Human-Computer Interaction

Course Introduction

Professor Bilge Mutlu

Today's Agenda

- Topic introduction
- HCI research at Wisconsin
- Course introduction

Instructional Team

Instructor: Bilge Mutlu

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People & Robots Laboratory

PhD, 2009, Carnegie Mellon University

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http://bmutlu.github.io/research-summary/

Instructional Team

TA: Yuna Hwang

Fourth year graduate student

Department of Computer Sciences

How about you?

Give us your name, program, year.

What is this course about?

Human-Computer Interaction (HCI), obviously!🙄

What does HCI mean to you?

Who can give a definition?

Different Perspectives

Design Implications

I want to design a compute r system and need to know what to design.

Systems

I would like to discover new ways of making user interfaces.

Evaluation

I have designed a computer system and would like to understand whether it is any good (for people).

Understanding Impact

I would like to understand how a computer system that I designed affects people's lives.

Societal Change

I would like to understa nd how a compute r technolo gy affects society

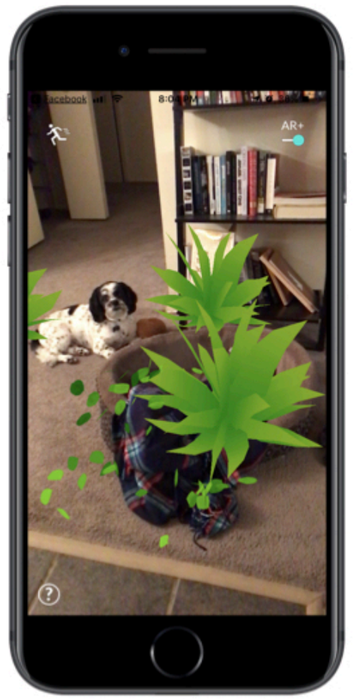
Definitions

“…a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.”

— ACM

Where does HCI fit within Computer Science?

1



[1] Image sources: 1, 2, 3, 4, 5, 6

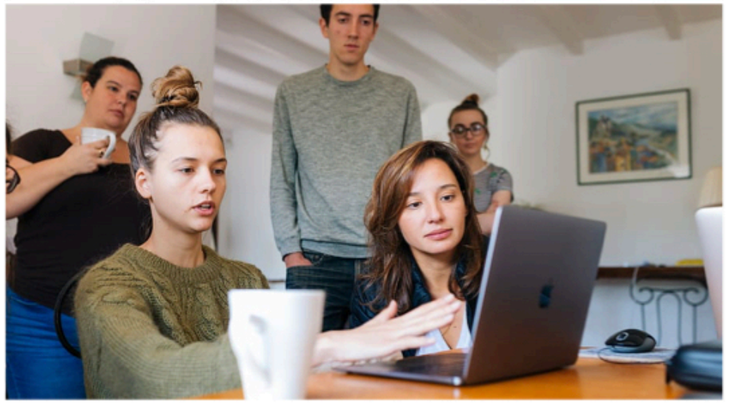
What's missing here?

“The old computing is about what computer can do, the new computing is about what people can do [using the computer].”[2]

— Schneiderman, 2002

[2] Image source

3



[3] Image sources: 1, 2, 3, 4, 5, 6

This course is cross-listed with Psychology and Educational Psychology. Where does HCI fit within psychology/education?

4

[4] Image sources: 1, 2, 3, 4

What's missing here?

