

# Current Topics in Media Computing and HCI

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

Summer term 2016

<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 2016

- 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)
  - Interactive Textiles
  - Augmented reality in HCI
  - Personal fabrication and personal design
  - HCI design patterns
  - Interactive museum guide systems
  - Touch and tangibles on large interactive surfaces

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.Sc. 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 conference papers
  - CHI, UIST, ISS, DIS, Ubicomp,...
- Recent journal articles
  - TOCHI,...
- Older seminal papers



Heidelberg, Germany September 12-16

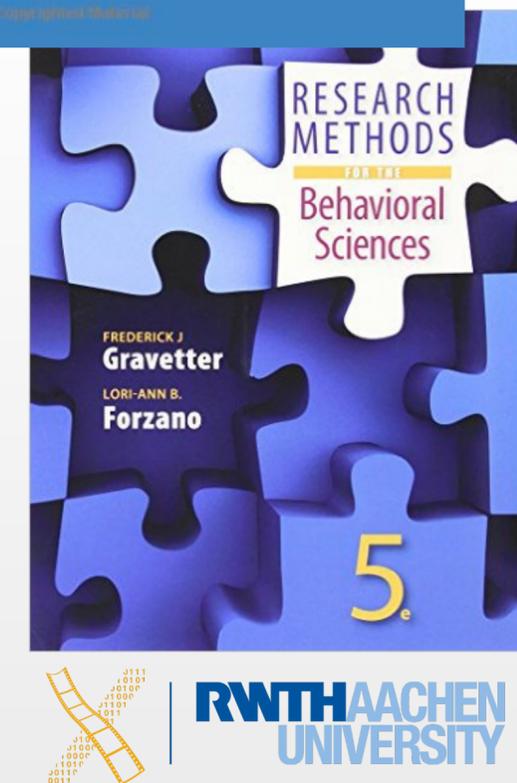
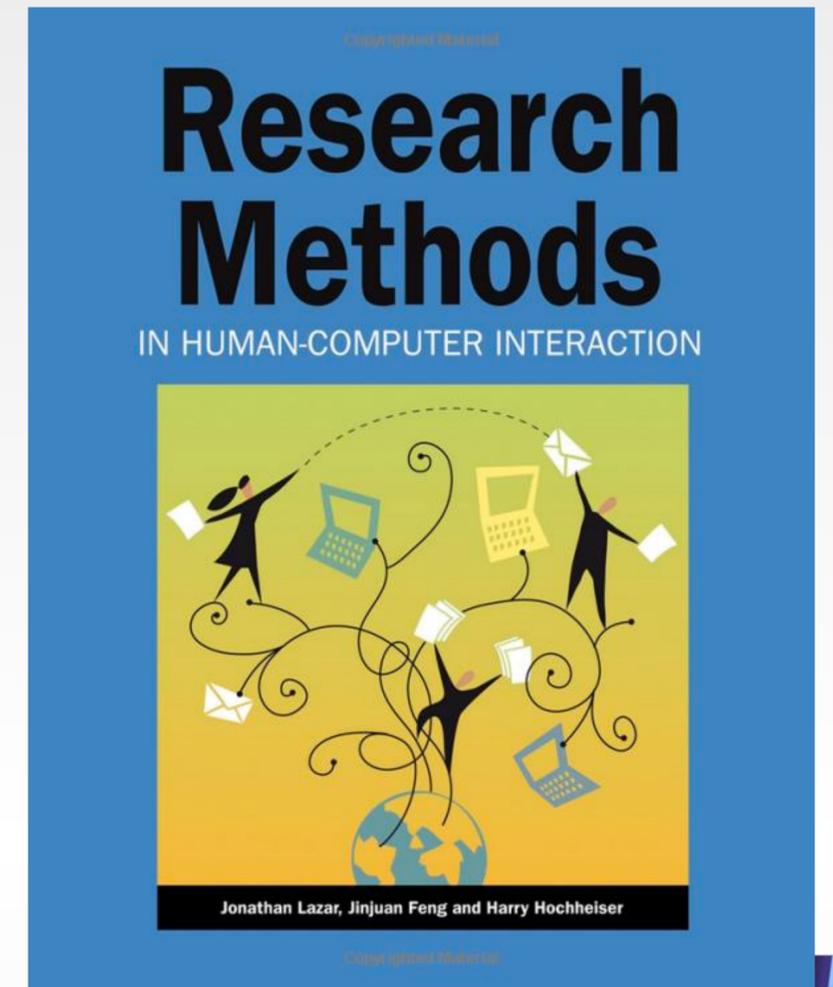
## UBICOMP 2016



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# Literature Sources

- Recent books
  - Research Methods in HCI (Lazar et al., 2010)
    - Highly **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, 2015)
    - Further **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: Wednesday, 14:15–15:45
  - Practice skills learned from the lecture and discuss reading and written assignments
  - 3 written assignments (in groups)
  - 1 mini HCI research project (in groups)

Active attendance in both  
lecture and lab expected!



# Final Grade

- 30% midterm (June 14)
- 15% 3 written assignments
- 10% mini HCI research project
- 45% final (August 2nd **or earlier**)

# Limited Seats

- **40 seats** available (but already >50 registrations)
- Register in CAMPUS or email Phil for registration **today**
- Priority will be given based on:
  - Semester
  - Prior involvement with classes at this chair
  - Handing in the declaration of compliance tomorrow in the lab
- You will know if you're in by tomorrow after the lab
- First assignment in the first lab (tomorrow)



# CTHCI 2016 Plan

Lecture date	Lecture topic	Lecture presenter	Lab date	Lab topic	Lab moderator	Written assignment	Assignment logistics					
							Release	Deadline for peer submission	Peer feedback deadline	Deadline for final submission	Written feedback	Discussion in the lab
12/04/16	(no lecture: Orientation)	–	13/04/16	(no lab: Orientation)	–	–						
19/04/16	R1: Three approaches to HCI research	Jan	20/04/16	Paper reading and identifying contribution types	Phil	A01: Categorizing research contributions and writing contribution statements	20/04/16					
26/04/16	R2: Mechanics of experimental research and how to write a user study protocol (Case study: Text-entry techniques)	Jan	27/04/16	Literature searching and contributions & benefit statement	Phil	(A01 peer feedback)		27/04/16				
03/05/16	(No Lecture: Student Representative Council Meetings)	–	04/05/16	Designing experimental user studies	Phil	A02: Reverse-engineering user study protocol	04/05/16		02/05/16	04/05/16		
10/05/16	R3: Understanding statistics in HCI research	Krishna	11/05/16	(No Lab: CHI)	–	(A02 peer feedback)		11/05/16			10/05/16	
17/05/16	(No Lecture: Excursion Week)	–	18/05/16	(No Lab: Excursion Week)	–				16/05/16	18/05/16		
24/05/16	T1: Interactive Textiles	Nur	25/05/16	• A01 discussion • Writing a review for research papers	Phil	A03: Writing reviews for scientific articles	25/05/16				24/05/16	25/05/16
31/05/16	T2: HCI Research in Augmented Reality	Phil	01/06/16	• A02 discussion	Phil	(A03 peer feedback)		01/06/16				01/06/16
07/06/16	T3: Personal Fabrication	Jan	08/06/16	• Midterm exam preparation lab	Phil	(Midterm exam preparation)			06/06/16	08/06/16		
14/06/16	Midterm: R1–3, T1–3 (30%)		15/06/16	• Midterm exam discussion (not review)	Phil	A04: Mini HCI research project: ?	15/06/16				14/06/16	
21/06/16	R4: Peer-review process in HCI T4-1: Pattern language	Jan	22/06/16	• A03 discussion • Mini project group appointments	Phil	A04 Part 1: Research question				22/06/16		22/06/16
28/06/16	T4-2: Pattern language • Course evaluation	Jan	29/06/16	(No Lab: RWTH Sports Day)	–	A04 Part 2: Experimental protocol		29/06/16				
05/07/16	T5: Interactive Museum Guide Systems	Phil	06/07/16	Mini project group appointments	Phil	(A04 continued)			05/07/16			
12/07/16	T6-1: Touch and Tangibles on Large Interactive Surfaces	Simon	13/07/16	Final exam preparation lab	Phil	(A04 continued)						
19/07/16	T6-2: Touch and Tangibles on Large Interactive Surfaces	Christian Ch.	20/07/16	Mini project final presentation	Phil	A04 Report				21/07/16		



# 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
- Philipp Wacker, M.Sc.
  - [wacker@cs.rwth-aachen.de](mailto:wacker@cs.rwth-aachen.de)  
(start subject with “[CTHCI]”)
- Additional 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:

[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

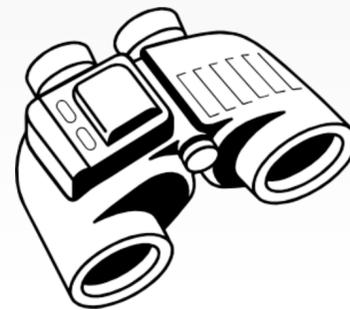
- Plagiarism will result in an immediate 5.0 for this class.
- Repeated plagiarism will also lead to banning from all other i10 classes.
- Sign the declaration of compliance and hand it in after the lab.

