Current Topics in Human–Computer Interaction

Seven Research Contribution Types • Reading Papers • Contribution & Benefit Statement

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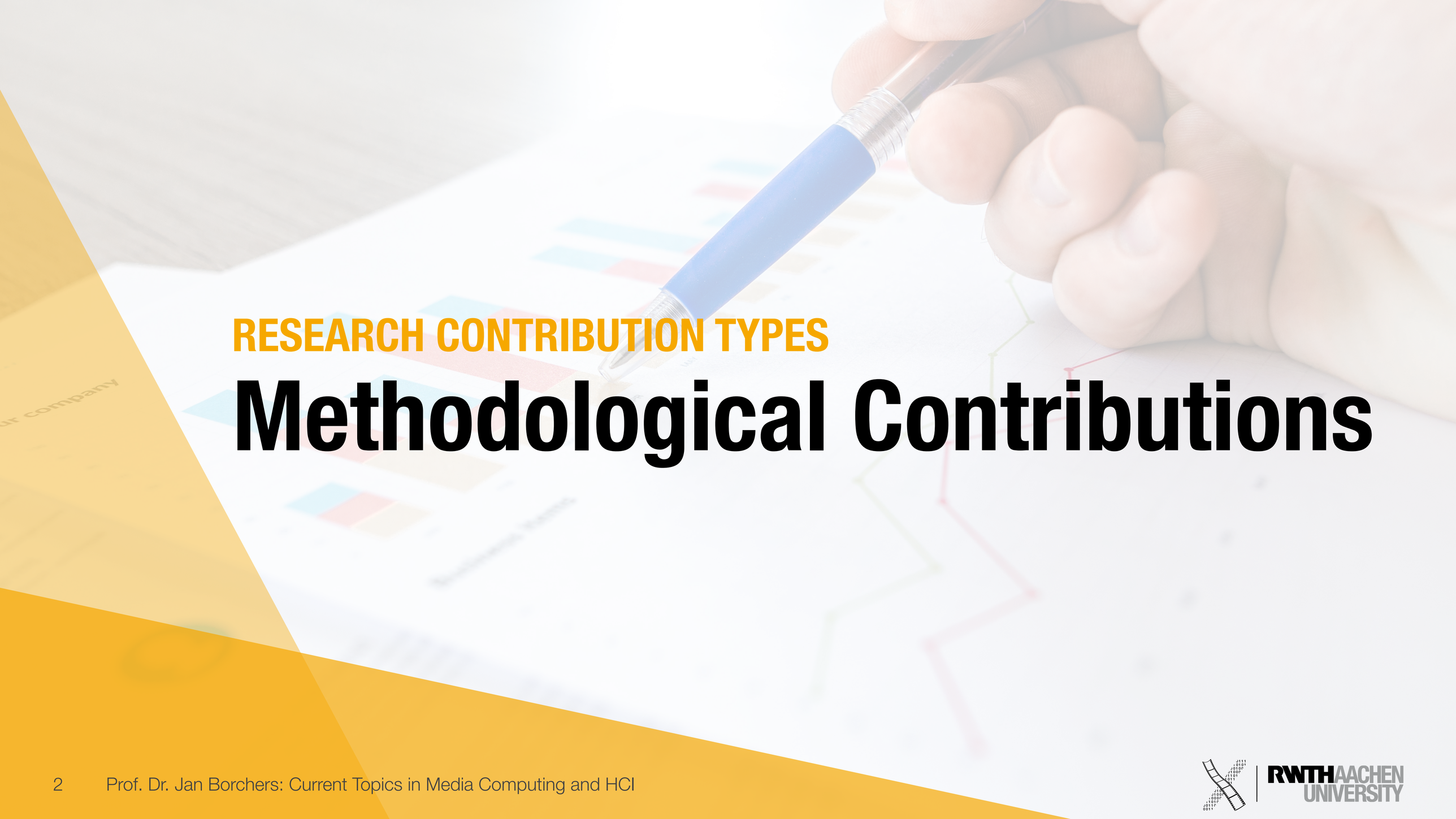


RESEARCH CONTRIBUTION TYPES

Methodological Contributions

Methodological Contributions

- Knowledge to **improve** how we do science and design, how we discover, measure, analyze or build things in research and practice

