

# CTHCI



## Current Topics in Human–Computer Interaction

Research Approaches in HCI

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Summer Semester '25

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



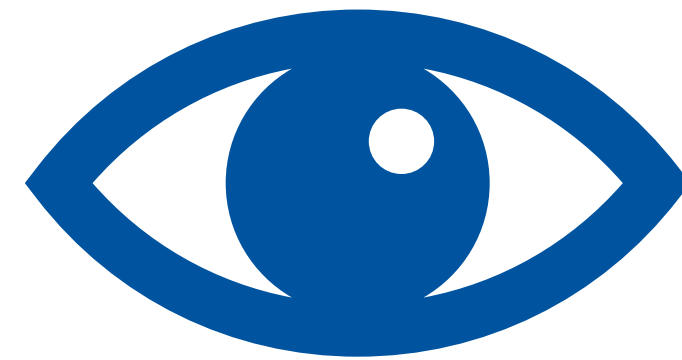
**RWTHAACHEN**  
UNIVERSITY

# Three Approaches to HCI Research



**Test**

Empirical science



**Observe**

Ethnography



**Make**

Engineering & Design



A hand holding a blue pen pointing at a document with charts and graphs. The document features a bar chart with blue, red, and yellow bars, and a line graph with green and red lines. The background is a light, blurred image of the same document. A yellow geometric shape is in the bottom-left corner.

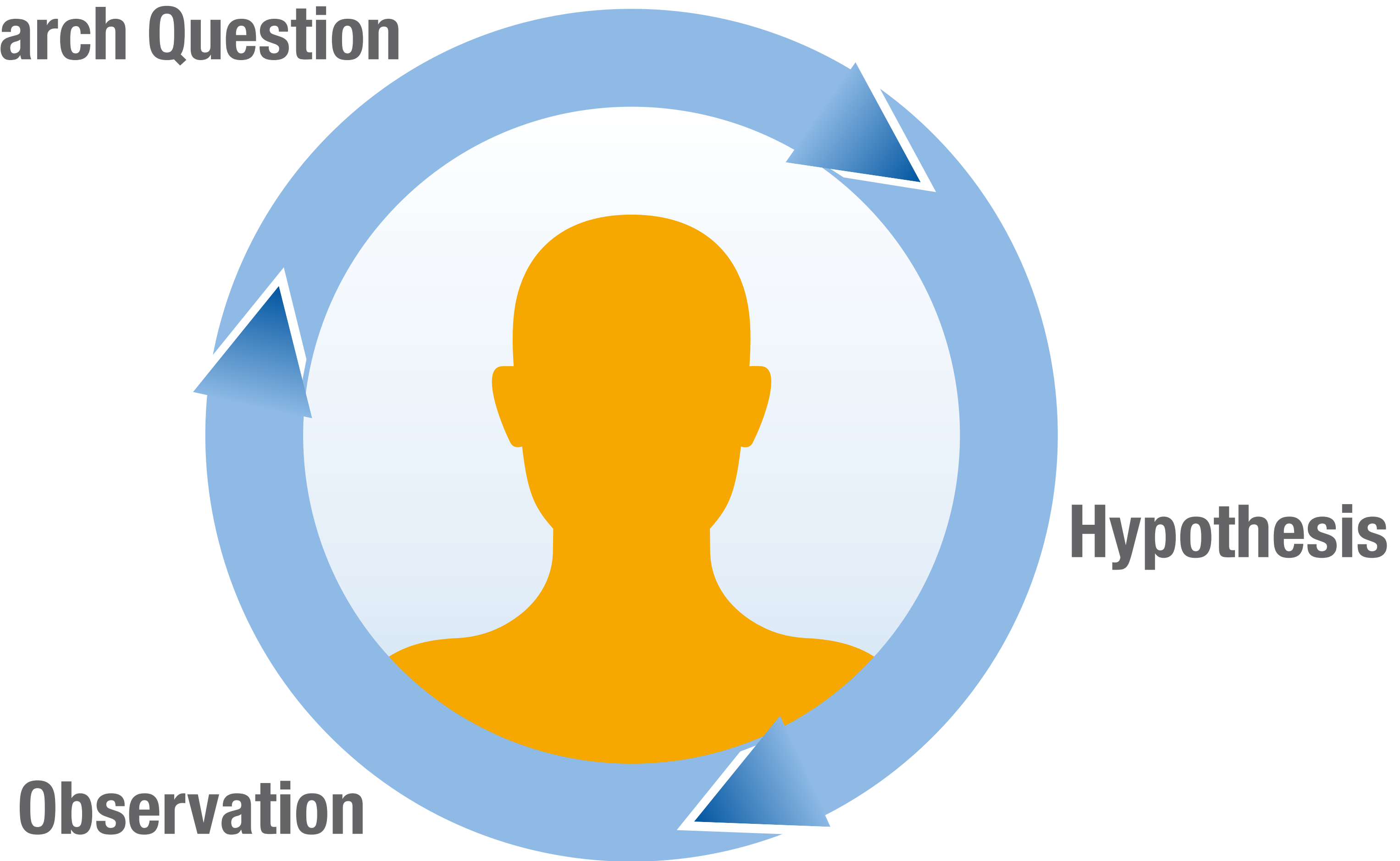
## CHAPTER 4

# Empirical Approach

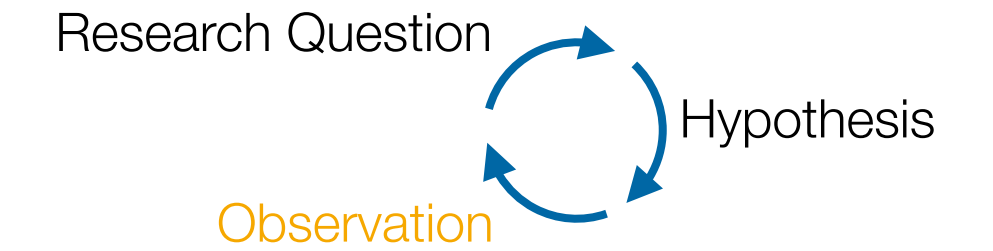


# Empirical Approach

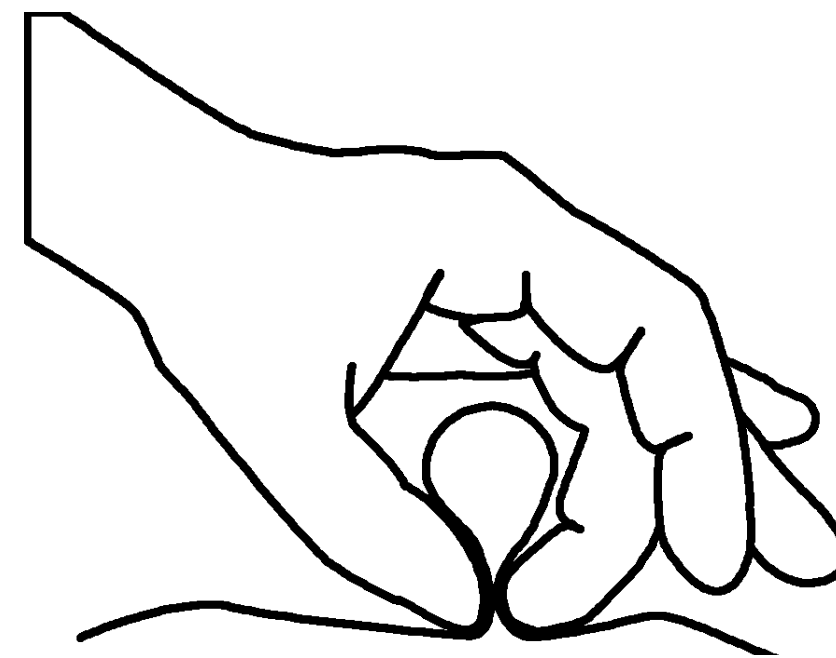
**Research Question**



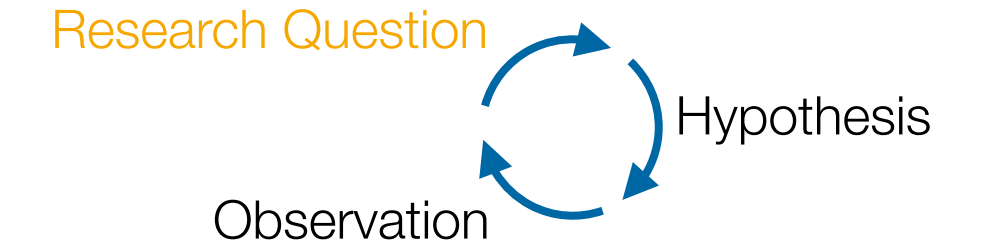
# Initial Observation



- 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?”

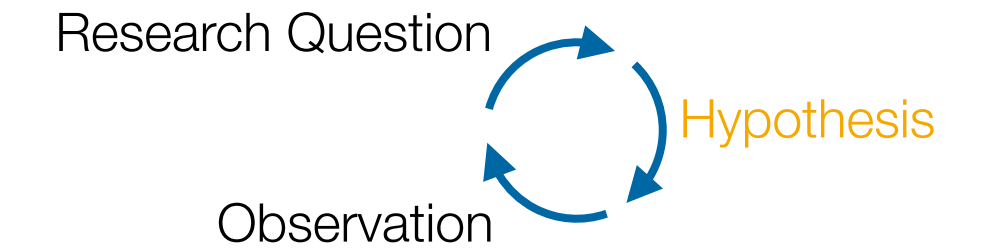


# Research Question



- Identify variables and research question for 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: “When pinching cloth, different **areas** of the body would differ in **preference** and **the way people pinch**”

