Human–Computer Interaction

Qualitative Data Analysis

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Today's Agenda

» Topic overview: *Qualitative Data Analysis*

» Assignment

Qualitative Data Analysis Mehtods

» Content analysis

» Discourse analysis

» Narrative analysis

» **Thematic analysis**

» **Grounded Theory**

What is Grounded Theory?[1][2]

» An *approach* to describe relationships where little is known or to provide a fresh take on existing knowledge

» A *method* to systematically build integrated sets of concepts from systematically obtained empirical data

» A *process* of composing knowledge through intimate contact with subjects, events

» A *theory* that is shaped by data as well as by the researcher

» HCI research adopts Grounded Theory as a systematic and rigorous method to analyze qualitative data

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[1]Glaser, B. G. and Strauss, A. The Discovery of Grounded Theory. Aldine DeGruyter, 1967.

[2]Strauss, A. L. and Corbin, J. Basics of Qualitative Research. Sage Publications, 1990.

What are key characteristics of Grounded Theory?

»   **Induction:** Theory emerges from data.[3]

»   **Fit:** Theory generated must:

>   »   *Fit* the data: categories should emerge from the data; data should not be forced into pre-existing categories.

>   »   Be *relevant*: theory should explain, interpret, predict phenomena.

>   »   Be *adaptable*: theory should be modifiable based on new data.

»   **Subjectivity:** Subjectivity can be minimized by (1) keeping an open mind, thinking comparatively, studying multiple viewpoints, and perdiodically asking big picture questions; (2) inter-rater reliability.

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[3] *Inductive* approaches to research aim to generate theory, and *deductive* approches to research aim to test theory.

How do we conduct Grounded Theory?

» Reading a textual database, including fieldnotes, interview transcripts, and other data that is translated into textual form

» Discovering and labeling variables

» Identifying and modeling relationships

Running Example

» 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 underlies success or failure of organizational adoption of robots.
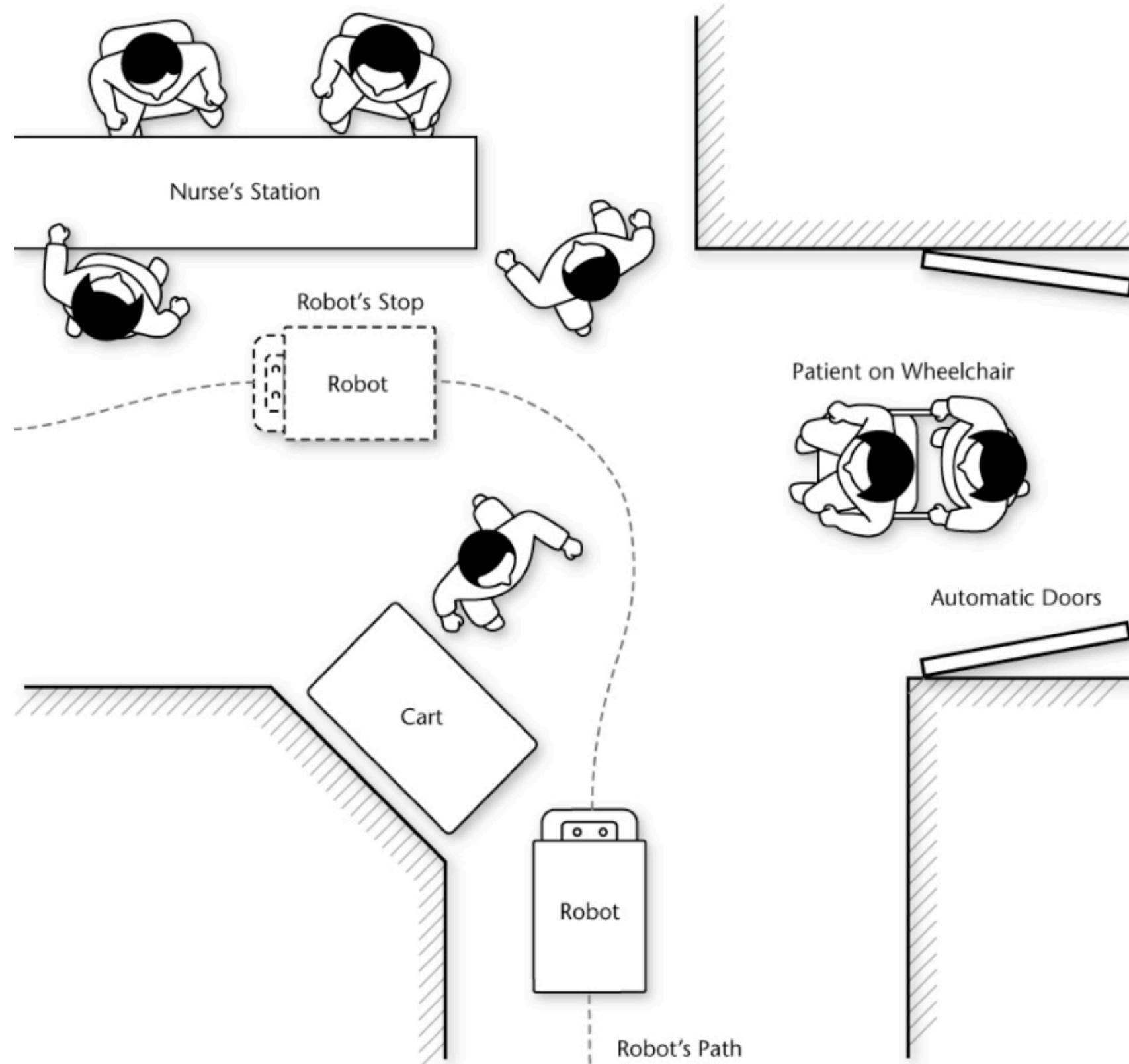
[13] Mutlu, B., & Forlizzi, J. (2008). *Robots in organizations: The role of workflow, social, and environmental factors in human–robot interaction.* HRI 2008.