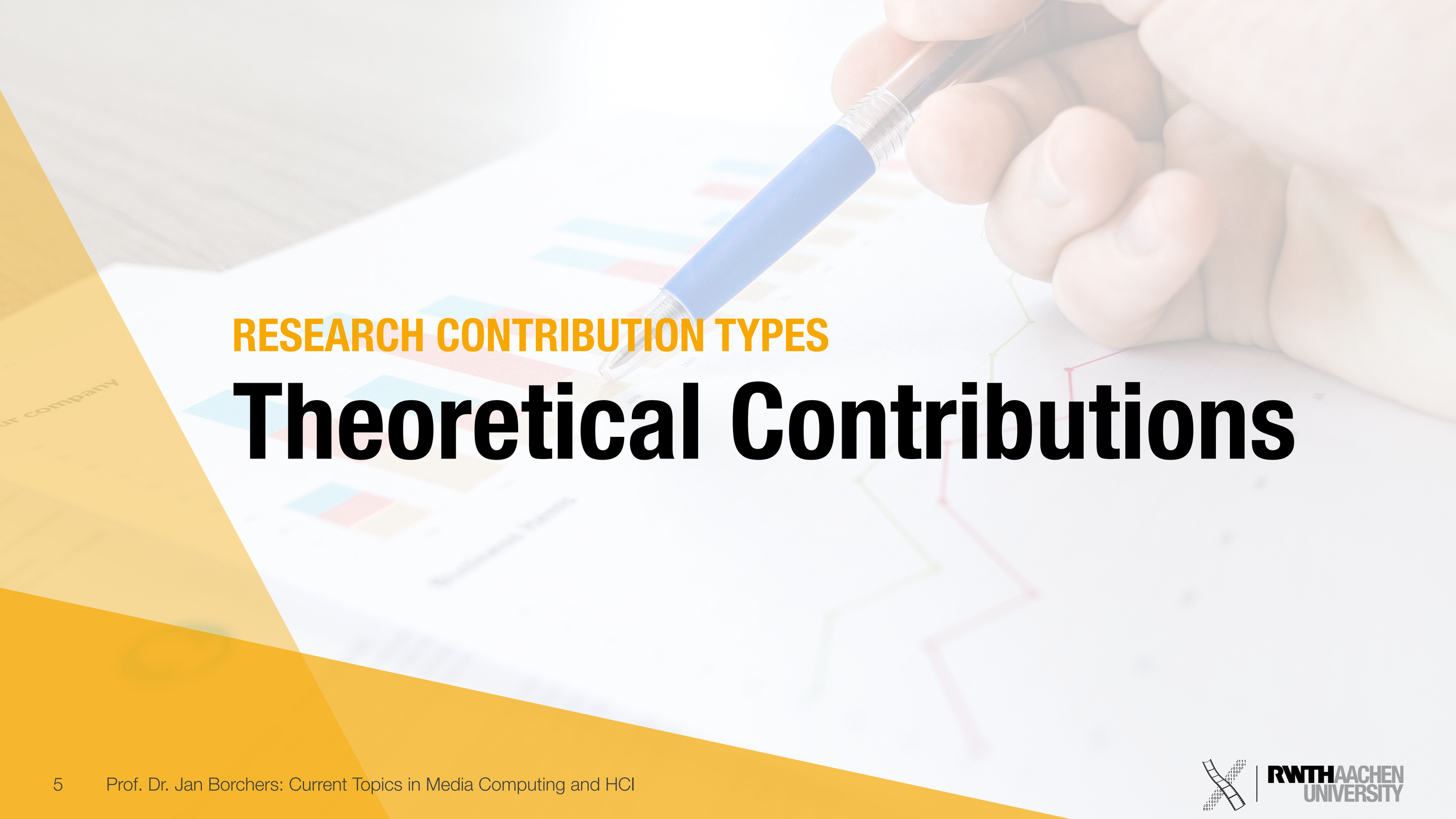
- Evaluated based on:
  - Utility
  - Reproducibility
  - Reliability

- Requires **repeated validations**

Example: Metrics for text entry research

- Soukoreff and MacKenzie developed **a new set of statistics to evaluate input errors** in keyboard-based text entry (published at CHI ’03)

- **Method for empirical experiments**
  - E.g., TOTAL ERROR RATE (new metric) combines errors committed but corrected and errors left in the transcribed text
  - Results analyzed with new and old statistics showed **similar numerical performance**



RESEARCH CONTRIBUTION TYPES

Theoretical Contributions

Theoretical Contributions

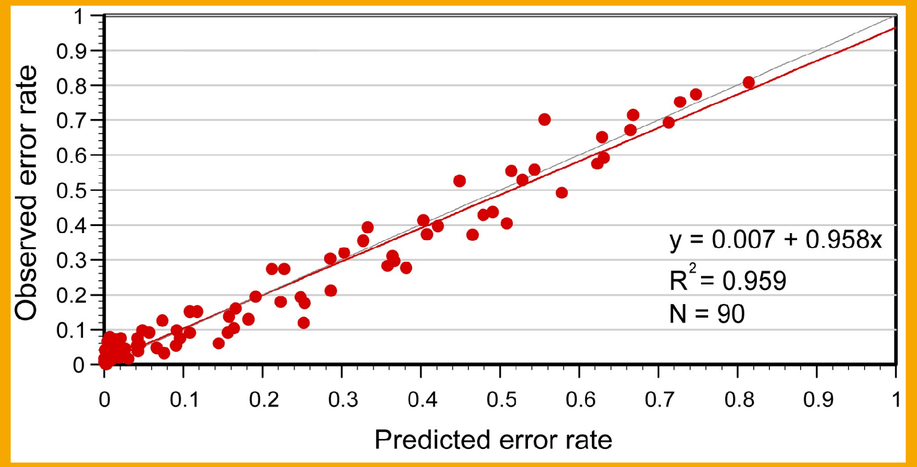
- Knowledge about what and why we do things, and our expectations
- Have descriptive and/or predictive power
  - Describe what would happen and explain why it occurs
- New **concepts**, **definitions**, **principles**, **models**, or **frameworks**
- Must be **testable** and **falsifiable**
- **Evaluated using empirical methods** based on novelty, soundness, power to describe, predict or explain, and ability to generalise

