
# Current Topics in Media Computing and HCI

## Research Approaches in HCI

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Summer Term 2020

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

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# Three Approaches to HCI Research

**Test**

Empirical science

**Look**

Ethnography

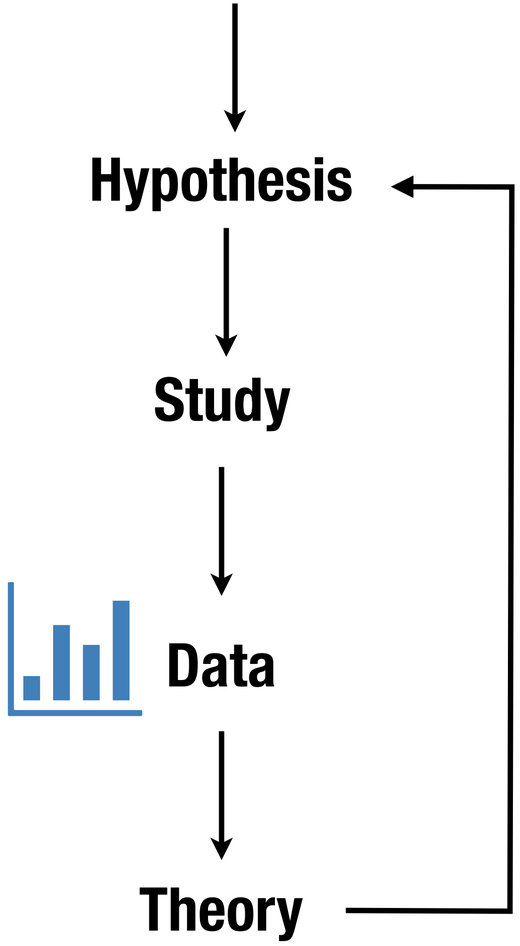
**Make**

Engineering & Design

CHAPTER 10

# Ethnography

# Experimental



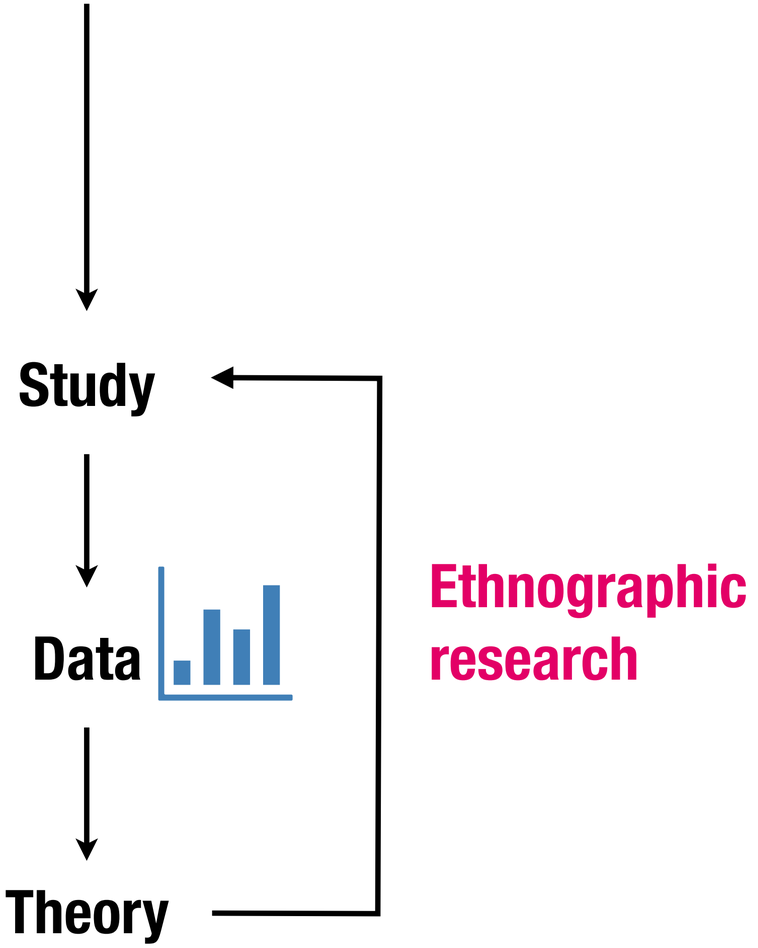

Experimental research

# Ethnography


Ethnographic research

# 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

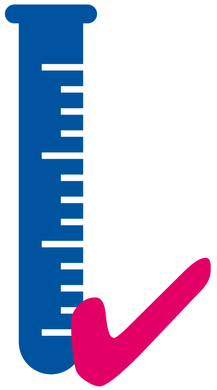
# Research Example: Vlogging in Dentist Training

- 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
  - Ethnographic study of current practice
  - Implementing and deploying prototype, then second ethnographic study

# Vlogging in Dentist Training: Understanding Current Practice

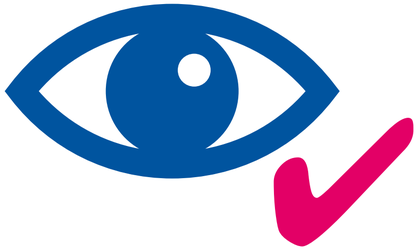
- Method (2004, **one year in the field**)
  - Observation
  - Video recording
  - Contextual interview
- 18 students, 4 instructors participated
- Sample finding: strategies used by clinical instructors
  - Molding: laying their hands over students' hands as they work with instruments
  - Directing: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

**Make**

Engineering & Design

CHAPTER 11

# Engineering & 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, intended benefits and unexpected outcomes documented

# 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
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Human-Computer Interaction Institute

Carnegie Mellon

Microsoft


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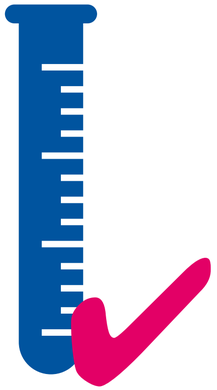
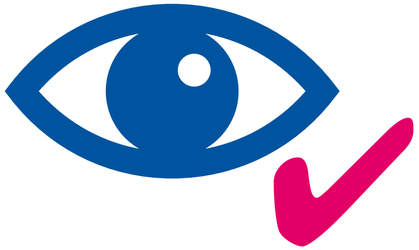
# Three Approaches to HCI Research



