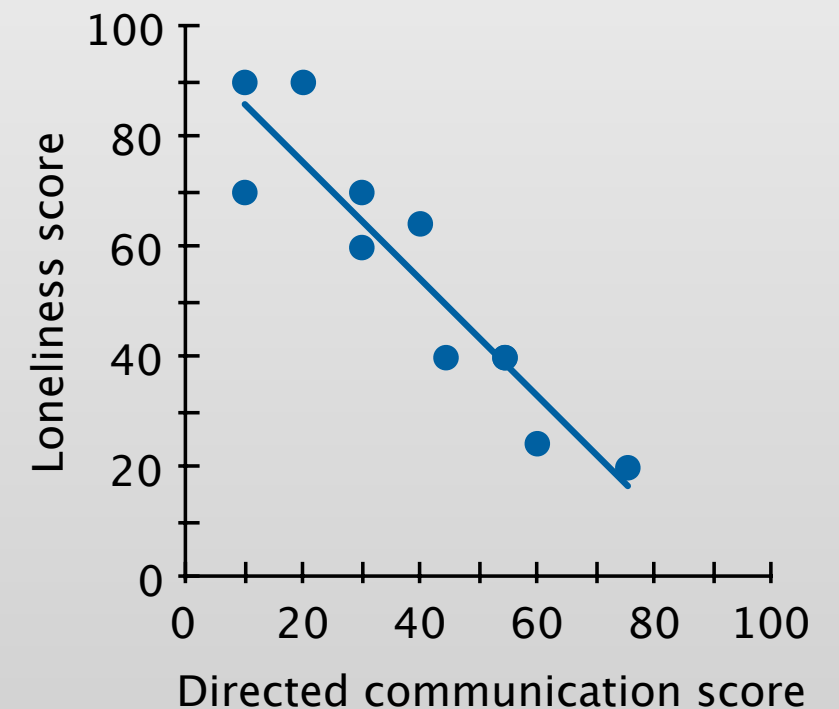
# Patterns in the Relationship between Variables



