Current Topics in Media Computing and HCI

Prof. Dr. Jan Borchers
Media Computing Group
RWTH Aachen University
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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 2014

• 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)
  • Coding and integrated development environment
  • Interactive surfaces and tangible UIs
  • Crowdsourcing and human computation
  • Augmented reality in HCI
  • Pattern language
  • Interactive television
  • Personal fabrication and personal design

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.A. Technical Communication (with focus on CS/HCI research)

• Prerequisite: DIS I
  • In class, assignments, and exams we assume that you know DIS I
Literature Sources

- Recent (usually last 2 years) conference papers
  - CHI, UIST, ITS, DIS, Ubicomp,…
  - Older seminal papers included
- Recent journal articles
  - TOCHI,…

Recent books
- Research Methods in HCI
  - Lazar et al. (2010)
- Recommended reading for more details about evaluation methods — especially if you are going to do your thesis at our chair!

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, 13:15–14:45 Attendance is compulsory!
  - Practice skills learned from the lecture and discuss reading and written assignments
  - 3 Written assignments (in groups)
  - 1 Mini HCI research project (in groups)
  - 1 Mock PC meetings (in groups)
- Extra supervision slots during mini project phase by appointment

Final Grade

- 30% midterm (June 3)
- 40% final (July 29)
- 5% × 3 written assignments
- 10% mini HCI research project
- 5% mock PC meeting
# CTHCI Team

**Prof. Dr. Jan Borchers**

**Chat Wacharamanotham, M.Sc.**  
chat@cs.rwth-aachen.de

**Topic presenters**

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## Learning Resources

- **Public website:**  
  [http://hci.rwth-aachen.de/cthci](http://hci.rwth-aachen.de/cthci)
- **L2P course room:** slides, literature, assignments
- **Lecture recordings on iTunes U**
  RSS links available on L2P
- **Research papers:** ACM Digital Library
  Free access from inside RWTH network

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## 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 human cognition and perception, objects are grouped in clusters of objects that seem similar to each other. This law is often used in psychology and related fields to explain how people group and categorize information.

**Law of Similarity**

The law of similarity states that objects 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:

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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.

Empirical Approach

- 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?”

Three Approaches to HCI Research

Empirical science

Test

Ethnography

Look

Engineering and design

Make
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”

Research Example: Pinstripe

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

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 among different areas on the body for pinching cloth.”

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 ⇒ 75 clips ⇒ 37 detailed transcriptions
- Analyzed the data to find common patterns/themes and construct theories that explain them

The normal natural troubles of driving with GPS
Available at: http://dl.acm.org/citation.cfm?id=2208285

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 into account the “intelligent driver”
    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 Facebook activity data, e.g.,
  - Friend count (actual)
  - Directed communication: comments, likes
  - Passive consumption of broadcasted items, e.g., status update

Patterns in the Relationship between Variables

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

Strength of the Relationship between Variables

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

- 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

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.”

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
Three Approaches to HCI Research

Test

Look

Make

Empirical science

Ethnography

Engineering and design

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

Ethnographic research

Study

Data

Theory
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**
- **Look**
- **Make**

- **Empirical science**
- **Ethnography**
- **Engineering and 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 and intended benefits and unexpected outcomes documented

* from James Landay 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
Available at: http://dl.acm.org/citation.cfm?id=1753394

Three Approaches to HCI Research

Test
Empirical science

Look
Ethnography

Make
Engineering and design
The Messy Truth

Observation → Prototype 1 → Prototype 2 → ... → Prototype n → Commercial product

Related scientific theory → Descriptive model → Predictive model → Long-term effect study

Research Example: CommandMaps

- Scarr et al., Best paper CHI '12
- Improve toolbar (specifically Microsoft's Ribbon interface)
- In-class exercise:
  - Contributions?
  - Benefits?
  - Which part uses empirical science, ethnography, and engineering/design approach?

CommandMaps

CommandMaps, CHI '13
Available at: http://dl.acm.org/citation.cfm?id=2207713

- 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]
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, 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
• Read this paper today:
  • Seven Research Contribution Types in Human-Computer Interaction
    — Jacob Wobbrock, 2014
• Come to the lab tomorrow!
  • Literature searching and reading techniques
  • Help with CAMPUS/L2P problems
• Read this paper before next lecture:
  • How to Read an Engineering Research Paper — William G. Griswold

Links to articles: hci.rwth-aachen.de/cthci