Human-Computer Interaction

Qualitative Research

Professor Bilge Mutlu

What do we do in the following situations?

1. Theory is *nascent* in an area

2. If you would like to take a fresh look at a mature topic

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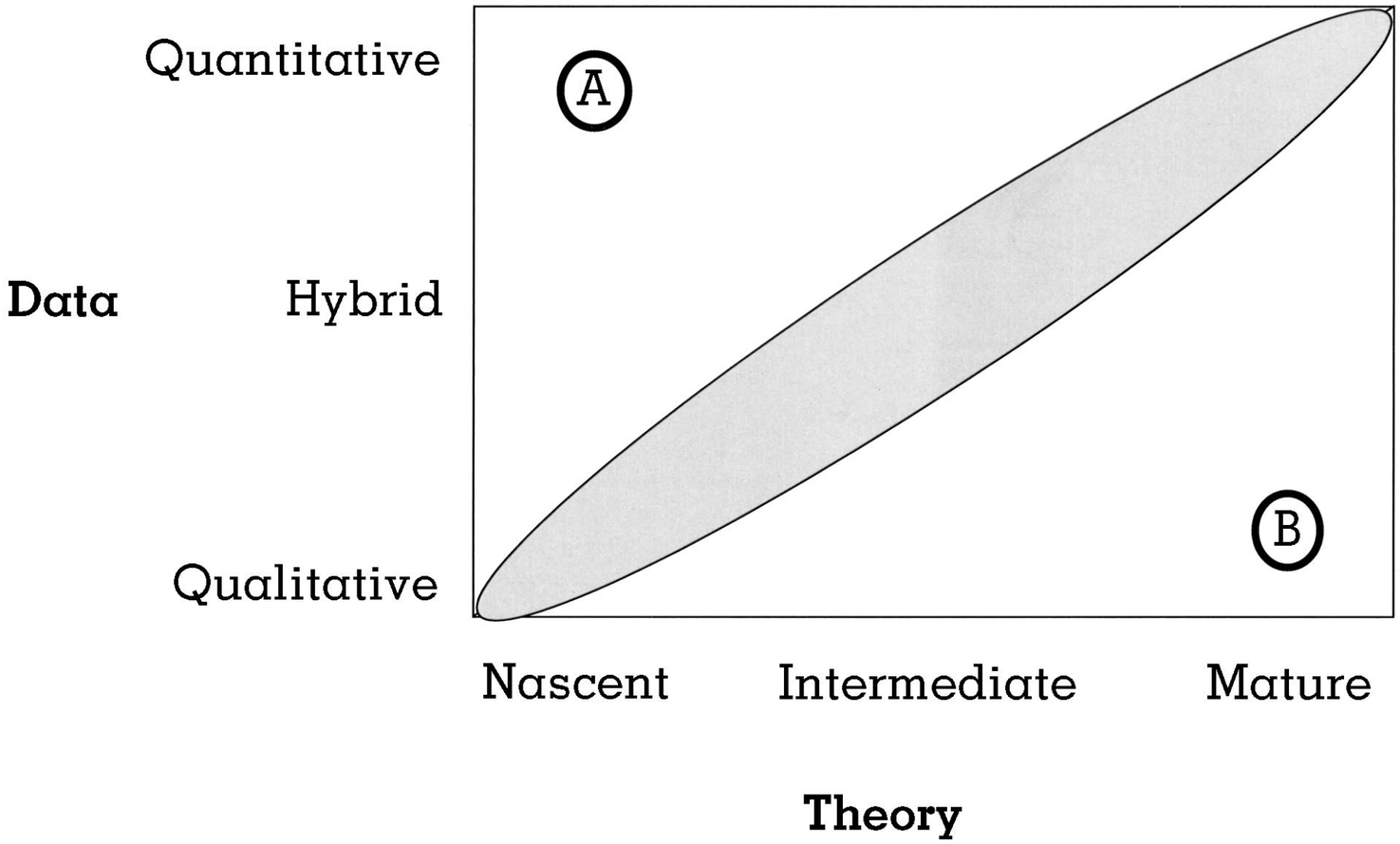

[1] Edmondson & McManus, 2007, Methodological fit in management field research

We use qualitative research methods.

Definition: Qualitative research is an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. The researcher builds a complex, holistic picture, analyzes words, reports detailed views of informants, and conducts the study in a natural setting (p. 15).[2]

Methods:

1. Narrative (Inquiry)
2. Phenomenology
3. Grounded Theory
4. Case Study
5. (Participatory) Action Research
6. Ethnography

[2] Creswell et al., 2007. Qualitative research designs: Selection and implementation

1. Narrative (Inquiry)[2]

Definition: A qualitative research method involving studying one or two individuals, gathering data through collecting their stories, reporting individual experiences, and chronologically ordering the meaning of those experiences.

Originates primarily from the humanities, e.g., literature, history, anthropology, sociology, sociolinguistics, and education.

Utilizes individual "stories" (told/journaled) and various other resources (documents, photos, historical accounts) and presents individual stories in chronological representation.