**Test**

**Empirical science**



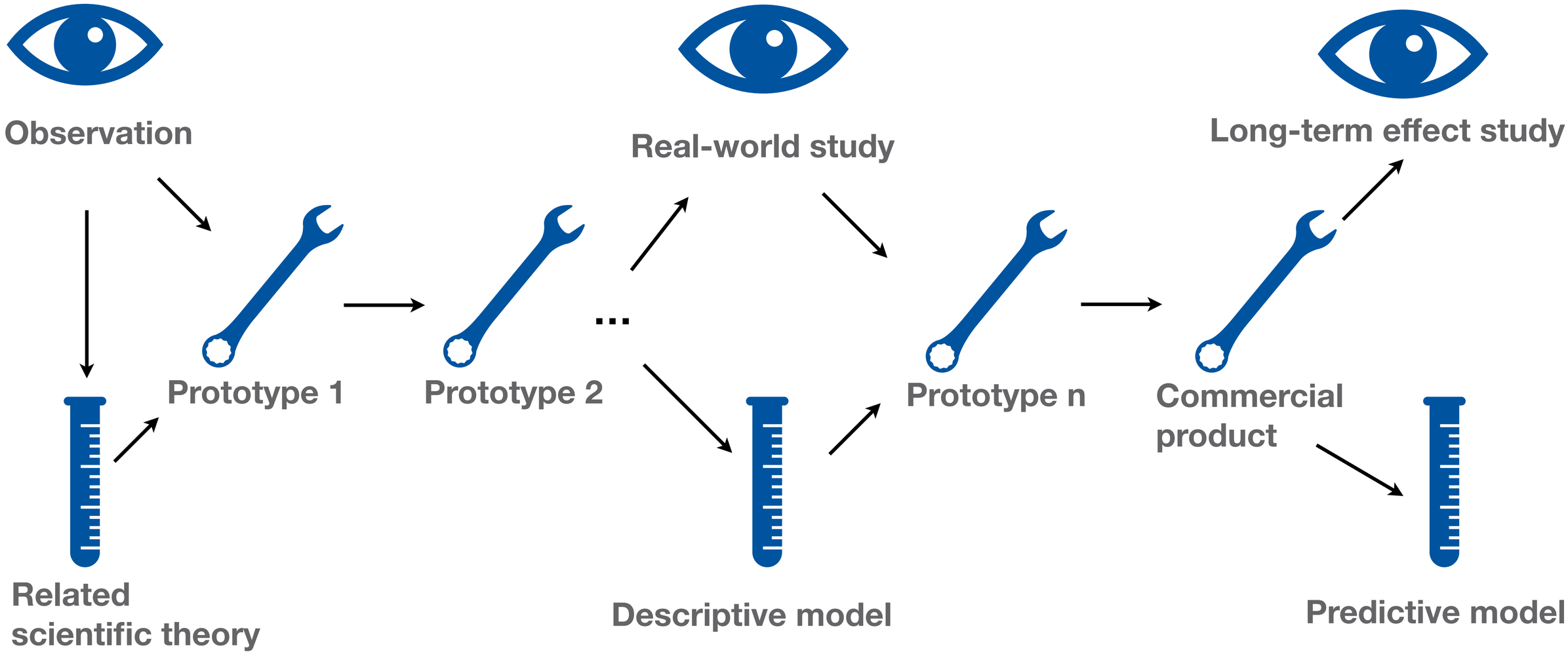
**Look**

**Ethnography**

**Make**

**Engineering & Design**

# The Messy Truth



# CommandMaps

- 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]