# Three Approaches to HCI Research



Test

Empirical science



Look

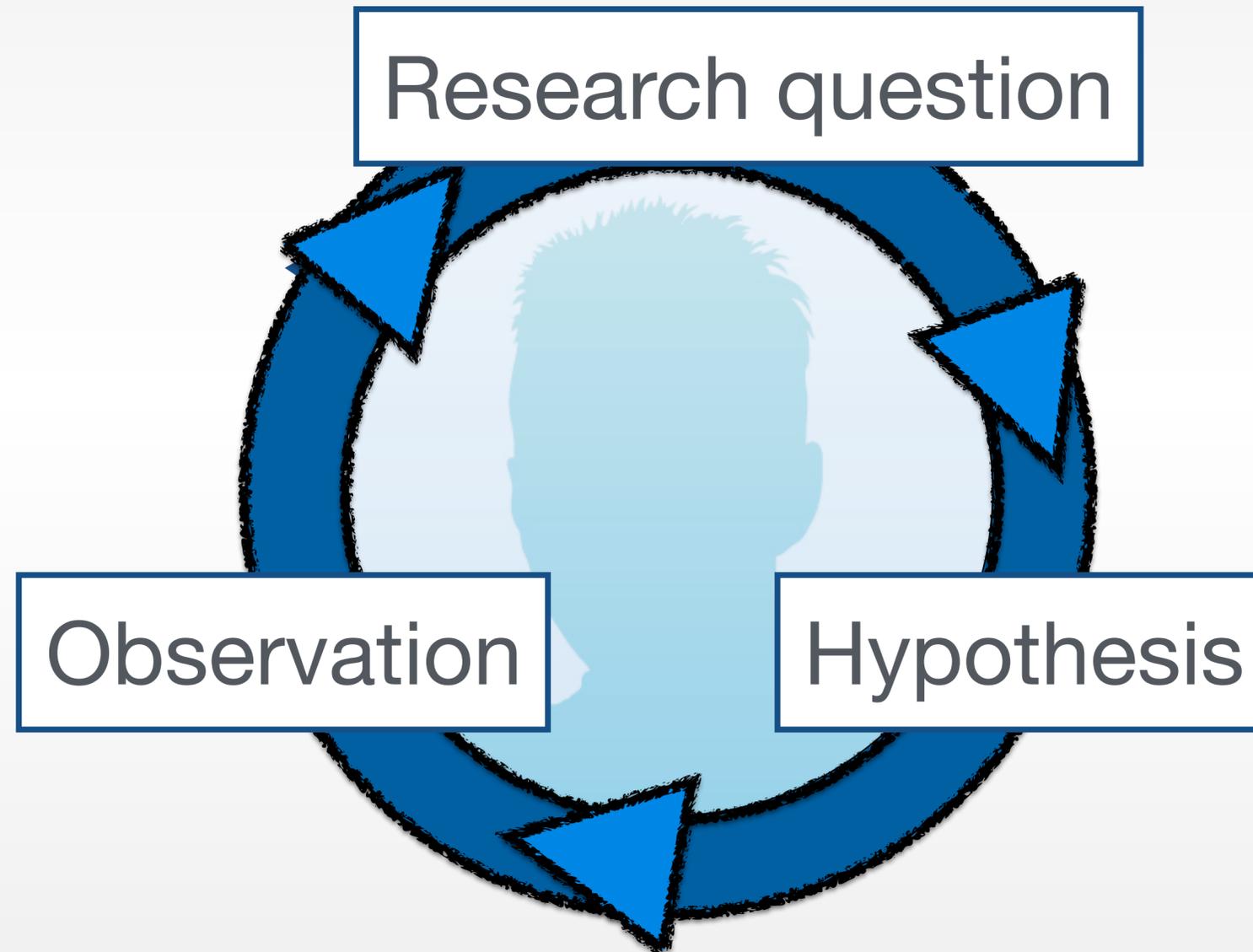
Ethnography



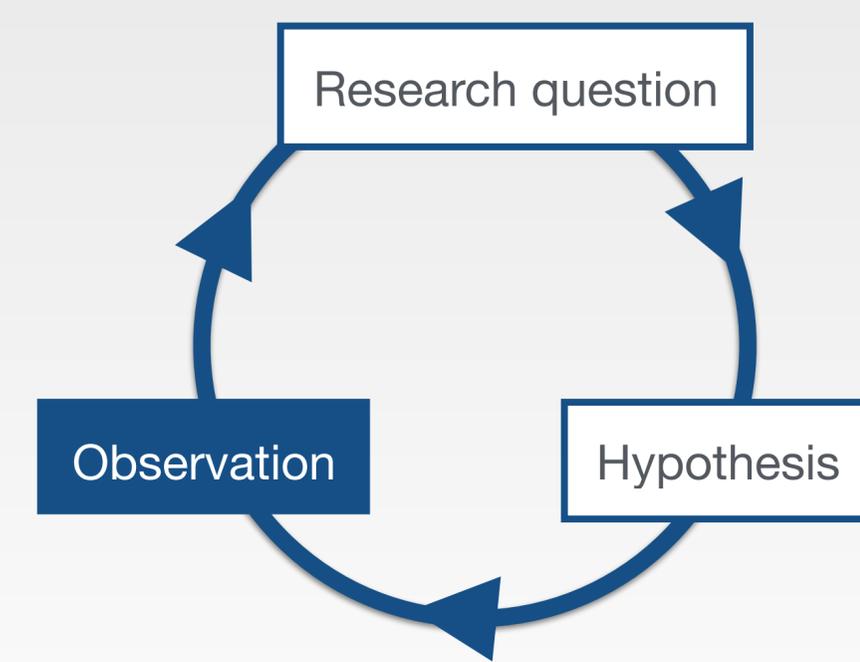
Make

Engineering  
and design

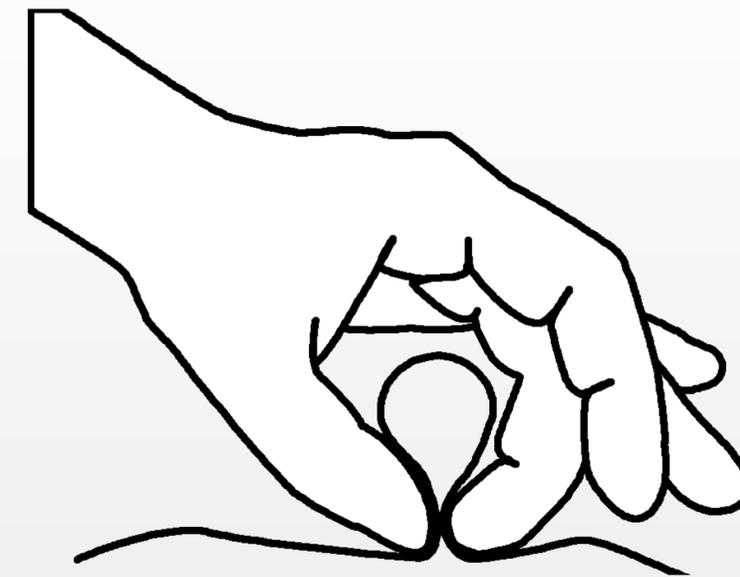
# Empirical Approach



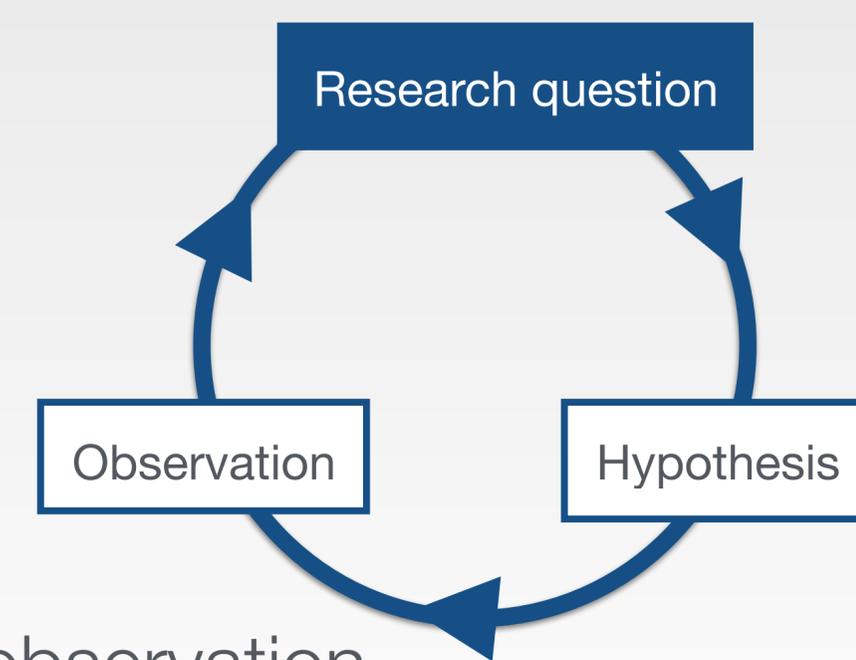
# Initial Observation



- 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?”

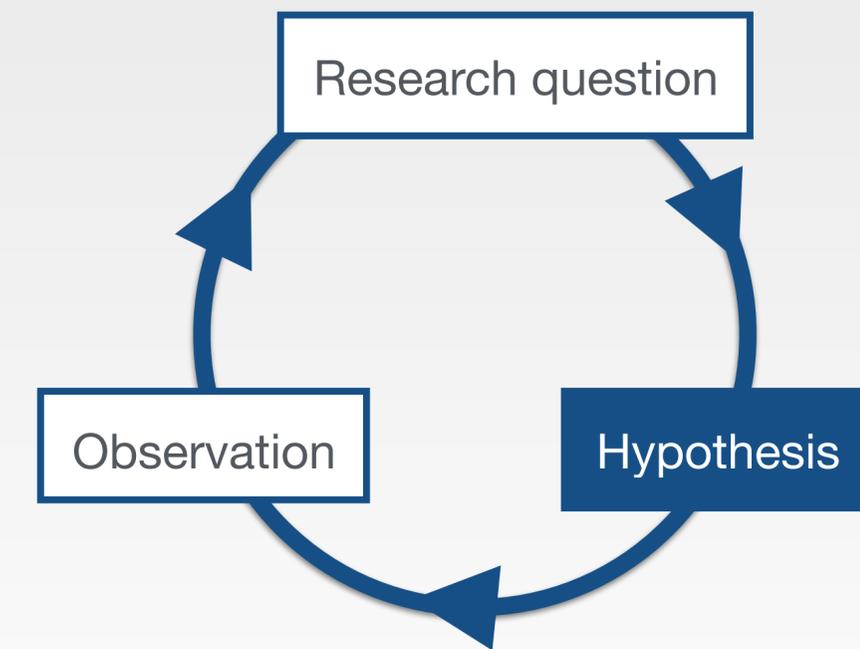


# Research Question



- 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**”