[2] Creswell et al., 2007. Qualitative research designs: Selection and implementation

DOI:10.1145/1536616.1536636

Meaning can be as important as usability in the design of technology.

BY KRISTEN SHINOHARA AND JOSH TENENBERG

A Blind Person's Interactions with Technology

CURRENT PRACTICE IN computer interface design often takes for granted the user's sightedness. But a blind user employs a combination of other senses in accomplishing everyday tasks, such as having text read aloud or using fingers along a tactile surface to read Braille. As such, designers of assistive technologies must pay careful attention to the alternatives to sight to engage a blind user in completing tasks. It may be difficult for a sighted designer to understand how blind people mentally represent their environment or how they apply alternative options in accomplishing a task. Designers have responded to these challenges by developing alternative modes of interaction, including audible screen readers,[11] external memory aids for exploring haptic graphs,[20] non-speech sounds for navigating hypermedia,[16] two-finger haptic interfaces for touching virtual objects,[22] haptic modeling of virtual objects,[13] and multimodal (auditory, haptic, visual) feedback for simple computer-based tasks.[10] The effectiveness of these alternative modes of interaction is studied primarily through a usability framework, where blind and visually impaired users interact with specific devices in a controlled laboratory environment. These developments in assistive technology make a point to take advantage of the alternative modes of interaction available to blind users.

Physical obstacles are not the only considerations affecting interaction between blind users and everyday artifacts. As we found in this study, elements of meaning, such as socialization, efficiency, flexibility, and control, strongly influence the use of both digital and non-digital artifacts by blind users. Taken-for-granted factors, such as an individual's social ties or busy schedule, might determine whether and how an object is used. Therefore, designers may need to pay close attention to the external factors that influence an individual's choice and use of technology. Conversely, and equally as important, designers must also consider how an individual's internal values and desires affect their technology preferences.

The study described here is an in-depth exploratory and descriptive case study[24] of a blind individual using various technologies in her home. Previous studies in lab settings compared interactions against a set of heuristics or with a control group, allowing researchers to isolate events in order to understand how users interact with specific technologies on a narrow range of tasks. We took this study out of the lab and into the home to get a better sense of the nuances of everyday life influencing how a blind user interacts with technology. It differs from the usability approaches in several ways. First, we wanted to look across a range of technologies for common kinds of task failure and workarounds, rather than on a single technology or task. Second, because emerging technologies involve a choice of what to place in hardware and what to place in software, such as whether to have physical or virtual buttons on a cellphone, we wanted to investigate user interaction with both digital and physical objects to better understand the trade-offs in hardware vs. software design choices. Third, the investigation was situated within the individual's home rather than in the laboratory to better understand artifact use in a naturalistic setting. And fourth, our interviews concerned not only usability but aesthetics, affect, meaning, historical associations of use in context, and envisioning of future technologies. Overall, we were concerned about what technologies were most valued and used, when they were used and for what purpose, the difficulties experienced in their use, the workarounds employed, and the meanings and interpretations associated with their use.

Without careful consideration for both the limitations in usability and the meaning of the interactions affecting blind users, sighted technology designers may unwittingly create interfaces with the wrong affordances or that are dissonant with a user's personal preferences, resulting in task failure. Already known is that the visually impaired must make alternative accommodations to accomplish the same tasks day in and day out. What is little known is how much of an influence an individual's personal values and surroundings have on the choice of where, when, and how technology is used. Observations in a user's home of interactions with existing technologies may provide insight into the way surroundings and personal preferences are drawn on to help complete daily tasks.

As we suggest in the study, the combination of functionality *and* socially situated meaning determines for the user the actual usability of a technology to accomplish specific tasks. These technologies hold meaning that affects the ways individuals understand themselves in relation to the communities to which they belong.

BrailleNote from HumanWare; http://www.humanware.com/en-usa/home.

PHOTOGRAPH BY ALEX WEALE

Background

Developing the study, we drew on a number of literatures, including in assistive technology for people with visual impairments, task breakdowns and workarounds, and design ethnography in the home:

Design ethnography. The study design reflects Clifford Geertz's view that "man is an animal suspended in webs of significance he himself has spun."[8] Significance is constructed not only from behavior and discourse, but in the materials with which people interact. Many are mundane objects—measuring cups, cellphones, sticky notes.

[3] Shinohara & Tenenberg, 2009, A blind person's interactions with technology

2. Phenomenology

Definition: The study of the shared lived experiences of individuals that focuses on a particular phenomenon (e.g., anger) to capture the essence of these experiences.

Philosophical roots in Husserl, Heidegger, Sartre, Merleau-Ponty.[2]

Utilizes interview data, systematic reductive analyses, and generating textual statements of the essence of the experience.

[2] Creswell et al., 2007. Qualitative research designs: Selection and implementation

A foundational HCI text that applies phenomenological principles (drawing from Dewey and Merleau-Ponty) to understand people's felt, embodied experience of technology.[12]

[12] McCarthy, J. & Wright, P.C., (2004). Technology as experience. Cambridge, MA: MIT Press.