The Grounded Theory Process
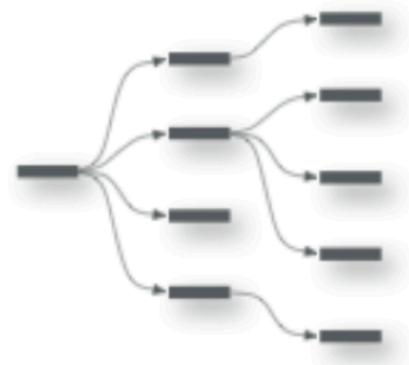
Open Coding   Axial Coding   Selective Coding   Comparative Analysis   Theory Building
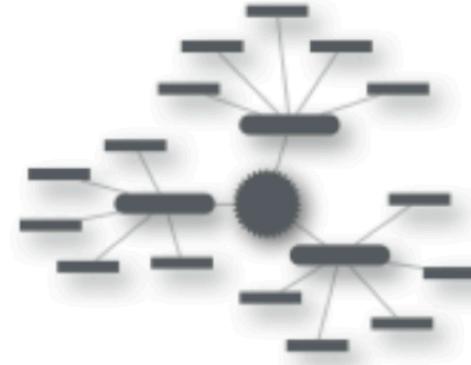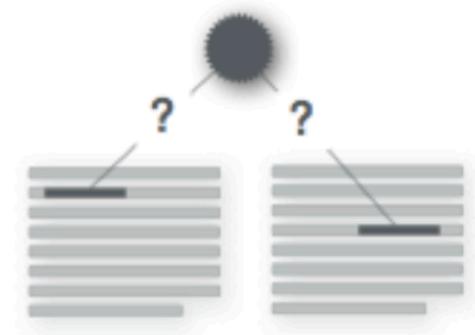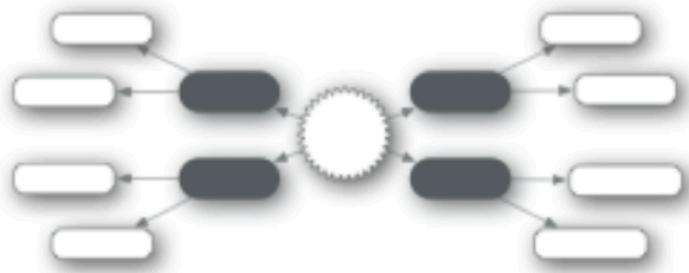
Open Coding[4]

Coding for concepts that are significant in the data as abstract representations of events, objects, relationships, interactions, etc.

{abusing the robot}

I kicked it before and I was told not to…
[laughs]…when it first came.

[4] Mutlu, B. & Forlizzi, J. (2008). <u>Robots in Organizations: Workflow, Social, and Environmental Factors in Human–Robot Interaction</u>.

What happens during open coding?

» **Goal:** Identify and name concepts that capture phenomena in the data.

» Read data line–by–line, noting actions, experiences, emotions, or meanings.

» Stay close to participants' words (*in vivo* codes) before abstracting.

» Constantly ask: "What is happening here?" and "What does this tell me about the phenomenon?"

What are guiding questions for open coding?[5]

» **What actions, feelings, or consequences are present?**

» **What causes, contexts, and strategies appear?**

» **What outcomes follow?**

» **How does this instance compare to others?**

» **What surprises me or contradicts earlier codes?**

C054	POST	R: Okay. Tell me about the likes. And then we'll go back to the recording ((inaudible)). What did you like about the reading activities?
C054	POST	C054: Um I liked, well that it gave me something to do. Um I liked how you, like, you kind of got a certain amount of books to pick out. So then like because they're all kind of like in my area. And they just, I don't know, they're just all, I liked the
C054	POST	R: Okay. So that was probably the main thing, that you had a good selection of books to go from. Anything else you can think of that you liked about the activities?
C054	POST	C054: (2 sec) No.
C054	POST	R: What about the actual, um, the packet? The parts of this. Can you think of anything there that was (1 sec) something you liked?
C054	POST	C054: Oh yeah, that, that was (2 sec). I liked how I just, it just, I don't know, I liked how like (1 sec) you kind of got to like talk about what, because like, usually like when you're reading alone, you don't get to like talk about how you, what you read
C054	POST	R: Okay. What do you, what do you mean by talk about? How did you talk about what you did?
C054	POST	C054: Like, so like, when you're just like sitting there reading by yourself, if, like when you do, like, after you're done you just are done. Like this, it gives you
C054	POST	R: Okay. Do you remember? Could you describe what, what did you do then? After you finished reading a book, what did you do?
C054	POST	C054: Well, I wrote down like the name of the book, or time, if I liked it, if I didn't.
C054	POST	R: Okay. So that was nice? You liked doing that?
C054	POST	C054: Yeah.
C054	POST	R: Um. Tell me about the recording then. You said that was something you didn't really like.