Example: Fitts' Law Error Model

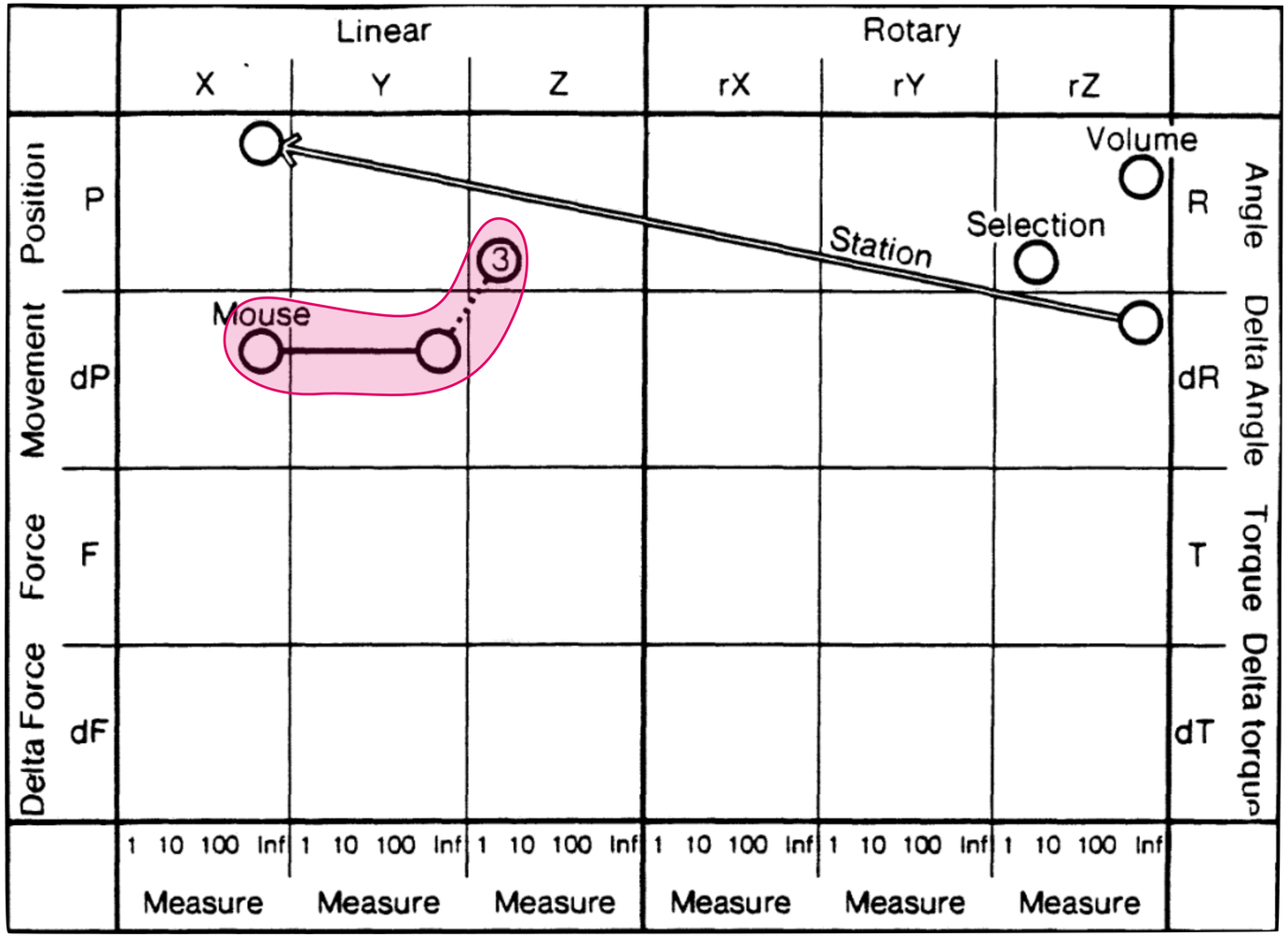
- Wobbrock et al. mathematically derived a predictive error rate model from Fitts' law, and evaluated the validity of that model (published at CHI '08)