# Current Topics in Media Computing and HCI

## Experimental Research Part 1 & Writing a Protocol

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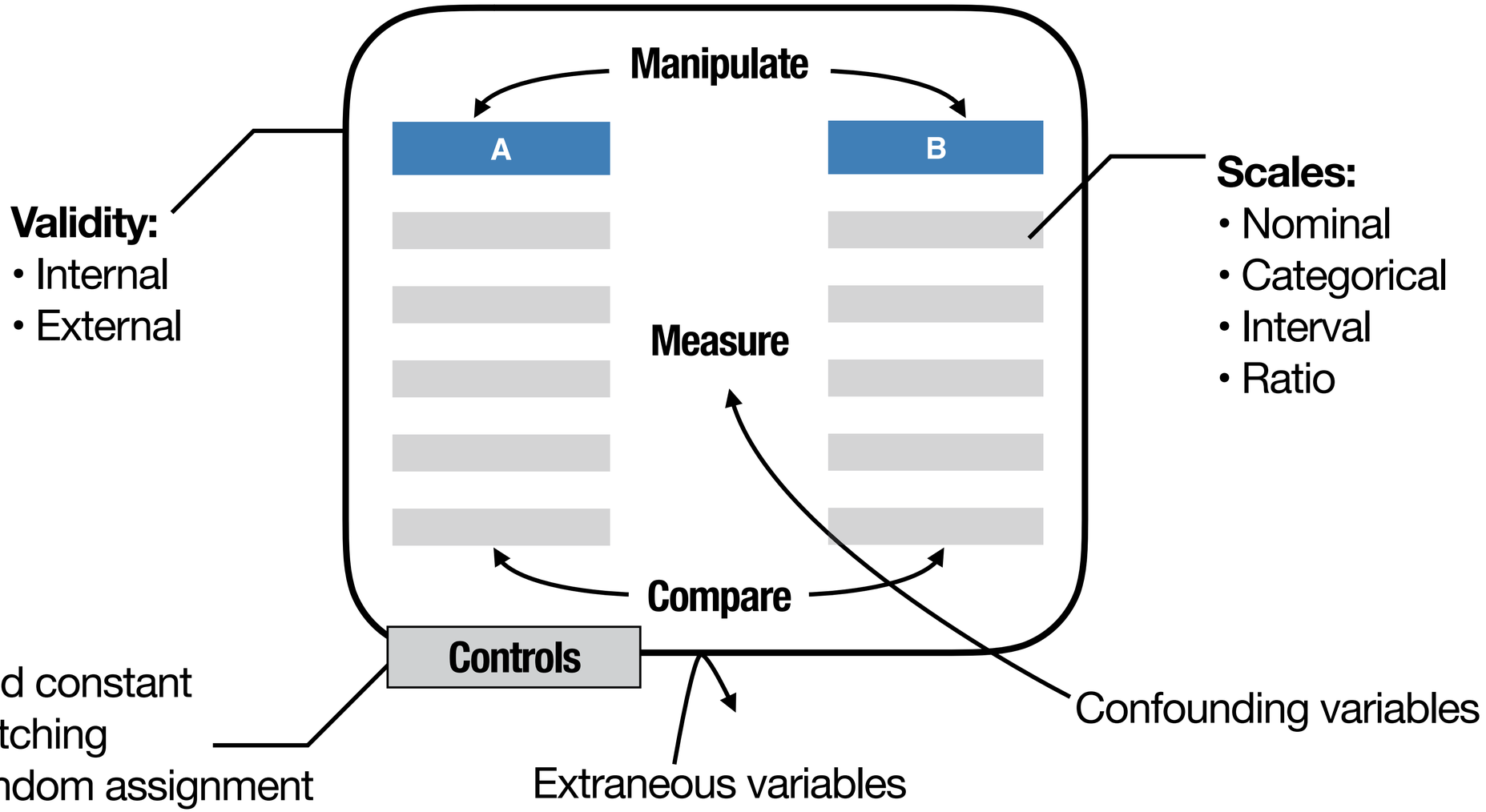
# Operationalization