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[5] Michaelis, J. E., & Mutlu, B. (2018). Reading socially: Transforming the in-home reading experience with a learning-companion robot. *Science robotics*, *3*(21), eaat5999.

How do we move from in vivo codes to abstraction?

Raw Quote	In Vivo Code	Researcher Concept
"I keep hitting refresh because it freezes."	"hitting refresh"	coping strategy
"I just wait and hope it loads."	"wait and hope"	user resignation
"It's so annoying — I quit the app."	"quit the app"	frustration → abandonment

What is inductive vs. deductive coding?[6]

Inductive Coding	Deductive Coding
Codes emerge from the data—phrases or meanings expressed by participants.	Codes start from theory or prior research—concepts defined before analysis.
The researcher stays *close to the data*, using participants' language (*in vivo* codes).	The researcher applies a predefined codebook or conceptual framework.
Aims to build theory or discover new patterns when little is known.	Aims to test, refine, or extend theory by checking data against expectations.
Typically involves many, narrow codes that are merged into broader categories in later cycles.	Uses fewer, higher-level codes that may be revised as data reveal nuances.
Example: Coding interviews on AI use to identify new themes like "trust calibration."	Example: Coding same interviews using categories from *Technology Acceptance Model* (TAM).

[6] Skjott Linneberg, M., & Korsgaard, S. (2019). Coding qualitative data: A synthesis guiding the novice. Qualitative research journal, 19(3), 259-270.

Can I combine these approaches?

» A blended or **abductive** approach is also commonly used in HCI research[7]

» Allowing unexpected patterns to inform/reshape existing theory

» Move back and forth between data and theory:

   » Start inductively to "give voice" to participants.

   » Introduce theory later to interpret/connect findings.

» Abduction maintains *openness to surprise* while ensuring *theoretical grounding*.
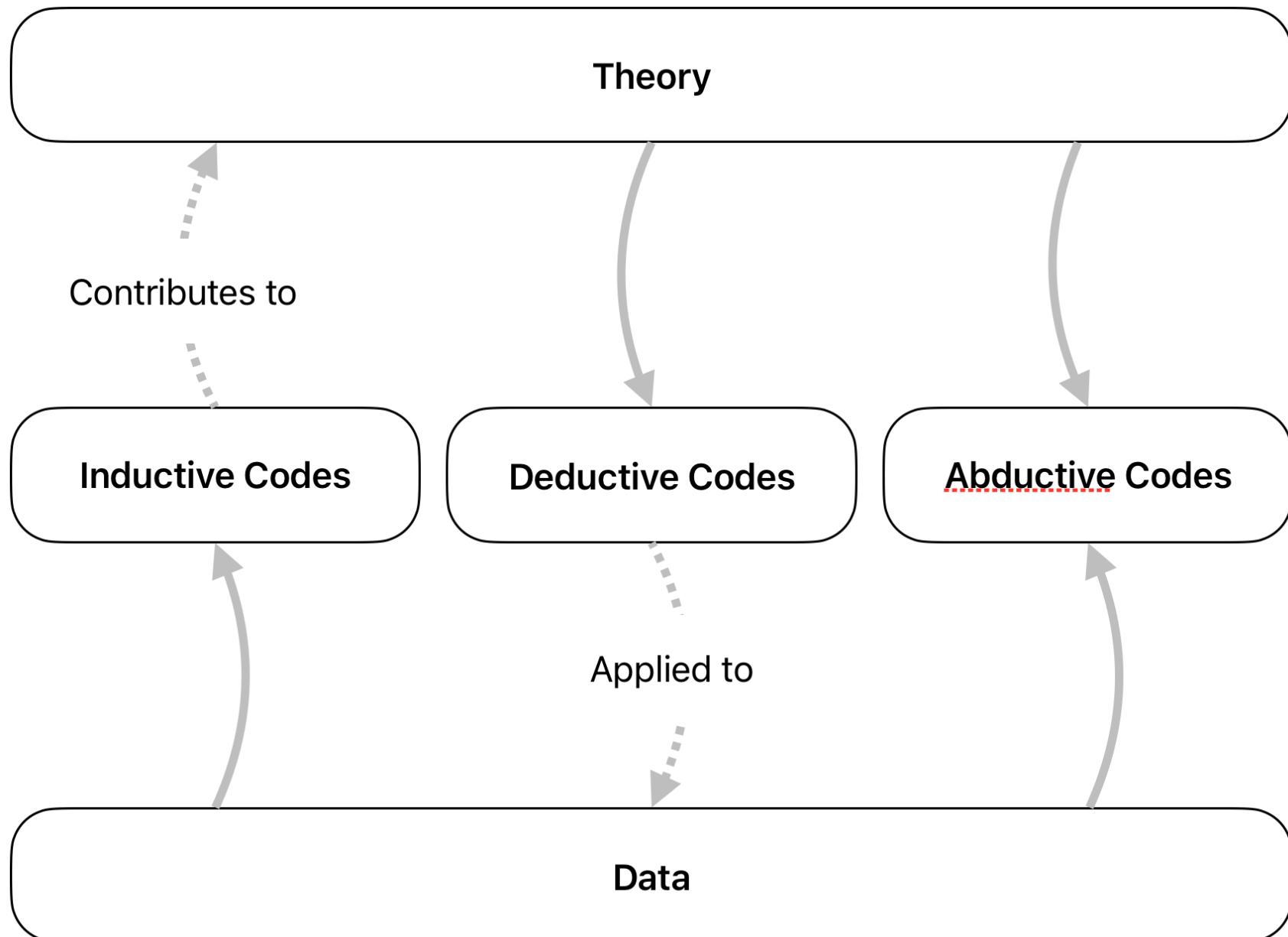
[7] Lazar et al. (2017). Chapter 11 — Analyzing Qualitative Data. Research methods in human–computer interaction. Morgan Kaufmann.