- **Theoretical contribution**
  - Mathematically derived error rate model

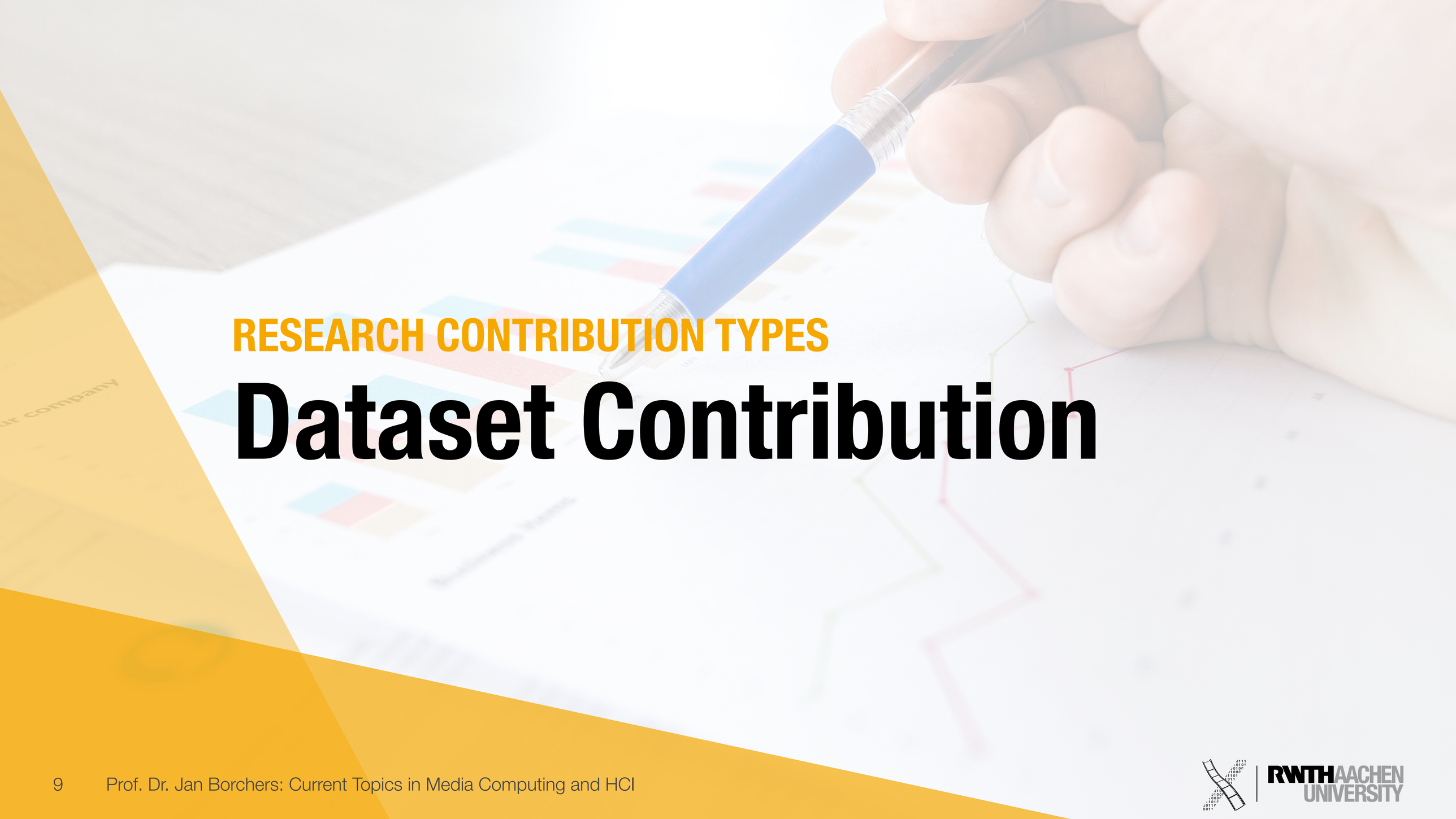
- **Empirical evaluation**
  - Manipulated Fitts' law parameters
  - Found that observed results correlate strongly with predicted results