- **Research Question:**
  “Young participants will have significantly better memory than older participants”
- How could we study this?
- Variables?
- Operationalization?

# Operationalization

- **Hypothesis:**
  “Participants aged between 16 and 30 years will recall significantly more nouns from a list of twenty nouns than participants aged between 55 and 70.”

# Basic Elements of Experimental Study



# Basic Elements of Experimental Studies

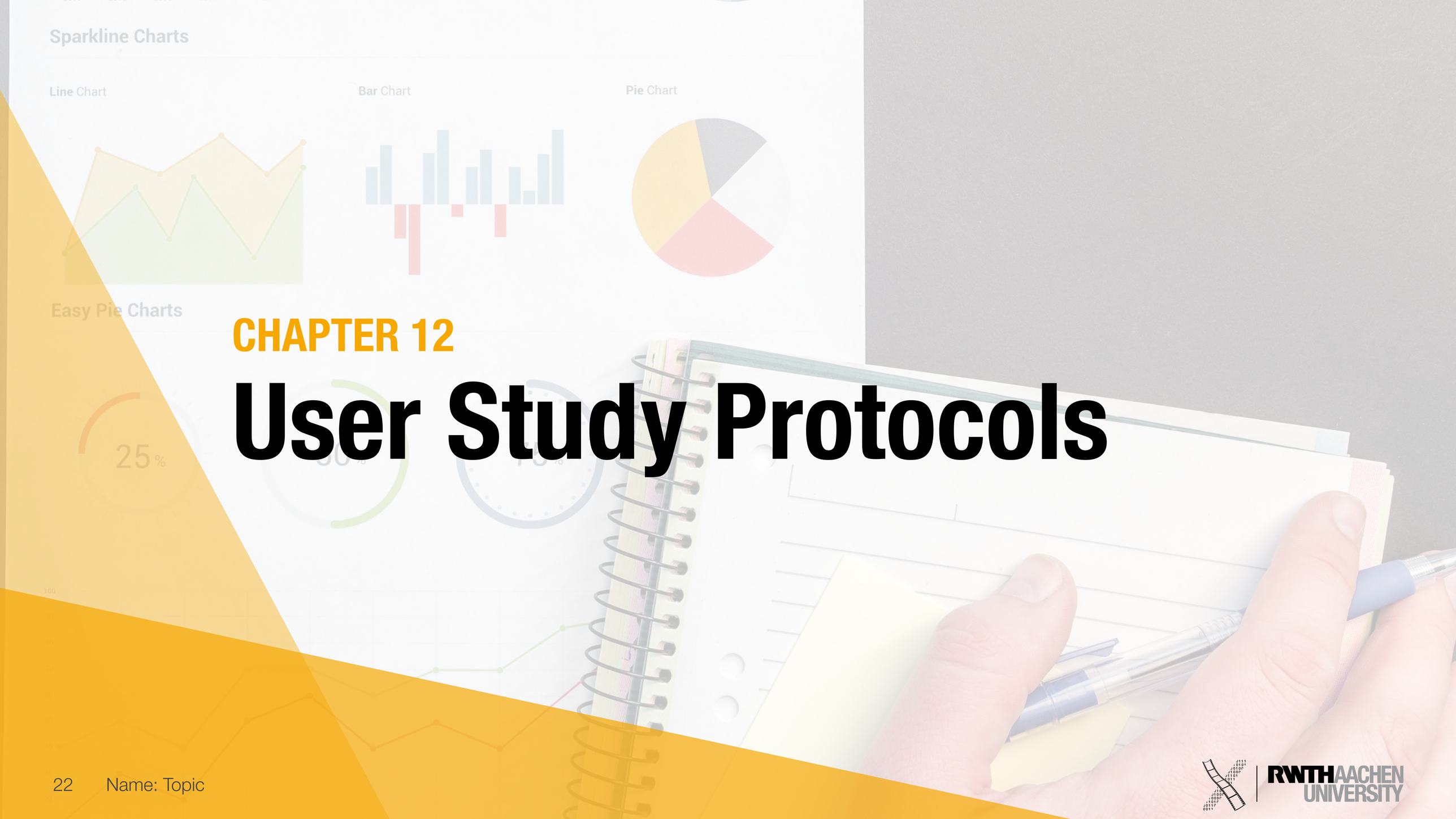
- **Manipulation:** Changing the value of the independent variable to create treatment conditions
- **Measurement:** Measure the value of the dependent variable in each treatment condition
- **Comparison:** The score of one treatment condition is compared with another. Consistent differences between treatments ⇒ evidence of causality
- **Control:** Other variables are controlled to be sure that they do not influence the two variables being examined



Definitions from Gravetter and Forzano

CHAPTER 12

# User Study Protocols



# User Study Protocol*

- A document that explicitly states why and how a research project is being conducted

- Purpose:
  - Clearly state the **research question** and **hypotheses**
  - **Plan** the **research procedure** in detail
  - A **guide** for all involved personnel
  - **Monitor** research **progress**



*(O'Brien and Wright, 2002) How to write a protocol

# Context & Aim

## Research context:

- What is the **status quo**?
- What are the **problems/disadvantages** to this?
- What is your plan to **improve** this?

## Aim:

- Describe the purpose of **this study** to tackle the problems mentioned in the context.

# Variables

A clear list of your variables including a short description, all levels and scales

## Independent Variables:

**Device Size:** The size of the input surface.

- Levels:
  - SMALL: 66 mm x 50 mm (4:3 aspect ratio, a covered iPod was used for this)
  - LARGE: 196 mm x 147 mm (4:3 aspect ratio, iPad was used for this)

## Dependent Variables:

**Targeting Error**: Distance in mm from center of the first touch point to the target's center (ratio scale).

# Hypotheses

- Should clearly describe the relationship of your IV and your DV
- You can also group your IVs
- Be sure it's clear what variables you're talking about (IV & DV)
  - not “the performance of A is better”
- Clearly state your expectations (not “there will be a difference”)

*“Blender conditions will decrease success rate and increase number of failed attempts & targeting errors”*

# Task Section

Should include all information a participant needs to know to **do the task with confidence.**

What's the **main set of operations** the participant has to perform?

