

# CTHCI



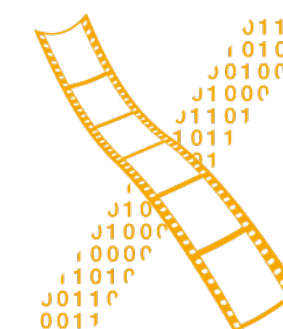
## Current Topics in Human–Computer Interaction

Seven Research Contribution Types ct'd • Reading Papers • Contribution & Benefit Statement

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

Summer Semester '26

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

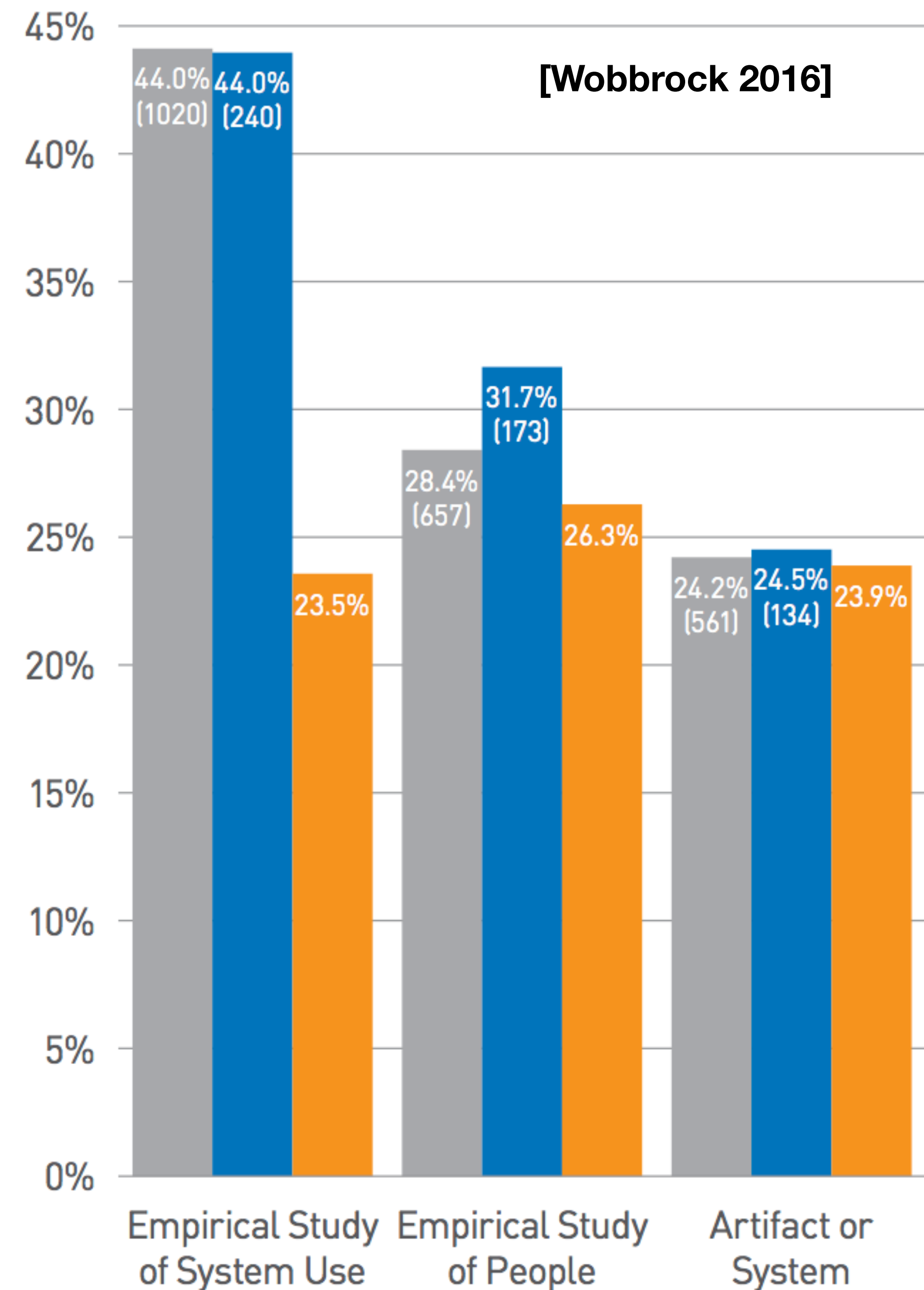


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# Review

- How will your grade be computed?
- What is plagiarizing?
- What are empirical contributions?
- What is an artifact contribution?