How do we ensure objectivity of coding?

Reliability analysis measures the extent to which independent coders evaluate a behavior to reach the same conclusion.

What are some measures of reliability?

» *Agreement among coders*: Measures how much coders agree as percentage of coded segments

» *Cohen's κ*: Takes into account agreement that could happen by change

» *Fisher's κ, Krippendorff's α*: Alternatives to Cohen's κ

How do we calculate Kappa?

$$\kappa = \frac{P(a) - P(e)}{1 - P(e)}$$

κ: Cohen's Kappa

$P(a)$: Probability of *observed* agreement

$P(e)$: Probability of *chance* agreement

How do we interpret Kappa values?

» < 0 — *no agreement*

» 0–.20 — *slight*

» .21–.40 — *fair*

» .41–.60 — *moderate*

» .61–.80 — *substantial*

» .81–1.00 — *almost perfect*

What process do we follow to test reliability?

1. Choose your measure (e.g., Cohen's κ)

2. Determine minimum level of reliability ($\kappa \geq .80$)

3. Identify your *reliability sample* (e.g., 10% of the full sample)

4. Train another coder and ask the coder to code the reliability sample

5. Calculcate reliability (iterative process: retrain, recode, recalculate)

6. Report inter-rater reliability

How do we go from codes to theory?

Coding as an iterative, cyclical process:[6]

» **First-cycle coding:** descriptive or in vivo; many short codes; data-driven.

» **Second-cycle coding:** pattern, focused, or axial; grouping → relationships.

» Each cycle involves rereading, refining, merging, or splitting codes.

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[6] Skjott Linneberg, M., & Korsgaard, S. (2019). Coding qualitative data: A synthesis guiding the novice. Qualitative research journal, 19(3), 259–270.

Increasing levels of abstraction, conceptualization, theorizing:

1. **Open codes** → "delays," "bugs," "frustration."

2. **Axial codes** → "breakdowns in interaction."

3. **Selective coding** → Model of "user adaptation to unreliable systems."

Axial Coding

Concepts are categorized into explanations of arising phenomena (e.g., repeated events, actions, interactions)
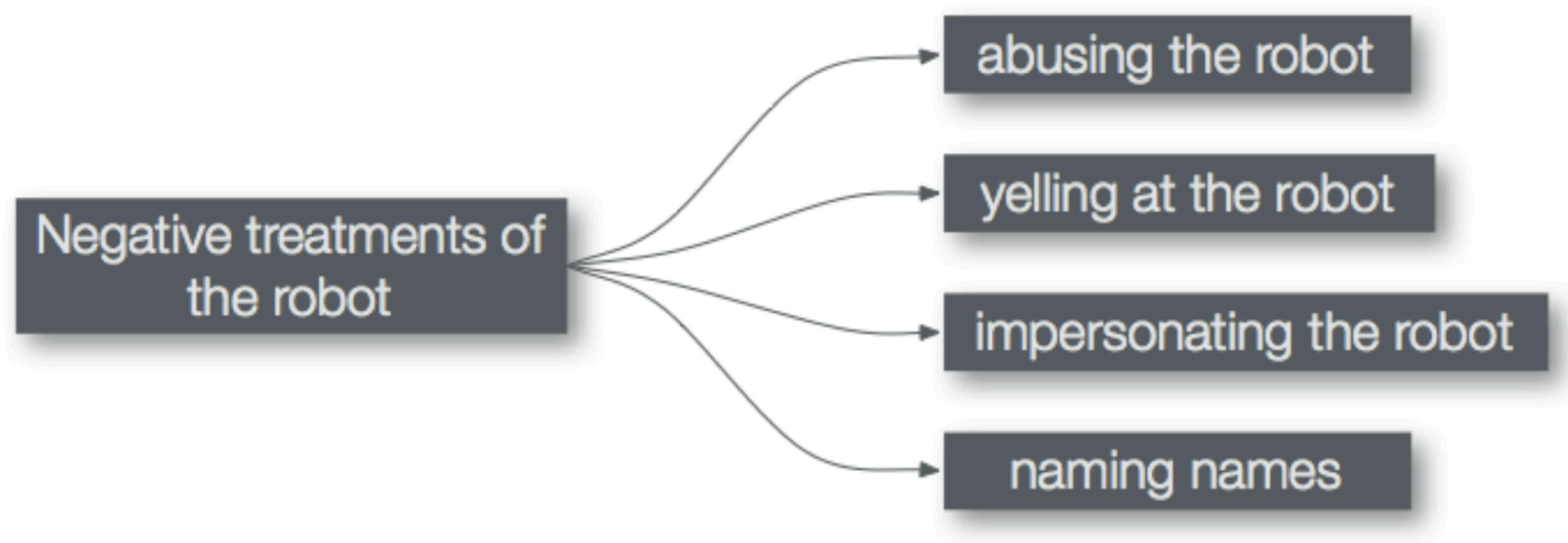
Example: from data to open codes to axial codes[7]