5

[5] Image sources: 1, 2, 3, 4

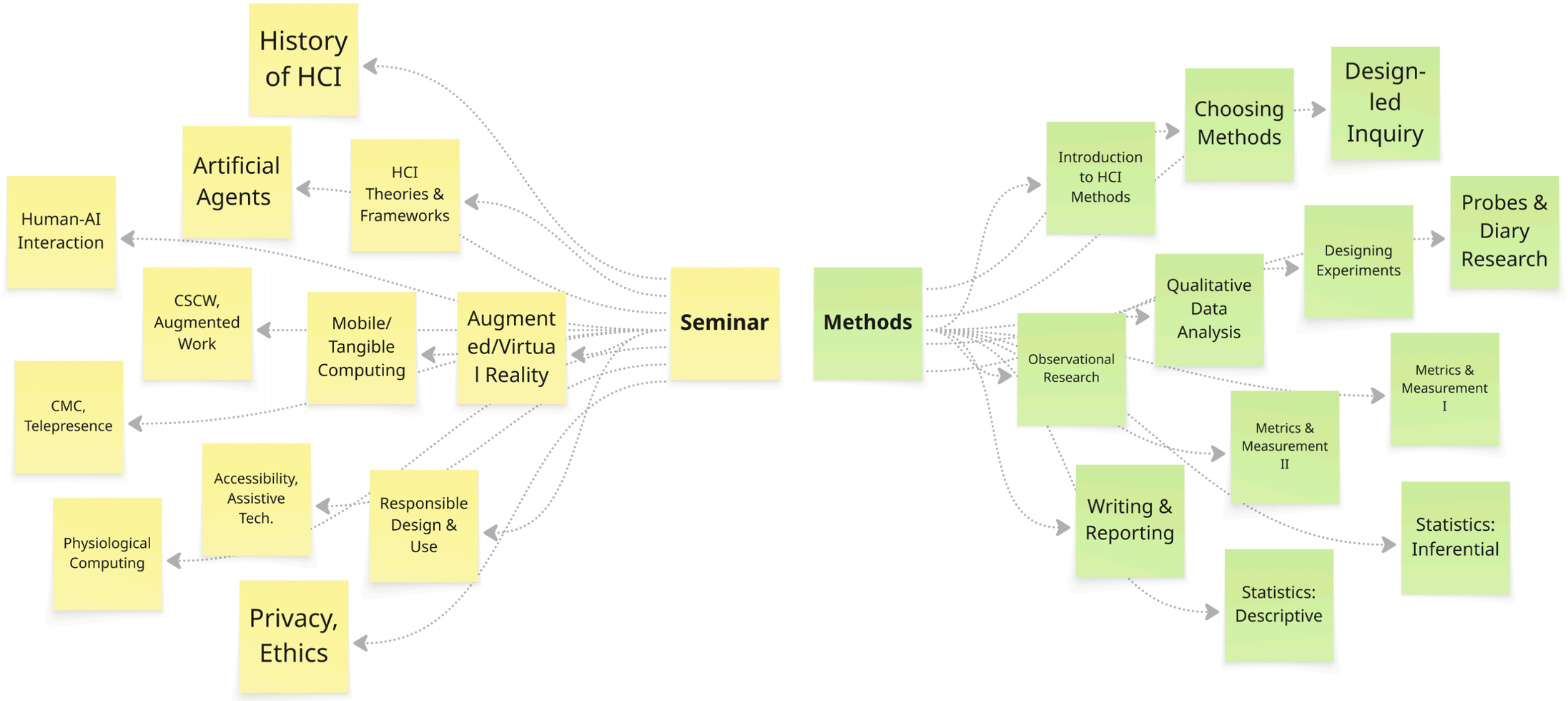
Seminar in HCI

+

Research Methods in HCI

+

Independent Study in HCI


History of HCI
Artificial Agents
HCI Theories & Frameworks
Human-AI Interaction
CSCW, Augmented Work
Mobile/ Tangible Computing
Augmented/Virtual Reality
Seminar
CMC, Telepresence
Accessibility, Assistive Tech.
Responsible Design & Use
Physiological Computing
Privacy, Ethics
Methods
Introduction to HCI Methods
Choosing Methods
Design-led Inquiry
Qualitative Data Analysis
Designing Experiments
Probes & Diary Research
Observational Research
Metrics & Measurement I
Metrics & Measurement II
Writing & Reporting
Statistics: Inferential
Statistics: Descriptive

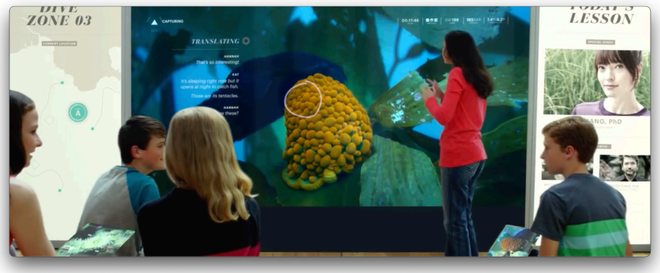
Wearable computing[7]

CSCW

CMC

Tangible computing/AR

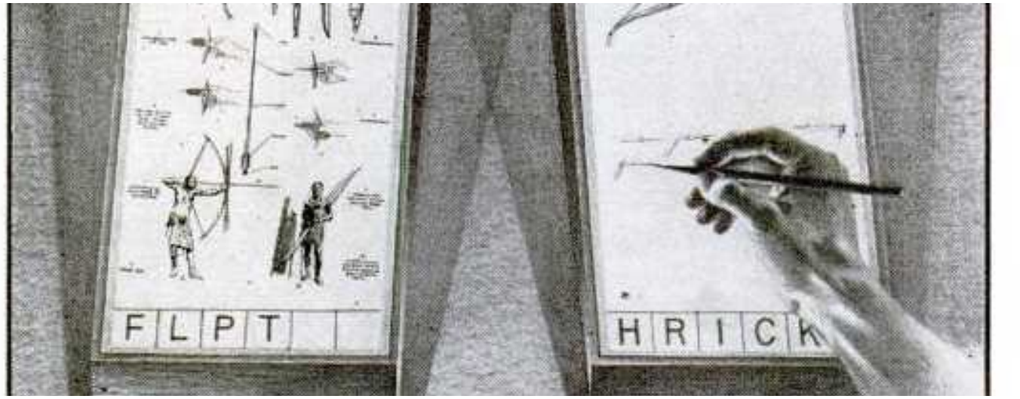
Educational Technology

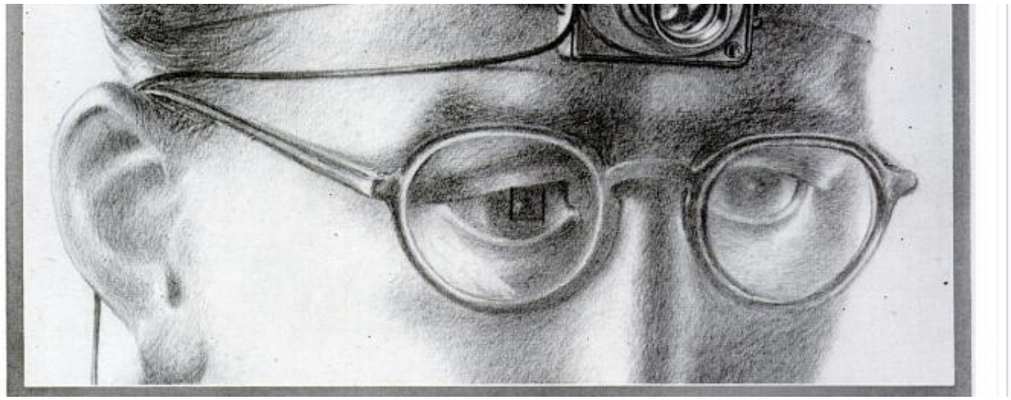


Human-Robot Interaction

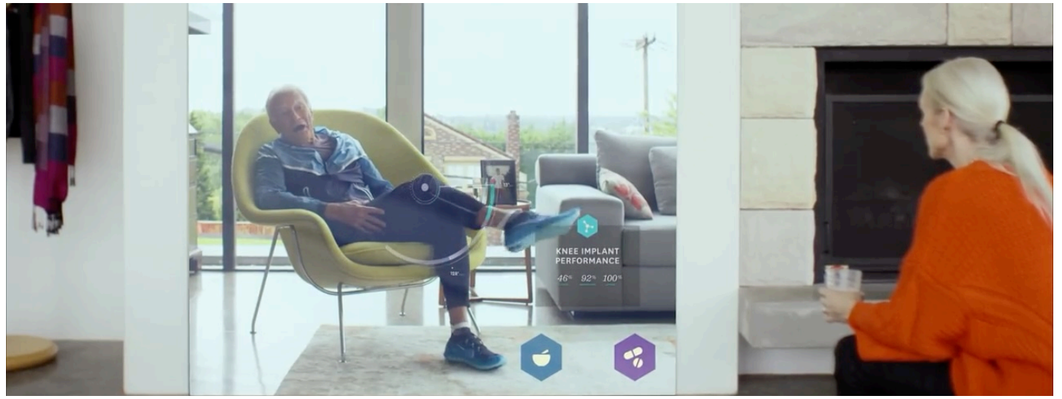
[7] Microsoft Office

1945 (Vannevar Bush)[8]





2015 (Microsoft)



[8] Wired, Microsoft

Questions?