General relationship

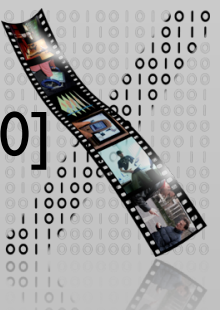


Positive relationship

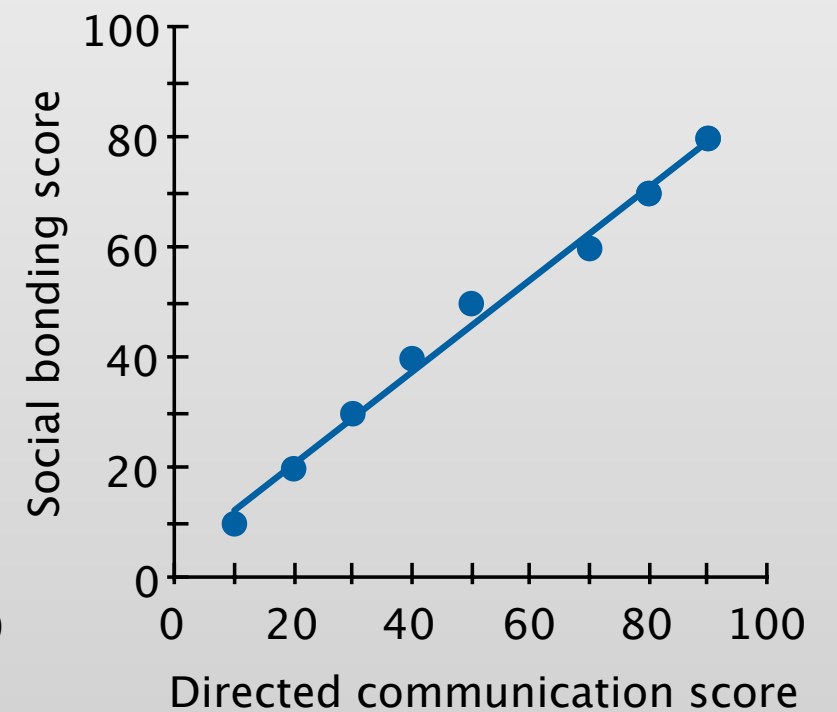
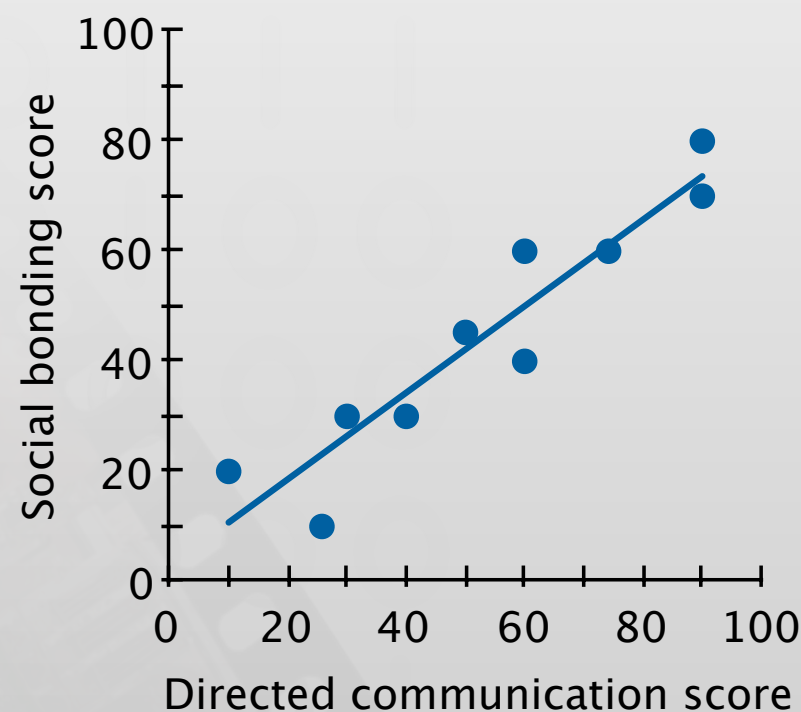
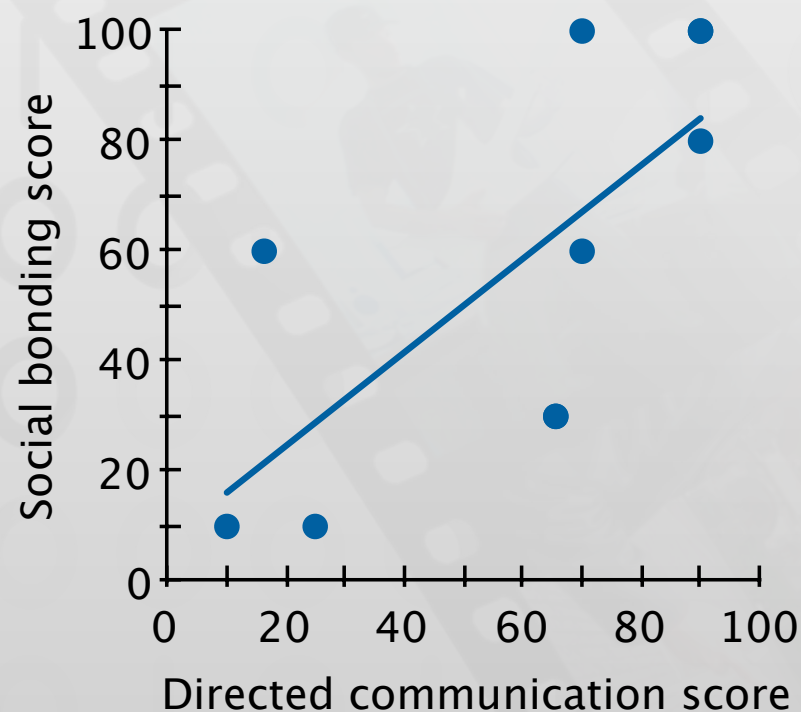


Negative relationship

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



# Strength of the Relationship between Variables



Weak



Strong

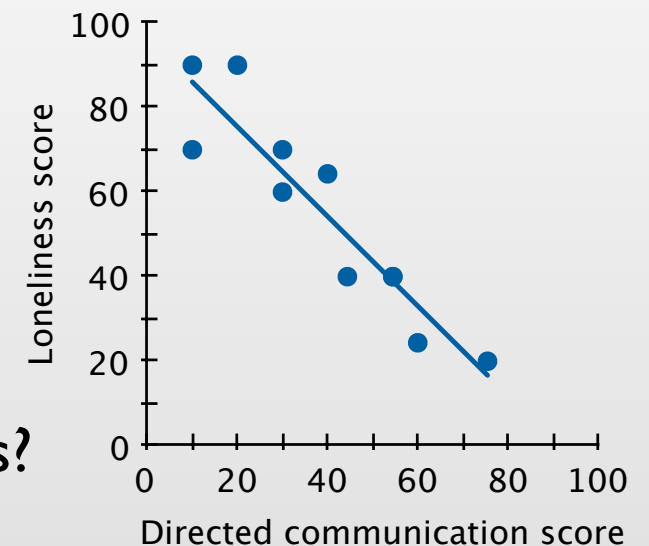
Simulated data for instructional purpose