Data	Open codes	Axial codes
we could start with the pain onset..constant vs. intermittent, you have location and then for neuropathic type pain you'd be looking for dythesthesia or neurological defects.	Different presentations of pain— temporal pain onset, location, types	**Assessment** (current episode)
we look at how the patient is positioned, whether they are rocking back and forth holding their stomach? that can preclude different etiologies.. we'd ask questions like is it dull or throbbing or sharp, are there associated things with it, what kind of things make it better, worse?	Visual and verbal—Different ways of identifying/obtaining signs/symptoms	**Visual and verbal**
that's something you want to know— their current opiod regime.. we look at what worked in the past (to manage the pain), what is the role of adjuncts?.. at a minimum I would want to know a diagnosis as soon as I know a diagnosis a number of other things may crawl into my brain.	Historical data—medication and diagnosis	**Triage**
There was often a temporal circumstance like a procedure the next day or just arriving on the unit. A 'temporal' circumstance seems to lower the coping skills and modulating pathways changed and suffering intensified.	Examples of nonphysical pain (unit arrival, procedure), other event (nonphysical), suffering intensified, temporal circumstance	**Understanding pain**

Helps identify (dotted arrow between "Visual and verbal" and "Different presentations of pain")

FIGURE 11.2

Example open and axial codes from a grounded theory analysis of issues relating to palliative care pain management. Note that the axial codes both abstract multiple open codes into more general categories and also (in the case of the arrow labelled "helps identify") describe relationships between the codes.

Adapted from Kuziemsky, C.E., et al., 2007. A grounded theory guided approach to palliative care systems design. International Journal of Medical Informatics 76, S141–S148.

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[7] Lazar et al. (2017). Chapter 11 — Analyzing Qualitative Data. Research methods in human–computer interaction. Morgan Kaufmann.

Selective Coding

Categories are classified into *conditions*, *actions/interactions*, and *consequences* (templates that help us establish causal relationships) and relationships among categories are established to generate several individual models.
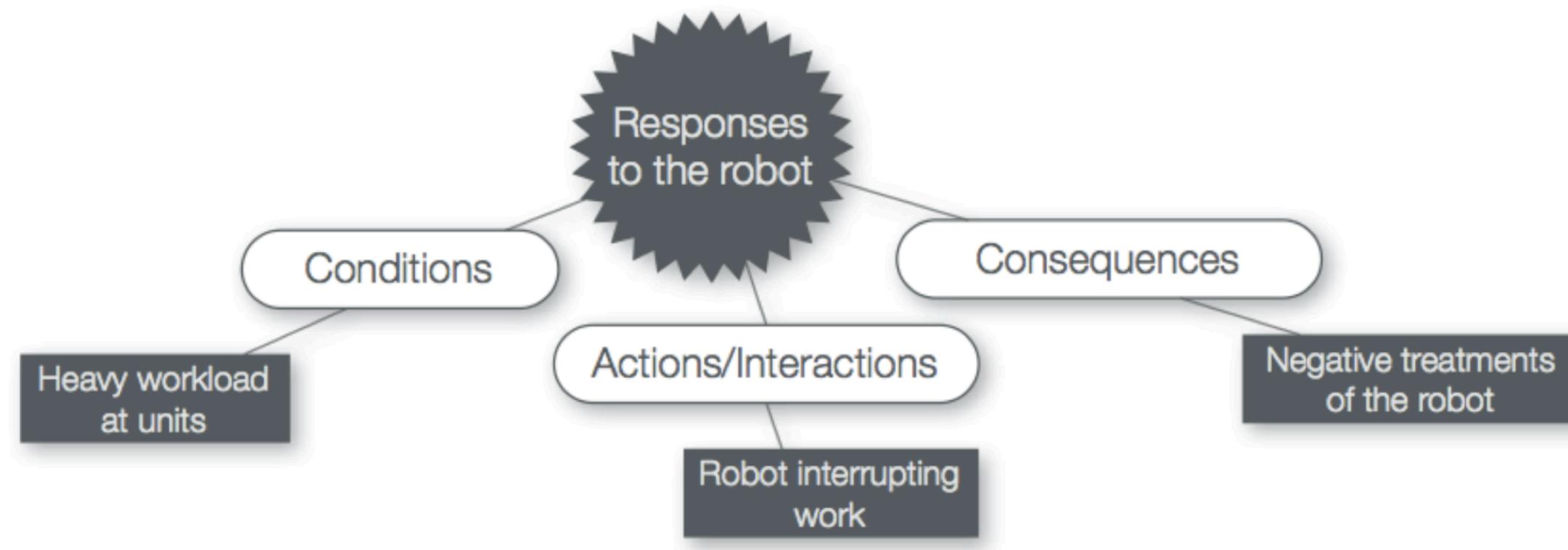
Comprative Analysis

Each phenomenon is compared across several dimensions to understand how it is affected by social, physical, or organizational structures.