# Hypothesis

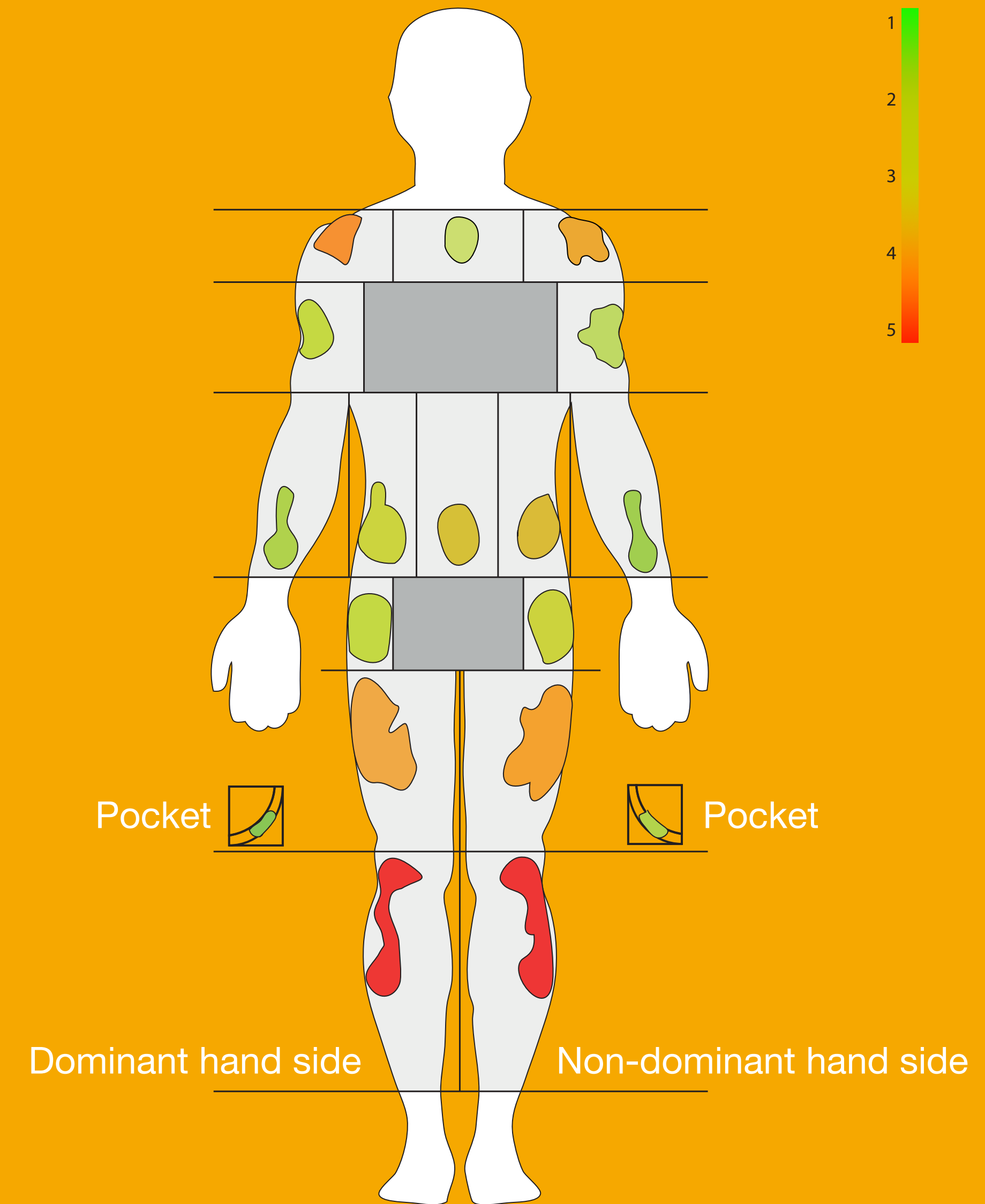


- **Concrete and testable** statements derived from the research question
- **Operational definition:** a specific set of operations for measuring external, observable behavior
- In-class exercise: try giving an operational definition for the variables highlighted below
  - “There would be a difference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



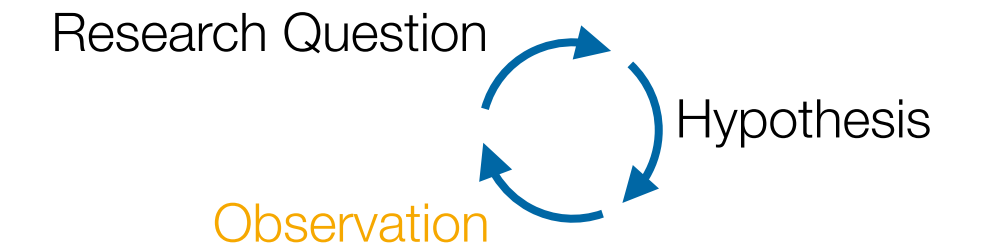
# Example: Pinstripe

- 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 (operationalization):
  - Identify 16 different body areas
  - Ask the participants to perform the pinching gesture in these areas
  - Collect convenience rating in 5-point Likert scale





# Conducting the Study



- Goal: 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** on other variables





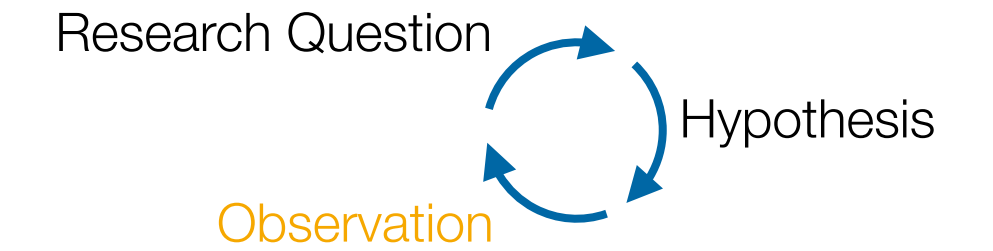
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**EMPIRICAL**

# **Descriptive Research**



# 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



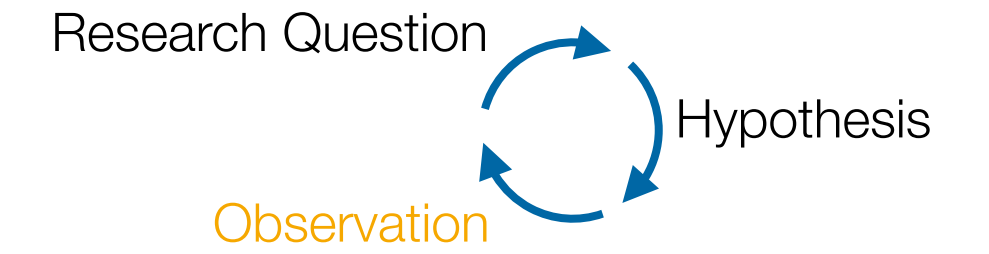
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**EMPIRICAL**

# **Relational Research**



# Relational Research



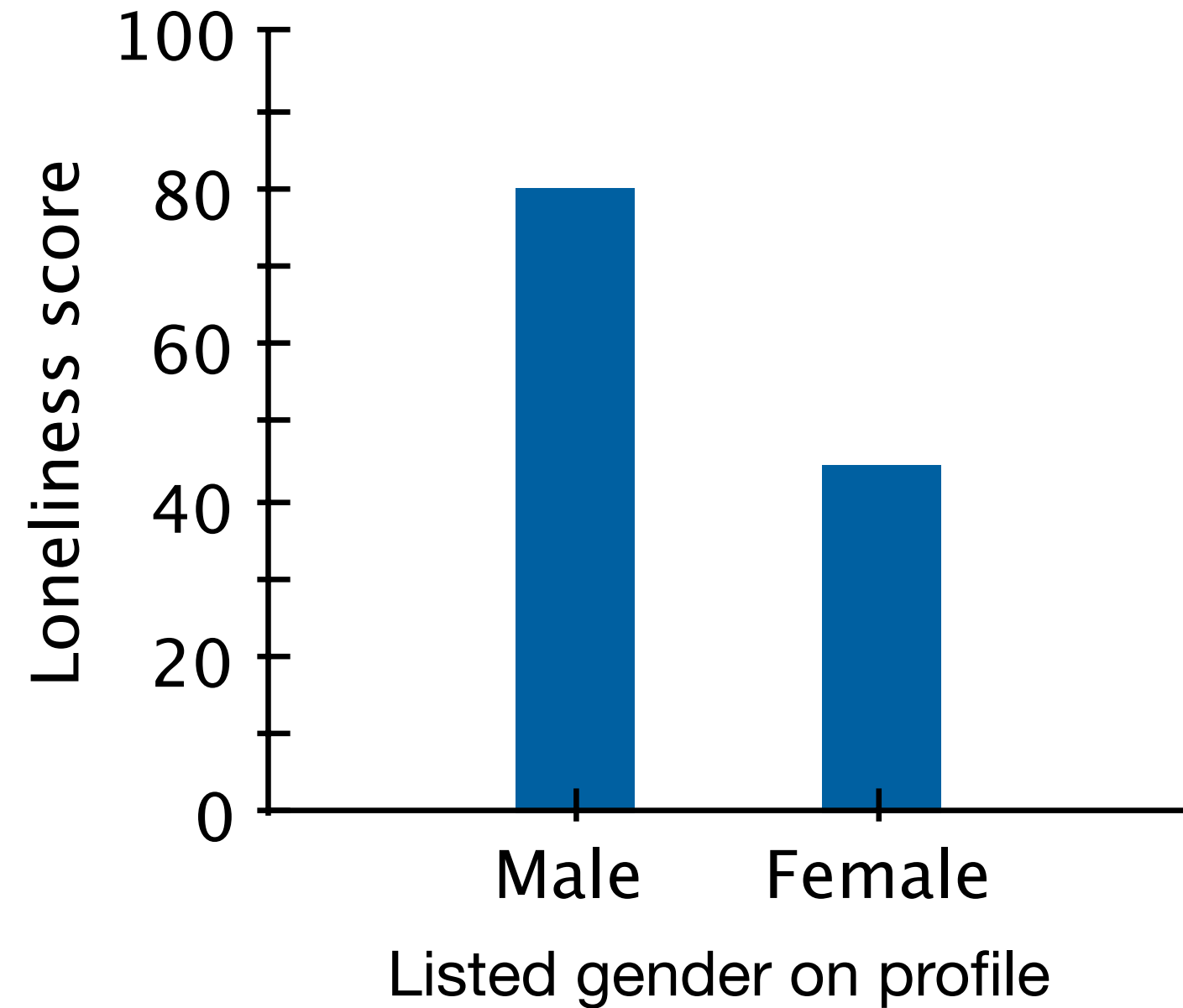
- Measure a set of variables for each participant
- Examine the data to identify **patterns** and relationships
  - Goal: Finding **correlations** (changes in one variable are consistently and predictably accompanied by changes in another variable)
- Measure the **strength** of the relationships