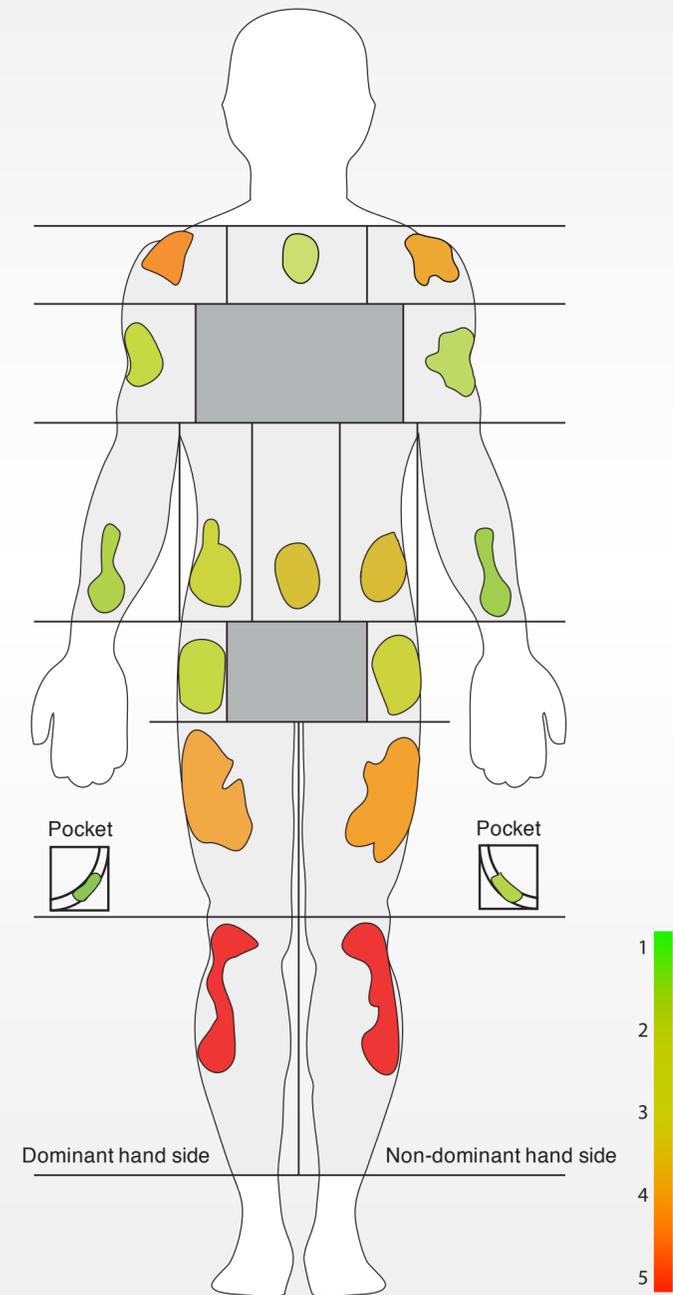
# Hypothesis



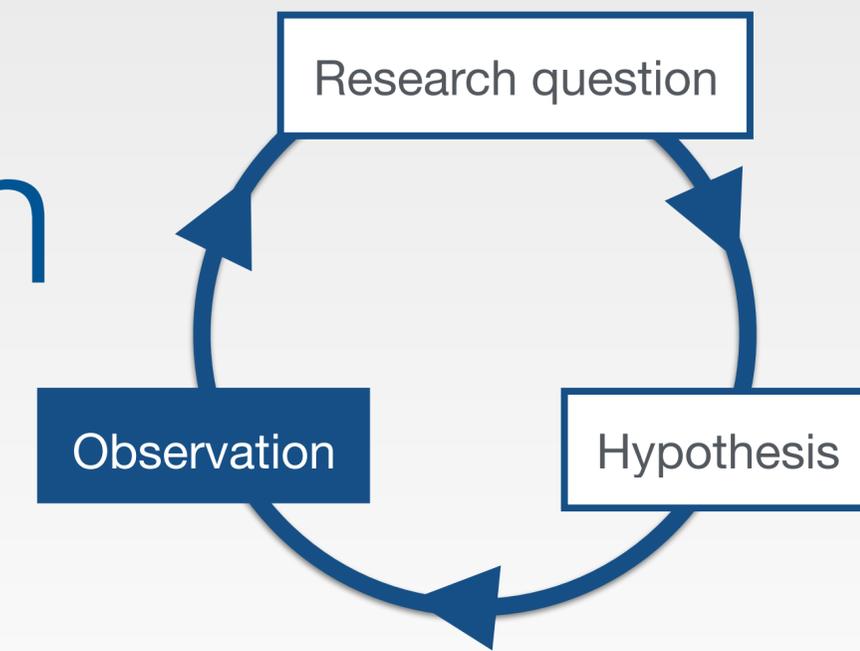
- Concrete and testable statements derived from the research question
- Operational definition: a specific set of operations for measuring external, observable behavior
- In-class exercise: try giving an operational definition for the variables highlighted below
  - “There would be a difference in user’s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