Perceptions of the robot

Transcript from **high-workload** unit — negative

"[The robot] does tend to be annoying when [there are] 15 things are going on."

positive — Transcript from **low-workload** unit

"I think [the robot] is a delight I think it works fine, as it is."
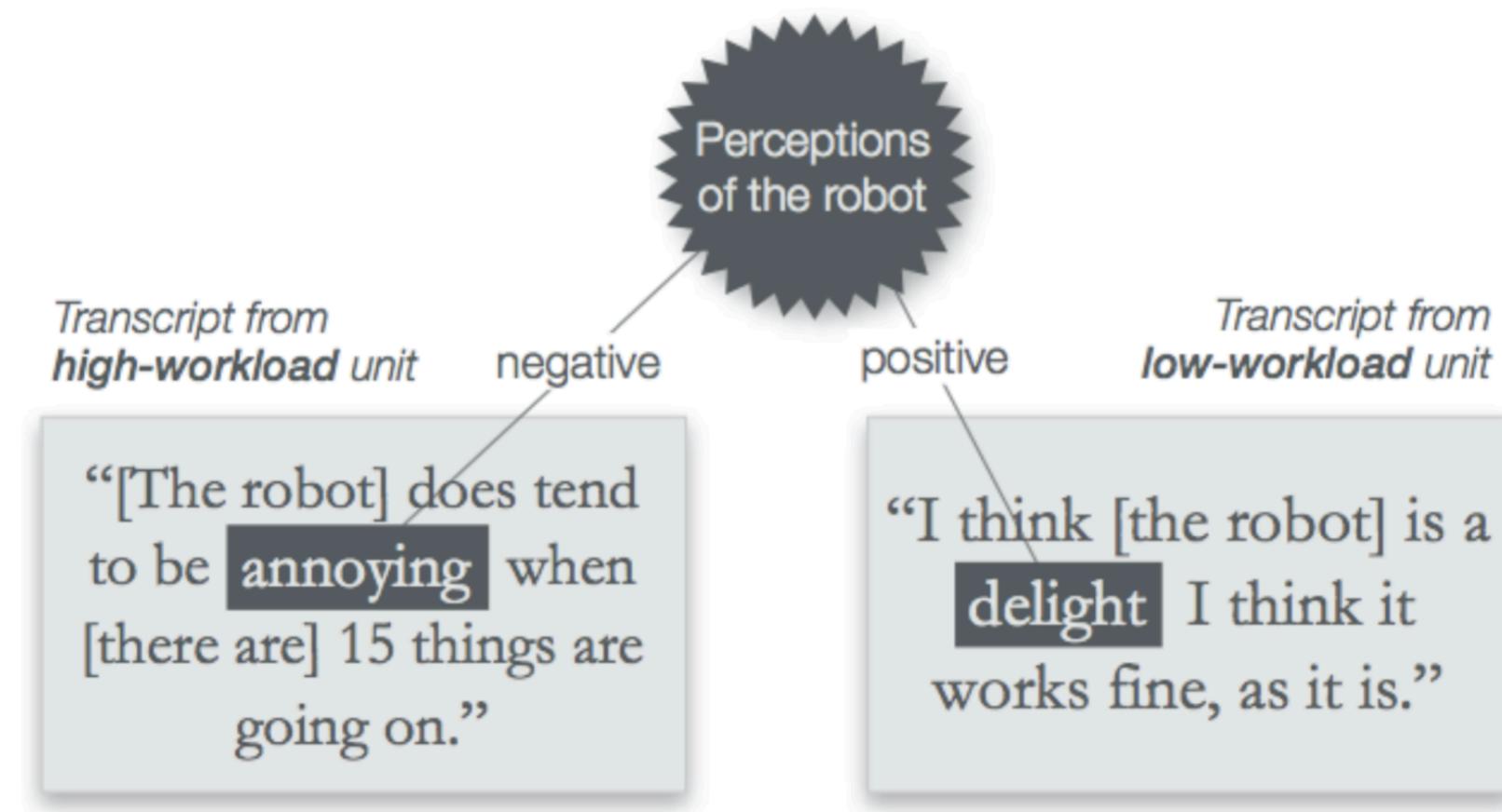
Theory Building