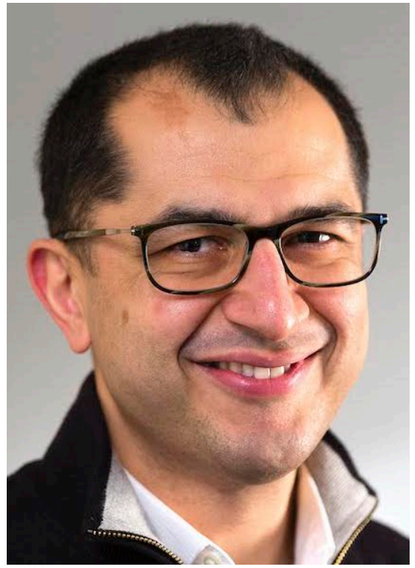
HCI Research @ Wisconsin

CDIS [CS, iSchool]

Distributed [ISyE, EdPsych, Psych, ME]

HCI Research in CS

Bilge Mutlu



HRI, human-AI interaction, design research

Yuhang Zhao

AR/VR interfaces, accessibility

Michael Gleicher

Information visualization, graphics, HRI

Michael Hagenow

HRI, haptic interfaces, shared control

HCI Research at the iSchool

Corey Jackson

Citizen science, science engagement, online communities

Adam Rule

Medical informatics, health decision making, information visualization

Jacob Thebault-Spieker

Social computing, bias and fairness

Devansh Saxena

Human-AI interaction, AI innovation

Other HCI-related Research on Campus

John Lee (ISyE)

AR/VR, automotive interfaces, human-AI interaction

Paula Niedenthal (Psych)

Affective human-machine interaction

Shamya Karumbaiah (Ed Psych)

Human-centered AI, learning

Michael Zinn (ME)

Haptic interfaces


iDEA
UW–Madison
Institute for Design
& Embodied AI

Questions?

Course Outline

What's the difference between 570, 571, and 770?

“…a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.”

— ACM

“…a discipline concerned with (**570**, **571**) [the design, evaluation and implementation of interactive computing systems for human use] and with (**770**) [the study of major phenomena surrounding them].”

— ACM

770

- Research methods
- For grads from across campus
- Project-based
- No technical background

570

- Design methods
- For undergrads
- Project-based
- No technical background

571

- Design/building methods
- For CS undergrads
- Assignment-based
- Needs at least CS-400 & JS

Let's focus on 770

Learning Goals

1. Define research questions, construct hypotheses, map out and identify gaps in the research literature, and situate research questions and hypotheses in existing knowledge
2. Gain familiarity with seminal research across various topics in human-computer interaction
3. Determine the research approach that best fits a research question, identify variables of interest for empirical investigation, and design qualitative, qualitative, and hybrid studies

1. Determine appropriate objective, behavioral, physiological, subjective, and composite measures for empirical investigation
2. Design survey questions, construct scales, and assess reliability and validity
3. Analyze qualitative and quantitative data using grounded theory and statistical methods
4. Carry out a project to investigate an original research question in human-computer interaction
5. Write an academic paper to report on research design and findings

Setting Expectations

1. Be prepared to read a lot 1–3 papers + 1 book chapter each week
2. This class will take about 10-15 hours/week (university guidelines require a *minimum* of 9 hours for 3-credit courses, and that's for undergraduates)
3. A substantial semester-long project where you will work with others
4. Be prepared to engage in discussion; expect a lot of interactivity

AI Use

I strongly support building a strong AI toolbox and using it for your work for class. However, but build *good habits*. A way to think about it…

Deliberative Activities

- Learning, growth
- Entertainment
- Sharing, connection-making

Consequential Activities

- Search for information
- Make calculations for a problem
- Check for spelling

Appopriate Uses of AI

- *Supporting* deliberative activities
  - Questioning concepts
  - Critically analyzing your work
  - Collaborative ideation
- *Replacing* consequential activities
  - Check for spelling

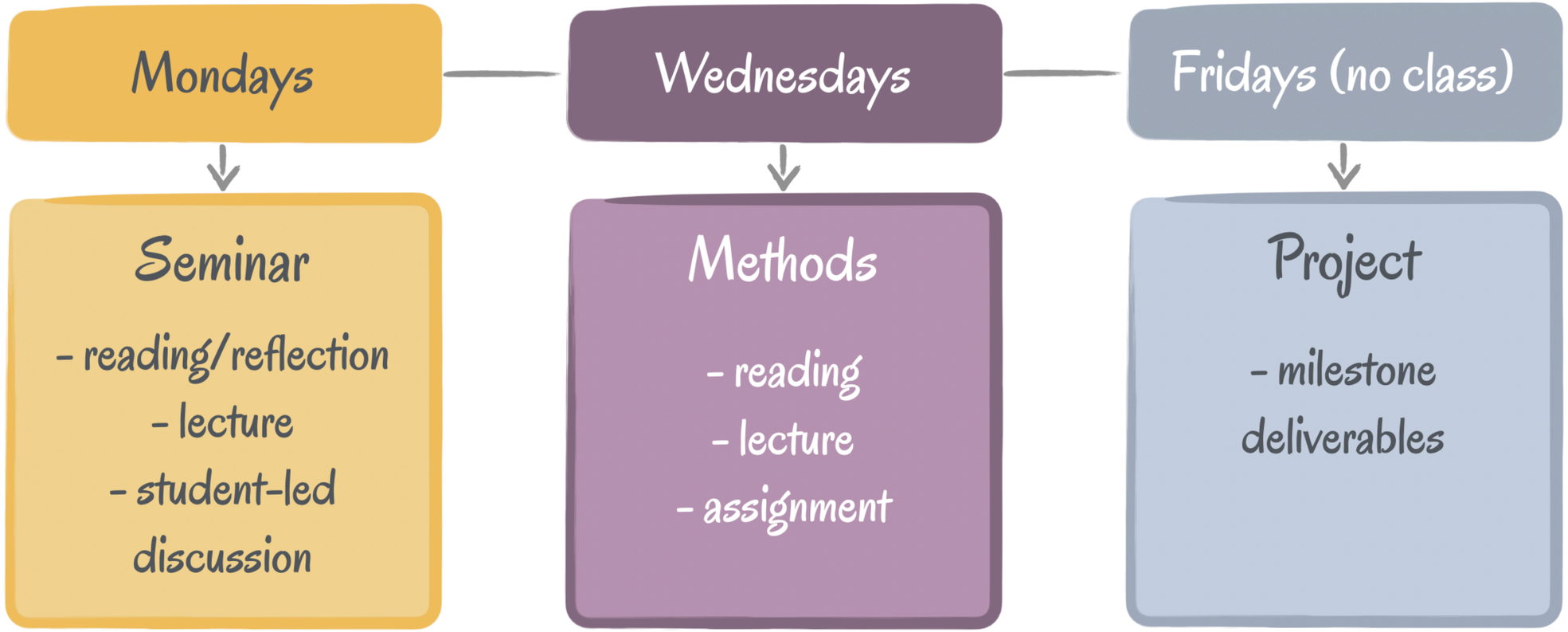
Inappropriate Uses of AI

- *Replacing* deliberative activities
  - Reading a paper on your behalf
  - Writing content for assignments, project
- *Not replacing* consequential activities

Questions?