# Research Example: Pinstripe

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

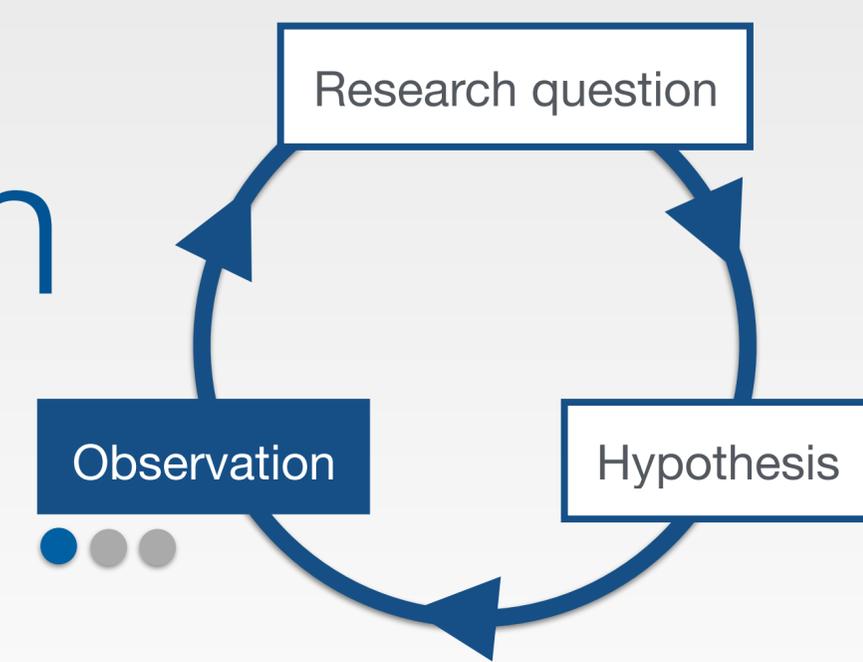


# Planned Observation



- 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.**

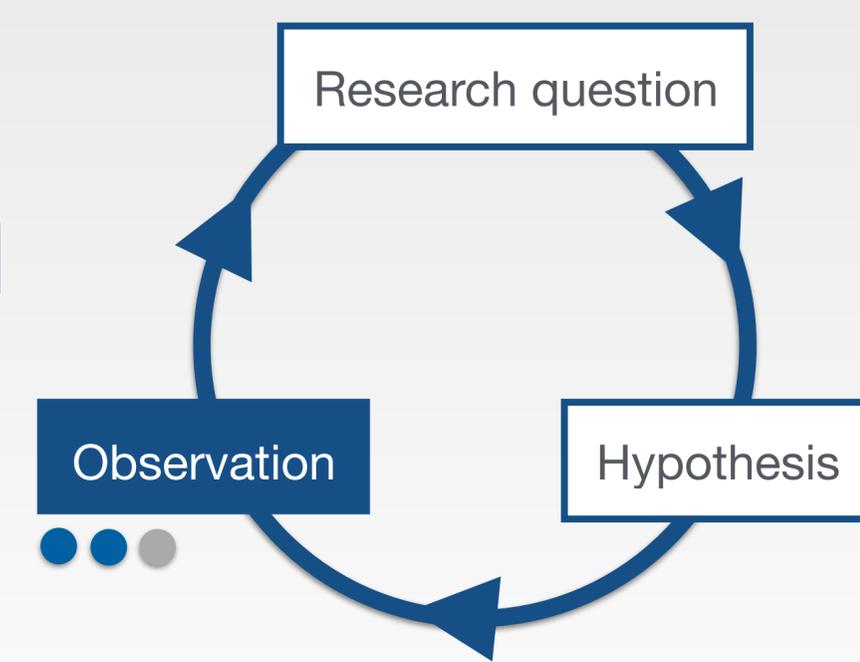
[Source](#)



# 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 “driver intelligence” into account
    - 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

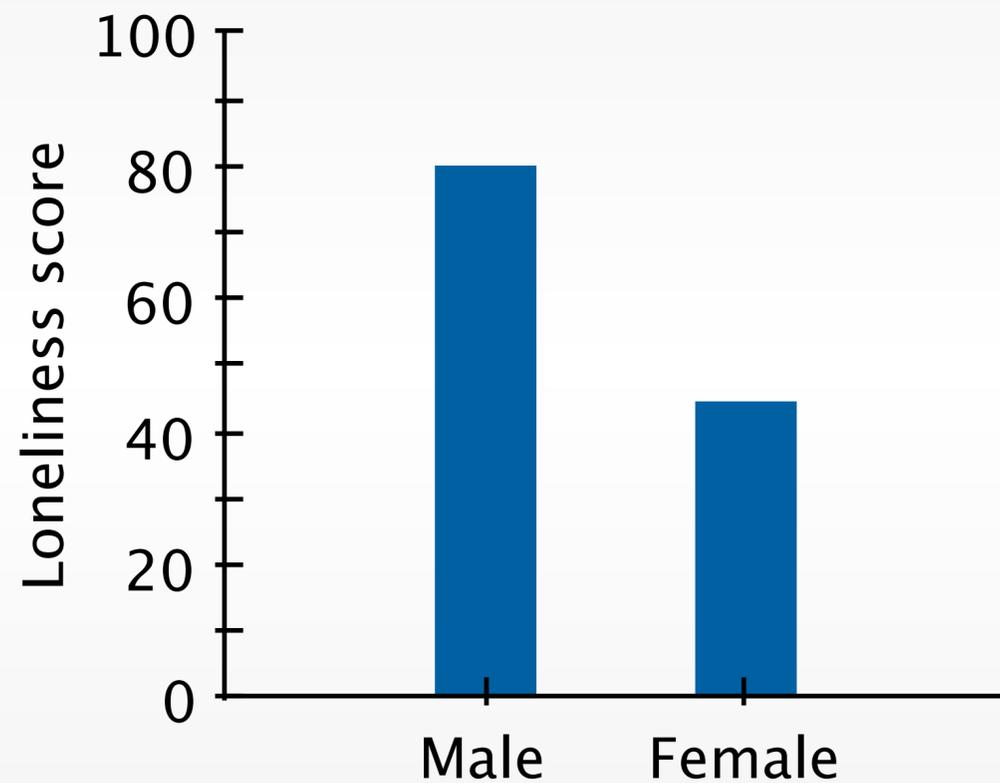


- Measure a set of variables for each participant
- Examine to identify **patterns** of relationship
  - Changes in one variable are consistently and predictably accompanied by changes in another variable
- Measure the **strength** of the relationship

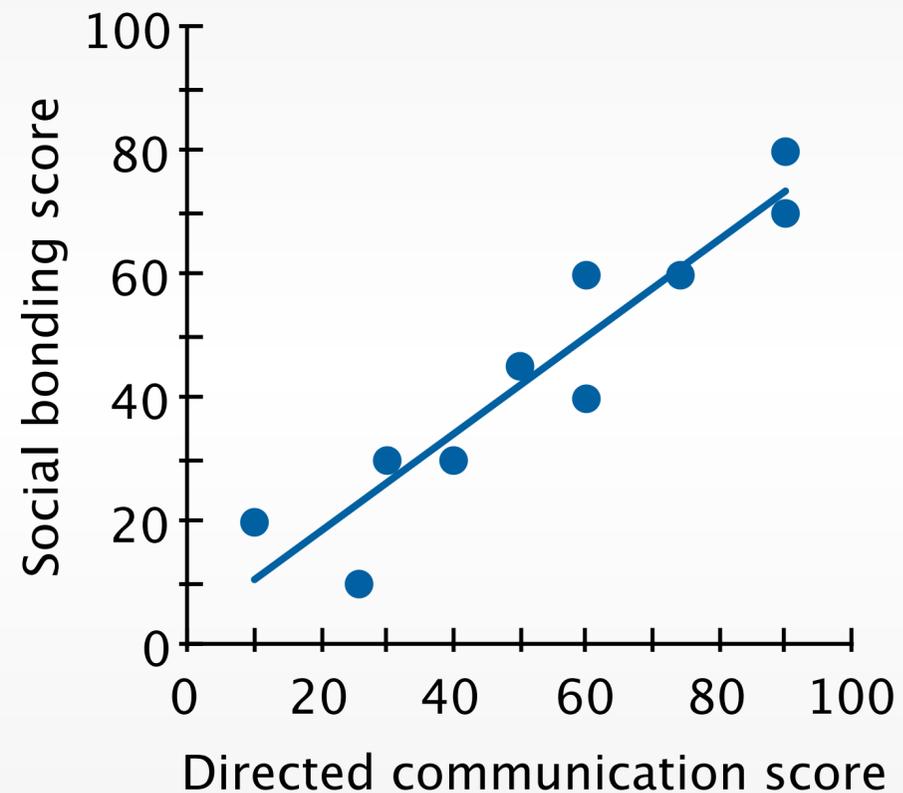
# Research Example: Social Network Activity and Social Well-Being