# Example: Social Network Activity and Social Well-Being

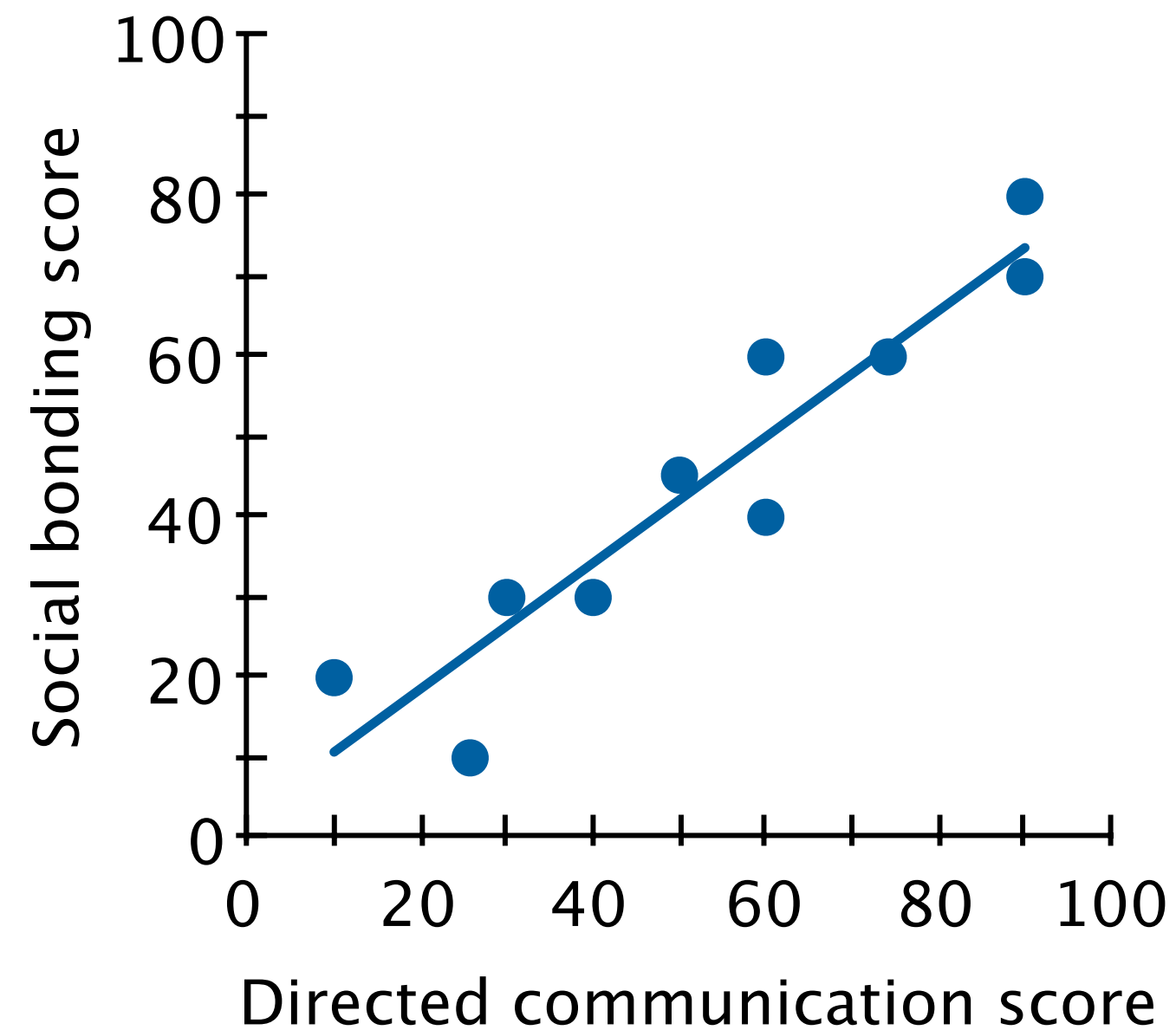
- Burke (CMU), Marlow, and Lento (Facebook), Best paper CHI '10 🏆
  - “An empirical analysis of the **relationship** between **direct** and **passive communication** on Facebook and social well-being, including loneliness, bridging, and bonding social capital.”
- Survey using Likert scales (N = **1193**)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



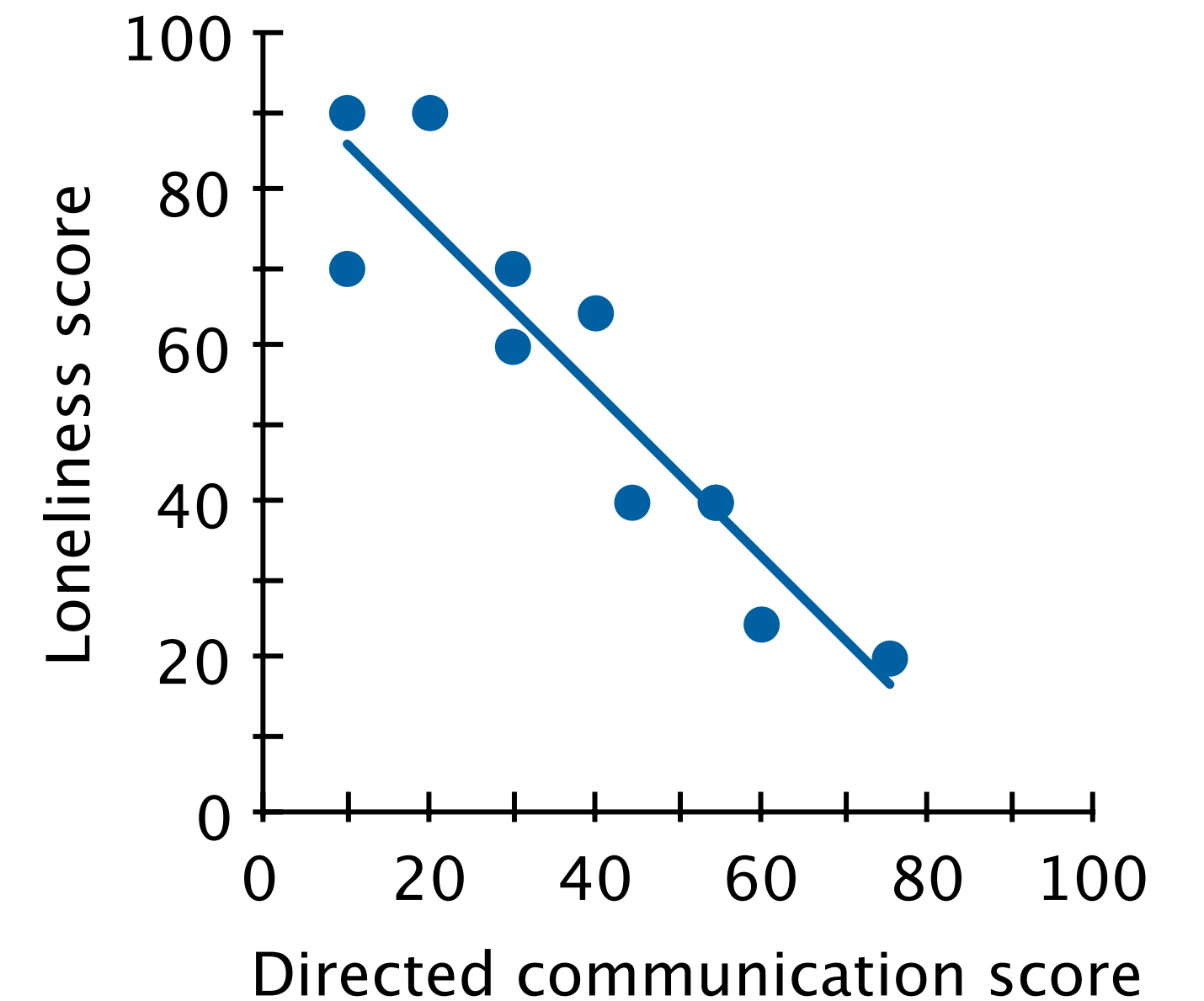
# Patterns in the Relationship between Variables