Overview of Syllabus

Three modules



Module 1: Seminar

General Outline[9]

We will read seminal papers, discuss them online and in class.

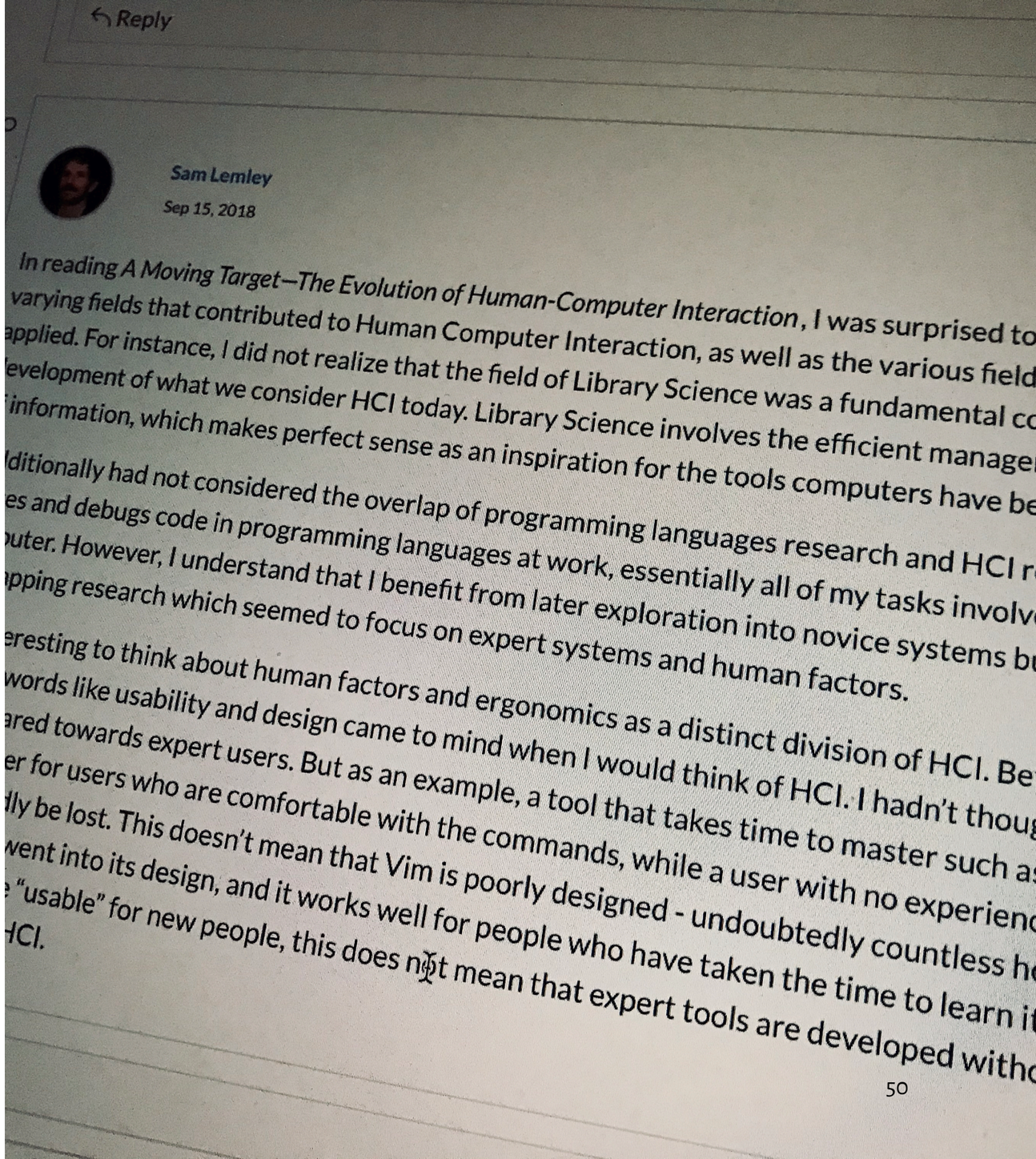
- You will read 1–2 papers per week and will find 1 resource (an academic paper, popular science article, a video) yourself
- First 45 minutes of Tuesday class
- I will give a 30-minute overview of the topic and lead a 30-minute in-class

[9] Image source

Online Discussion

Reflect on the topic

- **Read:** Skim all of the assigned papers for the week and read at least one paper in depth.
- **Create:** Prepare a single slide with one of the following approaches:
  - Provocation
  - Critical Artifact
  - Policy or Design Recommendation



Classroom Discussion

At Monday's class:

- Short (~30 min) introduction to the topic.
- A few slides will be randomly selected. If your slide is chosen, you will use it to lead about 5-10 minutes of class discussion.
- Alternate between classroom and group discussion formats

We'll review the process on Monday.

Why are we doing this?

- **Dialectics** — through discussion, we establish common themes/concerns/ground
- **Reflection** — you rarely get the chance to engage in open-ended discussion on research topics
- **Trivium** — you will get the grammar (language), logic (mechanics), and rhetoric (arguments) of a topic

Module 2: Methods

General Outline[10]

We will learn about HCI research methods through lectures and hands-on-activities.