- 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

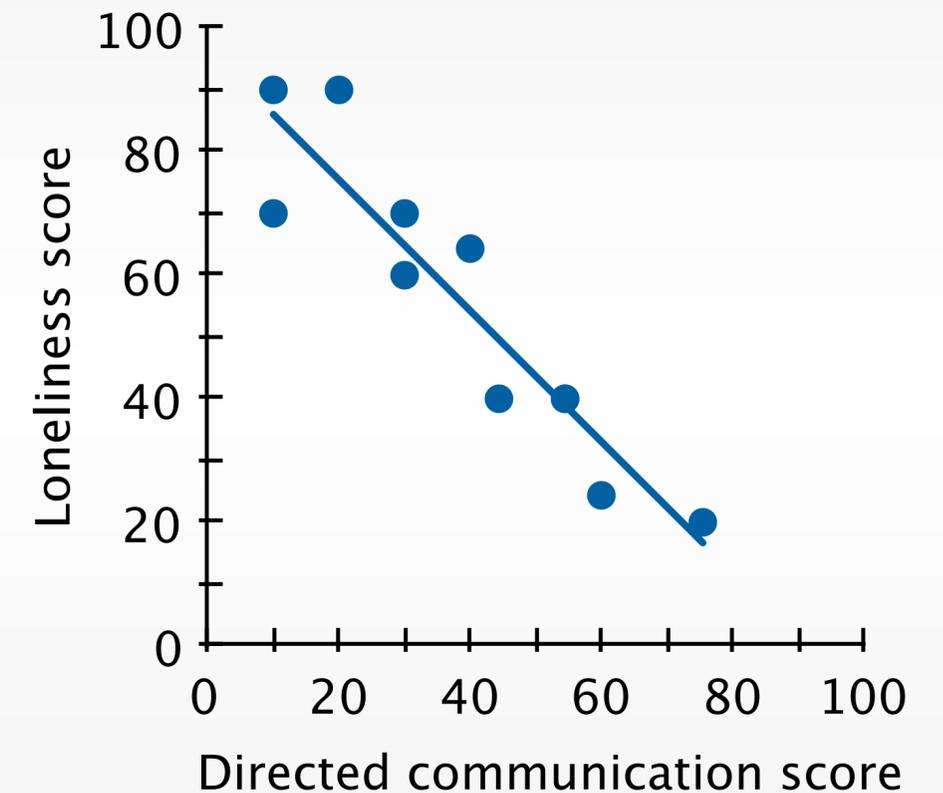
# Patterns in the Relationship between Variables



General relationship



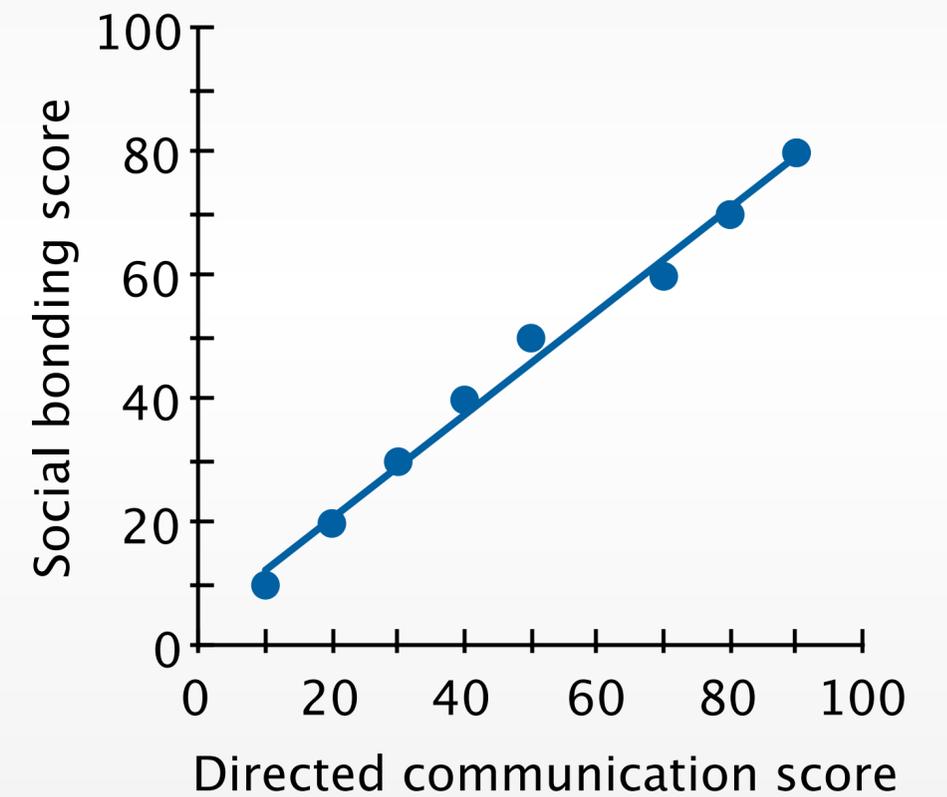
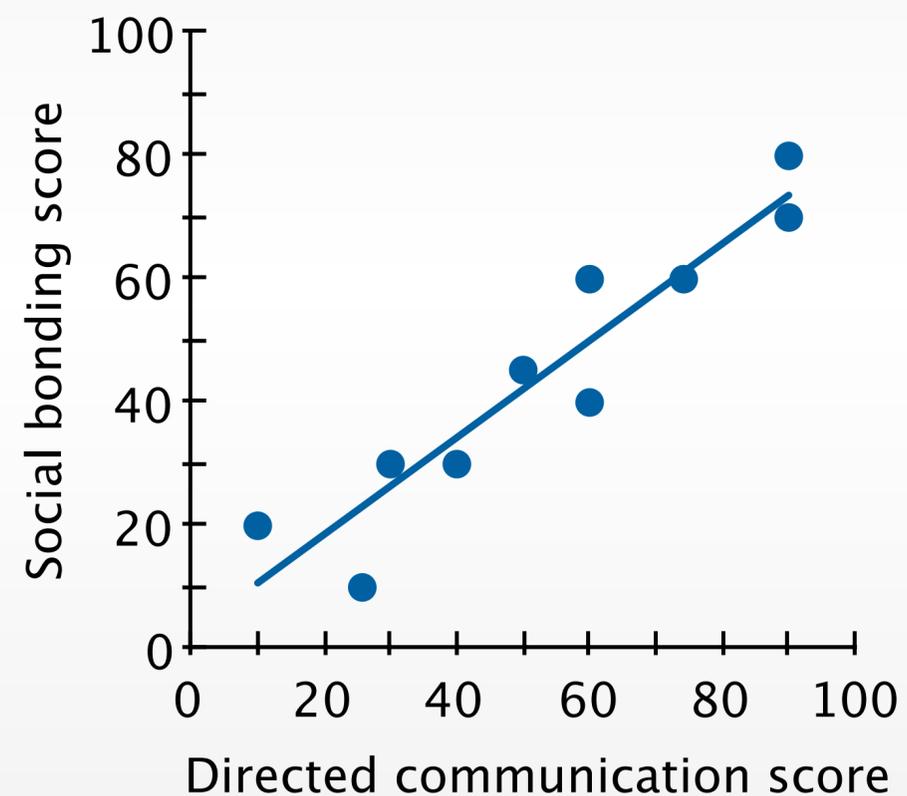
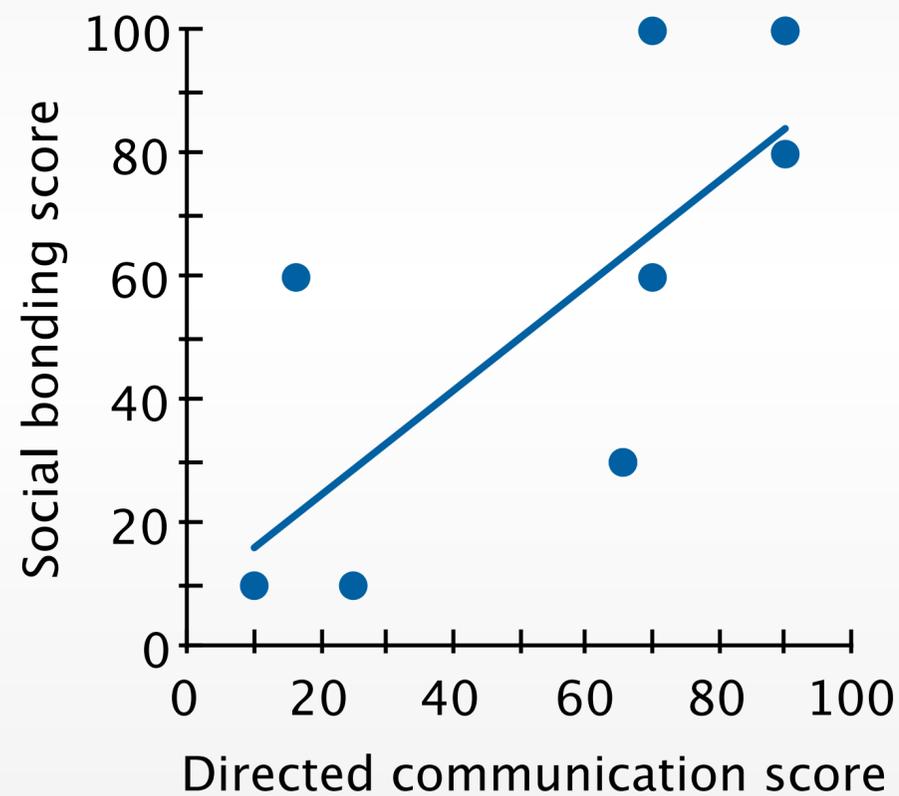
Positive relationship