*For the lab, collect ideas for empirical and artifact contributions*



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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**
- Usually harder than single artifacts or empirical studies

# 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)
- Contribution: a **new method** for such experiments
  - E.g., new metric TOTAL ERROR RATE combines errors committed but corrected and errors left in the transcribed text
- Validation: Results analyzed with new and old statistics showed **similar numerical performance**

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**RESEARCH CONTRIBUTION TYPES**

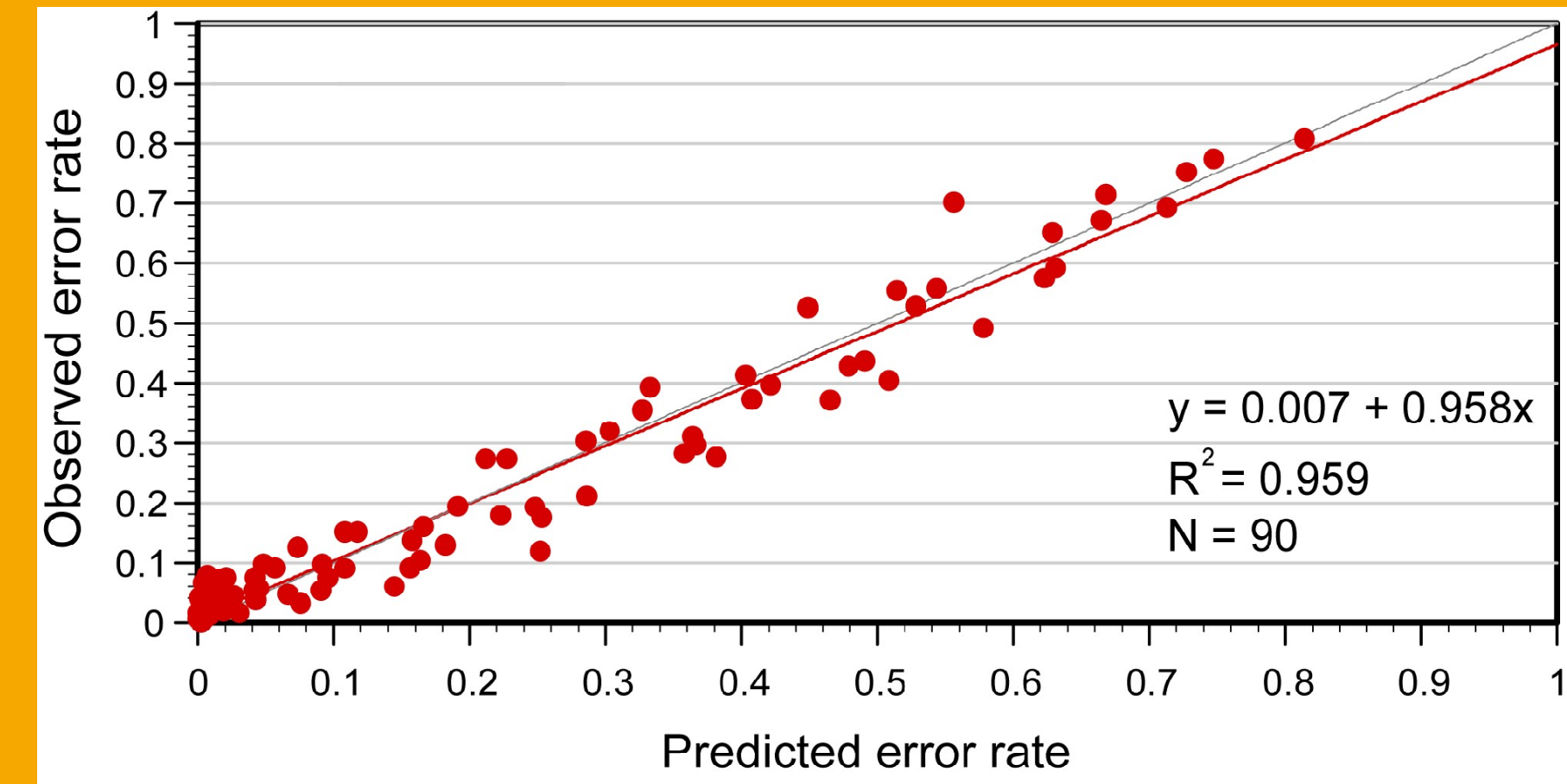
# Theoretical Contributions

# Theoretical Contributions

- Knowledge about **what** we do and **why**, and our expectations
- Quantitative or qualitative
- 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

DIS II Topic

		Linear				Rotary						
		X	Y	Z	rX	rY	rZ					
Position	P									Volume	R	
	dP	Mouse						Station		Selection	dR	
Force	F										T	
	dF										dT	
		1 10 100 Inf	1 10 100 Inf	1 10 100 Inf	1 10 100 Inf	1 10 100 Inf	1 10 100 Inf	1 10 100 Inf	1 10 100 Inf			
		Measure			Measure			Measure				

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



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**RESEARCH CONTRIBUTION TYPES**