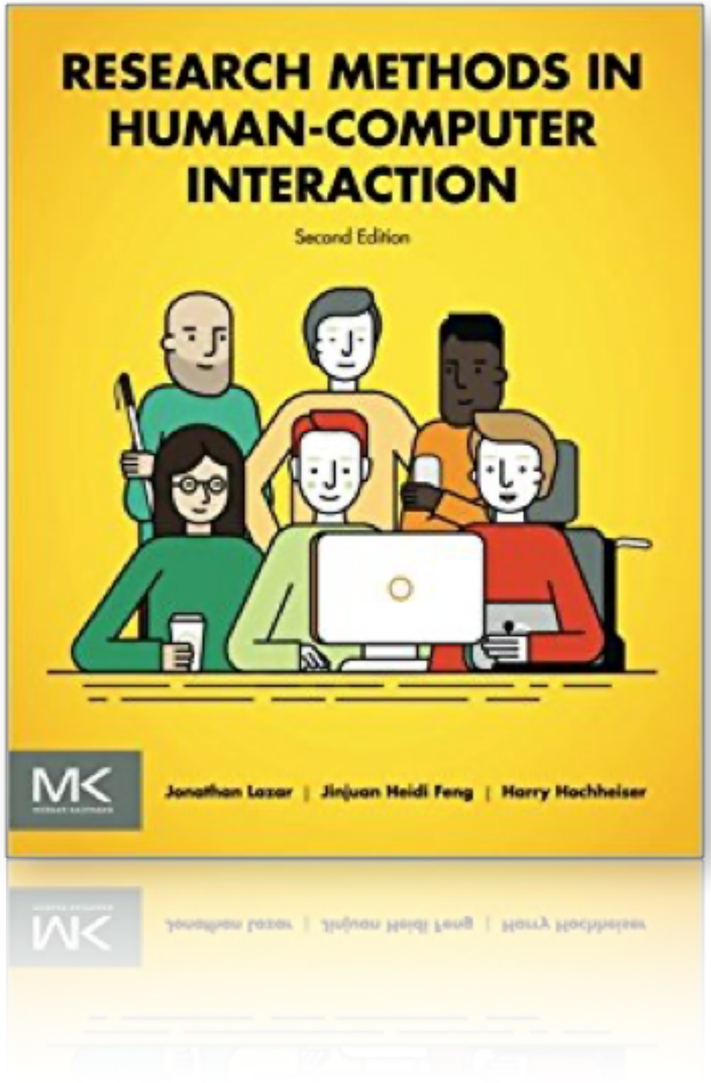
- Every week, a new research method is presented
- Reading a chapter from the textbook (necessary for the assignment)
- Lecture/tutorial for ~45 minutes
- Start weekly assignment that will be due the following week

[10] Image source

Textbook

Research Methods in Human-Computer Interaction, *Second Edition*, Lazar et al., 2017

Free through the University Library



Why are we doing this?

- **Learning** — you will learn a sample of all of the major methods and tools used in HCI research
- **Practice** — you will practice some of the critical ones in structured, guided ways

Module 3: Project

General Outline

We will carry out a semester-long research project where you will connect and practice the **seminar** and **methods** modules.

- ~3-student teams
- We will use the last 15 minutes of class on Mondays and/or Wednesdays to discuss project goals, steps, deliverables
- Feedback during office hours, through deliverables
- Expectations will differ based on the number of group members

Project Deliverable

— We will incrementally write a ~8-page paper in the ACM SigCHI format, potentially submittable to an HCI conference.

— The project should include both qualitative and quantitative methods.

2012

Chidambaram et al.

Designing Persuasive Robots: How Robots Might Persuade People Using Vocal and Nonverbal Cues

Vijay Chidambaram, Yueh-Hsuan Chiang, Bilge Mutlu
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{vijayc, yhchiang, bilge}@cs.wisc.edu

ABSTRACT

Social robots have to potential to serve as personal, organizational, and public assistants as, for instance, diet coaches, teacher's aides, and emergency responders. The success of these robots will depend on their ability to persuade users to follow diet regimen or to encouraging them to follow evacuation procedures in the case of a fire—will rely largely on their ability to persuade people to comply with their requests. Work from political communication to education suggest that the nonverbal behaviors of a human speaker play a key role in persuasion and research in HRI has shown that people treat and interact with robots as they do with humans. In this paper, we explore how a robot might effectively use these behaviors, particularly vocal cues, to persuade people to comply with its requests. Specifically, in an experiment with 24 participants, we evaluate how manipulations in a robot's use of nonverbal cues affected participants' perceptions of the robot's persuasiveness and their compliance with the robot's suggestions across four conditions: (1) no vocal or bodily cues, (2) vocal cues only, (3) bodily cues only, and (4) vocal and bodily cues. Our results show that participants complied with the robot's suggestions significantly more when it used nonverbal cues than they did when it did not use such cues. We also found that the robot was perceived to be persuading participants more when it used vocal cues. Our model of persuasive nonverbal cues and experimental results have implications for design of the dialogs of persuasive behaviors for humanlike robots.

Categories and Subject Descriptors

H.1.2 [Models and Principles]: User/Machine Systems—*Human factors*; H.5.2 [Information Interfaces and Presentation]: User Interfaces—*evaluation/methodology, user-centered design*

General Terms

Design, Human Factors

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HRI'12, March 5–8, 2012, Boston, Massachusetts, USA.
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Figure 1. The vocal and bodily cues of persuasion in human-robot interaction

Keywords

Persuasion, compliance, nonverbal immediacy, nonverbal cues, gaze, gestures, proximity, vocal tone

1. INTRODUCTION

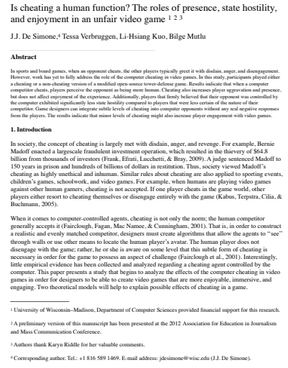
Robots hold great promise as social actors that may persuade users to follow recommendations in a variety of domains such as diet, exercise, an education [14], health [6], and wellbeing [28]. The success of these robots in motivating people to comply with their requests—whether to follow a diet regimen or to encourage them to follow fire-and-evacuation procedures—will rely largely on their ability to persuade people to comply with their requests.

Research in human communication has identified a number of behavioral attributes that shape individuals' interpersonal recordings—the degree of perceived bodily and psychological availability and immediacy [11]—and persuasion [12]. These attributes include primarily nonverbal behaviors such as gaze, proximity, body orientation, touch, gesture, posture, facial expression, smiling and vocal cues such as vocal tone and expressions [14]. While a considerable body of work in HRI has explored the persuasiveness of nonverbal cues in human-robot interaction (e.g., [15, 2, 6]), the way in which these cues might shape the persuasive ability of a robot has not been explored.

In this paper, we explore how robots might use nonverbal behaviors to effectively persuade users to follow their requests. We present an experiment with 24 participants, in which we evaluate how manipulations in a robot's use of nonverbal cues affected participants' perceptions of the robot's persuasiveness and their compliance with the robot's suggestions across four conditions: (1) no vocal or bodily cues, (2) vocal cues only, (3) bodily cues only, and (4) vocal and bodily cues. Our results show that participants complied with the robot's suggestions significantly more when it used nonverbal cues than they did when it did not use such cues. We also found that the robot was perceived to be persuading participants more when it used vocal cues. Our model of persuasive nonverbal cues and experimental results have implications for design of the dialogs of persuasive behaviors for humanlike robots.