3. Grounded Theory

Definition: A qualitative research design in which the inquirer generates a general explanation (a theory) of a process, action, or interaction shaped by the views of a large number of participants.[2]

Primarily utilizes interview data and, through a systematic, analytical process, constructs a theoretical model of phenomena.

Two forms: *classsical*[4] and *constructivist*[5] — "found" vs. "constructed" stories.[6]

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[2] Creswell et al., 2007. Qualitative research designs: Selection and implementation

[4] Strauss & Corbin, 1990, Basics of qualitative research

[5] Charmaz & Belgrave, 2007, Grounded theory

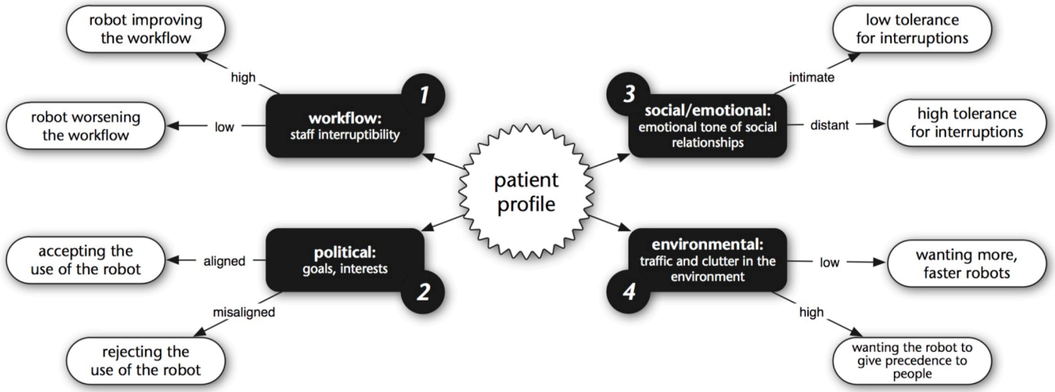
[6] O'Conner et al., 2018. An Exploration of Key Issues in the Debate Between Classic and Constructivist Grounded Theory

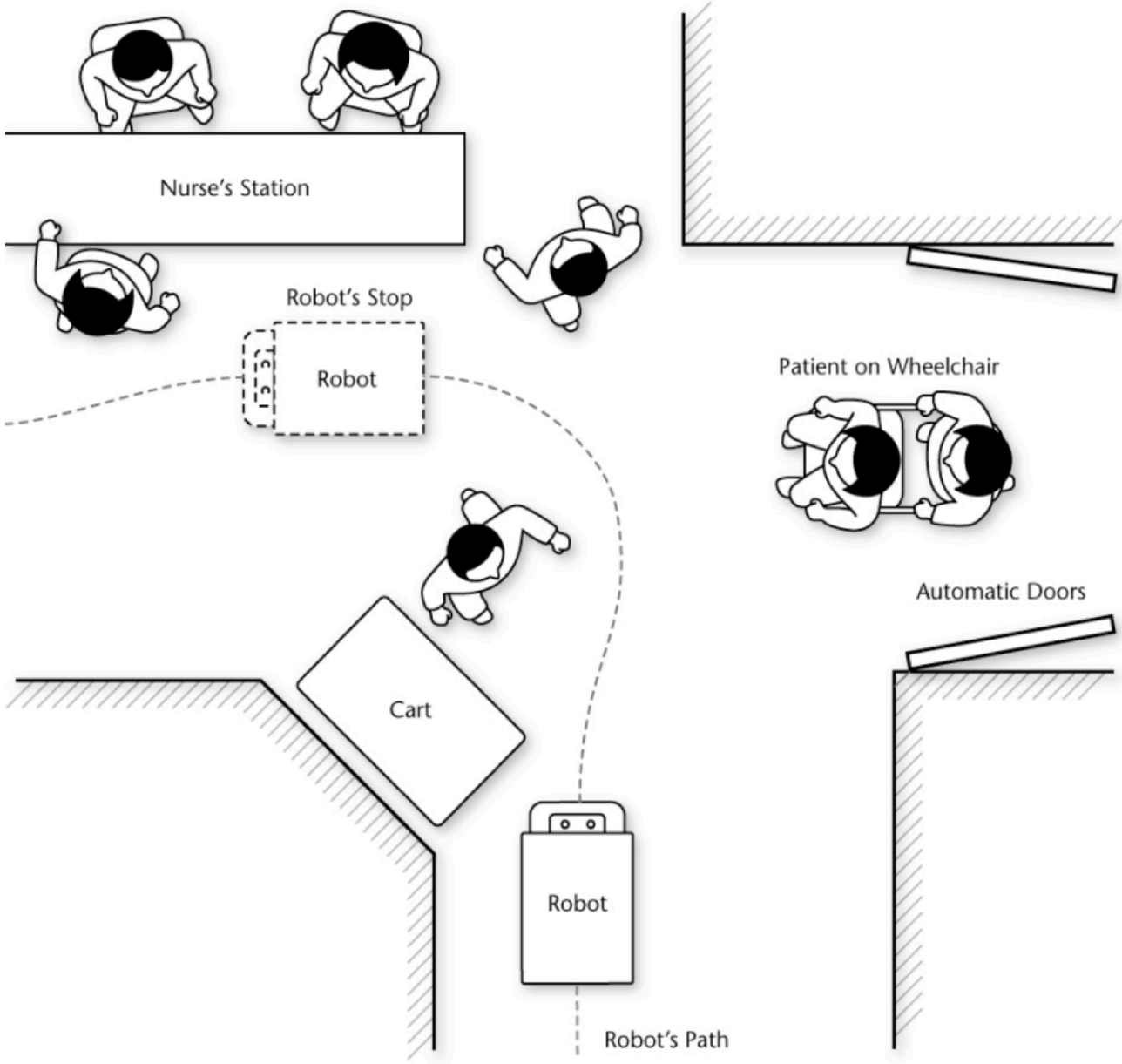
» 15-month ethnographic fieldwork in hospitals using delivery robots.[13]