- *Tap on the input device to hit a target on the screen.*

What happens after an **erroneous attempt**?

- *The target colors red, and the participant has four more trials to hit the target.*

When do you **collect data points**?

- *An error is measured when the first attempt was not successful.*

Should the participants **focus on speed or accuracy**?

# Experiment Procedure

Includes all information about what happens in the study as a full step-by-step list (as detailed as possible)

- Introducing the participant to the purpose of your study
- Explain what s/he has to do during the complete session (not only the task)
- Describe when they have to do the task, fill out questionnaires, can take breaks,…
- Are there any compensations, costs or risks?

# Participant Section

Describe your **target group**:

- Demographics: Age, handedness, sex, …

This is also the place to note the required number of participants

- Often depends on IVs

# Experimental Design

- Within- or between-subjects design?
- How do you care about order effects?
  - Which variables are counterbalanced, randomized, intentional order?
- Summary of the collected data (sample calculation):
  *(12 participants) × 3 INPUT CONDITION × 2 DEVICE SIZE × 3 BLOCK × 3 TARGET SIZE × 9 TARGET POSITION × 3 Repetitions*
  *= 17,496 total trials*

# Apparatus

Describe the software and the hardware

- Computer specifications
- UI toolkit
- Network communication
- Placement of the hardware
- ...

# Result Section

Briefly describe how you **plan to analyze** your data.