2012

De Simone et al.



Is cheating a human function? The roles of presence, state hostility, and enjoyment in an unfair video game [1] [2] [3]

J.J. De Simone,[4] Tessa Verbruggen, Li-Hsiang Kuo, Bilge Mutlu

Abstract

In sports and board games, when an opponent cheats, the other players typically greet it with disdain, anger, and disengagement. However, work has yet to fully address the role of the computer cheating in video games. In this study, participants played either a cheating or a non-cheating version of a modified open-source tower-defense game. Results indicate that when a computer competitor cheats, players perceive the opponent as being more human. Cheating also increases player aggravation and presence, but does not affect enjoyment of the experience. Additionally, players that firmly believed that their opponent was controlled by the computer exhibited significantly less state hostility compared to players that were less certain of the nature of their opponent's control. These results can integrate subtle levels of cheating into computer opponents without any real negative responses from the players. The results indicate that master levels of cheating might also increase player engagement with video games.

1. Introduction

In society, the concept of cheating is largely met with disdain, anger, and revenge. For example, Bernie Madoff enacted a largescale fraudulent investment operation, which resulted in the thievery of $64.8 billion from thousands of investors (Frank, Efrati, Lucchetti, & Bray, 2009). A judge sentenced Madoff to 150 years in prison and hundreds of billions of dollars in restitution. Thus, society viewed Madoff's cheating as highly unethical and inhuman. Similar rules about cheating are also applied to sporting events, children's games, schoolwork, and video games. For example, when humans are playing video games against other human gamers, cheating is not accepted. If one player cheats in the game world, other players either resort to cheating themselves or disengage entirely with the game (Kahns, Terpstra, Cilia, & Buchmann, 2005).

When it comes to computer-controlled agents, cheating is not only the norm; the human competitor generally accepts it (Fairclough, Fagan, Mac Namee, & Cunningham, 2001). That is, in order to construct a realistic and evenly matched competitor, designers must create algorithms that allow the agents to "see" through walls or use other means to locate the human player's avatar. The human player does not disengage with the game; rather, he or she is aware on some level that this subtle form of cheating is necessary in order for the game to possess an aspect of challenge (Fairclough et al., 2001). Interestingly, little empirical evidence has been collected and analyzed regarding a cheating agent controlled by the computer. This paper presents a study that begins to analyze the effects of the computer cheating in video games in order for designers to be able to create video games that are more enjoyable, immersive, and engaging. Two theoretical models will help to explain possible effects of cheating in a game.

[1] University of Wisconsin–Madison, Department of Computer Sciences provided financial support for this research.

[2] A preliminary version of this manuscript has been presented at the 2012 Association for Education in Journalism and Mass Communication Conference.

[3] Authors thank Karyn Riddle for her valuable comments.

[4] Corresponding author. Tel.: +1 816 589 1469. E-mail address: jdesimone@wisc.edu (J.J. De Simone).

2015

Johnson et al.

Handheld or Handsfree? Remote Collaboration via Lightweight Head-Mounted Displays and Handheld Devices

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[2] Department of Industrial and Systems Engineering
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ABSTRACT

Emerging wearable and mobile communication technologies, such as lightweight head-mounted displays (HMDs) and handheld devices, promise support for everyday remote collaboration. Despite their potential for widespread use, their effectiveness as collaborative tools is unknown, particularly in physical tasks involving mobility. To better understand their impact on collaborative behaviors, perceptions, and performance, we conducted a two-by-two technology type: HMD vs. tablet computer; task setting: static vs. dynamic) between-subjects study where participants (n = 64) remotely collaborated as "helper" and "worker" pairs in the construction of a physical object. Our results showed that, in the dynamic task, HMD use enabled helpers to offer more frequent directing commands and reduced workers' mental demand, leading to faster task completion. In the static task, while tablet use helped convey subtle visual information, helpers and workers had conflicting perceptions of how the two technologies contributed to their success. Our findings offer strong design and research implications, underlining the importance of a consistent view of the shared workspace and the differential support collaborators with different roles receive from technologies.

ACM Classification Keywords

H.5.3 Information Interfaces and Presentation: Group and Organization Interfaces–*Collaborative computing, Computer-supported cooperative work, Evaluation/methodology*

General Terms

Human Factors; Performance; Experimentation

Author Keywords

Computer-supported cooperative work; remote collaboration; videoconferencing; head-mounted displays (HMDs); wearable computing; handheld devices; tablet computers

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ACM 978-1-4503-2922-4/15/03 $15.00
http://dx.doi.org/10.1145/2675133.2675176

Figure 1. Participants remotely collaborated in pairs using either a tablet or an HMD in a construction task in one of two task settings: a static task, requiring little mobility, or a dynamic task setting, requiring high levels of mobility.

INTRODUCTION

Collaborative work across many domains involves physical tasks. A team of doctors performing surgery, workers repairing machinery, and young adults learning how to cook from their parents are examples of hands-on activities where the level of expertise differs across members of the collaboration. Distributed physical tasks, in which not all members of the collaboration are collocated, have important roles in medical, industrial, and educational domains. With the rapid development of communication and collaboration technologies that enable remote workspace sharing, such as smartphones, tablets, and lightweight head-mounted displays (HMDs), remote collaboration for physical tasks has become more feasible than ever [9]. Remote collaborators can receive support in real time from their co-workers, family members, or friends who have expertise in their task—not just those individuals who are most geographically accessible.

While many technologies that support assistance in physical tasks are finding widespread use, little research has been conducted to evaluate their efficiency and effectiveness in these settings. One class of collaboration technologies are handheld mobile devices, such as smartphones and tablet computers, which are equipped with videoconferencing capabilities that can enhance collaboration [8]. Tablets are also becoming increasingly popular for both work and casual use [9]. The larger screen size of a tablet computer relative to the smartphone may

2017

Rakita et al.

