

Human-Computer Interaction

What is HCI Research?

Professor Bilge Mutlu

Today's Agenda

- Where we left off
- **What is HCI research?** – kinds of contribution
- **Project kickoff** – the speculative-design workshop
- How you get a team over the weekend
- Crit feedback etiquette

Where we left off

Three strands, decoupled by day – **Monday** seminar, **Friday** methods, the **project** across both.

Fundamentals are the medium, not the message.

You took home a card: **Technology × Context × Perspective**. Today it goes to work.

Two jobs today

This lone Friday does double duty.

First half

What is HCI research? – the kinds of contribution a project can make

Second half

Launch the project – put a topic on the board and recruit into it

Reading behind today¹

Lazar, Feng & Hochheiser (2017), **Ch. 1** – *Introduction to HCI research*.

¹ Lazar, J., Feng, J. H., & Hochheiser, H. (2017). [Research Methods in Human-Computer Interaction](#) (2nd ed.). Morgan Kaufmann.

What is HCI research?

What counts as HCI research?

Mostly **empirical** or **design-based** – often both.

- **Empirical** – understand a phenomenon from observation or experience
- **Design-based** (*artifact / system*) – understand a design space by building in it
- Plus a handful of less common types

The formal version²

Wobbrock & Kientz name **seven** kinds of contribution:

- | | |
|-------------------|------------|
| 1. Empirical | 1. Dataset |
| 2. Artifact | 2. Survey |
| 3. Methodological | 3. Opinion |
| 4. Theoretical | |

²Wobbrock, J. O., & Kientz, J. A. (2016). [Research contributions in human-computer interaction](#). *interactions*, 23(3), 38–44.

The four you'll live in

Empirical

interview · diary · lab experiment
· field study

Methodological

new method · new measure ·
new instrument

Artifact

system · device · toolkit ·
technique · envisionment

Theoretical

framework · design space ·
conceptual model

Empirical research, in four questions

Who?

Sample – random, purposive, snowball, convenience

Where?

Context – natural setting, field, or controlled lab

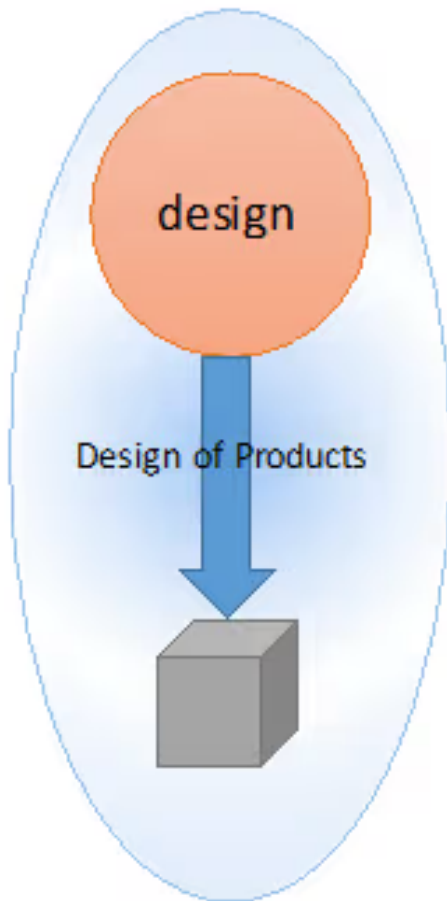
Why?

Goals – representation (*deep, small-n*) or generalization (*broad, large-n*)

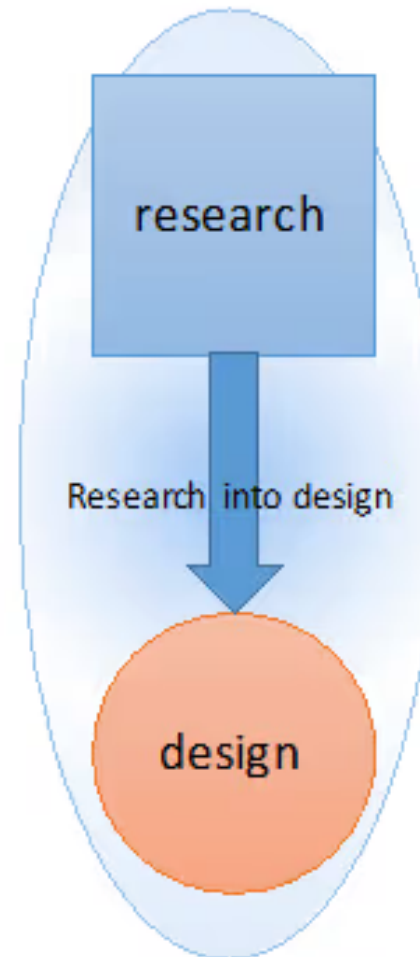
What?