General relationship



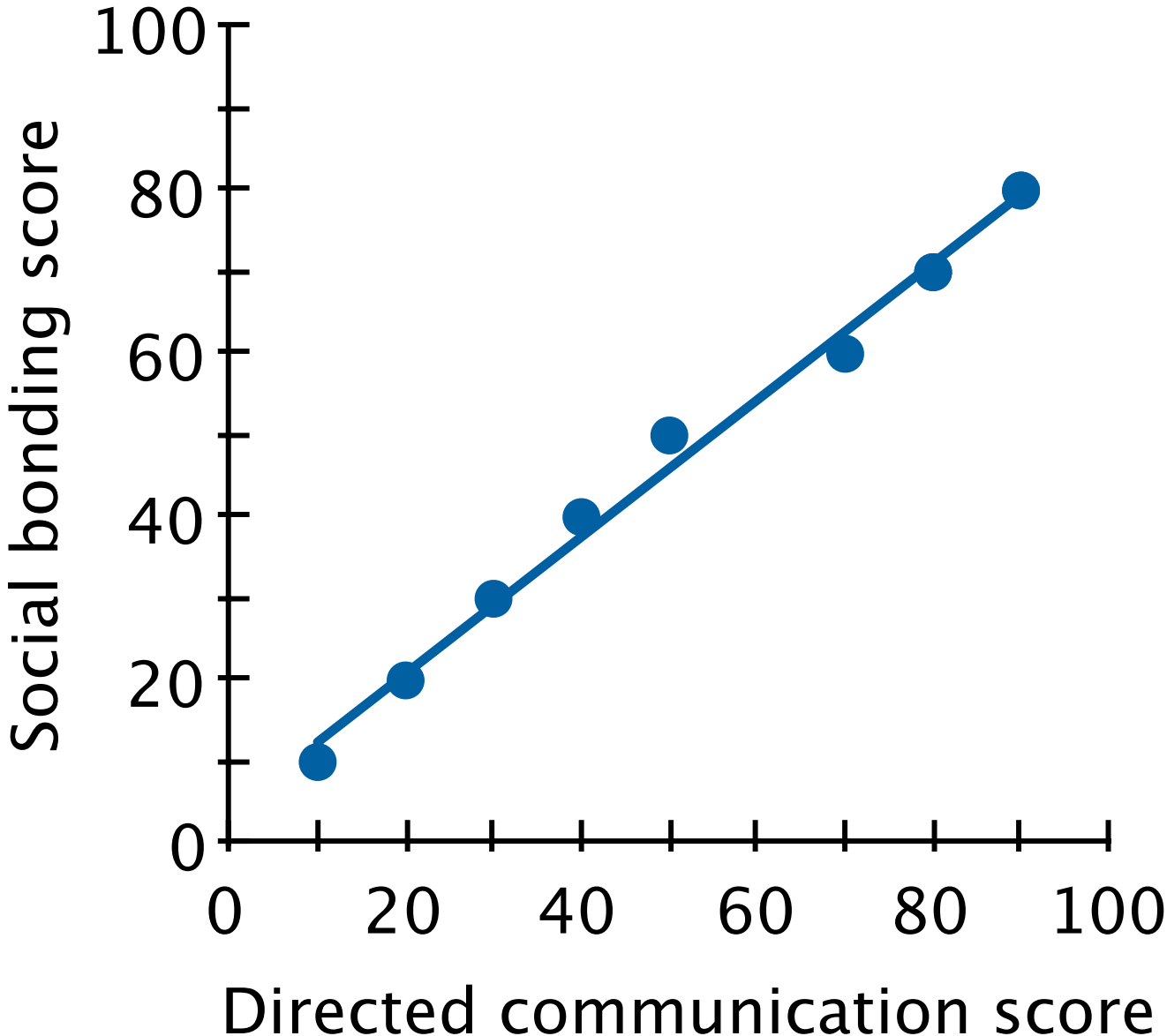
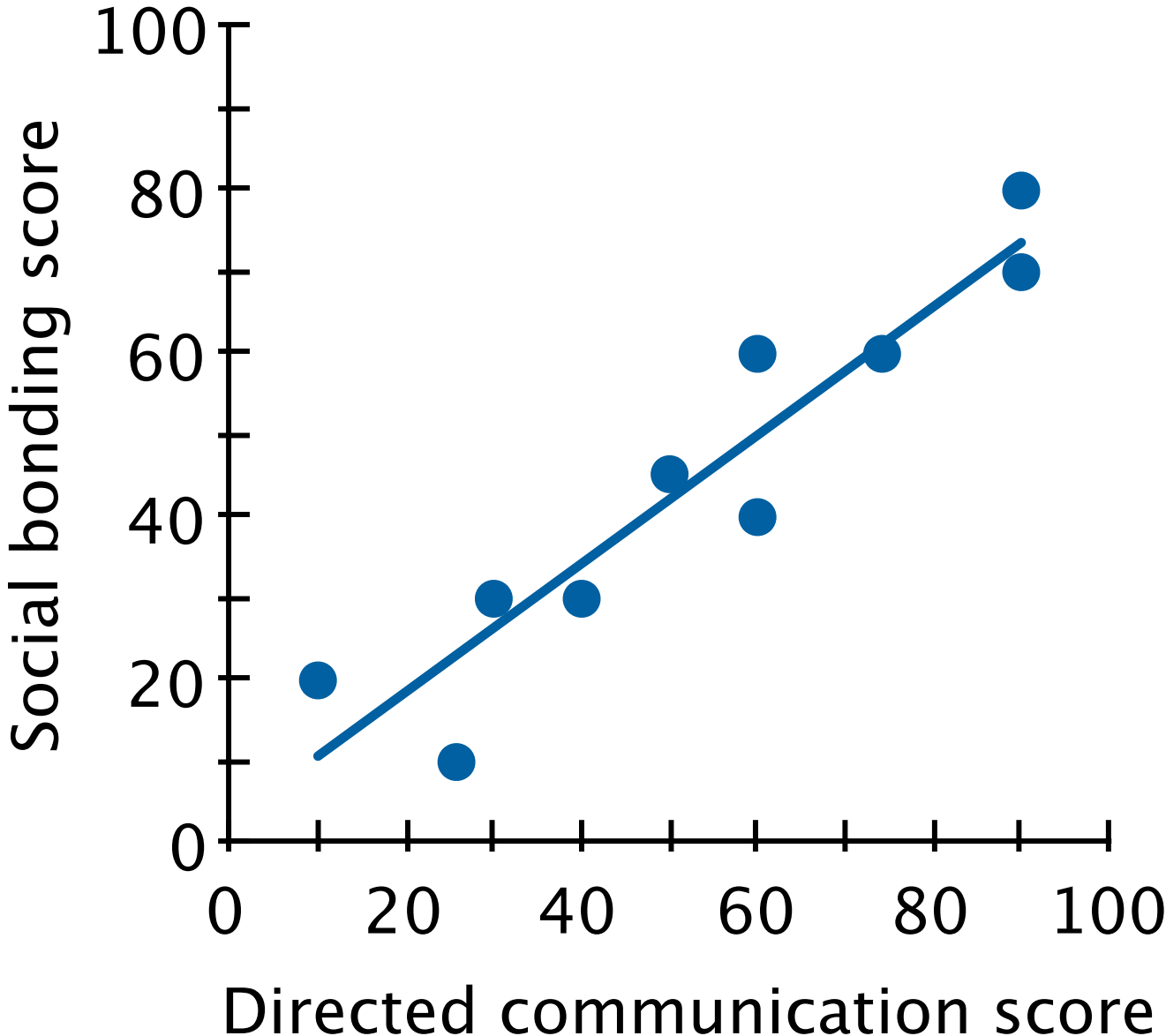
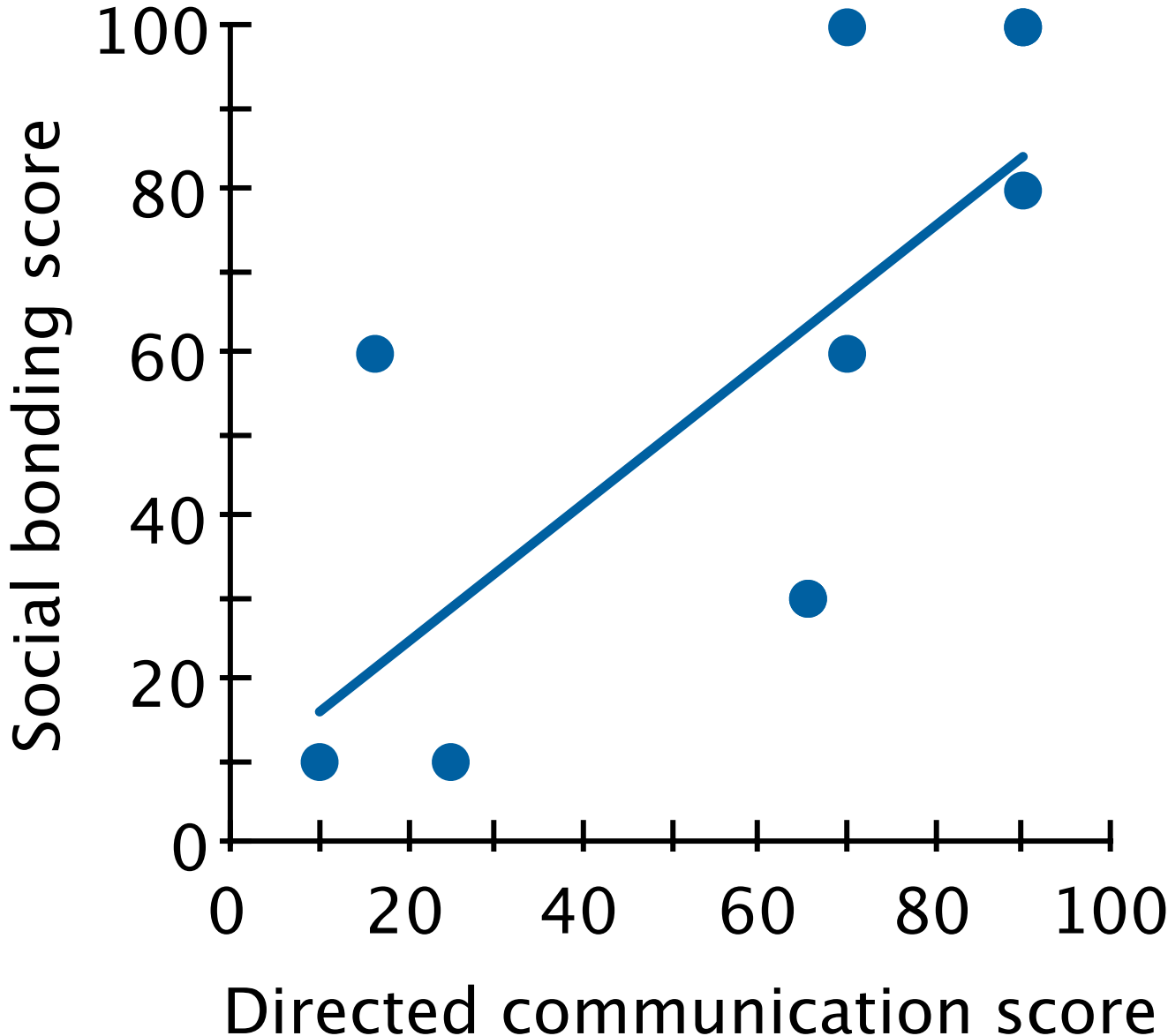
Positive relationship



Negative relationship

Simulated data for instructional purposes, based on results from [Burke et al., CHI '10]