» Applied *grounded theory analysis*.

» A theoretical model linked workflow, social/emotional, political, and environmental factors to robot acceptance.

» Showed that contextual misfit—not just usability—drives success or failure of organizational robotics.





[13] Mutlu, B., & Forlizzi, J. (2008). *Robots in organizations: The role of workflow, social, and environmental factors in human-robot interaction.* HRI 2008.

4. Case Study

Definition: A case study is an approach in which (a) one case (single case study) or a small number of cases (comparative case study) in their real life context are selected, and (b) scores obtained from these cases are analysed in a qualitative manner.[7]

Forms of case studies: *exploratory*, *descriptive*, *explanatory*.[8]

Utilizes documents, archival records, interviews, direct observations, participant observations, and physical artifacts.

[7] Dul & Hak, 2007, Case study methodology in business research

[8] Yin, 2003, Case study research; designs and method

» Aimed to understand how software architecture and organizational distance affect coordination.[14]

» Multi-site case study using interviews, observations, and document analysis in industrial software teams.

» Found that software structure mirrors communication structure; architectural partitioning can manage coordination across distance.

[14] Herbsleb & Grinter (1999). Architectures, Coordination, and Distance: Conway's Law and Beyond. IEEE Software.

Geographically distributed development teams face extraordinary communication and coordination problems. The authors' case study clearly demonstrates how common but unanticipated events can stretch project communication to the breaking point. Project schedules can fall apart, particularly during integration. Modular design is necessary, but not sufficient to avoid this fate.

Architectures, Coordination, and Distance: Conway's Law and Beyond

James D. Herbsleb and Rebecca E. Grinter, Bell Laboratories

Software engineering researchers have long argued that the architecture of a system plays a pivotal role in coordinating development work. Over 30 years ago, Melvin Conway proposed what has since become known as Conway's Law—that the structure of the system mirrors the structure of the organization that designed it.[1] This relation, Conway argued, is a necessary consequence of the communication needs of the people doing the work. David Parnas, in fact, defined a software module as "a responsibility assignment rather than a subprogram,"[2] driving home the idea that modular design enables decisions about the internals of each module to be made independently. Of course, the computer that runs the software doesn't care. The point of structure is to support coordination of the development work.

Architecture, however, addresses only one of the several dimensions on which we must coordinate development. To support efficient use of resources, projects require plans that specify when milestones must be completed and who will do the

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5. (Participatory) Action Research

Definition: A qualitative research inquiry in which the researcher and the participants collaborate at all levels in the research process (participation) to help find a suitable solution for a social problem that significantly affects an underserved community (action).[2]

Involves participatory and collaborative reflection of people's relationships with other people or social structures.

[2] Creswell et al., 2007. Qualitative research designs: Selection and implementation

- Aimed to empower people with early dementia and their caregivers in a rural Japanese town.[16]
- 5-year community-based PAR → **three cycles** of *planning* → *action* → *reflection*.
  - *Cycle 1:* regain daily-life skills → *Cycle 2:* strengthen family & peer ties → *Cycle 3:* build community participation
- Restored confidence, improved caregiver coping, reduced stigma.

[16] Nomura et al. (2009). Empowering Older People with Early Dementia and Family Caregivers. IJNS, 46, 431–441.