Data – qualitative, quantitative, or mixed

Design-based research



conventional design creating products



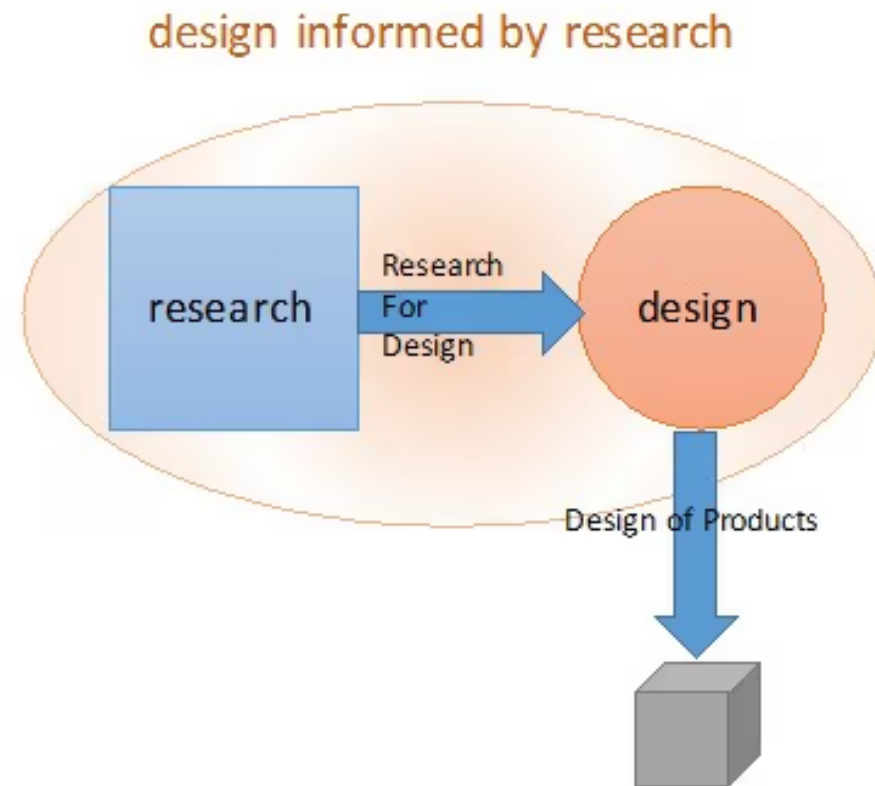
research about design methods



conventional research creating knowledge

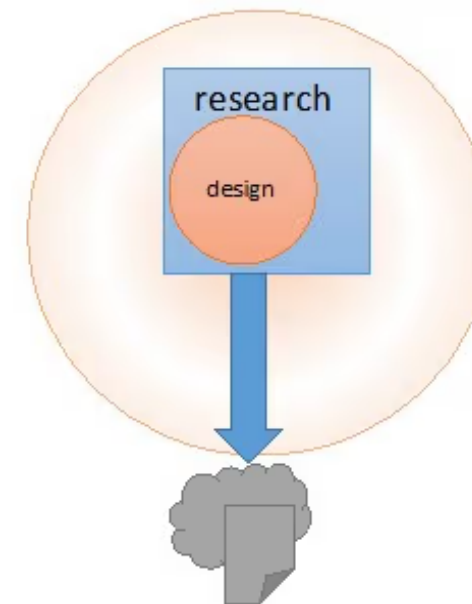
For design, or through design?