# Strength of the Relationship between Variables

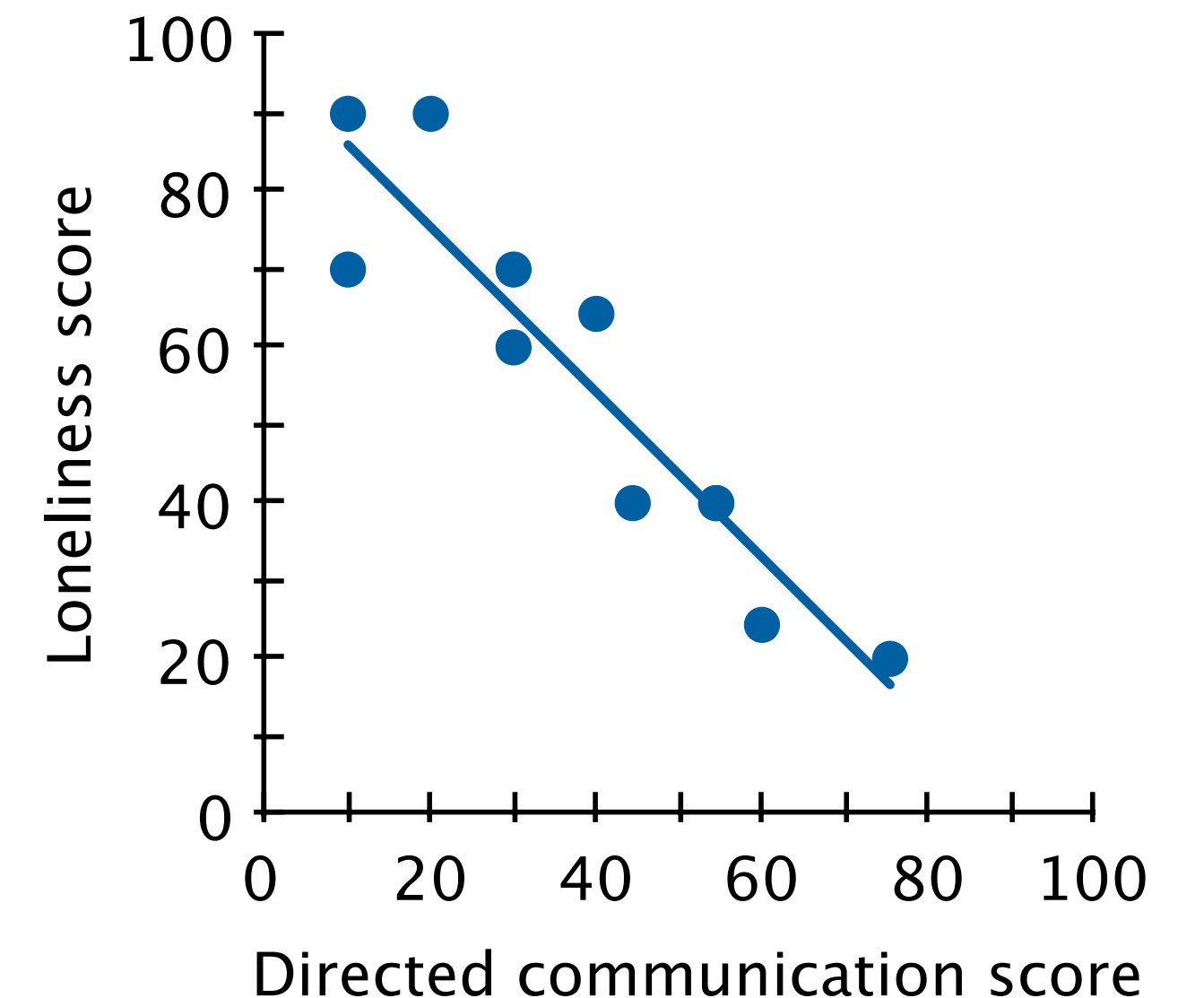


Simulated data for instructional purposes



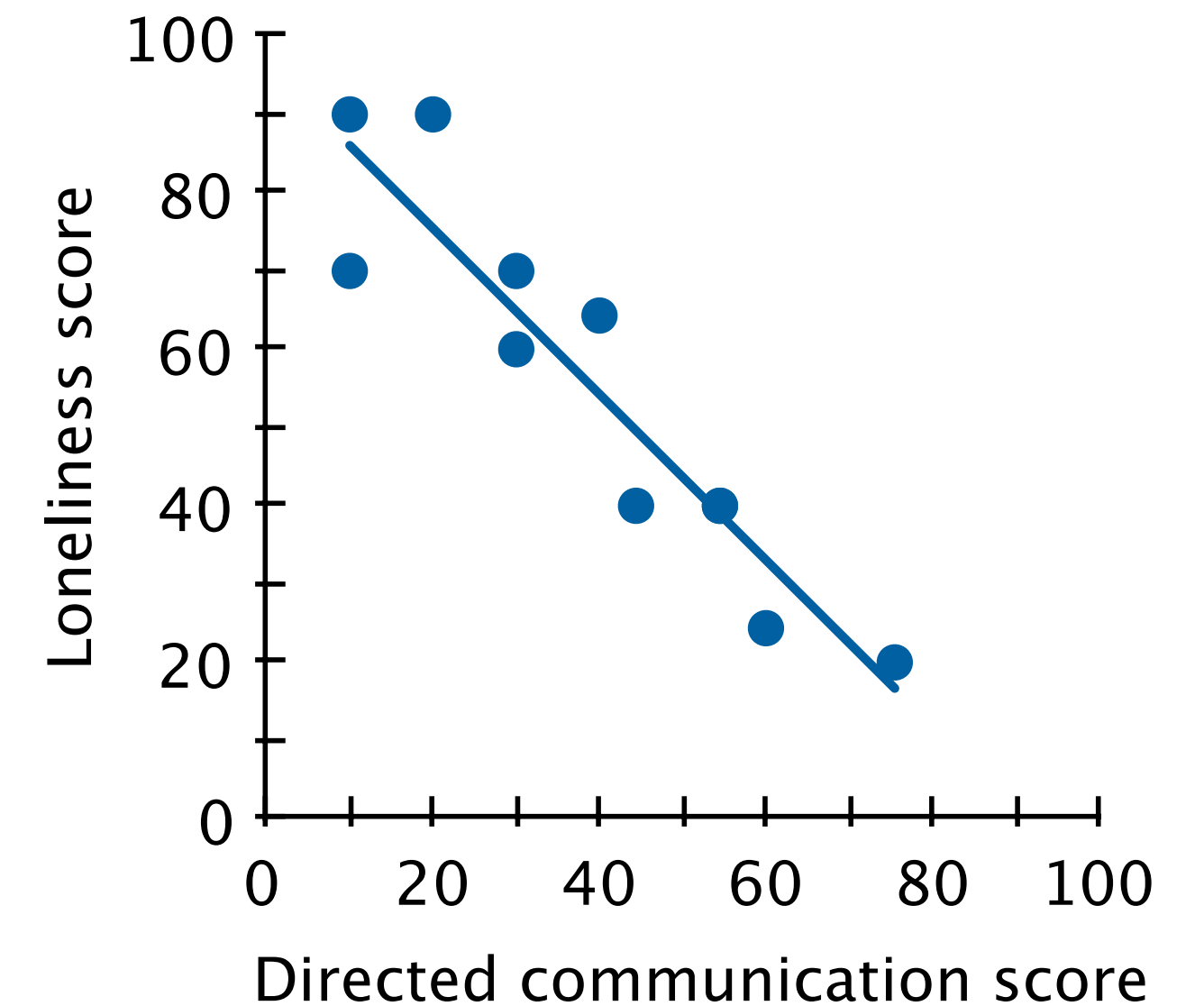
# Limitations of Relational Research

- **Correlation does not imply causation**
- E.g., here we do not know:
  - Loneliness  $\Rightarrow$  less direct communication?
  - Less direct communication  $\Rightarrow$  loneliness?
  - 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)





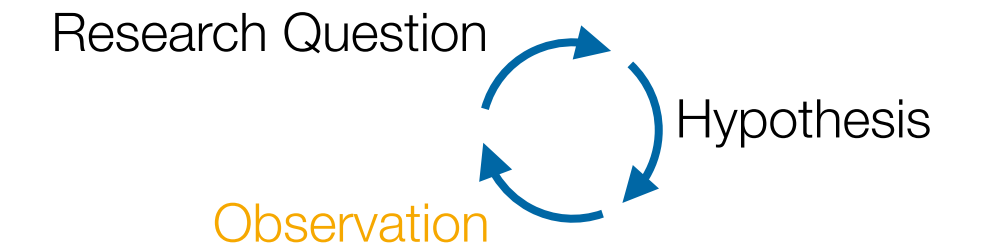
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**EMPIRICAL**

# Experimental Research



# 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 from DIS1
  - Between-groups vs. within-groups
  - Benefits and drawbacks
- More details in next lecture



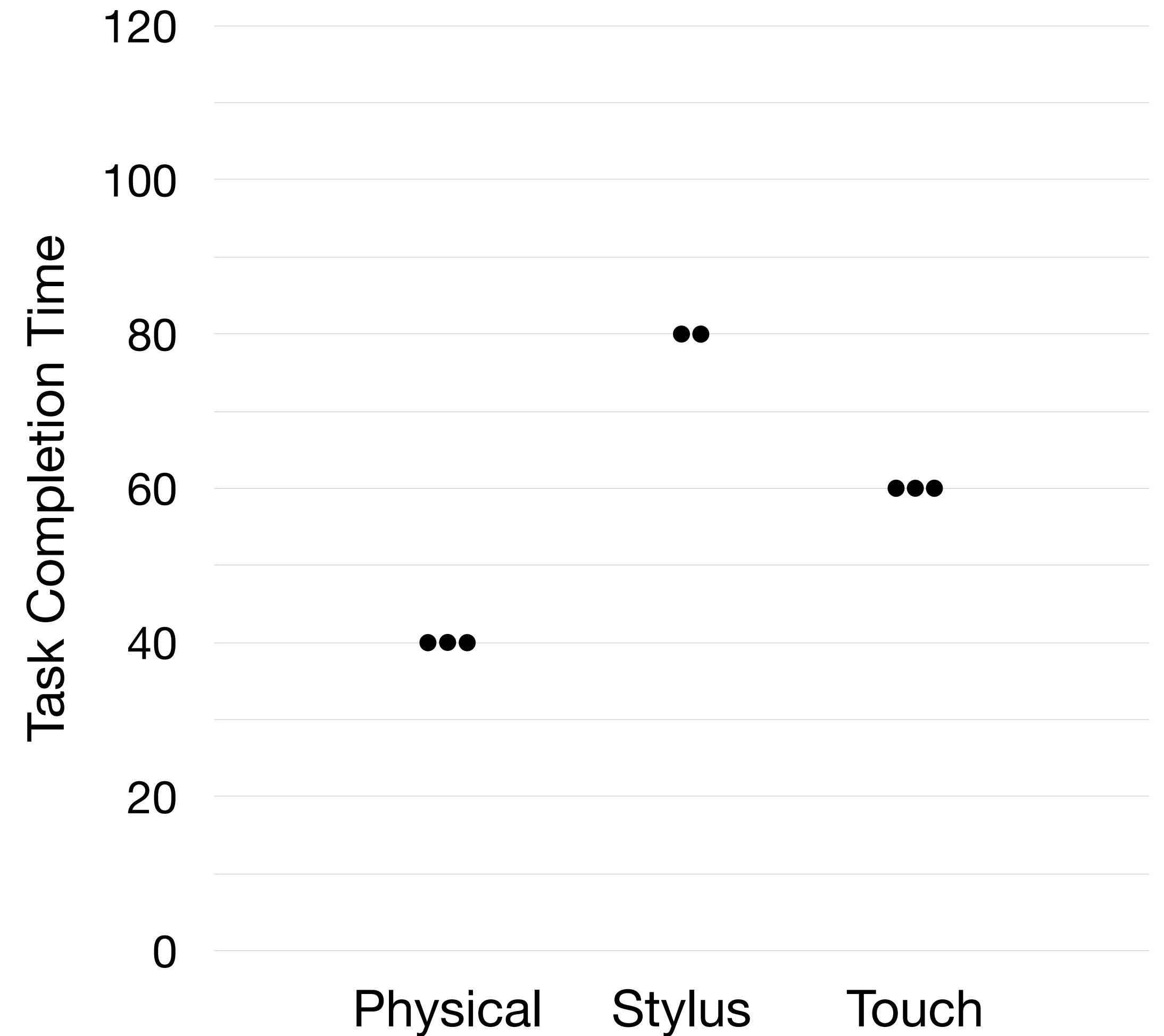
# Exercise: Mobile Phone Text Input Example