Negative relationship

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

# Strength of the Relationship between Variables



Weak

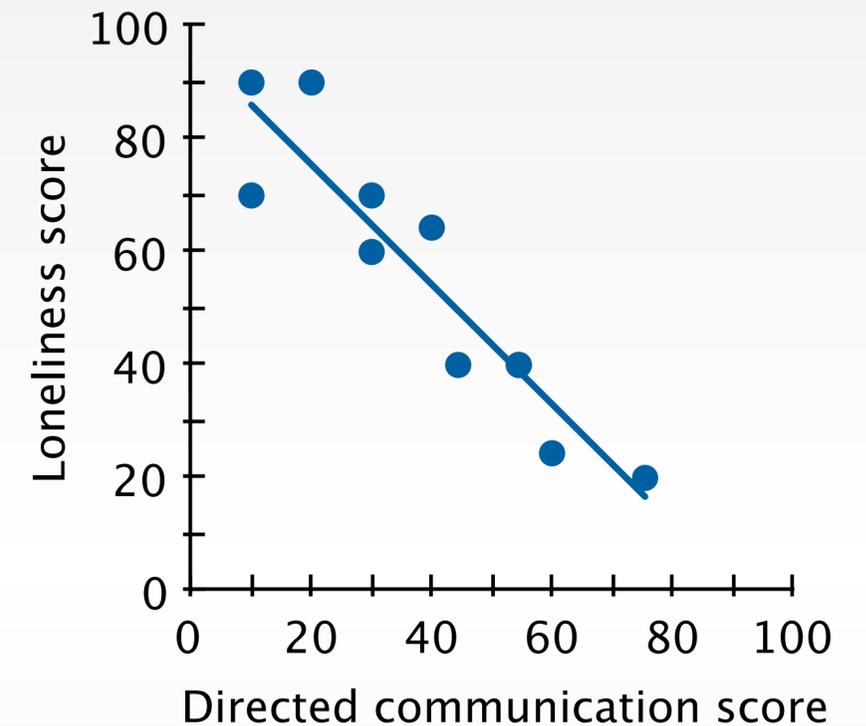


Strong

Simulated data for instructional purpose

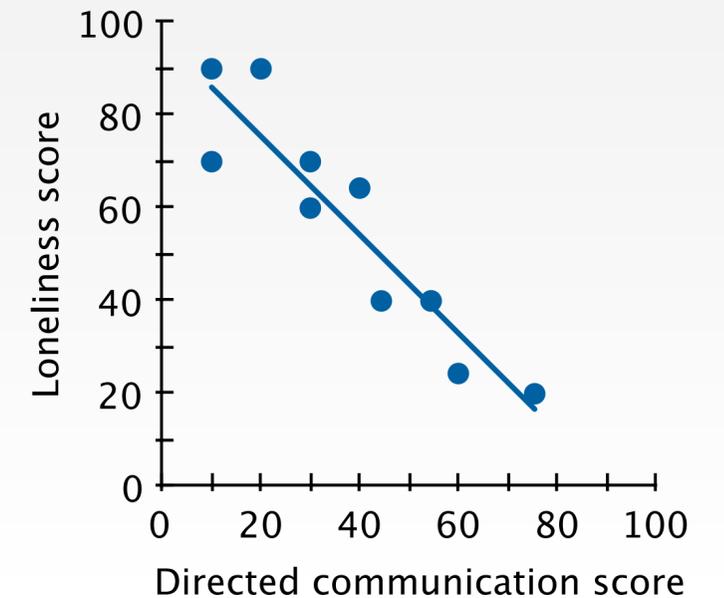
# Limitations of Relational Research

- 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

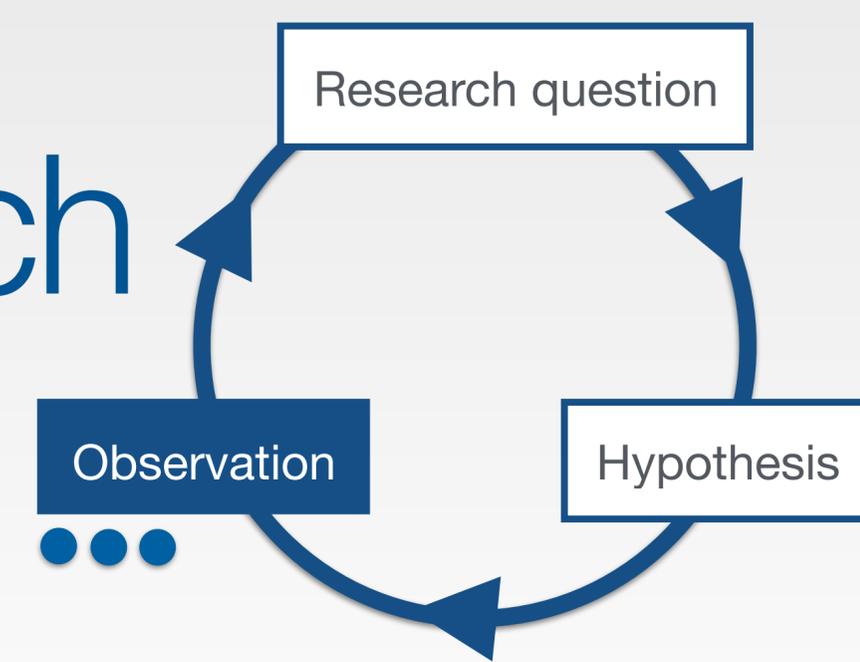


# Limitations of Relational Research

- **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