Research *for* design

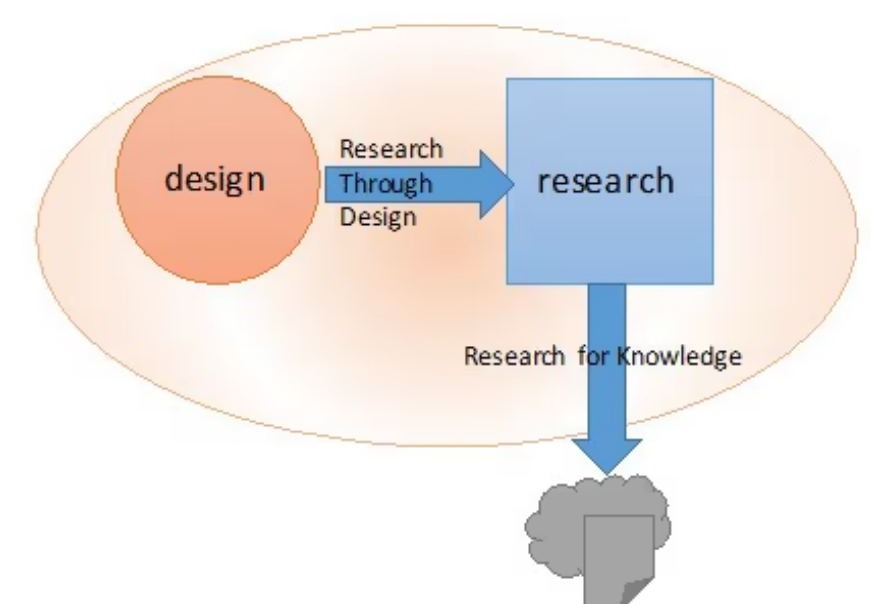


Research *through* design

design as part of research



designerly ways of doing research



Research that **informs** a design.

Design that **creates** knowledge.

From contribution to question

The contribution you're aiming at shapes:

- what a good **research question** looks like
- which **method** can answer it
- what counts as **evidence** that you succeeded

You don't have to name it today. It follows from the question, and the question comes first.

Project Kickoff

Where these have gone

Session: Conversation and Proxemics March 5–8, 2012, Boston, Massachusetts, USA

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

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ABSTRACT

Social robots have to potential to serve as personal, organizational, and public assistants as, for instance, diet coaches, teacher’s aides, and emergency respondents. The success of these robots—whether in motivating users to adhere to a diet regimen or in encouraging them to follow evacuation procedures in the case of a fire—will rely largely on their ability to *persuade* people. Research in a range of areas from political communication to education suggest that the nonverbal behaviors of a human speaker play a key role in the persuasiveness of the speaker’s message and the listeners’ compliance with it. In this paper, we explore how a robot might effectively use these behaviors, particularly vocal and bodily cues, to persuade users. In an experiment with 32 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. The results showed that participants complied with the robot’s suggestions significantly more when it used nonverbal cues than they did when it did not use these cues and that bodily cues were more effective in persuading participants than vocal cues were. Our model of persuasive nonverbal cues and experimental results have direct implications for the design of persuasive behaviors for humanlike robots.

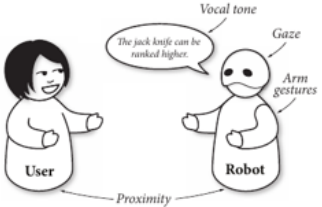


Figure 1: The vocal and bodily cues of persuasion in human-robot interaction.

Keywords

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

1. INTRODUCTION

Robots hold great promise as social actors that may positively affect and improve people’s motivation and compliance in such areas as education [13], health [31], and well-being [29]. The success of these robots in motivating people will rely largely on their ability to *persuade*. But how could robots persuade people? And how can we design persuasive robots?

Research in human communication has identified a number of behavioral attributes that shape individuals’ *nonverbal immediacy*—the degree of perceived bodily and psychological closeness between people—and suggested that individuals’ nonverbal immediacy plays a key role in persuading others [35]. These attributes include primarily nonverbal behaviors, particularly *bodily cues* such as proximity, gaze, gestures, posture, facial expressions, touching and vocal cues such as vocal tone and expressions [43]. While a considerable amount of research in robotics has explored the role of nonverbal cues in human-robot interaction (e.g., [47, 5, 25]), the way in which these cues might shape the persuasive ability of a robot has not yet been studied.