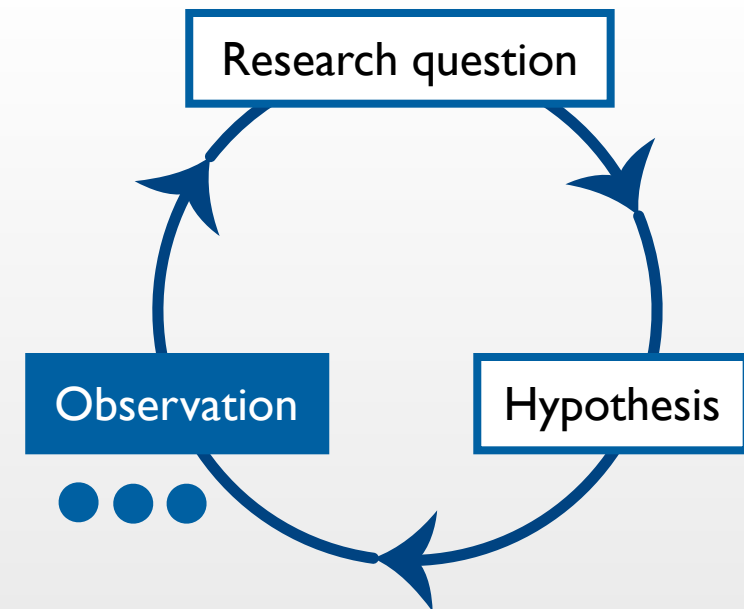


# Limitations of Relational Research

- 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

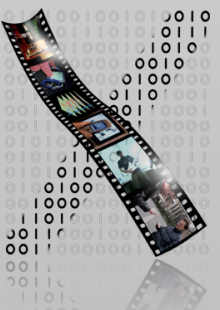


# Experimental Research



- 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

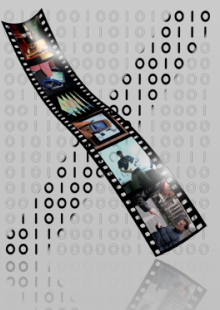
Lecture with Jan on 14.04.15 ended here and Nur completed the slide set during the lab on 16.04.15