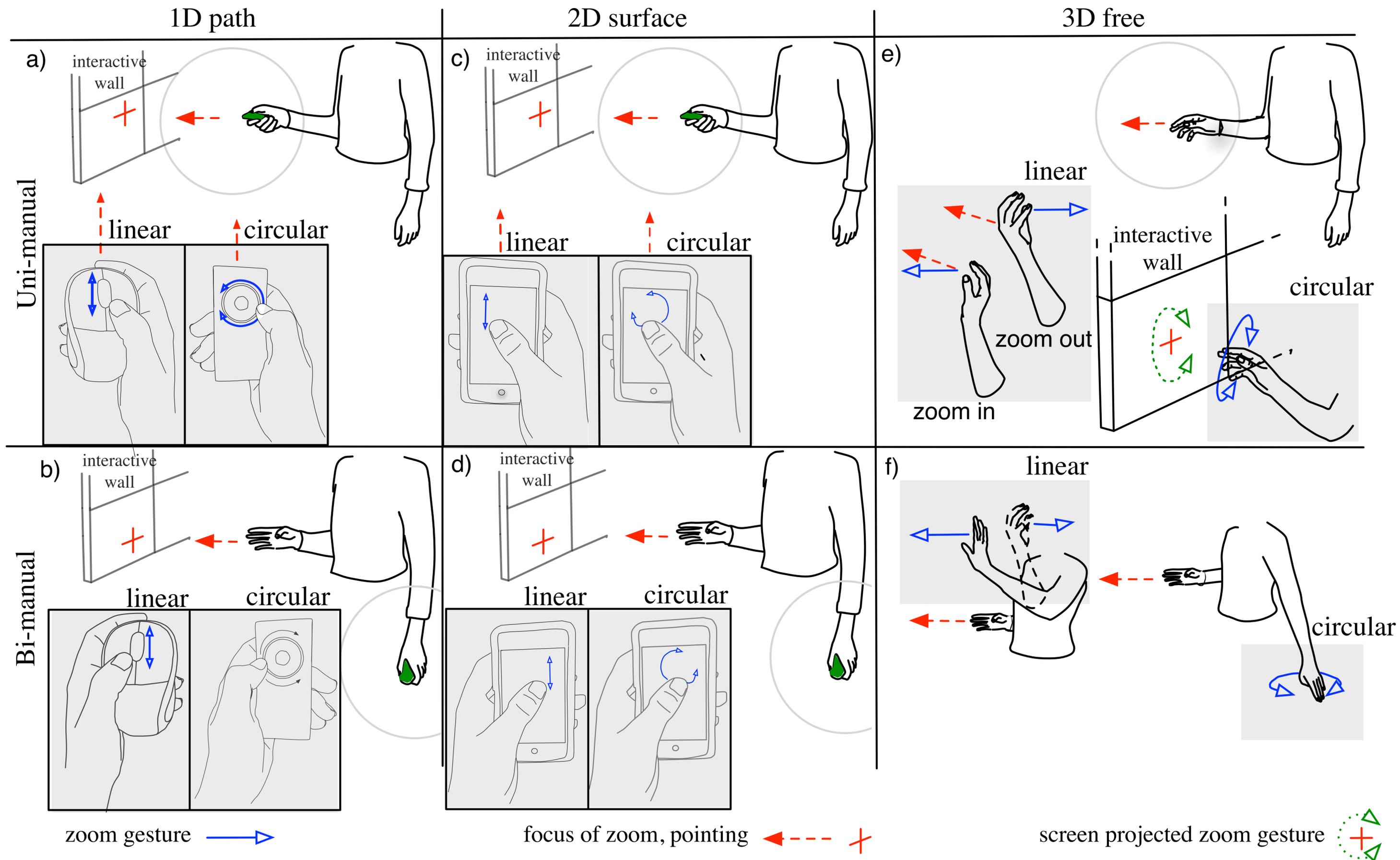
# Experimental Research



- 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.”



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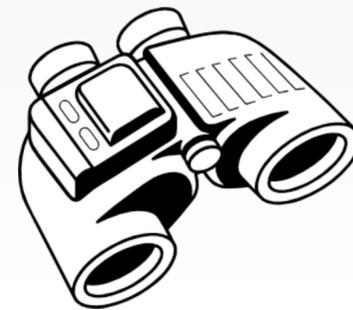


# Three Approaches to HCI Research



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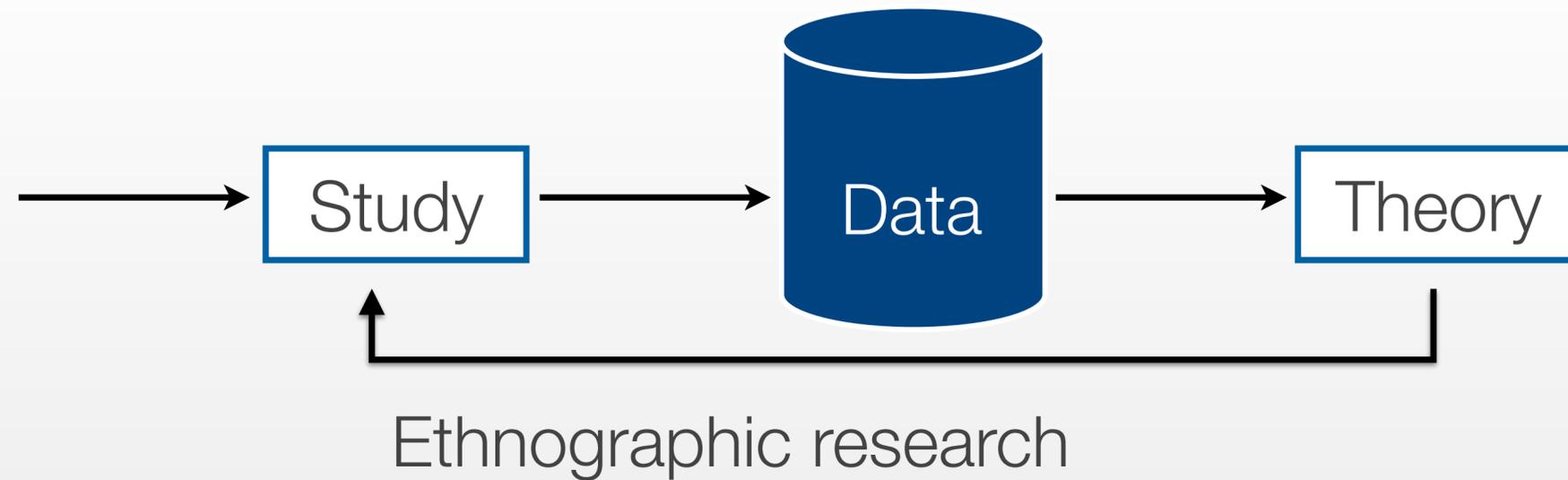
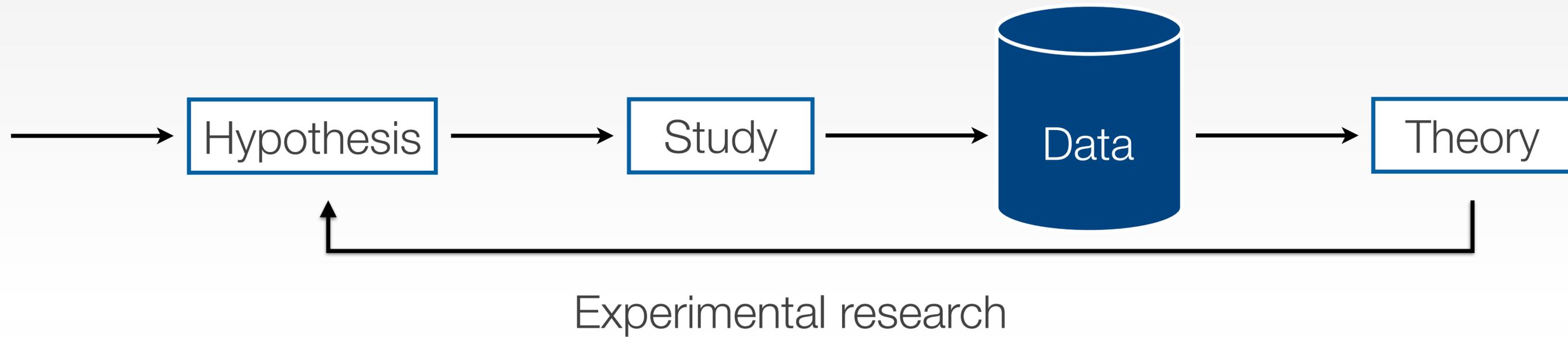
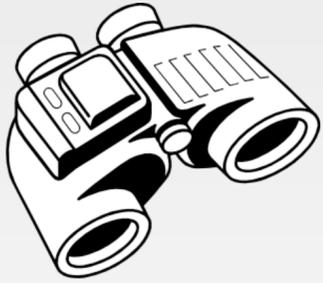
Ethnography