A few studies in human-robot interaction have explored how robots might be designed as persuasive agents [48, 37]. While existing work highlights the importance of persuasion in human-robot interaction and provides some guidelines for

There’s Just Something About Hands CSCW 2015, March 14–18, 2015, Vancouver, BC, Canada

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

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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 ($n = 66$) 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 more proactive assistance, resulting in marginally 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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CSCW 2015, March 14–18, 2015, Vancouver, BC, Canada.
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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 setting, requiring low levels of 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. These technologies promise easy assistance to users 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

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 and intuitively tele-operate robot manipulators. The premise of our method is that an interface that allows its user to direct a robot arm using the natural 6-DOF space of his/her hand would afford effective direct control of the robot; however, a direct mapping between the user’s hand and the robot’s end effector is impractical because the robot has different kinematic and speed capabilities than the human arm. Our key technical idea that by relaxing the constraint of the direct mapping between hand position and orientation and end effector configuration, a system can provide the user with the feel of direct control, while still achieving the practical requirements for telemanipulation, such as motion smoothness and singularity avoidance. We present methods for implementing a motion retargeting solution that achieves this relaxed control using constrained optimization and describe a system that utilizes it to provide real-time control of a robot arm. We demonstrate the effectiveness of our approach in a user study that shows novice users can complete a range of tasks more efficiently and enjoyably using our relaxed-mimicry based interface compared to standard interfaces.

1. INTRODUCTION

Telemanipulation systems, where a human user controls a robot arm from a distance, are valuable in scenarios where automation is impractical, where human judgment is essential, or where having the user engaged in the task is desirable [25]. However, controlling a robot arm from a distance introduces a number of challenges, including limitations in the capabilities of human operators and technical challenges in effectively translating human operator commands into robot actions. While shared control strategies are often used to improve performance by providing higher-level control through automation, such strategies have limited applicability, as they require prior knowledge of user goals, target object locations, and feasible robot trajectories [29, 15, 23, 6, 11, 35, 8]. Therefore, many applications involving telemanipulation must rely on direct control of robot arms. While successful real-world applications of direct control exist, such as tele-surgery, these interfaces are designed for expert users with substantial skill and training. Broadening applications and the potential users of telemanipulation, such as family members

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HRI ’17, March 06–09, 2017, Vienna, Austria
© 2017 ACM. ISBN 978-1-4503-4336-7/17/03...\$15.00.
DOI: <http://dx.doi.org/10.1145/2969824.3020254>

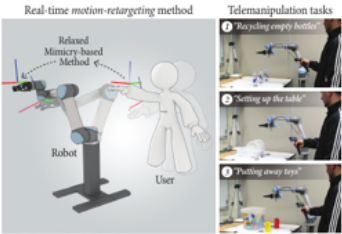


Figure 1: We propose a mimicry-based telemanipulation method that uses relaxed constraints on the mapping between a user and a robot arm as an effective real-time control mechanism and evaluate it in three telemanipulation tasks that follow a home care scenario.

providing remote home care for an elder parent, requires interfaces that are intuitive and effective to novice users.

Our goal is to provide a direct control interface that will allow 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 opportunity for extensive training in system operation [13, 14]. We posit 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 has become practical with the recent emergence of a variety of technologies, including visual tracking (e.g., the Microsoft Kinect [4]) and wireless controllers (such as the HTC Vive [5], 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

¹Microsoft Kinect: <https://dev.windows.com/en-us/kinect>

²HTC Vive: <http://www.vive.com/us/>

ToonNote: Improving Communication in Computational Notebooks Using Interactive Data Comics

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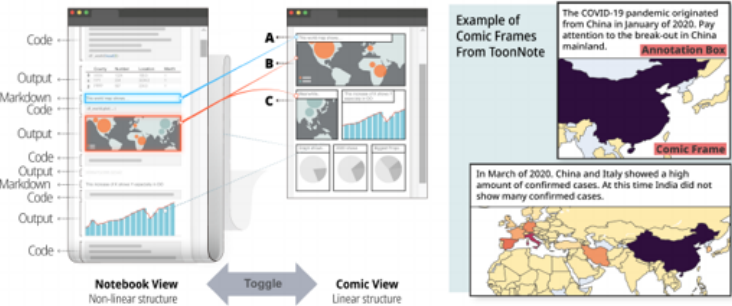


Figure 1: ToonNote is a novel technique for representing computational notebooks in the form of interactive data comics: **Notebook View** uses the traditional computational notebook’s format (using a combination of markdown/code/output), which affords detailed analysis, but makes it difficult to easily comprehend the high-level story behind the data. Therefore, **ToonNote** provides a high-level, curated narrative of the dataset in **Comic View**. The author can choose different markdown (A) and outputs (B) which can be combined in single or multiple (C) 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., tables, graphs). The combination of disparate materials is known to hinder the comprehension of notebooks, making it difficult for analysts to collaborate with other analysts unfamiliar with the dataset. To mitigate this problem, we introduce *ToonNote*, a JupyterLab extension that enables the conversion of notebooks into “data comics.” *ToonNote* provides a simplified view of a Jupyter notebook, highlighting the most important results while supporting 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 12 users, demonstrating the effectiveness of the produced comics. We discuss how our findings

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CHI ’21, May 8–13, 2021, Yokohama, Japan
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ACM ISBN 978-1-4503-4096-4/21/05...\$15.00
<https://doi.org/10.1145/3411794.3448434>

Corrected Version of Record, V.1.1. Published June 3, 2021.