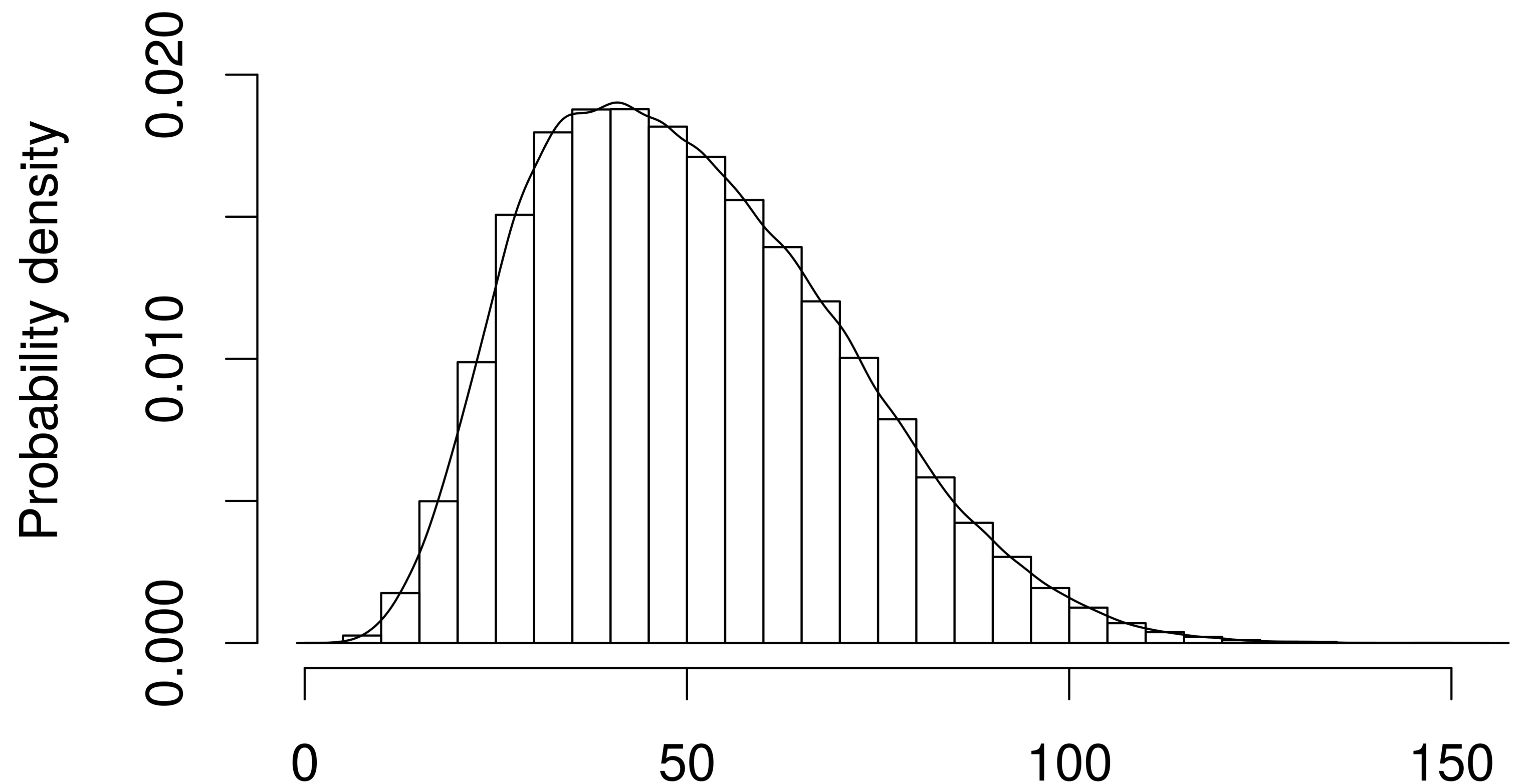
# **Dataset Contributions**

# Dataset Contributions

- Corpus of **raw data points** including an **analysis of its characteristics**
- Standardized datasets enable comparing:
  - Algorithms
  - Systems
  - Methods
- Evaluation:
  - How representative is the data? Is it useful 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 and analysed a **data set** (N=168,593) containing keystroke entries and provided an analysis (published at CHI '18: [DOI](#))
  - Presented sentence
  - Written sentence
  - For each Keypress
    - Press timestamp