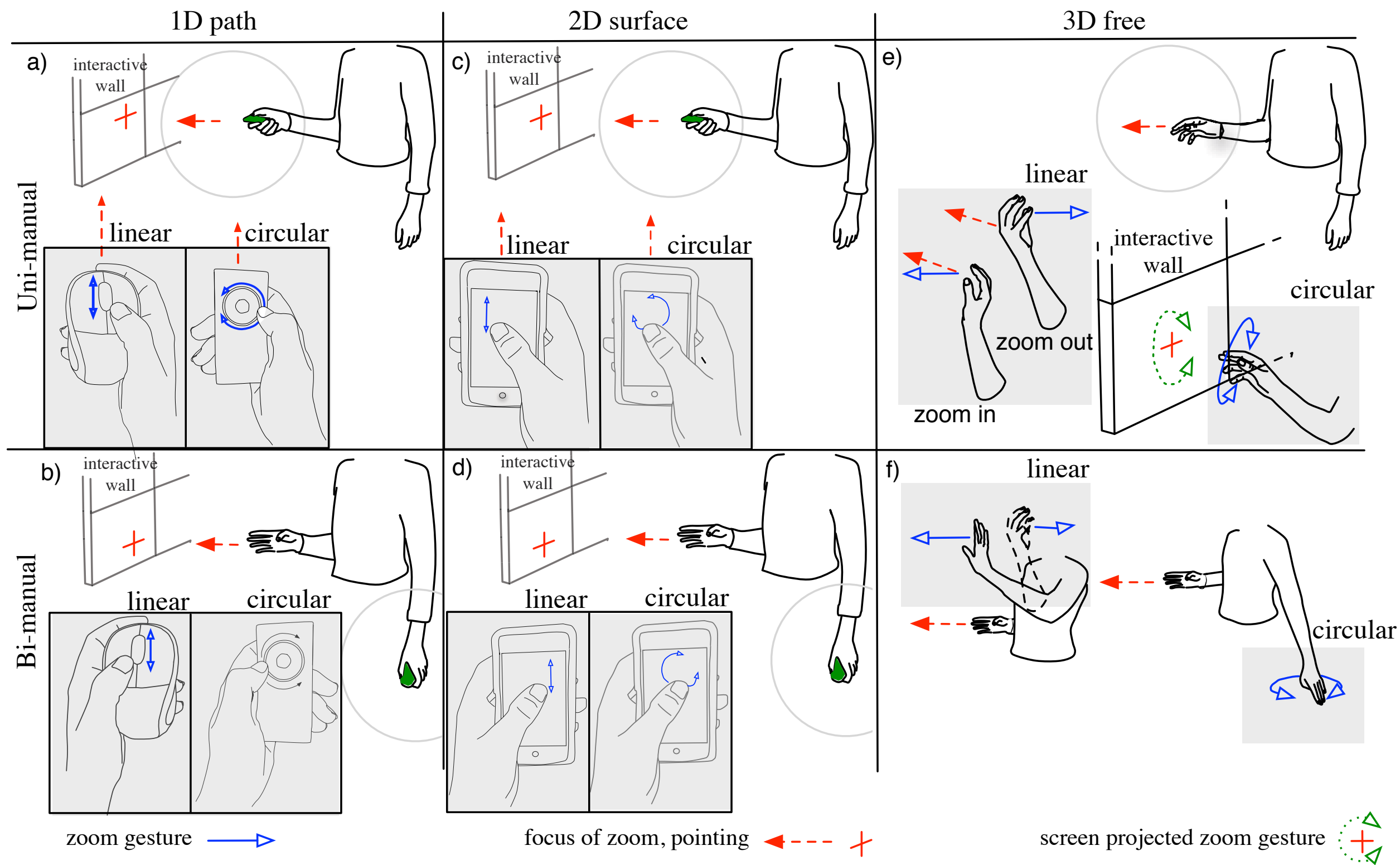


# Research Example: Mid-air Pan-and-Zoom on Wall-sized Displays



- 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.”