Four of the five. All started as a 770 project.

Five projects, five venues

	Team	Venue	Cited
2012	Chidambaram, Chiang	HRI – persuading with a robot's vocal and nonverbal cues	405
2012	De Simone, Verbruggen, Kuo	Computers in Human Behavior – cheating in an unfair game	17
2015	Johnson, Gibson	CSCW – head-mounted vs. handheld for remote collaboration	90
2017	Rakita	HRI – mimicry-based teleoperation of robot arms	152
2021	Kang, Ho	CHI – data comics for computational notebooks	61

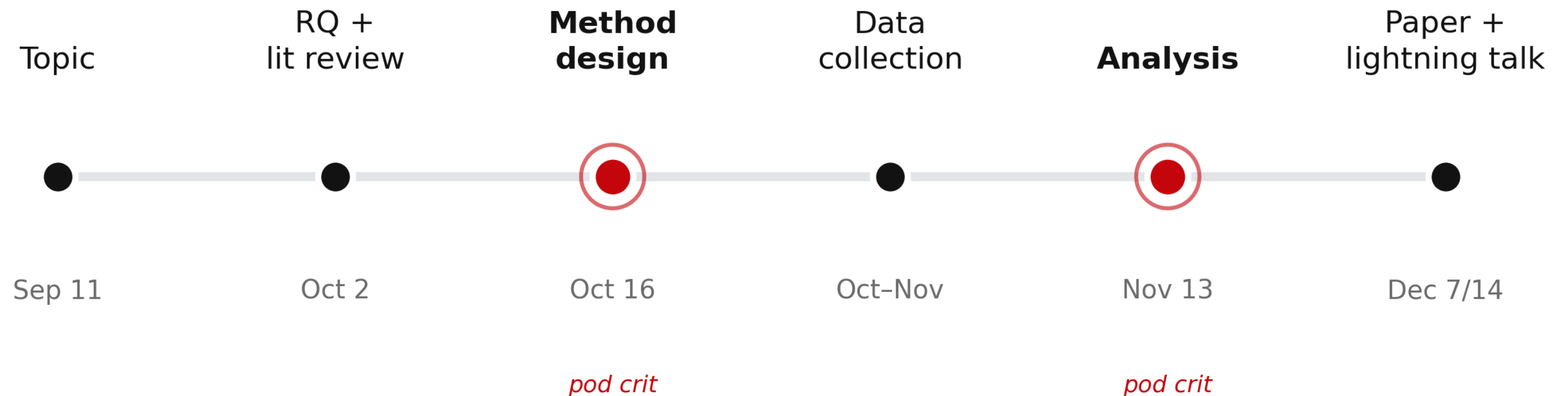
The road ahead

- Topic (*today*)
- Literature survey + RQs
- Method
- Data
- Analysis, results
- Final paper + lightning talk

The paper is written **incrementally**, in Overleaf, in ACM format.

Assembled across the term – not started in December.

Six milestones, two crits



Speculative Design Workshop

Minutes	Who	What
0-5	me	How the marketplace works – you make topics, not teams
5-10	solo	Your card → one research question + a ≤10-word tagline
10-20	your table	Round-robin, ~30 s each. The table picks the 2-3 it would most want to work on
20-28	table, then everyone	Post them to the shared sheet – then get up and walk the room
28-30	me	Five or six taglines read out at random

Posting and browsing

Post

- One laptop per table → the **shared sheet**
- Cast it to your pod monitor
- **Research question • tagline**
• **your name**

Then move

- **Leave your table.** Read other tables' monitors
- Find a topic you'd spend a semester on
- Talk to the person who posted it

Brought your own idea? Post it

How you get a team

Topics go on the board. **You recruit into them over the weekend.**

- **Friday evening** – each topic becomes a **Canvas group, capacity 3**
- **Friday → Monday** – browse all, join one. **First come, first served**
- **Monday Sep 14** – teams are final

The tagline is doing real work. It's how someone decides to spend a semester with your question.