    - Release timestamp
  - Keyboard layout



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**RESEARCH CONTRIBUTION TYPES**

# Survey Contributions

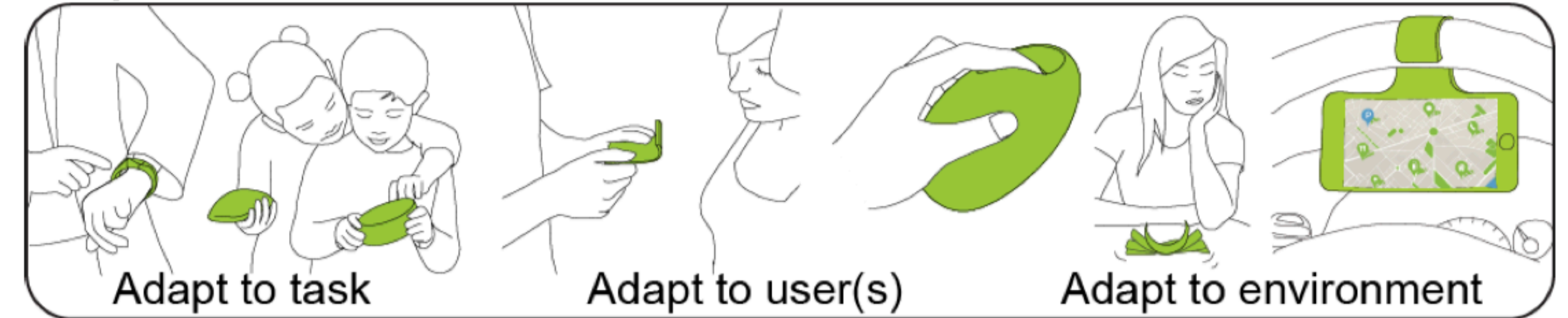
# Survey Contributions (“Review Articles”)

- A meta-analysis or synthesis of existing research, to expose trends and gaps
- Not a mere list of related work
- Evaluation:
  - Completeness, depth, maturity, organisation, opportunities for further research
- Similar to your seminar papers
- Sample journals:
  - Foundations and Trends in Human-Computer Interaction
  - ACM Computing Surveys