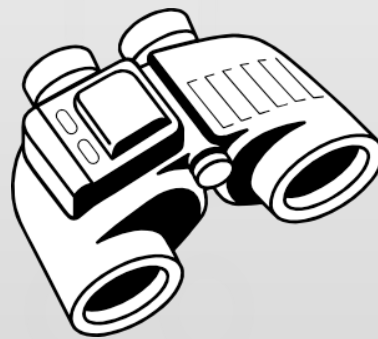


# Three Approaches to HCI Research



Test

Empirical science



Look

Ethnography

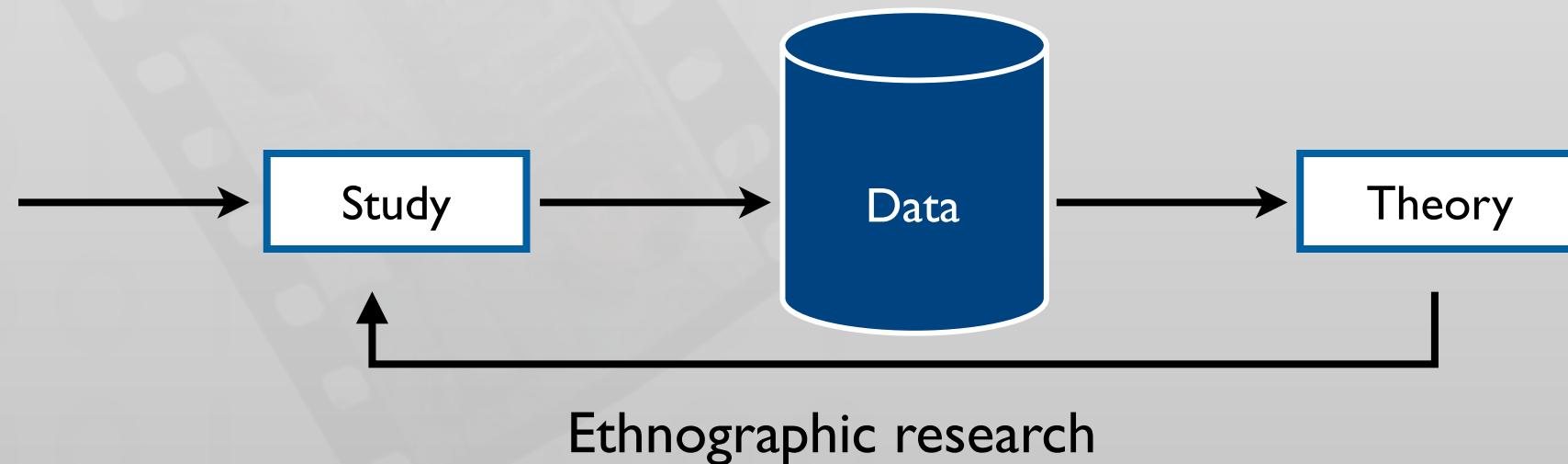
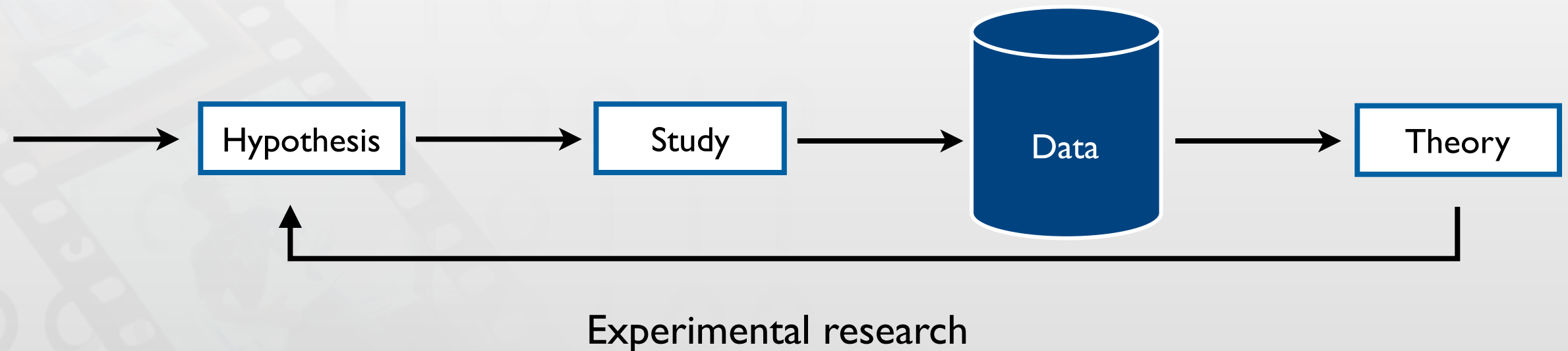
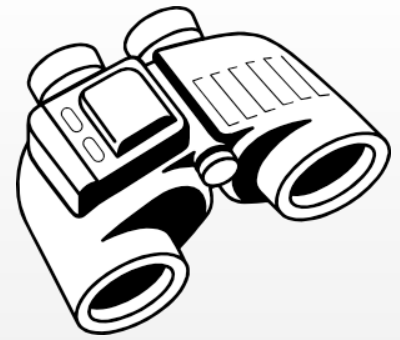