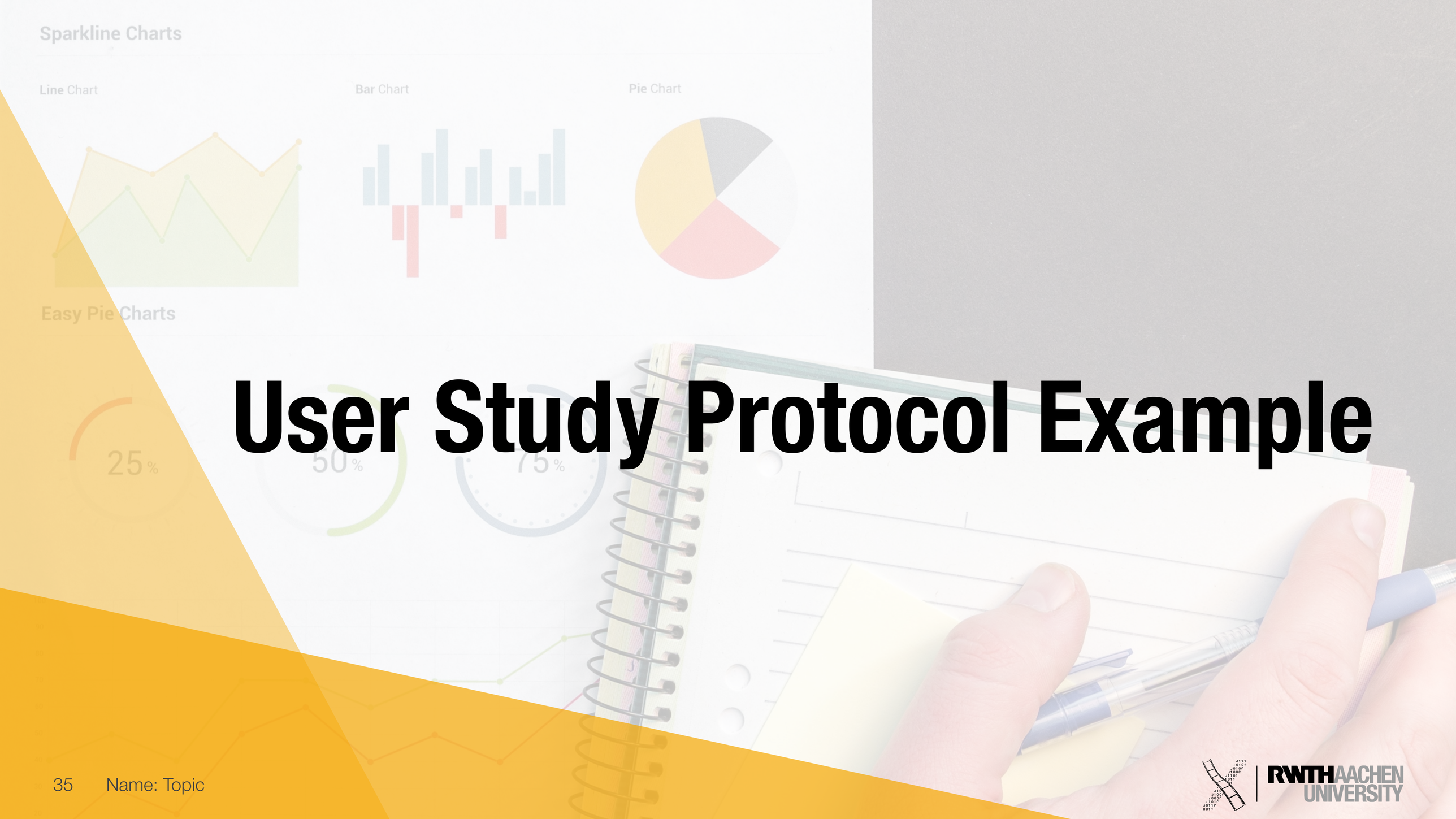
# References

Include all the references you used **in the protocol** (e.g., in your context section).

# Applications of the Protocol

In the end the conductor can

- Quickly setup the study environment using the **Apparatus section.**
- Explain the participant the study procedure using the **Procedure section.**
  - The conductor has a checklist for the procedure!
- Explain the participants their task using the **Task/Variables sections.**
- Quickly start first statistical analysis using the **Result section.**
- Give the protocol to other researchers to repeat the study.




# User Study Protocol Example

# Example Protocol: The Research Problem

- Title - “Evaluating the performance of a new keyboard layout”
- Research problem - “We intend to find if our new keyboard layout performs faster and with less errors than the QWERTY keyboard. The new layout would lead to smaller form factors.”
- Context - “There have been many new layouts that appear to perform faster than QWERTY but lead to fatigue [X, Y, Z]”
- Aim (derived from context)
- Hypotheses - “There is no difference in typing speed between the new layout and QWERTY”

# Protocol Structure: The Research Method 1/2

- Independent variables & dependent variables (levels, operational definition, measurement scale and unit)
- Task - “The user will perform a composition task using statements from MacKenzie et al. (CHI 2003). The participant will do the following activities to complete the task…”
- Subjects/Participants (number, main characteristics, criteria to include or exclude them)
- Experimental design (within or between groups and how the conditions will be assigned)