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International Journal of Nursing Studies 46 (2009) 431–441

INTERNATIONAL JOURNAL OF NURSING STUDIES
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Empowering older people with early dementia and family caregivers: A participatory action research study

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Received 15 September 2006; received in revised form 5 September 2007; accepted 28 September 2007

Abstract

Background: The increase in the number of people suffering from dementia is of increasing global concern. A survey on the living conditions of the elderly in a Japanese rural community revealed a high prevalence of early dementia and the necessity for interventions not only for the elderly with early dementia but also for their families.
Objective: To describe the implementation and process evaluation of a programme based on cognitive rehabilitation aimed at empowering the elderly with early dementia and education and counselling programmes aimed at likewise empowering their family caregivers.
Design: This study used a community health action research model. Participatory action research (PAR) was conducted through a cycle of planning, action, and reflection to identify effective interventions to empower participants with dementia (PsWD) and their caregivers.
Setting: A rural town in Japan.
Participants: This project involved 37 community-dwelling elderly with early or mild dementia and 31 family caregivers.
Methods: A focus group interview was used for assessment. A monthly activity-based programme based on cognitive rehabilitation was developed to improve cognitive function. Three types of data were collected: observational data collected during the activities, written comments from the caregivers, the record of phone interviews and counsellings with caregivers. These data were compiled in chronological order into a portfolio for analysis. To empower family caregivers, educational and counselling programmes were offered.
Results: The PAR lasted for 5 years and evolved over three cycles: individual, group and community. In the first cycle, the major focus of the intervention was to regain procedural skills for each PWD through a cooking programme. In the second cycle, to increase interactions with family members and with other PsWD, group activities that promoted communication among family members as well as among PsWD were implemented. The collective values and the beliefs of the PsWD's generation were validated by a series of trips to temples and shrines. In the third cycle, community participation was planned and implemented through culturally relevant sequential activities. PsWD demonstrated their expert skills and regained confidence. For family

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doi:10.1016/j.ijnurstu.2007.09.009

6. Ethnography

Definition: Ethnographic research projects use deep immersion and participation in a specific research context to develop an understanding that would not be achievable with other, more limited research approaches.[9]

Roots in anthropology and sociology, adopted by fields such as HCI.

Utilizes observation and interview data and systematic analyses to construct new understanding and theory.

[9] Lazar et al. (2017). Chapter 9: Ethnography. Morgan Kaufmann.

» Ethnographic field study of the use of collaborative robots at factories.[17]

» Used fly-on-the-wall observation and interviews for data collection.

[17] Sauppé, A., & Mutlu, B. (2015). The social impact of a robot co-worker in industrial settings. *CHI 2015*.

The Social Impact of a Robot Co-Worker in Industrial Settings

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ABSTRACT
Across history and cultures, robots have been envisioned as assistants working alongside people. Following this vision, an emerging family of products—collaborative manufacturing robots—is enabling human and robot workers to work side by side as collaborators in manufacturing tasks. Their introduction presents an opportunity to better understand people's interactions with and perceptions of a robot "co-worker" in a real-world setting to guide the design of these products. In this paper, we present findings from an ethnographic field study at three manufacturing sites and a Grounded Theory analysis of observations and interviews. Our results show that, even in this safety-critical manufacturing setting, workers relate to the robot as a social entity and rely on cues to understand the robot's actions, which we observed to be critical for workers to feel safe when near the robot. These findings contribute to our understanding of interactions with robotic products in real-world settings and offer important design implications.

Author Keywords
Computer-supported collaborative work; human-robot collaboration; collaborative robots; technology adoption; manufacturing; sociality; social cues; design guidelines

ACM Classification Keywords
H.5.3 Group and Organization Interfaces: Computer-supported collaborative work; **K.4.3 Organizational Impacts**: Computer-supported collaborative work

INTRODUCTION
While robots have long been envisioned as ubiquitous assistants that work in day-to-day human environments, the primary use of robotic technologies have been in factories and field settings for automating repetitive work or performing tasks that are inaccessible or dangerous for humans [19]. The last decade, however, has seen significant growth in the introduction of robotic products into homes and workplaces for tasks such as cleaning and delivery [6, 16]. One recent example

CHI 2015, April 18 - 23 2015, Seoul, Republic of Korea
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ACM 978-1-4503-3145-6/15/04$15.00
http://dx.doi.org/10.1145/2702123.2702181

Figure 1. A collaborative manufacturing robot (right) working alongside a human operator (left) on a manufacturing task.

is the emerging use of *collaborative manufacturing robots* in industrial settings, which is poised to drastically change how work is done in small- and medium-sized manufacturing facilities. Figure 1 shows such a robot working collaboratively with a human worker on a manufacturing task.

Unlike robots designed for automation and unsafe work, collaborative robots are designed to work alongside humans and to interact and collaborate with their users, potentially changing how people perceive and interact with robotic technologies. Research in HCI has proposed different roles that computer technologies play, including "tools," "media," and "social actors," that accordingly shape people's perceptions of and responses to these technologies [4]. Computer technologies that display aspects of human language, offer interactivity, and play roles that have traditionally been filled by humans elicit attributions of sociality and social responses [18]. We expect collaborative robots that play a "co-worker" role to also be perceived as social entities, although little is known about the potential social impact of the introduction of these technologies to industrial settings on individuals and organizations.

Previous research on the impact of the introduction of robotic technology into other types of human environments, such as hospitals [13, 16, 20] and the home [5, 6, 21, 22, 23] has shown that robots significantly change people's perceptions regarding their social relationships and trigger a process of sense-making that results in the application of specific schemas, such as "collaborator," "social entity," or merely "novelty." While we

*How do we conduct an **ethnography**?*

Where do we start?