- Research question: On a mobile phone, is typing faster using *physical keys* compared to using a touchscreen and your *fingers* or a *stylus*?
- IV: keyboard types: {physical, stylus, touch}
- DV: time in seconds for typing a specified sentence.
  - Begin: when the user presses the first key
  - End: when the user presses Enter
- Design: between-groups
  - Each keyboard is tested by 20 participants
  - Each participant types the sentence only once (one trial)



# Limitations of Experimental Research

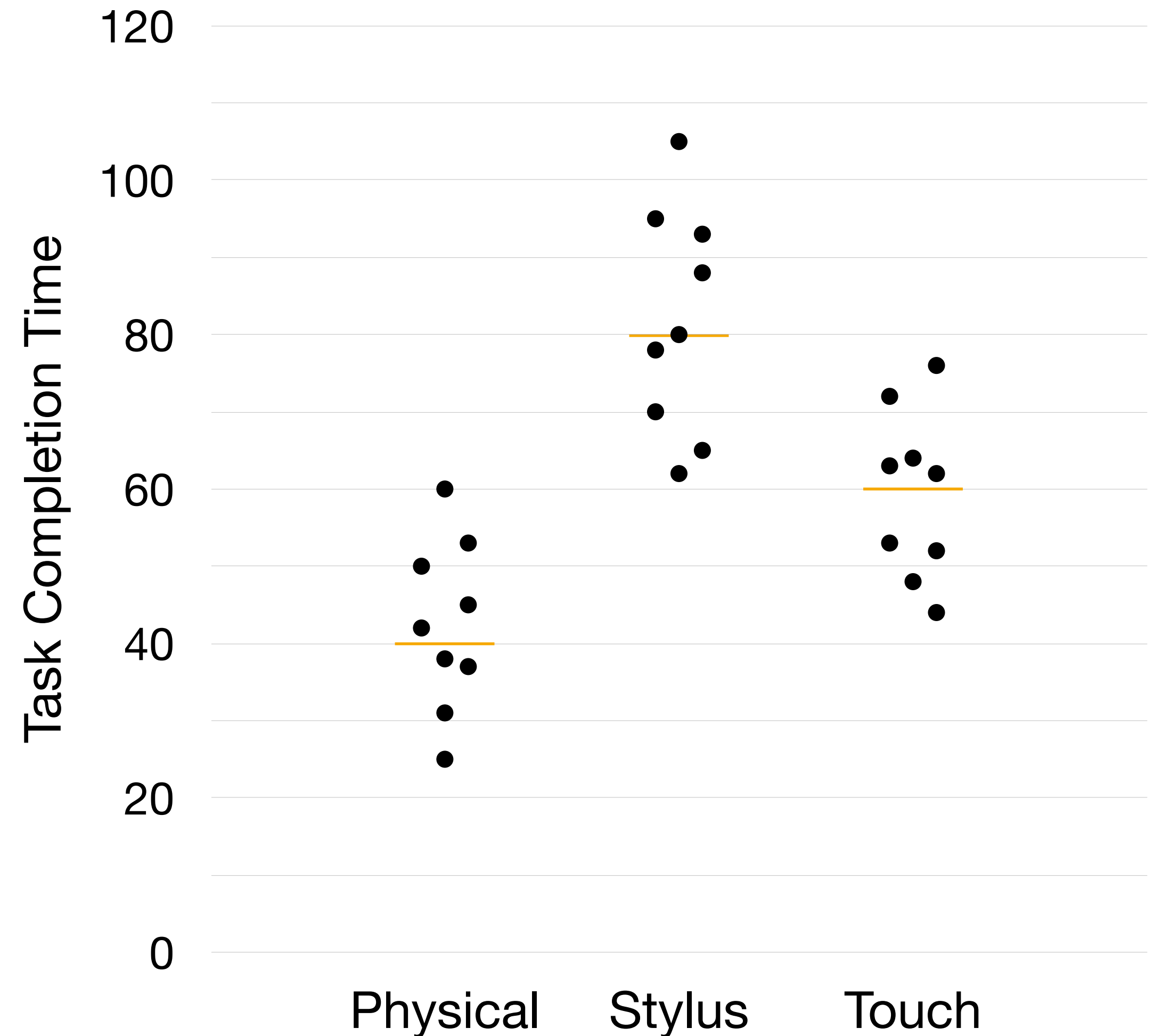
- Ideal world: variance caused by IV only (“IV has an effect on DV”)





# Limitations of Experimental Research

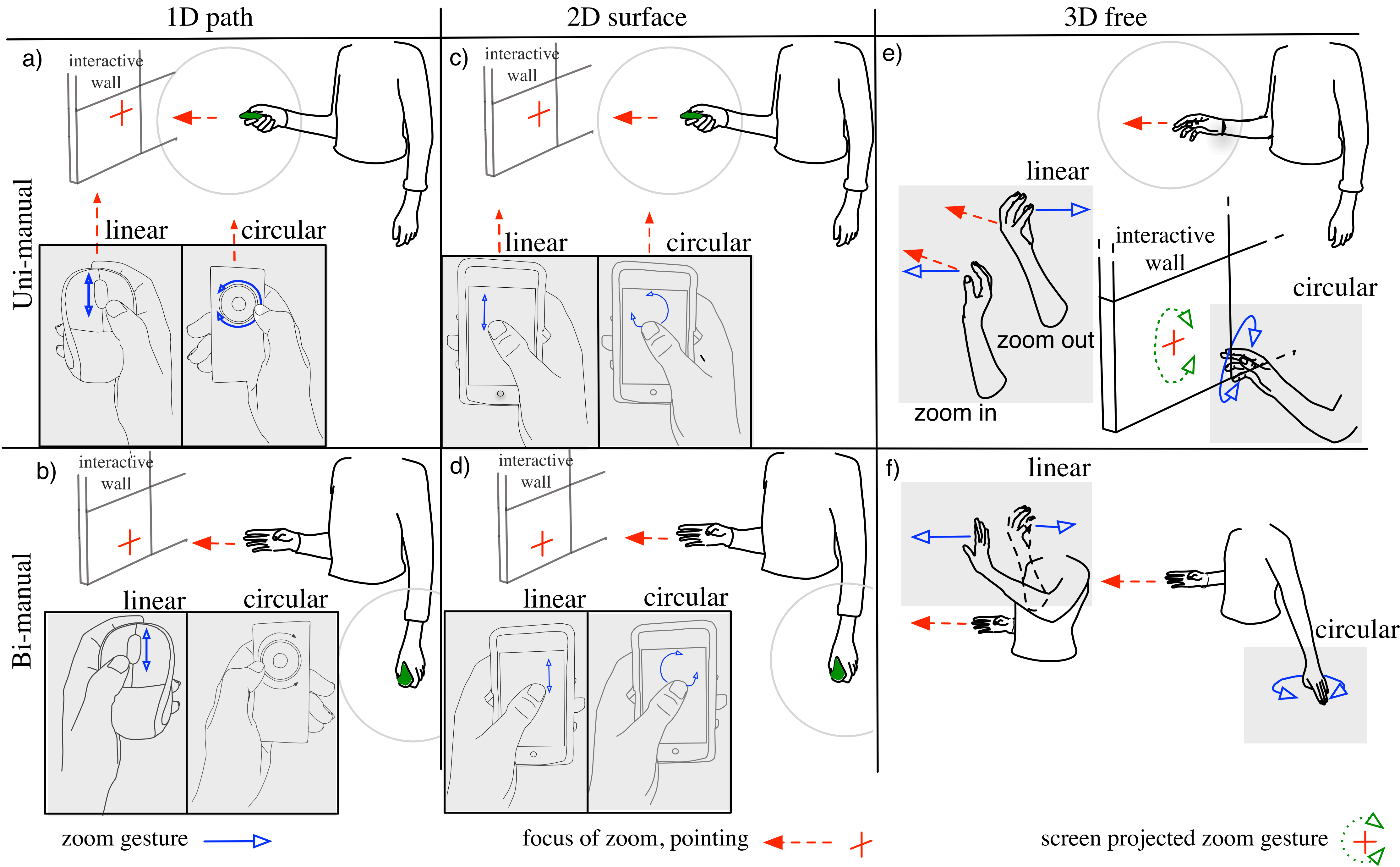
- Ideal world: variance caused by IV only (“IV has an effect on DV”)
- Real world: Data from experiments is noisy (here: differences between people or trials)
- => Variance caused by IV **and/or** by those uncontrolled factors (“confounding variables”)?
- Statistics help resolve this