Example: Input Devices Design Space



Card et al., The design space of input devices, CHI '90



RESEARCH CONTRIBUTION TYPES

Dataset Contribution

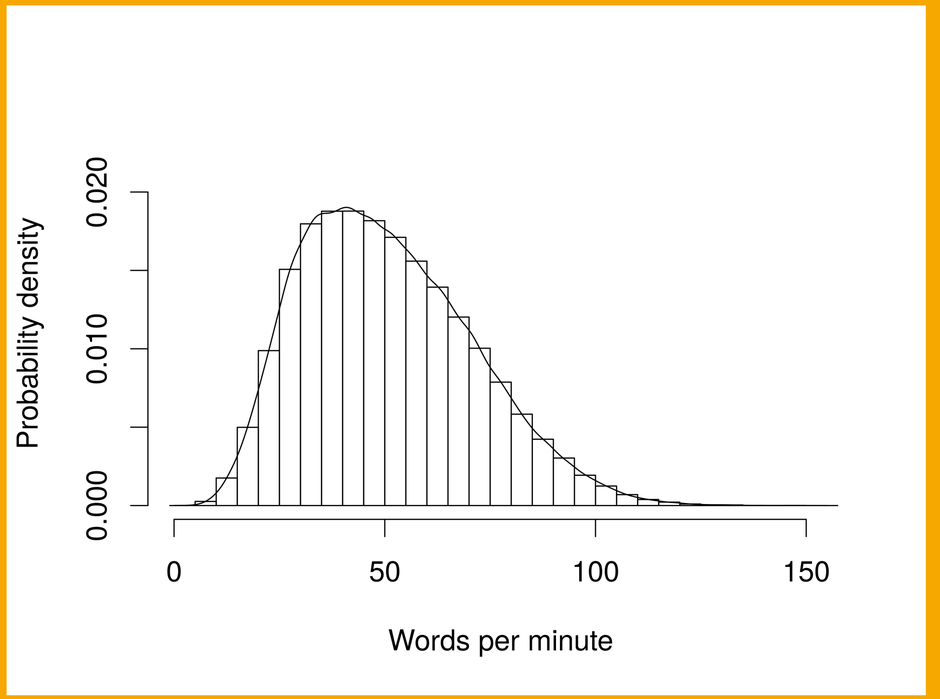
Dataset Contributions

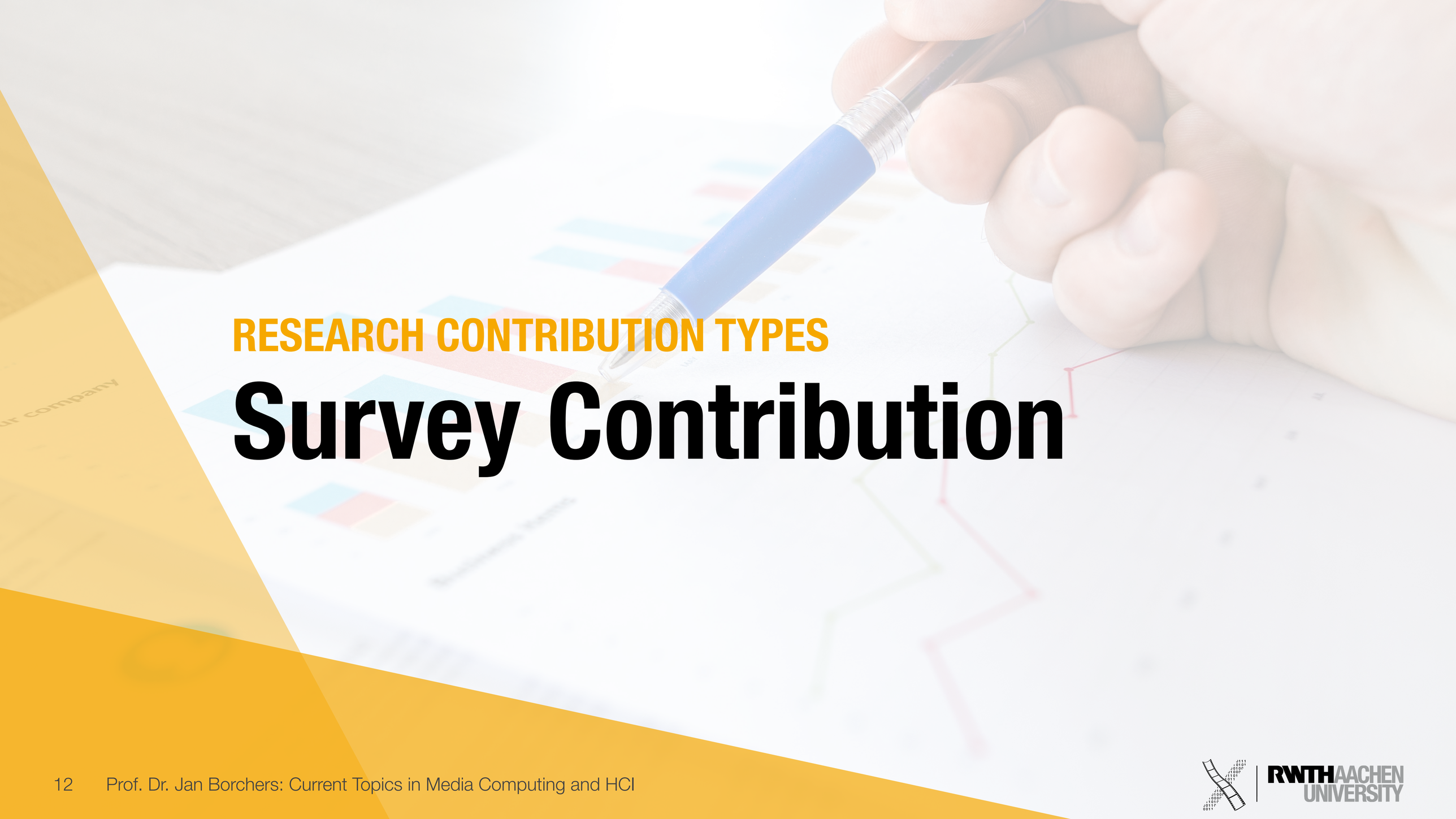
- Corpus of **raw data points** including an **analysis of its characteristics**
- Standardized datasets enable comparing:
  - Algorithms
  - Systems
  - Methods
- Evaluation:
  - Usefulness and representation of the data to the research community
- Usually **accompanied by tools** that allow viewing the data and applying it