Two rules for the weekend

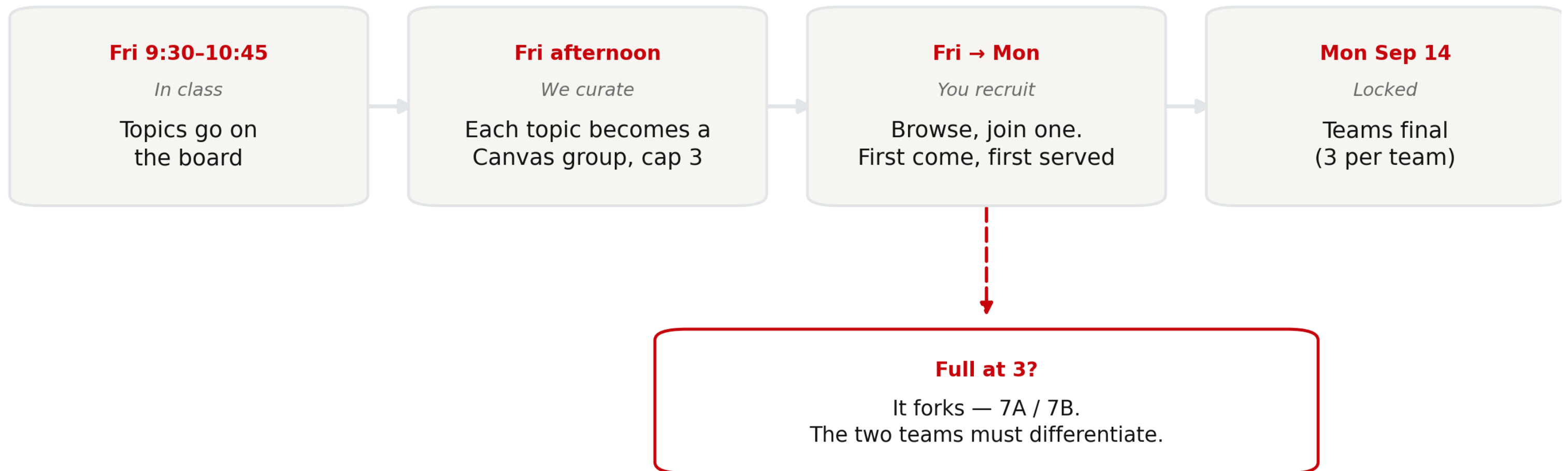
The fork rule

- A topic fills at **3** and closes
- More demand? **Fork**: 7A / 7B
- The two teams must **differentiate** – population, context, method, or measure
- The B team says how in its

Sit with your team

- **Mon Sep 14** – first time you're all in a room together
- **Standing pods** – two teams, one table – announced before **Sep 21**
- That seat is yours for the term

The weekend, end to end



The three card decks

Technology

LLMs & agents · XR
& sensing · robotics
& IoT · wearables ·
ubiquitous systems

Context / population

health · learning ·
accessibility · work ·
everyday life ·
vulnerable groups

Perspective

usability ·
experience · ethics ·
adoption · creativity
· repair &
sustainability