A Motion Retargeting Method for Effective Mimicry-based Teleoperation of Robot Arms

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ABSTRACT

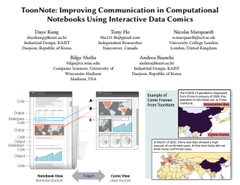
In this paper, we introduce a novel interface that allows novice users to effectively teleoperate robot arms and will support applications such as remote home-care or tele-nursing that require considerable human judgment and involvement without the operator being overburdened by the complexity of the task. The key is that enabling users to work in the "natural" space of their arms will allow them to draw on their inherent kinesthetic sense and ability to perform tasks in controlling a robot. That is, mapping the movement of the user's arm, particularly the position and orientation of their hand, to the movement of the robot can allow intuitive and effective control of the robot without significant training. Capturing arm motion, however, requires sensing technologies and, as with all sensing technologies, including visual tracking (e.g., the Microsoft Kinect[1]) and wireless controllers (such as the HTC Vive[2] shown in Figure 1). However, translating captured motion into robot movements in a manner that successfully meets the demands of robot control remains a key challenge. Furthermore, because we lack satisfactory solutions to this challenge, the premise that such a mapping between human and robot arms serves as effective interface for direct control has not been validated.

The key technical challenge stems from differences in the characteristics and capabilities of robot and human arms, making a direct

Figure 1: We propose a mimicry-based telemanipulation method that uses relaxed constraints on the mapping between a user and a robot's arm to create an effective interface to efficiently and enjoyably teleoperate robot arms for three telemanipulation tasks that follow a home care scenario.

2021

Kang et al.



ToonNote: Improving Communication in Computational Notebooks Using Interactive Data Comics

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Figure 1: ToonNote is a novel technique for representing computational notebooks in the form of interactive data comics. Notebook View uses the traditional computational notebook's format (using a combination of markdown/code/output), which affords detailed analysis, but makes it difficult to easily comprehend the high-level story behind the data. ToonNote, however, allows users to create Comic Panels (A) from Notebook View cells (B) and arrange them in Comic View (C), which can be combined in single or multiple (Comic Frames). When viewing the data in the Comic View, readers can focus on data storytelling, and not be hindered by code, unnecessary outputs, or markdown – and can switch back to the Notebook View when needed.

ABSTRACT

Computational notebooks help data analysts analyze and visualize datasets, and share analysis procedures and outputs. However, notebooks typically combine code (e.g., Python scripts), notes, and outputs (e.g., visualizations) in a single-column layout that can make it difficult for analysts to collaborate with other analysts unfamiliar with the data or specific analysis techniques used. We present ToonNote, a hypothetical extension that enables the conversion of notebooks into "data comics." ToonNote provides a simplified view of a Jupyter Notebook and allows analysts to create comic panels to support more interactive and free exploration of the dataset. This paper presents the results of a formative study that motivated the system, its implementation, and an evaluation with 10 users, demonstrating the effectiveness of the produced comics. We discuss how our findings

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IUI '21, April 14–17, 2021, College Station, TX, USA
https://doi.org/10.1145/3397481.3450693

371 citations

17 citations

90 citations

132 citations

50 citations

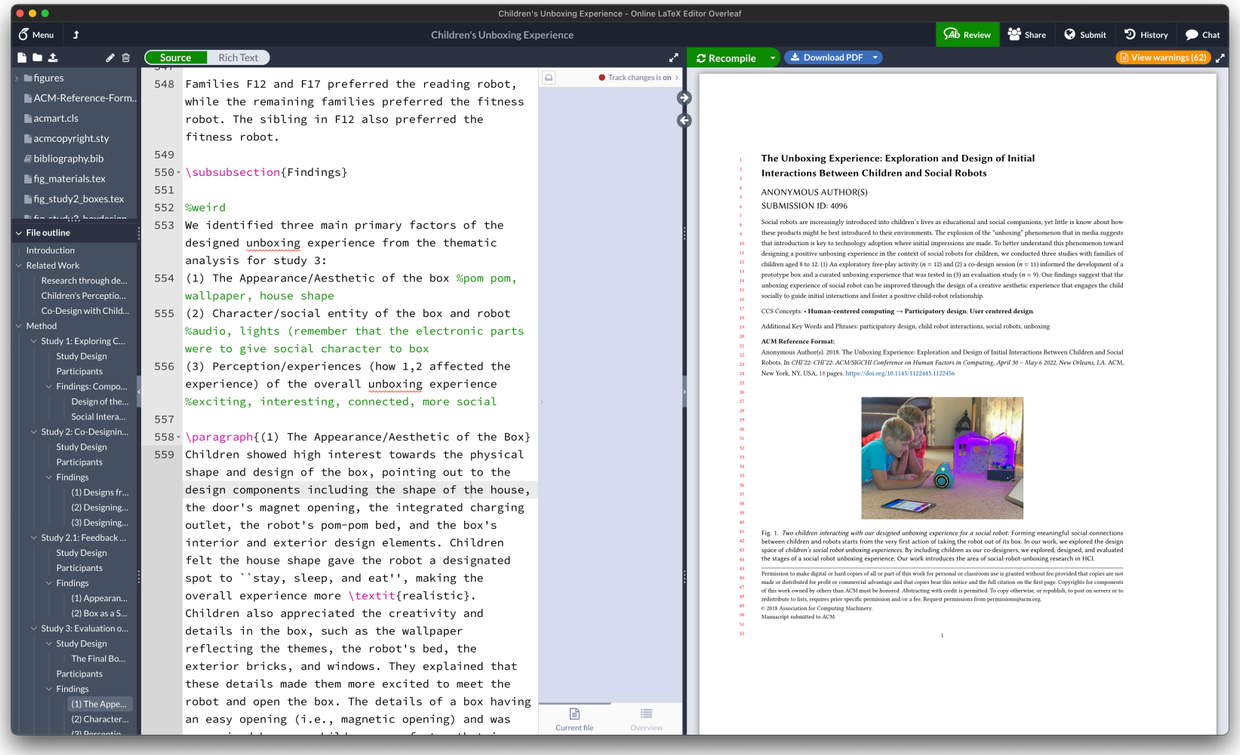
Project Topics

Take inspiration from CHI 2025 paper-award winners using the algorithm:

1. Skim a set of papers
2. Focus on 2-3 based on interest/research style
3. Read related work to understand gap
4. Read what the paper did to understand where it fits
5. Determine what else remains unexplored from limitations
6. Zoom out, choose topic, find partners

Project Deliverables[11]

- Project Topic
- Literature survey, RQs
- Method
- Data
- Analysis, results
- Final paper



[11] Image source

Why are we doing this?

- Practicing research in an uncontrolled, unstructured, long period
- Bridging the seminar and the methods, contextualizing the methods within the seminar topics

Questions?