A final theoretical model (or models) is constructed based on the results of the comparative analysis; existing theory is embedded in this model.
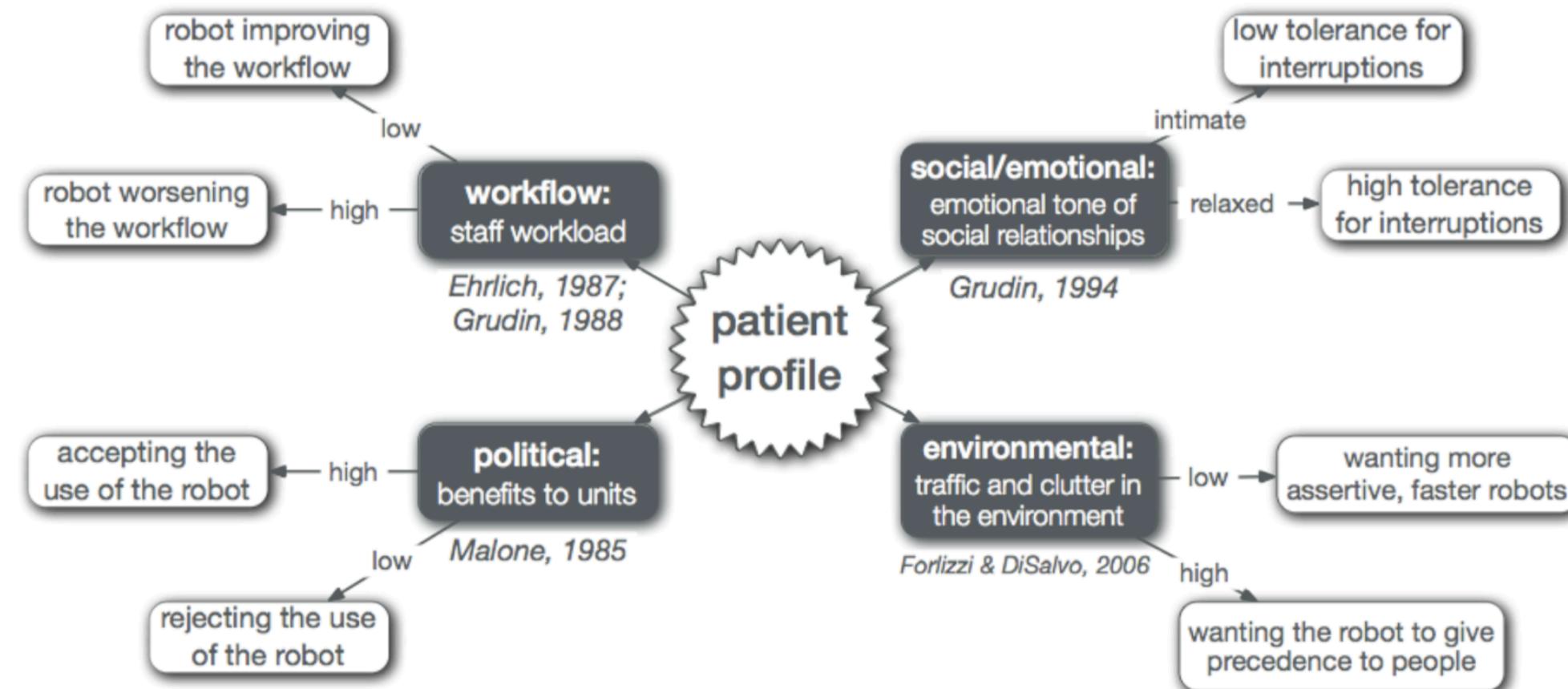
Recap of the Grounded Theory Process

Open Coding → Concepts

Axial Coding → Categories

Selective Coding → Causal Relationships

Comparative Analysis → Stories

Theory Building → Theories
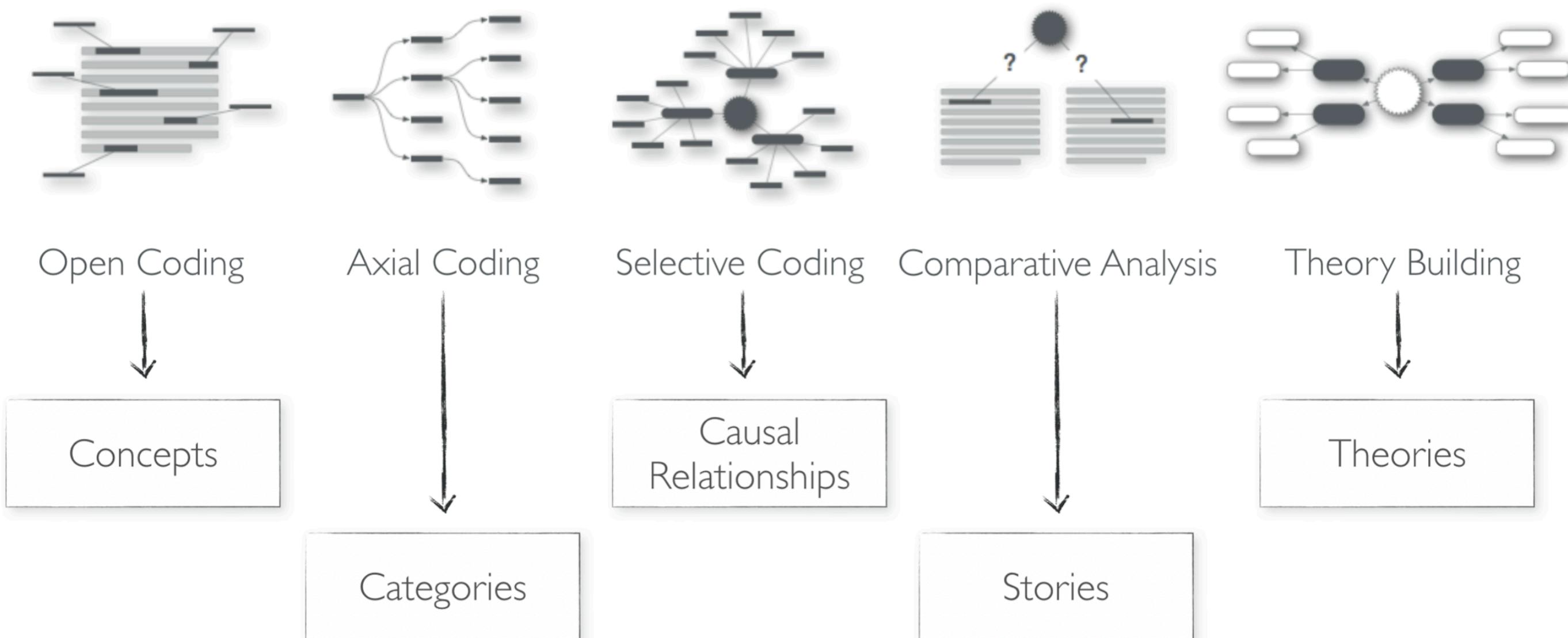
Thematic Analysis