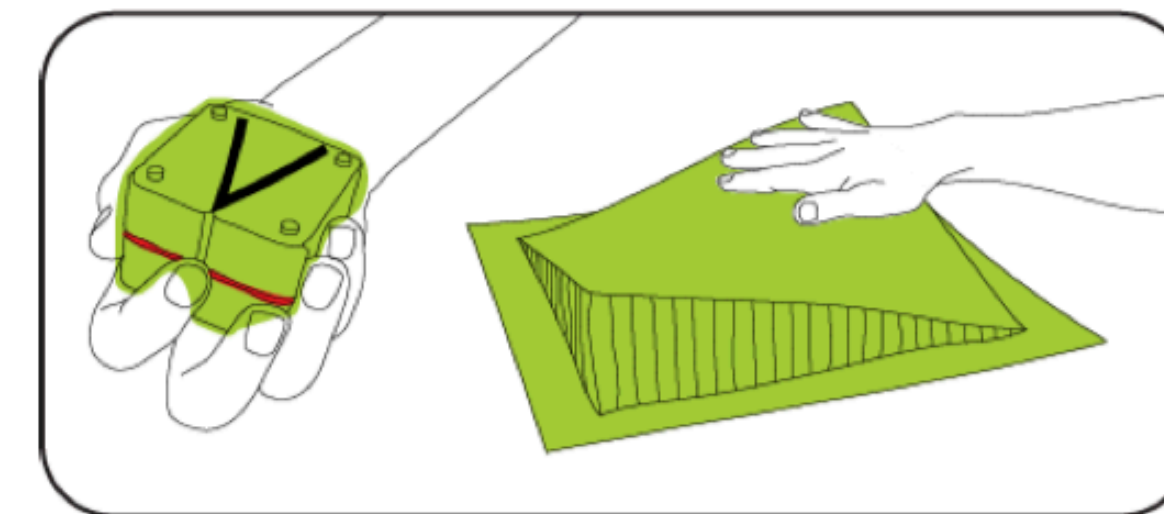
# Example: Shape-Changing Interfaces

- Alexander et al. **survey challenges for shape-change research** across different fields like engineering, robotics etc. (published at CHI '18: [DOI](#))
  - Identifies 12 grand challenges
  - Highlights their importance and opportunities
  - We used this for our SKIRIM grant proposal