Example: The 136M Keystrokes Dataset

- Dhakal et al. generated a **data set** (N=168,593) containing keystroke entries and provided an analysis (published at CHI ’18)

- Example Data Points
  - Presented sentence
  - Written sentence
  - For each Keypress
    - Press timestamp
    - Release timestamp
  - Keyboard layout





RESEARCH CONTRIBUTION TYPES

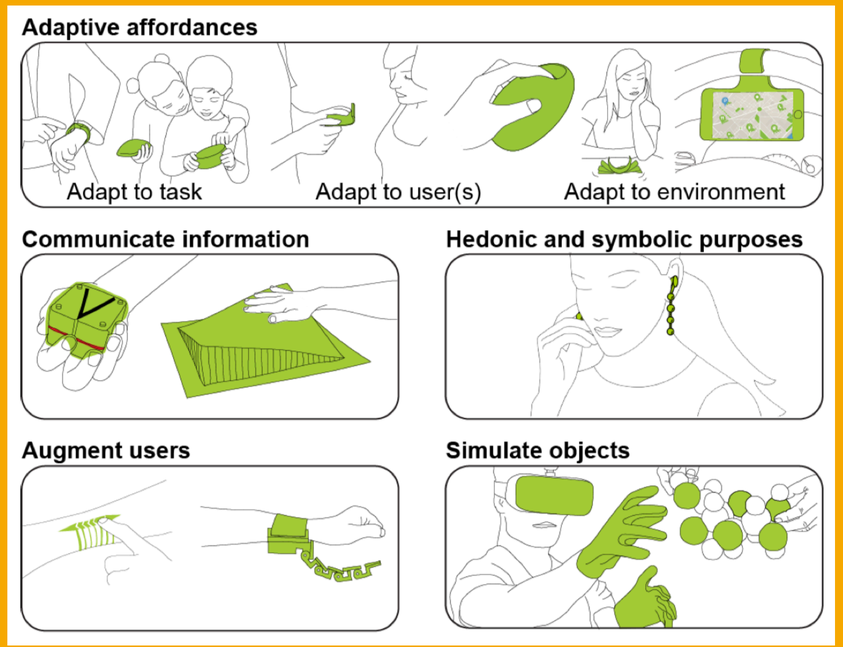
Survey Contribution

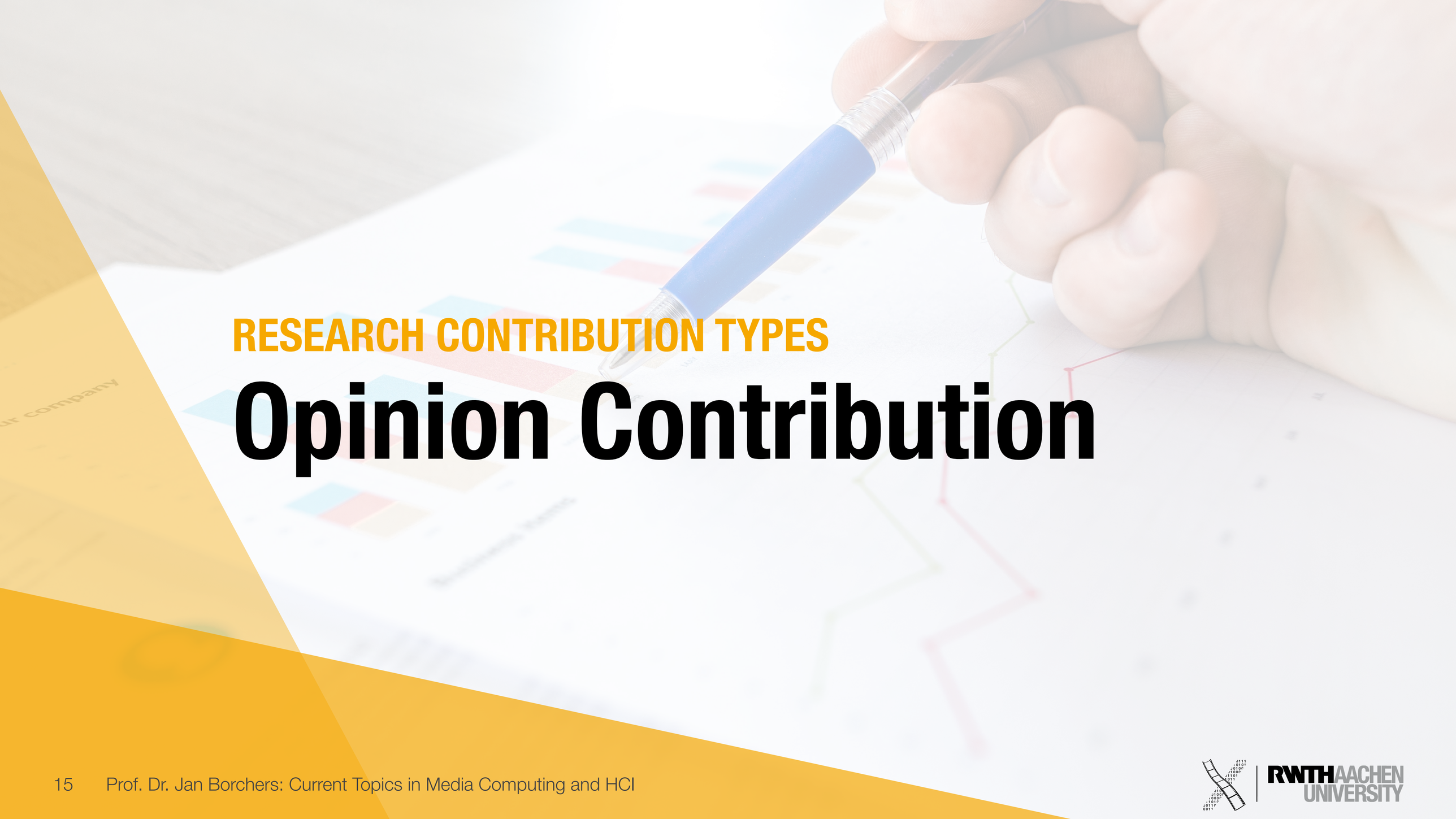
Survey Contributions (“Review Articles”)