Course Policies

Grading

Assessments	Points
Seminar: Participation in online discussions	15
Methods: Hands-on activities	30
Project	30
Final presentation & Paper	20
General: Attendance, participation	5
Total	*100*

Letter grade	Grade range	Description
A	93.5–100	Excellent work *(Exceeds expectations)*
AB	89.5–93.4	Good work *(Robustly meets all stated requirements)*
B	83.5–89.4	Adequate work *(Meets the spirit of all stated requirements)*
BC	79.5–83.4	Slightly below adequate *(Missing small required elements or turned in late without approved extension)*
C	73.5–79.4	Below adequate *(Missing required elements or turned in late without approved extension)*
D	73.4–63.5	Well below adequate *(Missing many required elements or turned in late without approved extension)*
F	63.5	Inadequate *(Work not turned in, no extension requested)*

Rule of Thumb: If you complete every assignment, you should be getting an **A** or an **AB**. So, just come to class, do the work, and don't worry about your grade.

Communication

Type	Examples	Channel
Question about course content	"R is giving me a singularity error;" "Should we be turning in our data file?"	Post on Piazza
Personal questions	"I am traveling to a conference on <date>;" "I have to travel to my home country because of an emergency!"	Send message to me/TA via email
Feedback request	"Can we get feedback on our study design;" "Can you check if I'm doing this analysis right?"	Office hours + appointment

During Class

Laptops/tablets: Laptop and tablet use is encouraged for the ongoing class and discouraged for anything else:

— Engaging in Piazza; looking through readings, slides; researching

Phones: Should be put away.

In general, please strive to **be present**.

Late, Absence Policy

Late assignments: The class follows a student-friendly "late days bank" model. You have a total of 3 late days that can be used across all deliverables.

Each project group will have **one grace day** for your assignment across the semester (Five project assignments in total; cannot be used for the final paper submission).

Missing class: $E[m] = 3, m = \{0, 1, \ldots, 29\}$, so we will discount two absences from classroom discussion/initial assignment work.

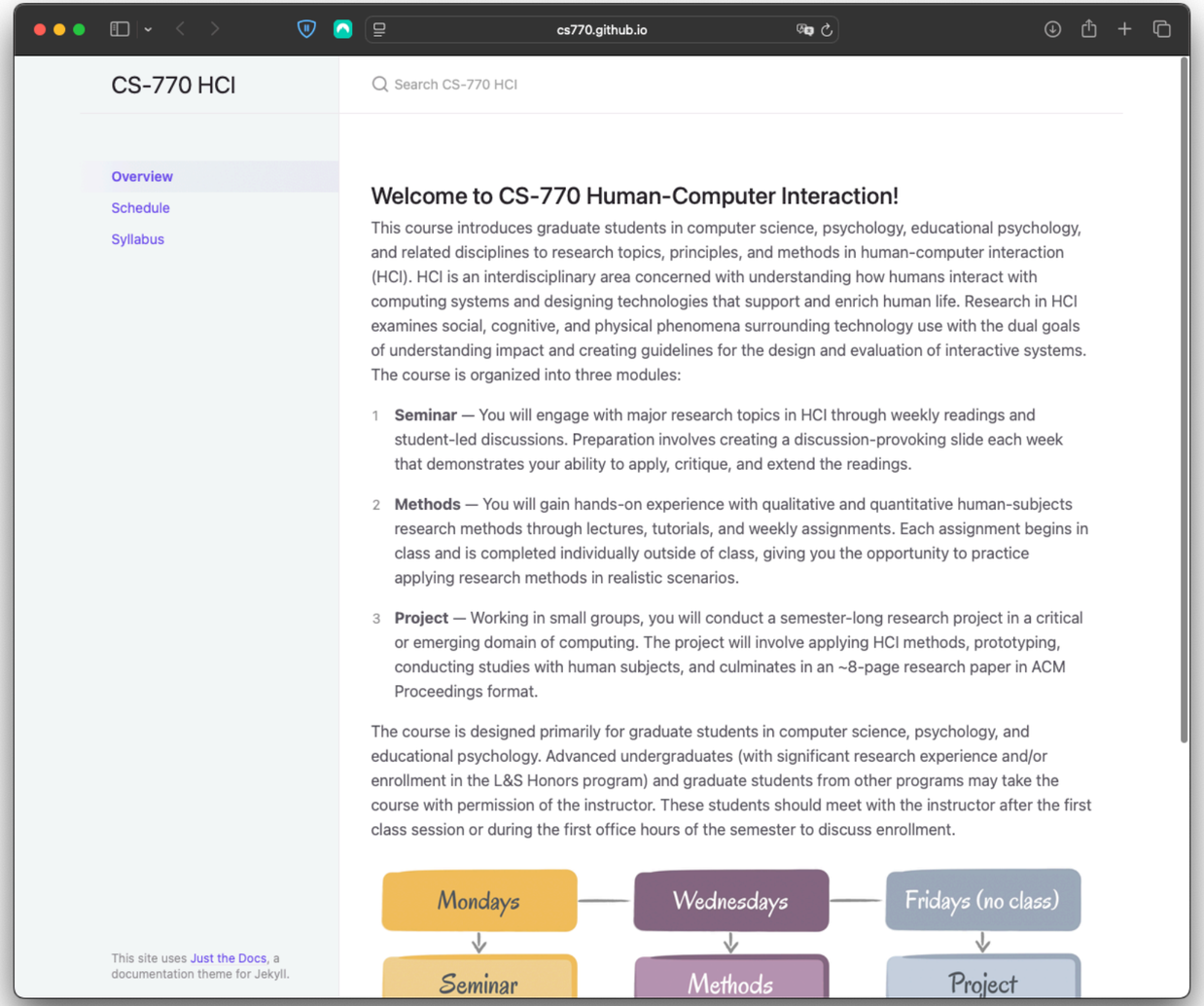
Logistics

— Course Website | Course Canvas

Office Hours

— **Instructor:** Monday 2:15-3:00 pm, CS 2513

— **TA:** Mondays 2:30 - 3:30pm — Zoom (👈 press link to connect) | Wednesdays 2:30-3:30pm — Morgridge 2513



Enrollment

- Classroom has 75 seats
- Enrollment (as of this morning): 75
- Waitlist: 35

My recommendation: attend class and see who drops by Monday. We can usually include 1/3-1/2 of the waitlist by the time the roster settles.

Questions?

What's next?

— **Seminar:** *Readings* due on Monday; *submission* — due on Monday

— **Method:** *Chapter reading* — due on Wednesday

— **Project:** We'll discuss on Monday; *topic selection* — due Sep 9

— **Logistics:** Office hours will start next week