Using the same techniques, we can utilize a *simplified* process:
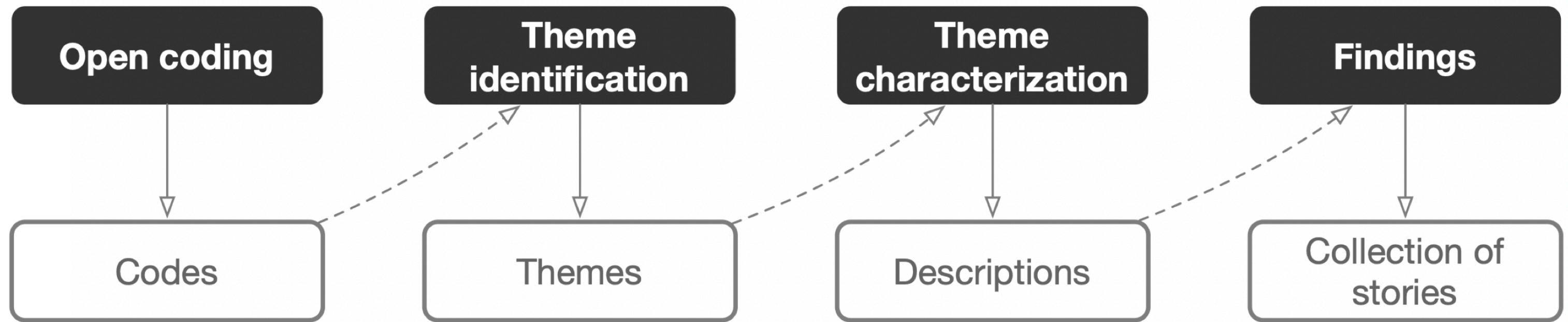
Method Selection

When is thematic analysis or Grounded Theory appropriate?

Grounded Theory

» Building substantive theory

» Studying social phenomena

Thematic Analysis

» Qualitative evaluations of systems

» Triangulation

Maintaining Transparency in Qualitative Analysis

Inter-rater realibility only addresses subjectivity in coding.

Other ways to maintain transparency:[7]

» Keep an analytic memo for each major insight or decision.

» Document code evolution (what was merged, renamed, or dropped).

» Link evidence: quote → code → category → claim (chain of evidence).

» Maintain a shared "codebook"(see example in [5]) if working in teams.

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[7] Lazar et al. (2017). Chapter 11 — Analyzing Qualitative Data. Research methods in human-computer interaction. Morgan Kaufmann.

[5] Michaelis, J. E., & Mutlu, B. (2018). Reading socially: Transforming the in-home reading experience with a learning-companion robot. *Science robotics*, *3*(21), eaat5999.

Example Analytic Memo

Memo #7: Noticing repeated "workarounds." Possible theme = "users repairing the system." Relates to resilience literature. Need to compare with interviews 4 and 6 to see if same pattern appears.

Rigor in Qualitative Analysis

Criterion	Meaning	Practice
Fit[1]	Codes reflect data	Stay close to participant language
Relevance[1]	Explains phenomena	Iterate to capture core processes[1]
Adaptability[1]	Theory evolves with new data	Refine categories
Transparency[7]	Traceable logic	Memos + audit trail
Reliability[7]	Consistent interpretation	Inter-rater checks

[1] Glaser, B. G. and Strauss, A. The Discovery of Grounded Theory. Aldine DeGruyter, 1967.

[7] Lazar et al. (2017). Chapter 11 — Analyzing Qualitative Data. Research methods in human-computer interaction. Morgan Kaufmann.

From Coding to Insight

Summary: Qualitative analysis transforms *observations* into *understanding* through iterative and rigorous process of interpretation, abstraction, and theorizing.

Data → Codes → Themes → Relationships → Theory → Design Implications

Assignment: *Qualitative Data Analysis*

Analyze your Week 6 Assignment data to develop themes through *open → axial → selective coding*

1. Prepare data in a spreadsheet

2. Open → axial → selective coding

3. Identify 2−4 themes (narrative or diagram)

4. Reflect on your analytic choices

PDF + coding spreadsheet

Data → Codes → Categories → Themes → Insights