- A meta-analysis or synthesis of existing research, to detect trends and gaps
- Evaluated based on completeness, depth, maturity, organisation, and the opportunities they reveal for further research
- Not a mere list of related work

Example: Shape-Changing Interfaces

- Alexander et al. **survey challenges** for **shape-change research** across different fields like engineering, robotics etc.
  (published at CHI ’18)
  - Identifies 12 grand challenges
  - Highlights the importance and opportunities of these challenges





RESEARCH CONTRIBUTION TYPES

Opinion Contribution

Opinion Contributions

- Aim to **persuade**, not just inform
- Goal is to **initiate reflection, discussion, and debate**
- Build upon the other contribution types to make their case
- Evaluated based on:
  - Strength of the arguments
  - Supporting evidence
  - Consideration of the opposing perspectives
- Often by established researchers and for a broader audience

Example: Usability Evaluation Considered Harmful

- Greenberg et al. argued that usability evaluations are not always the right technique (published at CHI ’08)
  - **Claims:**
    - Usability evaluation can be ineffective if just done ‘by rule’ rather than ‘by thought’
    - But of course, it is still important, especially in the early stages of development ⇒ DIA cycle
    - Need to look at every usability evaluation individually

In-class Exercise: Identify Research Contributions

- Empirical
- Artifact
- Methodological
- Theoretical
- Dataset
- Survey
- Opinion

Abstract 1

Empirical • Artifact • Methodological • Theoretical • Dataset • Survey • Opinion

01 In this paper, we present an empirical analysis of deceptive visualizations.
02 We start with an in-depth analysis of what deception means in the context of data visualization,
03 and categorize deceptive visualizations based on the type of deception they lead to.
04 We identify popular distortion techniques and the type of visualizations those distortions can be
05 applied to, and formalize why deception occurs with those distortions.
06 We create four deceptive visualizations using the selected distortion techniques, and run a
07 crowdsourced user study to identify the deceptiveness of those visualizations.
08 We then present the findings of our study and show how deceptive each of these visual distortion
09 techniques are, and for what kind of questions the misinterpretation occurs.
10 We also analyze individual differences among participants and present the effect of some of those
11 variables on participants' responses.
12 This paper presents a first step in empirically studying deceptive visualizations, and will pave the
13 way for more research in this direction.

Pandey et al., How Deceptive are Deceptive Visualizations?: An Empirical Analysis of Common Distortion Techniques, CHI '15

Abstract 2

Empirical • Artifact • Methodological • Theoretical • Dataset • Survey • Opinion

01 We present the bubble cursor - a new target acquisition technique based on area cursors.
02 The bubble cursor improves upon area cursors by dynamically resizing its activation area
03 depending on the proximity of surrounding targets, such that only one target is selectable
04 at any time.
05 We also present two controlled experiments that evaluate bubble cursor performance in
06 1D and 2D target acquisition tasks, in complex situations with multiple targets of varying
07 layout densities.
08 Results show that the bubble cursor significantly outperforms the point cursor and the
09 object pointing technique [7], and that bubble cursor performance can be accurately
10 modeled and predicted using Fitts' law.

Grossman et al., The Bubble Cursor: Enhancing target acquisition by dynamic resizing of the cursor’s activation area, CHI ‘05

Abstract 3

Empirical • Artifact • Methodological • Theoretical • Dataset • Survey • Opinion

01 The defining characteristics of autism, including difficulty with nonverbal cues and need for
02 structure, and the defining characteristics of computer-mediated communication (CMC), including
03 reduction of extraneous cues and structured exchange, suggest the two would be an ideal match.
04 Interviews and observations of 16 adults on the high-functioning end of the autism spectrum
05 reveal that many seek greater social connectedness and take advantage of interest-based online
06 communities to foster successful, supportive relationships.
07 However, CMC intensifies problems of trust, disclosure, inflexible thinking, and perspective-
08 taking, making it difficult for some to maintain relationships. Interventions in the form of
09 information visualization and CMC- specific social skills training are presented.
10 Intervention considerations and participatory design opportunities are discussed.