1. Identify a domain where theory is *nascent* and where new theory can have great impact
2. Developing a general *research question* and focus that can be updated
3. Find a *setting* to study the phenomena of interest from this domain
4. Conduct *fieldwork* where we ask the question: *What is going on here?*

What is a setting?

Definition: A site where the phenomena of interest can be observed.

What is fieldwork?

Definition: An organic process where data *collection* and *analysis* develop symbiotically and becomes increasingly more focused over time.

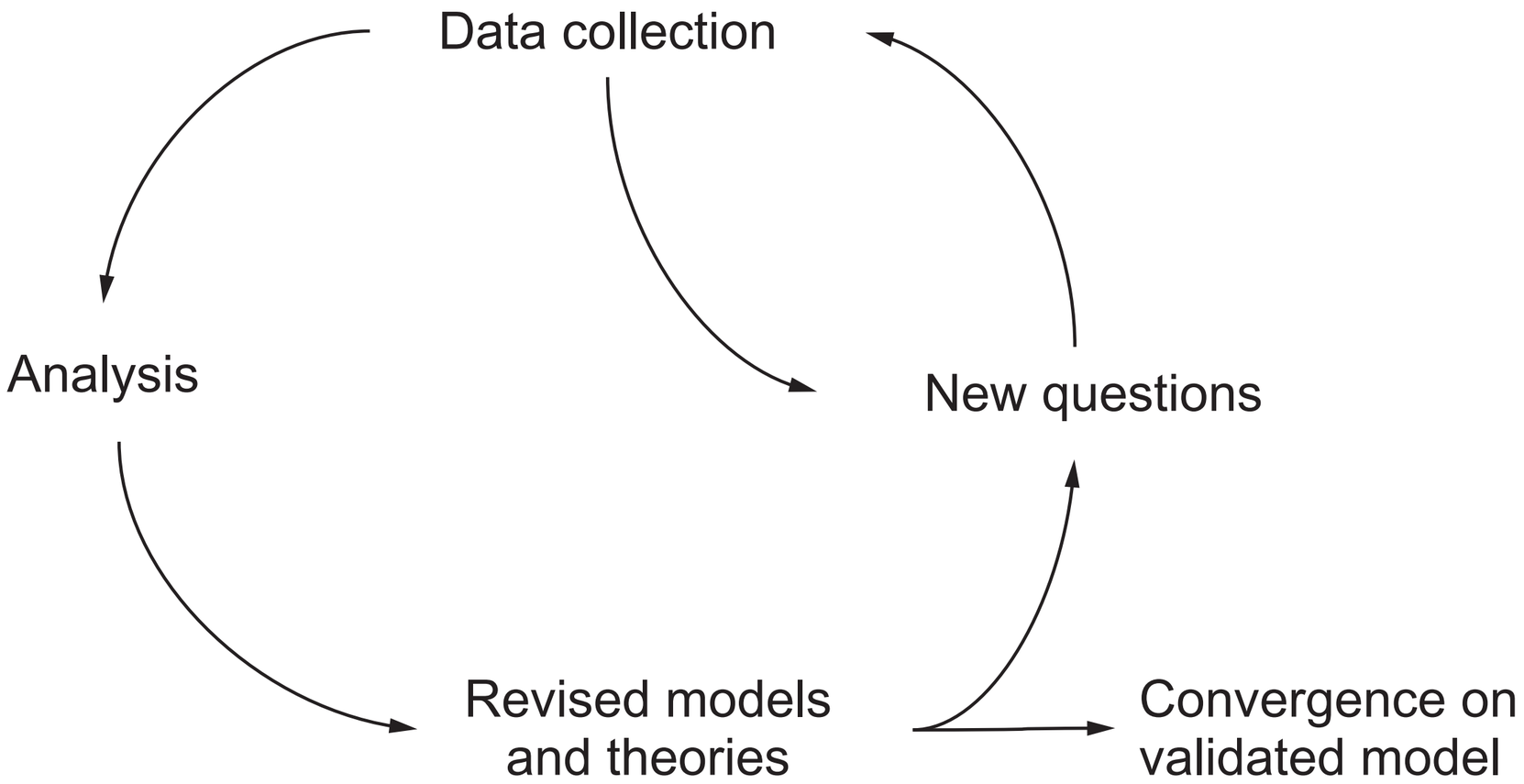
» Obtaining access to the site, informed consent

» Identifying *stakeholders*, choosing a *role*

» Discovering groups, situations for comparison

» Writing up detailed *fieldnotes*

9



[9] Lazar et al. (2017). Chapter 9: Ethnography. Morgan Kaufmann.