Make

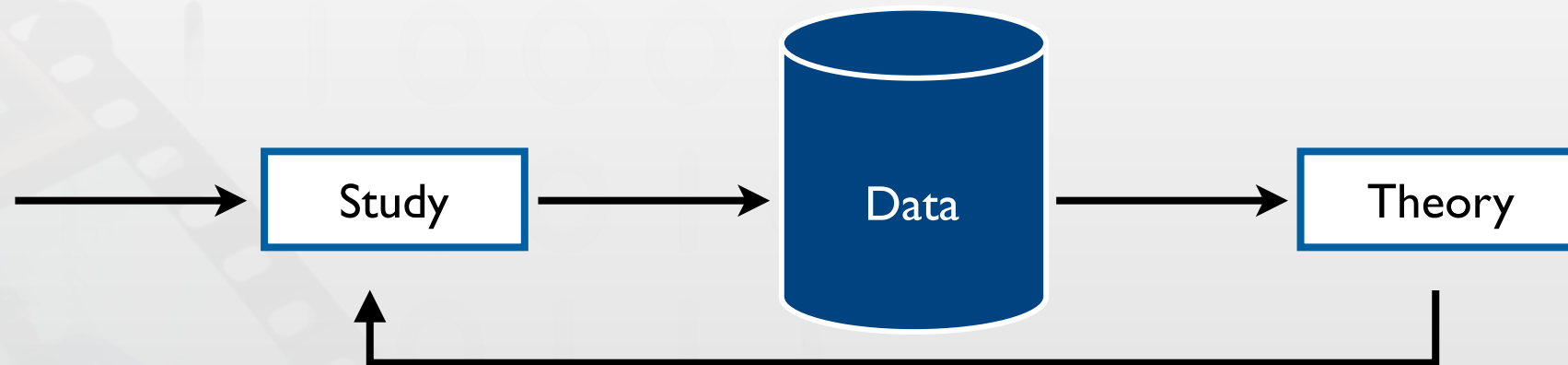
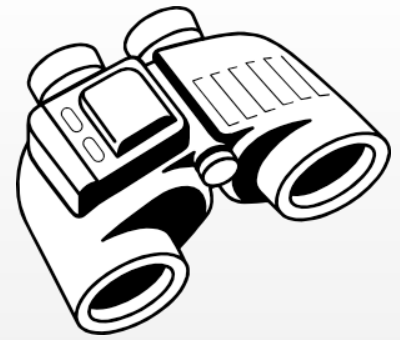
Engineering  
and design



# Ethnography



# Ethnography

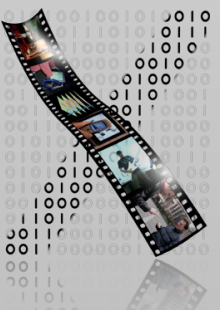


- Collect the data
- Code the data and find patterns that occur in the data
- Create theories that explain the data
- Try to attack the theories by gathering more data
  - Leads to stronger theories



# 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

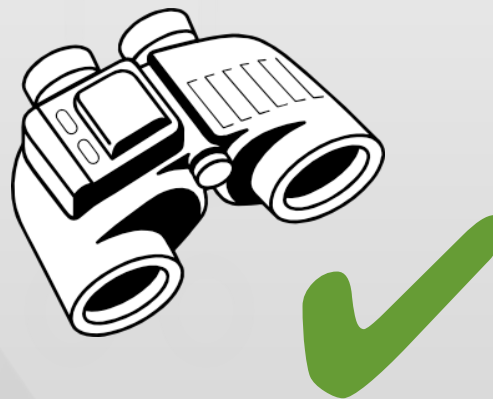


# Three Approaches to HCI Research



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Empirical science



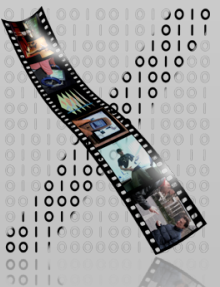
Look

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.”



# Skinput: Appropriating the Body as an Input Surface

---

Chris Harrison

chris.harrison@cs.cmu.edu

Desney Tan

desney@microsoft.com

Dan Morris

dan@microsoft.com

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Human-  
Computer  
Interaction  
Institute