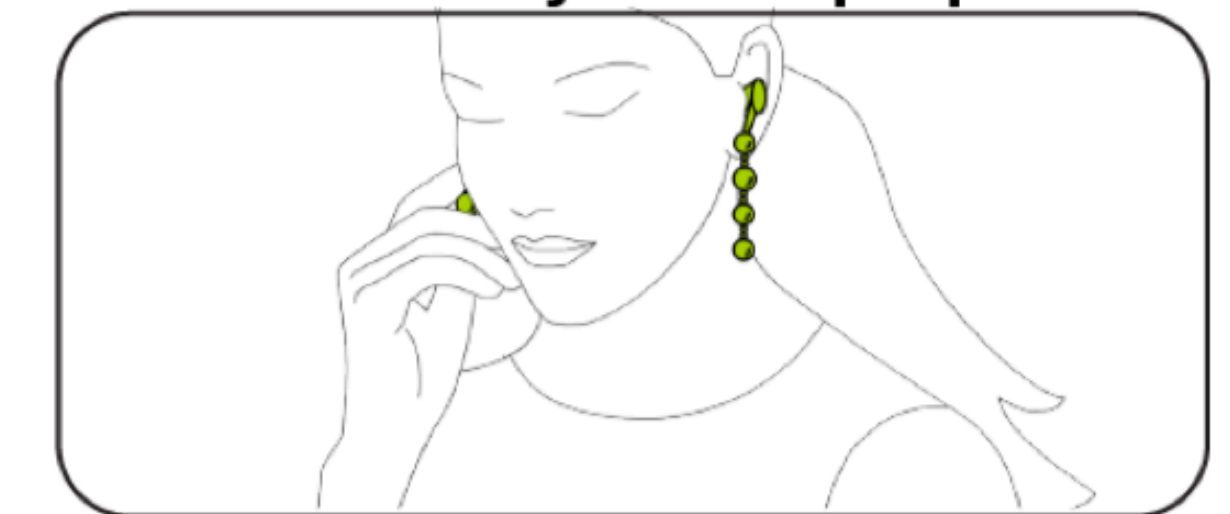
## Adaptive affordances



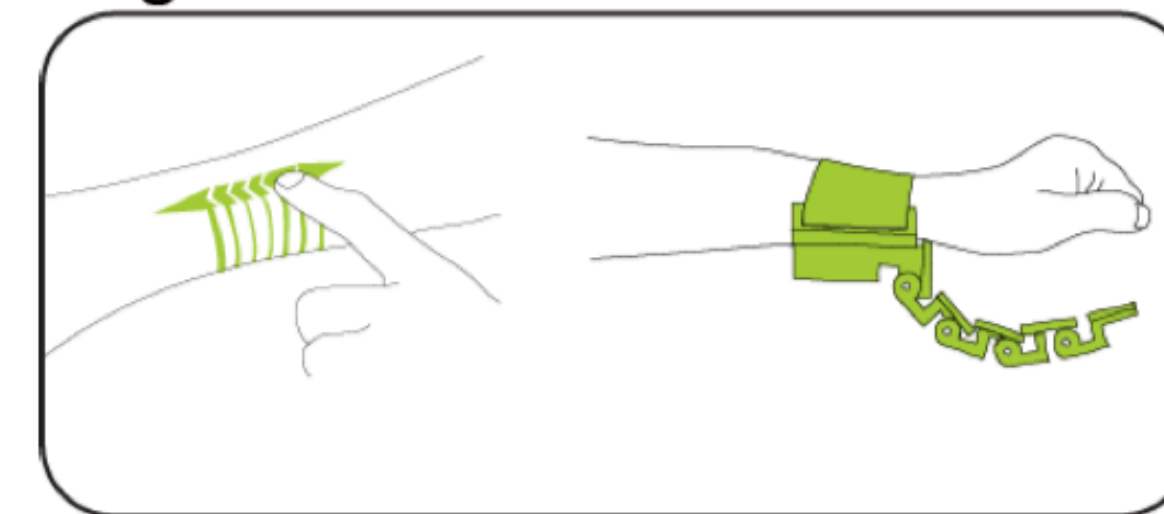
## Communicate information



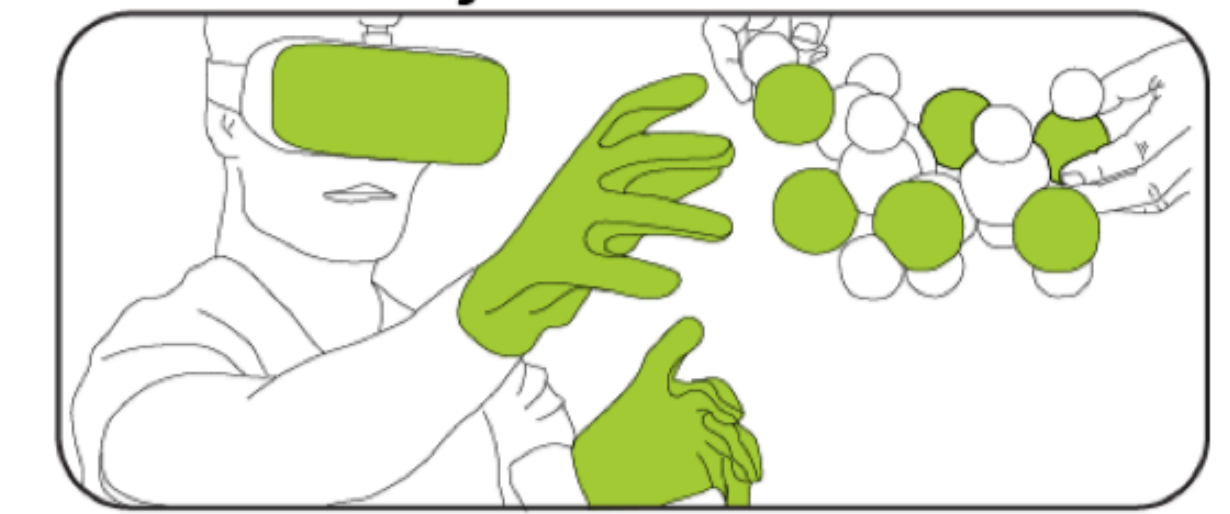
## Hedonic and symbolic purposes



## Augment users



## Simulate objects



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**RESEARCH CONTRIBUTION TYPES**