# Protocol Structure: The Research Method 2/2

- Experiment setup and/or apparatus (such as hardware or special features in the testing space)
- Experiment procedure (what the experimenter will do to setup the testing space)
- Data analysis methods
- References
- Include images or sketches if informative
- Write this section in future tense

# Extranous Variables

- Situational
  - Control
- Participants
  - Counterbalance
- Experimenter bias
  - Clear procedure

# In-class Exercise: Reconstruct a Protocol

- Watch paper video
- Look at the User Study section in the given paper
- Reconstruct the protocol
- Evaluate against the authors' protocol
- How did the paper attempt to establish internal and external validity?

# Understanding Finger Input Above Desktop Devices

hci.rwth-aachen.de/fins

Chat Wacharamanotham
Kashyap Todi
Marty Pye
Jan Borchers

CHI 2014
Room 718A
April 29th, 9:00 – 10:20

Source

# Protocol Evaluation Check List

- Is the research question stated clearly?
- Is there any alternative interpretation of the question?
- Suppose you can accept the stated hypotheses, does it contribute to the understanding of the research question?
- Are variables defined clearly on the operational level?
- Is there more than one possible interpretation for the variables?
- Is the experimental design chosen carefully with consideration of the trade-offs?
- Are the statistical methods specified?
- Are the resources needed to conduct the experiment stated?
- Is the duration of the experiment appropriate?
- Ultimate question: If you had no idea about the experiment before, could you pick up this protocol, set up, and conduct the experiment? (Replicability)

# Literature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