Carnegie Mellon

**Microsoft**

Source

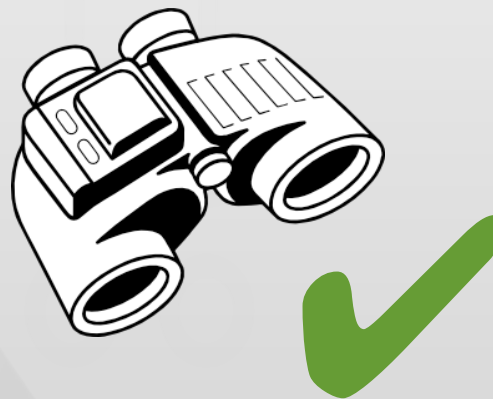


# Three Approaches to HCI Research



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Ethnography

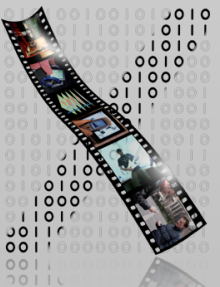
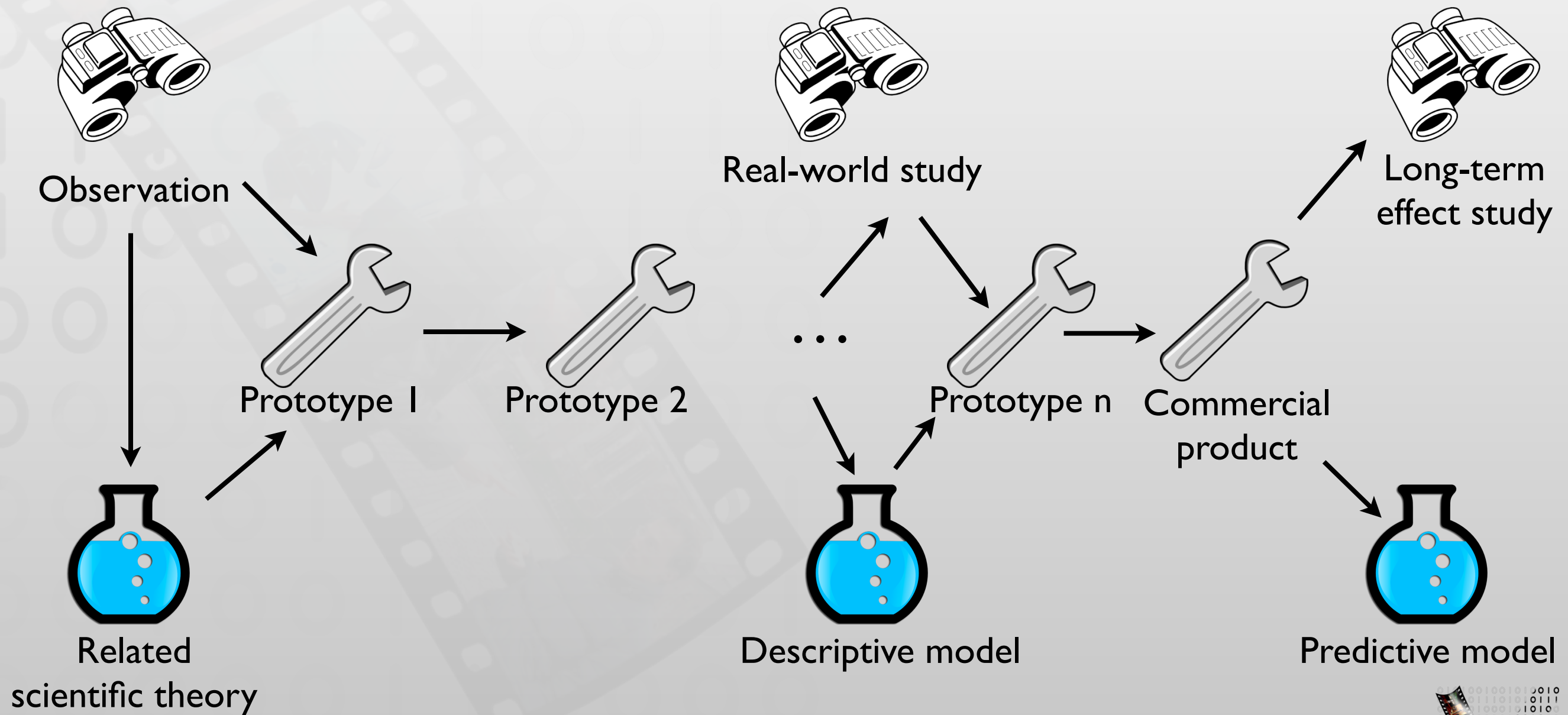


Make

Engineering  
and design



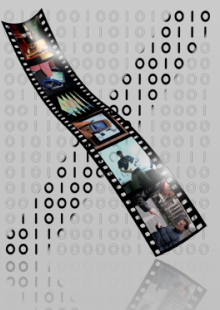
# The Messy Truth



# Closing Remarks: Design Meets Science

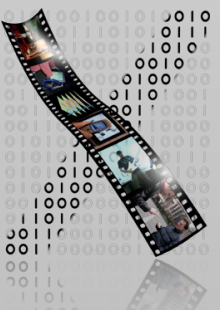
“This was my ideal model of how the supporting science could work. **It required good designers to actually do design**, but what we could do was help **structure the design space** so that the movement through that design space was much more rapid. The science didn’t design the mouse, but it **provided 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 by Friday!
- Read this paper today (definitely before the lab!):
  - [Seven Research Contribution Types in Human–Computer Interaction](#)  
— Jacob Wobbrock, 2014
- Come to the lab this Thu, April 16th!
  - Literature searching and reading techniques
  - Help with CAMPUS/L2P problems
- Read this paper before the 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)





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