Picking a topic worth studying

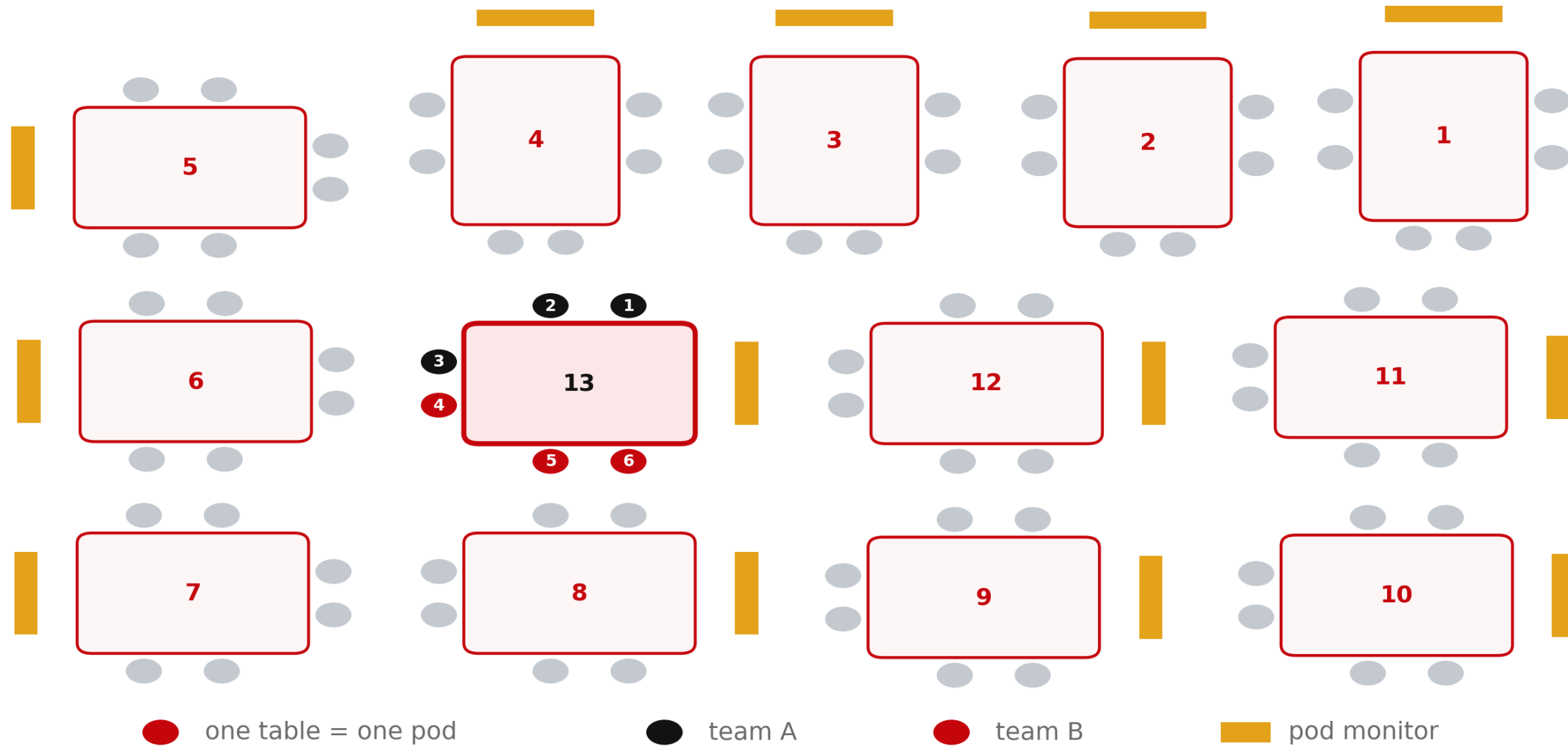
A problem worth a term is **understudied • significant • pervasive • persistent.**

- Odd card combinations are fine – they spark ideas even when they don't survive
- Choose a perspective you're actually drawn to
- Most of all: find teammates you click with

Teams and standing pods

- **Teams of 3** – fewer or more only as exceptions (*≈25 teams*)
- Teams are grouped into **standing pods – two teams at one table, six seats**
- The pod is your fixed unit all term: Monday discussion **and** Friday crits
- It's also the **backbone of attendance** – your seat is the check

The room



Crit etiquette – giving

- **Describe, don't judge** – "this is hard to interpret because..."
- **Ask questions** – "what made you choose that design?"
- **Build on ideas** – add, don't just react
- Be **kind, specific, and honest** – all three, or it isn't useful
- Focus on the **research goal**, not personal preference

Crit etiquette – receiving

- **Listen without defending** – you'll get your turn
- **Ask follow-ups** – get the note behind the note
- **Don't take it personally** – it's about the work, not about you

The first crit is modeled live before you run one yourselves.

Assignment – Project Framing Brief

(team; 1 page) · **Due Fri Sep 18, 9:30 am**

1. **Research question** – refined from your recruitment RQ
2. **Why it matters** – two or three sentences
3. **Rough direction** – what you'd build, study, or observe
4. **Likely contribution type** – your best guess, and why (*it can change*)
5. **Differentiation** – B-copy teams only: how you differ from the A team

What's Next?

- **Mon Sep 14 – Seminar: Foundations & Visions of HCI**
 - Read Bush, Licklider, Suchman; skim Shneiderman's 2×2
 - **Post one provocation slide** before class
- **Fri Sep 18 – M2: Choosing Methods + Research Ethics & IRB**
 - **Framing Brief due 9:30 am**
 - Each team posts a **3-line status** – done / blocker / next