# 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.”



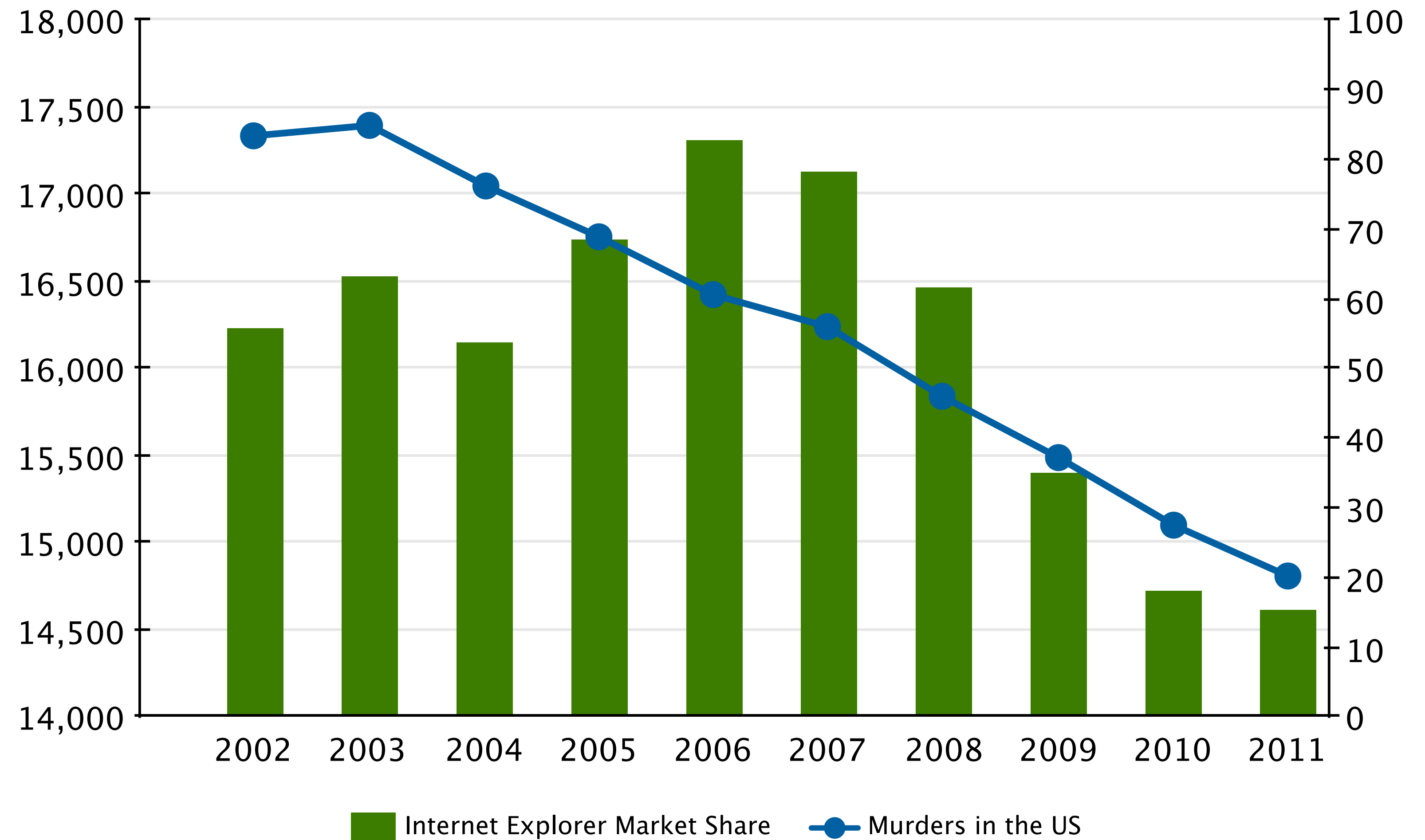




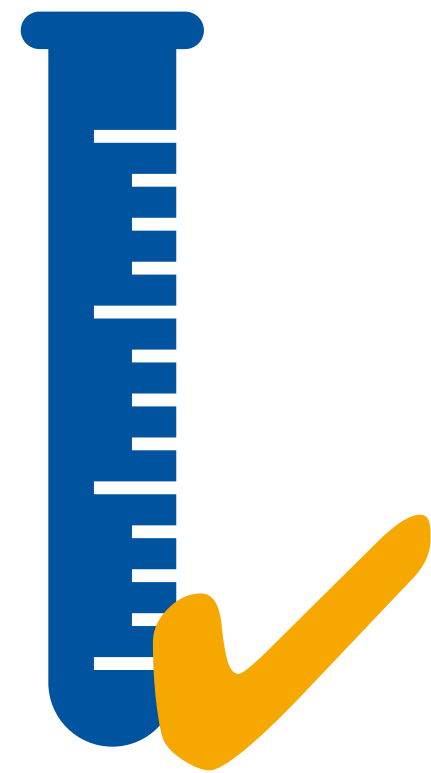


# Correlation Does Not Imply Causation

Adapted from a tweet of  
@altonncf with data from FBI  
and W3Schools

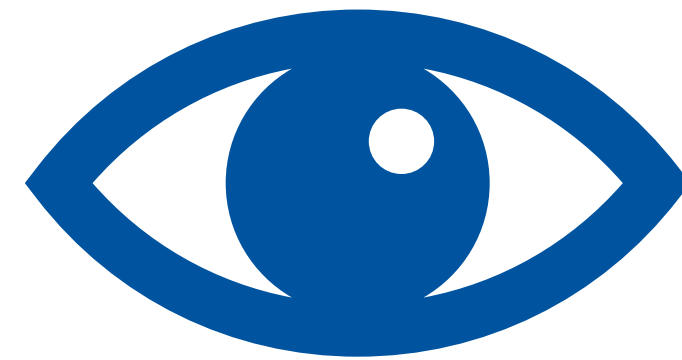


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## CHAPTER 5

# Ethnography

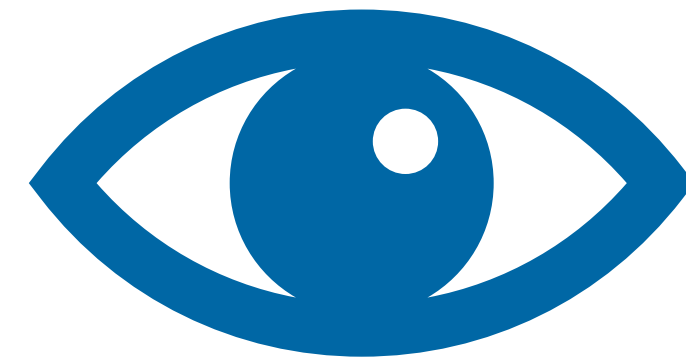


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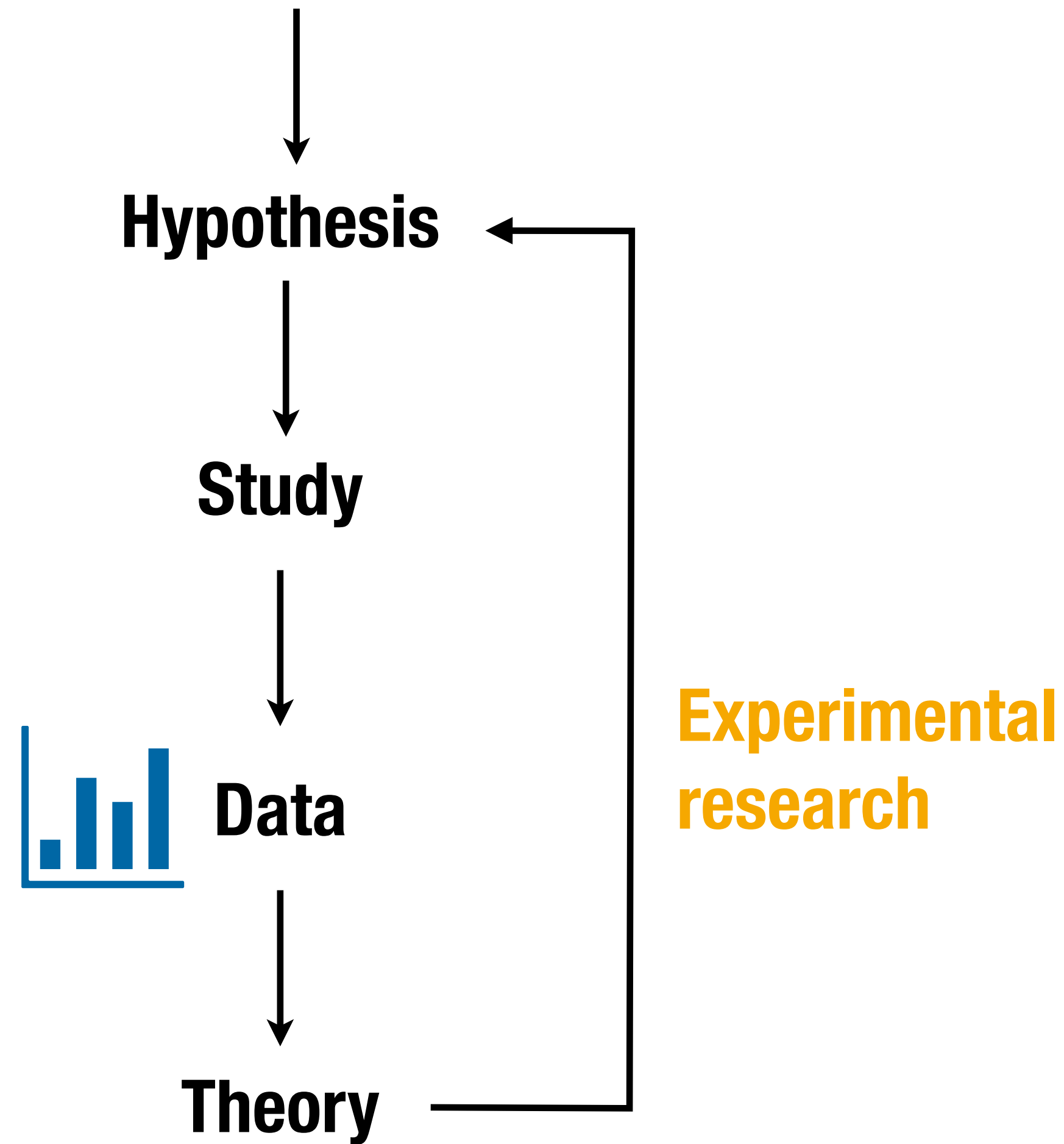