Burke et al., Social use of computer-mediated communication by adults on the autism spectrum, CSCW '10

CHAPTER 2

How to Read a Scientific Paper

How to Read A Scientific Paper

- Reading: '**How to Read a Scientific Article'** (Purugganan & Hewitt 2004)

1. Read the **title**, determine your interest

2. **Skim** the **paper** and identify the **structure**
   - **AIMRD** structure: Abstract, Introduction, Methods, Results, and Discussion

3. Read **abstract**: motivation, research problem, methodology, some results & conclusion

4. Jump to **figures**: identify experiments and results

5. At this point you decide whether to continue, store it for later, or discard it

How to Read A Scientific Paper

- **Abstract**
  - Purpose or rationale of study (why they did it)
  - Methodology (how they did it)
  - Results (what they found)
  - Conclusion (what it means)

How to Read A Scientific Paper

- **Introduction**
  - Purpose: create interest, clarify the domain
  - Common knowledge statement (broad)
  - What is known about the topic
  - What is not known
  - What question the authors asked and answered (specific)
- **Related work**
  - Similar work and base knowledge

How to Read A Scientific Paper

- **Methods** (more on that next week)
  - What experiments were done
  - What variables were considered
- **Results** (objective)
  - Statements of what was found (from observation & data analysis), and reference to the data in figures and tables
- **Discussion**
  - Shows how results (don’t) answer the authors’ question
  - Identifies unexpected findings

After reading, ask yourself:

- What specific **problem** does this research address? Why is it important?
- Is the **method** used a good one? The best one?
- What are the specific **findings**? Am I able to summarize them in short?
- Are the findings supported by persuasive **evidence**?
- Is there an **alternative interpretation** of the data that the author did not address?
- How are the **findings unique/new/unusual** or supportive of other work?
- How do these results relate to the **work I am interested** in?

CHAPTER 3

Contribution and Benefit Statements

Contribution and Benefits

- Reading: ‘Statement of Contribution and Benefits’ (Newman 2002)
- Describes the **contribution made** by the paper to HCI and the **benefit to people**
- **30 words** or less
- Examples:
  - *Describes a camera-based technique for tracking a laser pointer on a large display, and appropriate interactor widgets: provides an inexpensive way to support group interaction with one display.*
  - *Offers guidelines for the design of interfaces to be used by brain-injured people via the Cyberlink interface; usage can lead to improved communication by the brain-injured.*

Contribution

- The generic nature of the contribution and its **type** (technique, system, model)
  - ***A technique*** *for tracking a pointer on a large display*
  - ***Guidelines*** *for the design of interfaces to be used by brain-injured people*

- How it is **unique**
  - *A* ***camera-based*** *technique for tracking a pointer on a large display*
  - *Guidelines for the design of interfaces to be used by brain-injured people via the* ***Cyberlink interface***

Benefit

- If several benefits, choose the main one
- The nature of the benefit
- **Improvement** generated by it
  - ***Cost*** *of supporting group interaction is* ***reduced***
  - ***Communication*** *by the brain-injured is* ***improved***

More Examples

- Describes a system providing an audio background whilst a paper-based book is read; a way of applying interactive audio technology to enrich the reader's experience.

- Presents findings concerning the effect of input device size on steering tasks: can assist designers in optimally sizing input devices.

- Finds differences in the effectiveness of three tools for building GOMS models, when examined in terms of four criteria; offers recommendations for improvements in future GOMS tools.

- Presents a case study of a mixed-reality performance, offering observations about participants' experiences; suggests how participant engagement might be enhanced.

In-class Exercise: Write a Contribution and Benefit Statement

Improving command selection with CommandMaps

Joey Scarr, Andy Cockburn, Carl Gutwin, and Andrea Bunt. CHI 2012.

Designers of GUI applications typically arrange commands in hierarchical structures, such as menus, due to screen space limitations. However, hierarchical organisations are known to slow down expert users. This paper proposes the use of spatial memory in combination with hierarchy flattening as a means of improving GUI performance. We demonstrate these concepts through the design of a command selection interface, called CommandMaps, and analyse its theoretical performance characteristics. We then describe two studies evaluating CommandMaps against menus and Microsoft's Ribbon interface for both novice and experienced users. Results show that for novice users, there is no significant performance difference between CommandMaps and traditional interfaces—but for experienced users, CommandMaps are significantly faster than both menus and the Ribbon.

What to Do Now

- Begin working on the first assignment about searching and evaluating papers
- It will be discussed in the lab next week

Otherwise, see you **tomorrow** at the lab where we will practice identifying Research **Contribution Types** and writing **Contribution and Benefit Statements** 👋