# **Opinion Contributions**

# 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 arguments
  - Supporting evidence
  - Consideration of 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



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## CHAPTER 2

# The Structure of HCI Papers

# Structure of a (Good) HCI Paper

- **Abstract**
  - Describe the work, not the paper
    - Describe what was *done*
    - Describe what was *found*
  - Specific findings
  - 150–200 words

Required Read:  
“Catchy Titles Are  
Good: But Avoid  
Being Cute”  
Wobbrock 2015

[Wobbrock 2015]



# Structure of an HCI Paper

- **Introduction: 5-Point Structure**
  - State of the world...
  - BUT...
  - Therefore, we did... (1 par.)
  - The key findings are... (1 par.)
  - The contributions of this work are...
- “Absence from the literature” is the worst motivation (nobody cares?)
- 1–3 contributions itemized (often different *contribution types*)
- “Enables more research” is the worst outcome. What’s a real effect?

# Structure of an HCI Paper

- **Related Work (*similar to your seminar papers*)**
  - Other work relevant for your own. For each:
    - What was done?
    - What was found?
    - What was different?
    - No strings of citations without explanations
    - Not defensive
    - Grouped by themes
  - It's a teaching opportunity

[Wobbrock 2015]



# Structure of an HCI Paper

- **Design / Implementation** (if applicable; replicable by an expert; lots of figures here)
- **Methods** (replicable, more on that next week)
  - Qualitative or quantitative?
- **Results** (objective)
  - Reporting what was found (from observation & data analysis), and reference to the data in helpful figures and tables: “Tell a story with data”. Translate effects from raw numbers.
- **Discussion** (and limitations)
  - Shows how results (don't) answer the authors' question
  - What was interesting/surprising/unexpected? What matters?
- **Future Work and Conclusion** (zooming out, inspiring directions, popular press journalist stance)

[Wobbrock 2015]

# 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



# 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**?



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 gray with a white diagonal line. The text 'CHAPTER 3' is in orange, and the main title is in large black font. The page number '30' and the author's name 'Prof. Dr. Jan Borchers: Current Topics in Media Computing and HCI' are in the bottom left. The RWTH Aachen University logo is in the bottom right.

**CHAPTER 3**

# **Contribution and Benefit Statements**

# Contribution and Benefits

- Required 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

## **DungeonMaker: Embedding Tangible Creation and Destruction in Hybrid Board Games through Personal Fabrication Technology**

*Evgeny Stemasov, Tobias Wagner, Ali Askari, Jessica Janek, Omid Rajabi, Anja Schikorr, Julian Frommel, Jan Gugenheimer, Enrico Rukzio. CHI 2024.*

Hybrid board games (HBGs) augment their analog origins digitally (e.g., through apps) and are an increasingly popular pastime activity. Continuous world and character development and customization, known to facilitate engagement in video games, remain rare in HBGs. If present, they happen digitally or imaginarily, often leaving physical aspects generic. We developed DungeonMaker, a fabrication-augmented HBG bridging physical and digital game elements: 1) the setup narrates a story and projects a digital game board onto a laser cutter; 2) DungeonMaker assesses player-crafted artifacts; 3) DungeonMaker's modified laser head senses and moves player- and non-player figures, and 4) can physically damage figures. An evaluation ( $n = 4 \times 3$ ) indicated that DungeonMaker provides an engaging experience, may support players' connection to their figures, and potentially spark novices' interest in fabrication. DungeonMaker provides a rich constellation to play HBGs by blending aspects of craft and automation to couple the physical and digital elements of an HBG tightly.

# 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** 🙌