**Make**

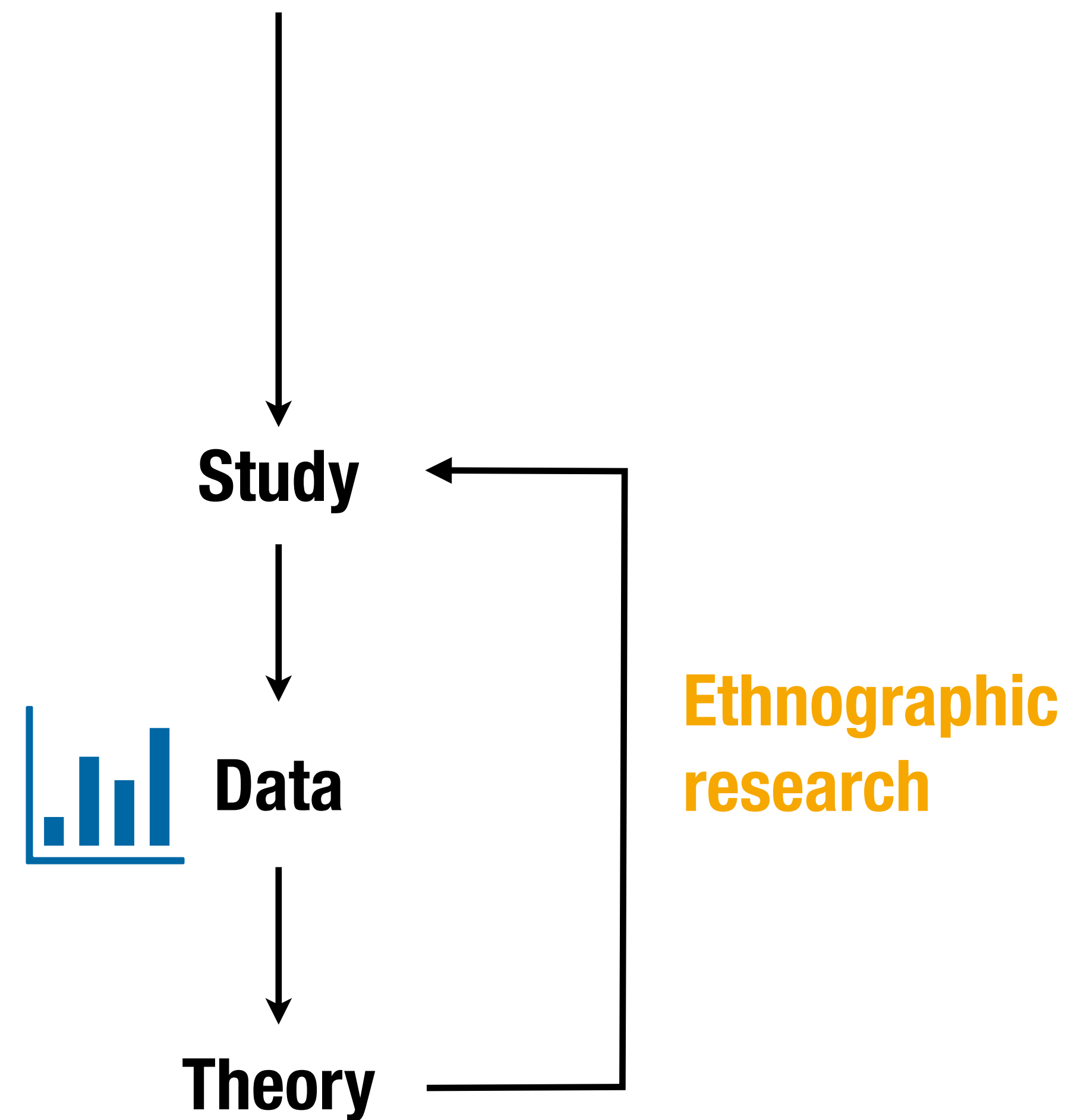
Engineering & Design



# Experimental

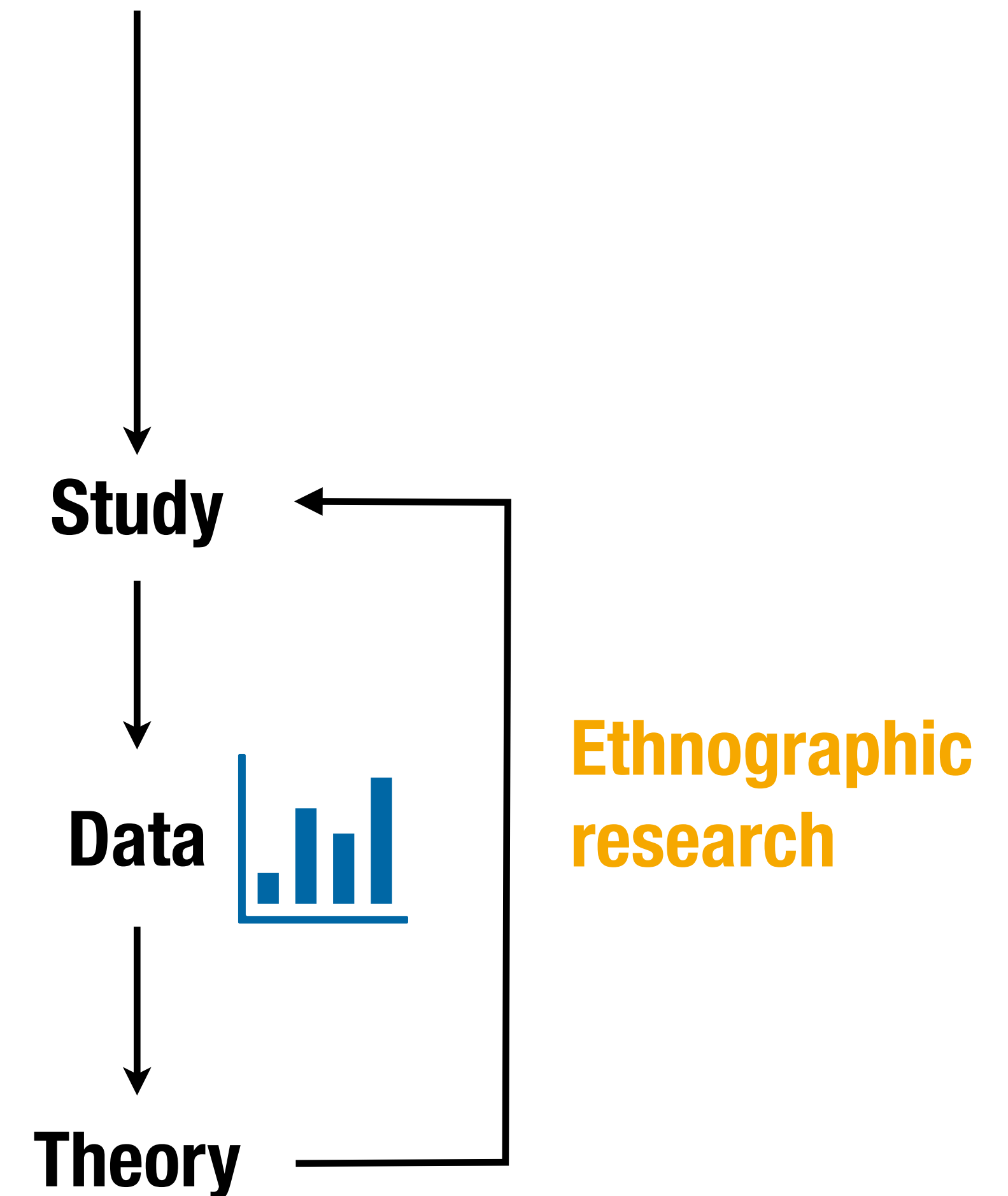


# Ethnography



# Ethnography

- Collect data with different methods, e.g.:
  - Observation
  - Interview
- Code data and find patterns in it
- 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 that increases the confidence of your conclusion
  - From different participants
  - From different types of data, e.g., observations, interviews, logs



# Example 1: The Normal 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.**



# Example 1: The Normal 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
  - GPSs are used in ways that the designers had not foreseen: Drivers must match instructions and the map to the actual situation
  - Designer should take “driver intelligence” into account
    - E.g., less persistent instructions when user decided to deviate from them

# Example 2: Video Blogging System in Dental Hygiene Clinical Instruction

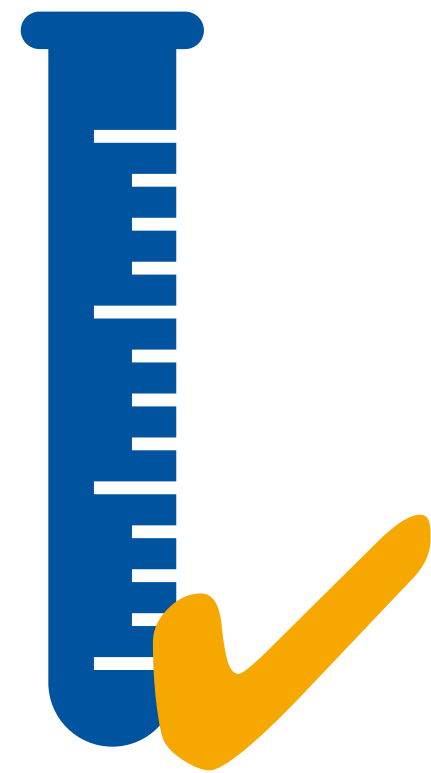
- Becvar and Hollan (UCSD), ACM GROUP '07
- Field site: Dental hygiene training program in San Diego, CA, USA
- Goals
  - Gain understanding of teaching and learning practices, media and representations
  - Implement & evaluate a design prototype based on those findings
- Method
  1. Ethnographic study of current practice
  2. Implementing and deploying prototype, then second ethnographic study



## Example 2: Video Blogging System in Dental Hygiene Clinical Instruction

- Method for the first part (ethnographic study, 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



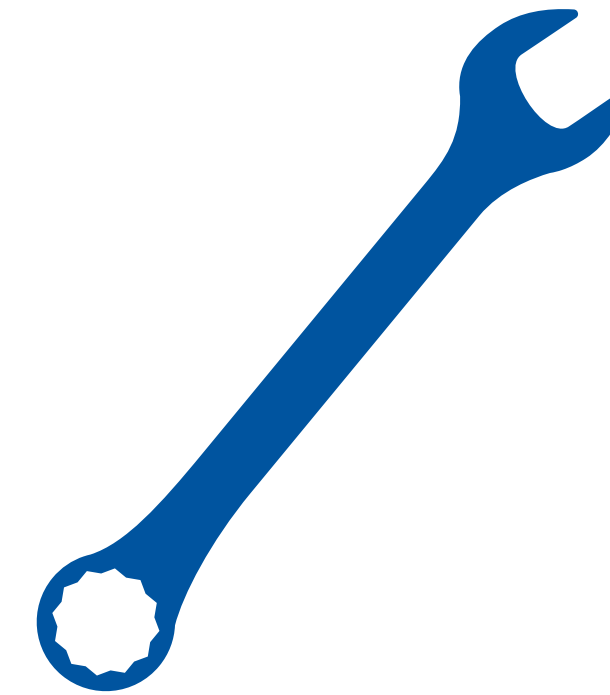
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# What's next?

- Introduction to the Mini HCI Project in **tomorrow's lab**
  - Official project start next week
  - Form groups of 3 in Moodle until next week, **April 30, 18:00**
- You will not be able to participate in the project and pass the course if you do not join a group in time

KW 18	KW 19	KW 20	KW 21	KW 22	KW 23	KW 24	KW 25	KW 26	KW 27	KW 28
<b>M1:</b> Research Topic	<b>M2:</b> Research Plan			<b>M3:</b> Conducting Research		<b>M4:</b> Data analysis			<b>M5:</b> Prepare Presentation	