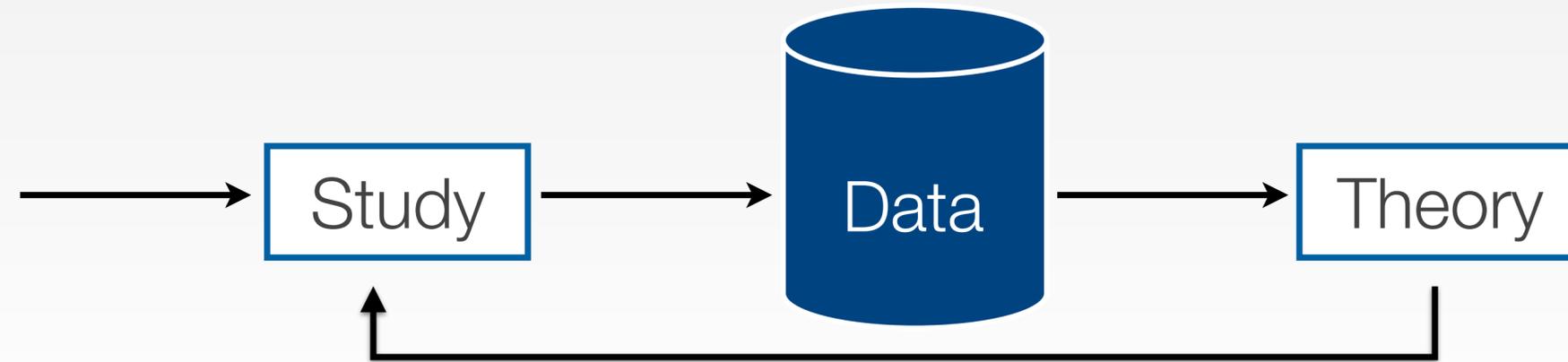
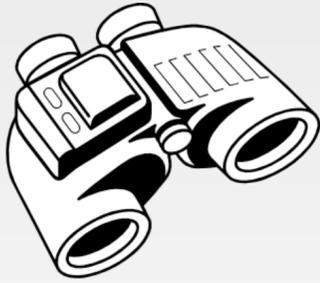
Make

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

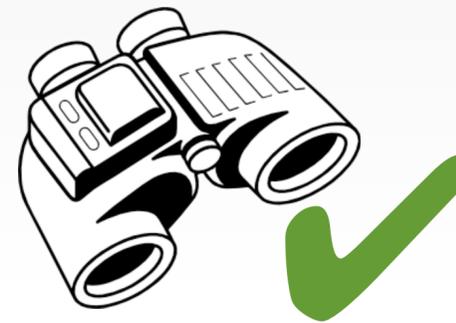
- Method (2004, [one year in the field](#))
  - Observation
  - Video recording
  - Contextual interview
- 18 students, 4 instructors participated
- Sample finding: strategies used by clinical instructors
  - Molding: laying their hands over students' hands as they work with instruments
  - Directing: 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



Test

Empirical science



Look

Ethnography



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# 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's 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

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**Dan Morris**

dan@microsoft.com

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**Human-  
Computer  
Interaction  
Institute**

**Carnegie Mellon**

***Microsoft***

[Source](#)



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# Three Approaches to HCI Research



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Look

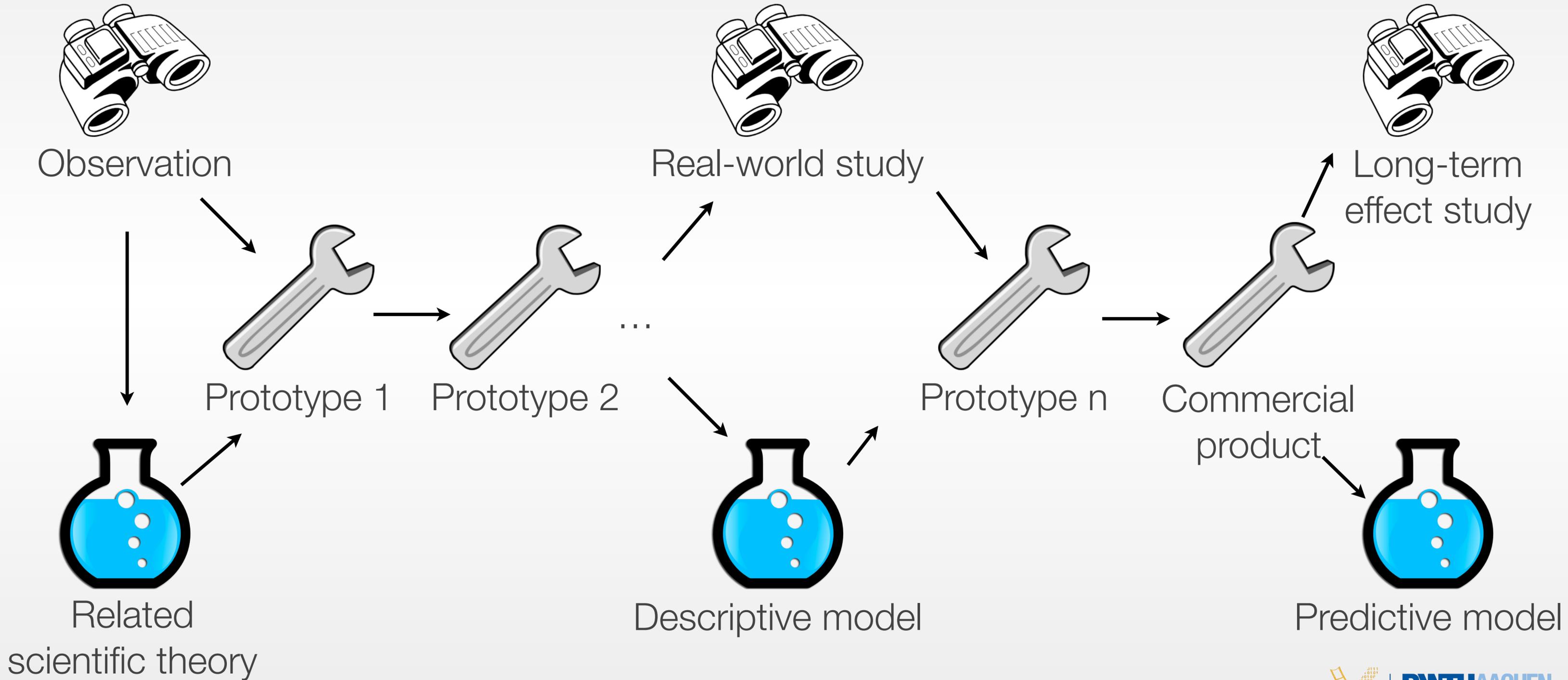
Ethnography



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. In Bill Moggridge, **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 **tomorrow!**
- Read this paper today (definitely before the lab!):
  - [Seven Research Contribution Types in Human-Computer Interaction](#)  
— Jacob Wobbrock, 2014
- Come to the lab this Wed, April 20th!
  - 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)

# Literature

- Thorsten Karrer, Moritz Wittenhagen, Leonhard Lichtschlag, Florian Heller, and Jan Borchers. 2011. Pinstripe: eyes-free continuous input on interactive clothing. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11). ACM, New York, NY, USA, 1313-1322. DOI=10.1145/1978942.1979137 <http://doi.acm.org/10.1145/1978942.1979137>
- Barry Brown and Eric Laurier. 2012. The normal natural troubles of driving with GPS. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '12). ACM, New York, NY, USA, 1621-1630. DOI=10.1145/2207676.2208285 <http://doi.acm.org/10.1145/2207676.2208285>
- Moira Burke, Cameron Marlow, and Thomas Lento. 2010. Social network activity and social well-being. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '10). ACM, New York, NY, USA, 1909-1912. DOI=10.1145/1753326.1753613 <http://doi.acm.org/10.1145/1753326.1753613>
- Mathieu Nancel, Julie Wagner, Emmanuel Pietriga, Olivier Chapuis, and Wendy Mackay. 2011. Mid-air pan-and-zoom on wall-sized displays. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11). ACM, New York, NY, USA, 177-186. DOI=10.1145/1978942.1978969 <http://doi.acm.org/10.1145/1978942.1978969>
- L. Amaya Becvar and James D. Hollan. 2007. Transparency and technology appropriation: social impacts of a video blogging system in dental hygiene clinical instruction. In Proceedings of the 2007 international ACM conference on Supporting group work (GROUP '07). ACM, New York, NY, USA, 311-320. DOI=10.1145/1316624.1316672 <http://doi.acm.org/10.1145/1316624.1316672>
- Chris Harrison, Desney Tan, and Dan Morris. 2010. Skinput: appropriating the body as an input surface. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '10). ACM, New York, NY, USA, 453-462. DOI=10.1145/1753326.1753394 <http://doi.acm.org/10.1145/1753326.1753394>