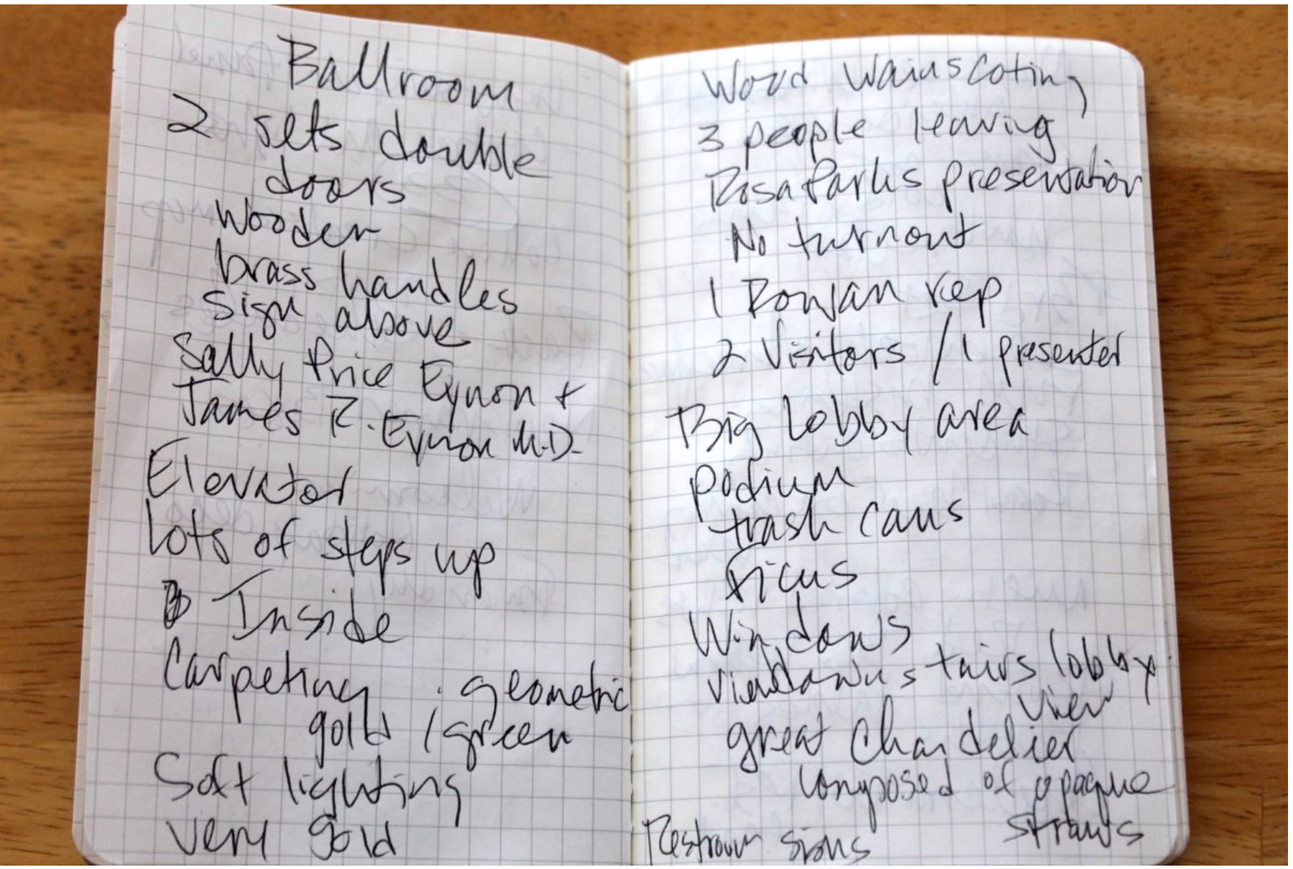
How do we collect data?

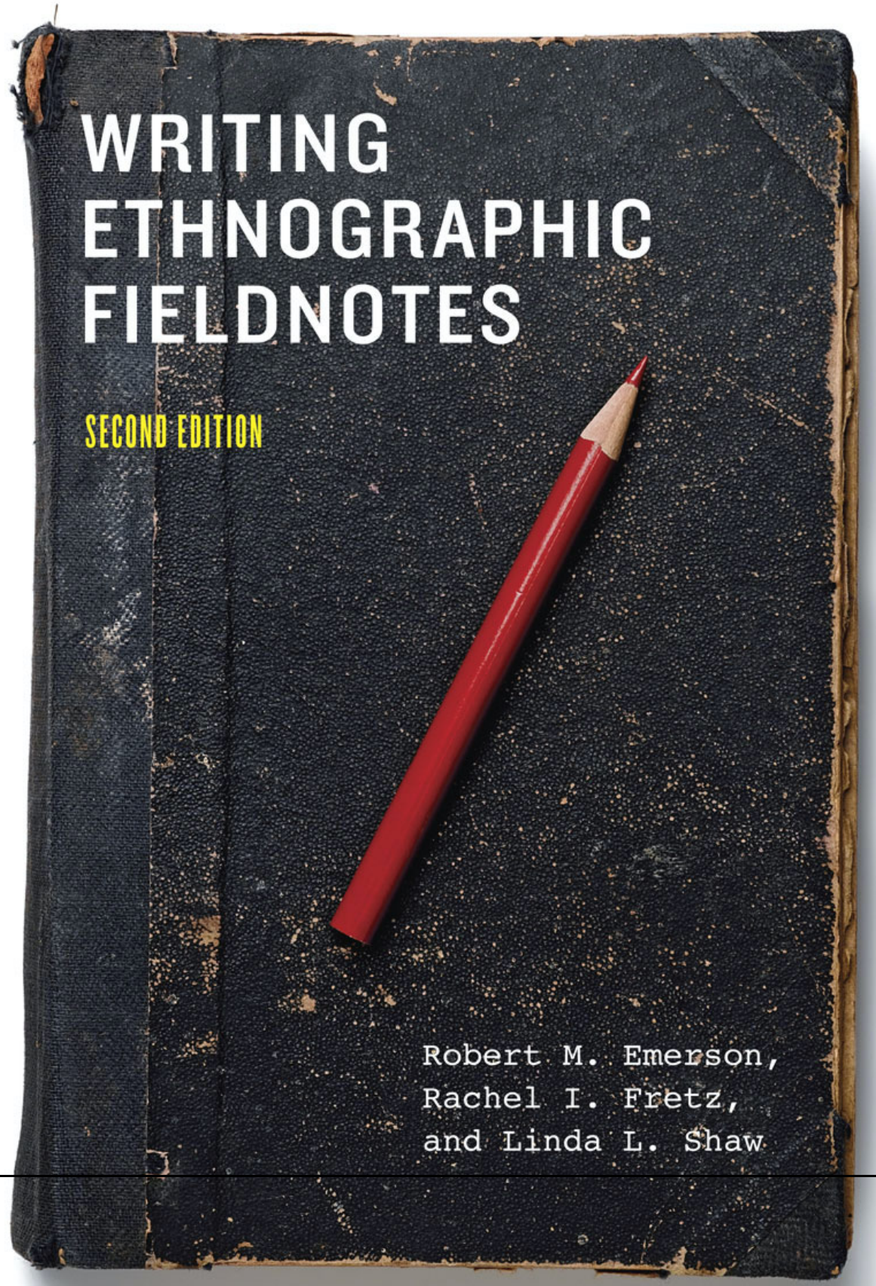
1. Fly-on-the-wall observations
2. Participant observation
3. Interviews

Fly-on-the-wall Observation

Definition: Observing social interactions in the setting without influencing the context in order to gain familiarity with the physical and social context of the study.

Produces *fieldnotes* of observations that can be captured in written, audio, or video form.





[10] Image sources: Left, Right

Participant Observation

Definition: Gaining an in-depth understanding of how the stakeholders in the setting interact with each other by participating in the activities that take place at the setting.

Produces *fieldnotes* of observations and personal reflections that can be captured in written, audio, or video form.

Interviews

Definition: Interviewing individuals to understand their perspectives, to understand how people see their world, and to validate findings from observations.

Open-ended, in-depth interviews with follow-up from observations and further probing.

Involves studying spoken language, body language, and coded speech.

Produces *transcripts* captured in written, audio, or video form.

What kind of data should I collect?

» Fieldnotes should capture everything observed and heard, researcher interpretations, including what one could not observe or understand.

» Audio/video recording is acceptable within limits. Transcription and reflection should happen immediately before interpretations are lost. Audio is recommended over video.

» Retrospective capture of field notes and interpretations should take place immediately.

» Photos can provide useful visual context to observations and interpretations.

What about digital ethnography?

Digital Ethnography (a.k.a. Netnography)[18][19]

- Extension of ethnographic methods to online settings such as forums, social media, virtual worlds, or gaming environments.
- Combines participant observation, interviews, and analysis of digital artifacts (posts, chats, videos, memes).
- Enables study of culture and interaction that occur *through* and *within* technology-mediated spaces.
- Raises unique *ethical issues* (e.g., informed consent in public vs. private online spaces, trace data use).
- Often employs *multi-sited ethnography*, tracing relationships between online and offline practices.

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[18] Kozinets, R. V. (2015). Netnography: Redefined. Sage Publications.

[19] Boellstorff, T., Nardi, B., Pearce, C., & Taylor, T. L. (2012). Ethnography and virtual worlds: A handbook of method. Princeton University Press.

What are some examples?

Some Well-known Ethnographies[11]

» Van Maanen, 1991, *The smile factory*

» Barley, 1986, *Technology as an occasion for structuring*

» Suchman, 1987, *Plans and situated action*

» Grudin, 1988, *Why CSCW applications fail*

» Bechky, 2006, *Gaffers, gofers, and grips*

[11] Compiled by Professor Sara Kiesler

Assignment: Ethnography & Netnography

Goal: Explore qualitative field methods for studying people and technologies in context.

Choose one approach:

» **Ethnography:** Observe in-person interactions in a physical setting.

» **Netnography:** Observe online interactions in a digital community.

Your task:

» Conduct 1 hour of observation + 2 short interviews (10–15 min each)

» Summarize what you observed (high level, no formal analysis)

» Reflect on the process and what you learned about doing fieldwork