Human-Computer Interaction

Design-led Inquiry

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Key Concepts in Design-Based Research

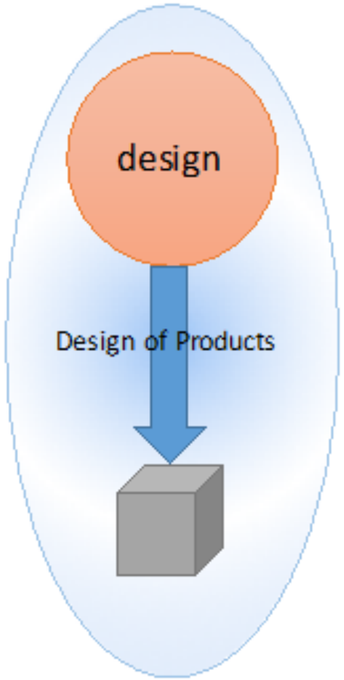
Research *for* design: Carrying out research to inform the design of a product or service.

research → design

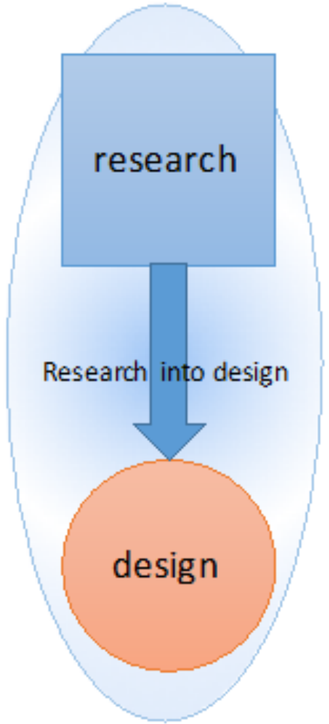
Research *through* design: Carrying out design to create knowledge about phenomena.

design ≈ research

How should we think about design and research?[2]



conventional design creating products

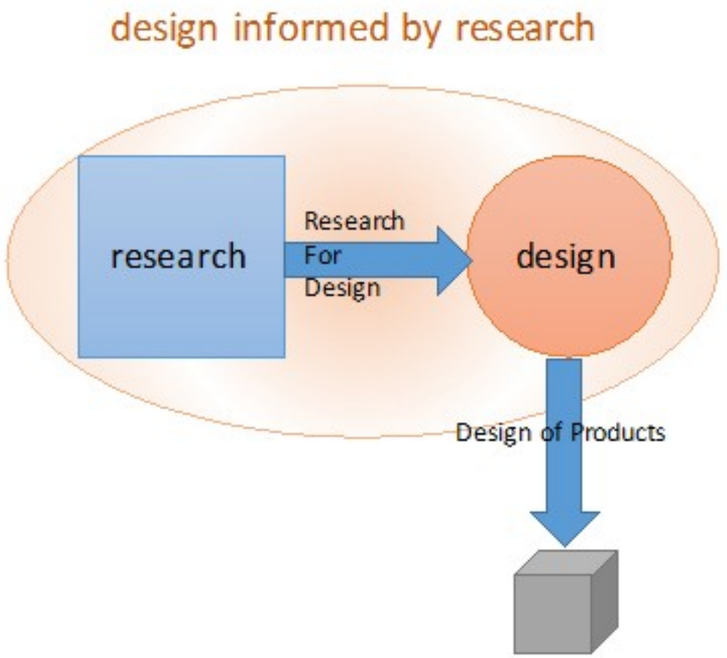


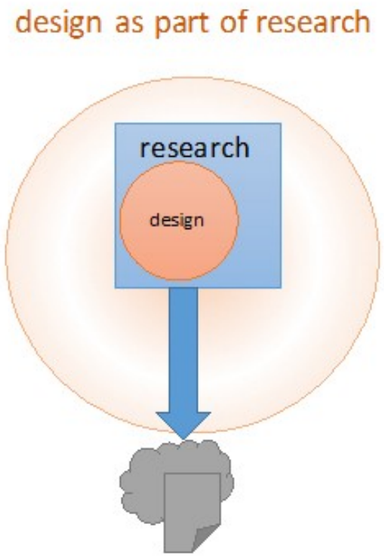
research about design methods

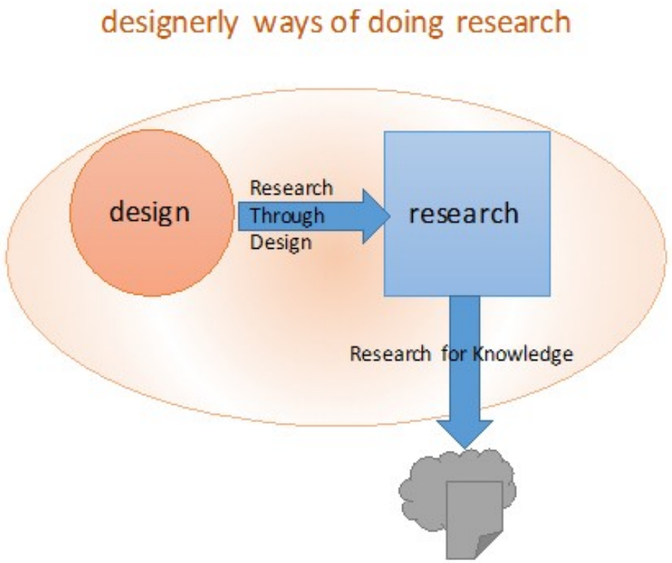
conventional research creating knowledge

[2] Stappers & Giaccardi, 2014

What is the relationship between design and research?[2]







[2] Stappers & Giaccardi, 2014

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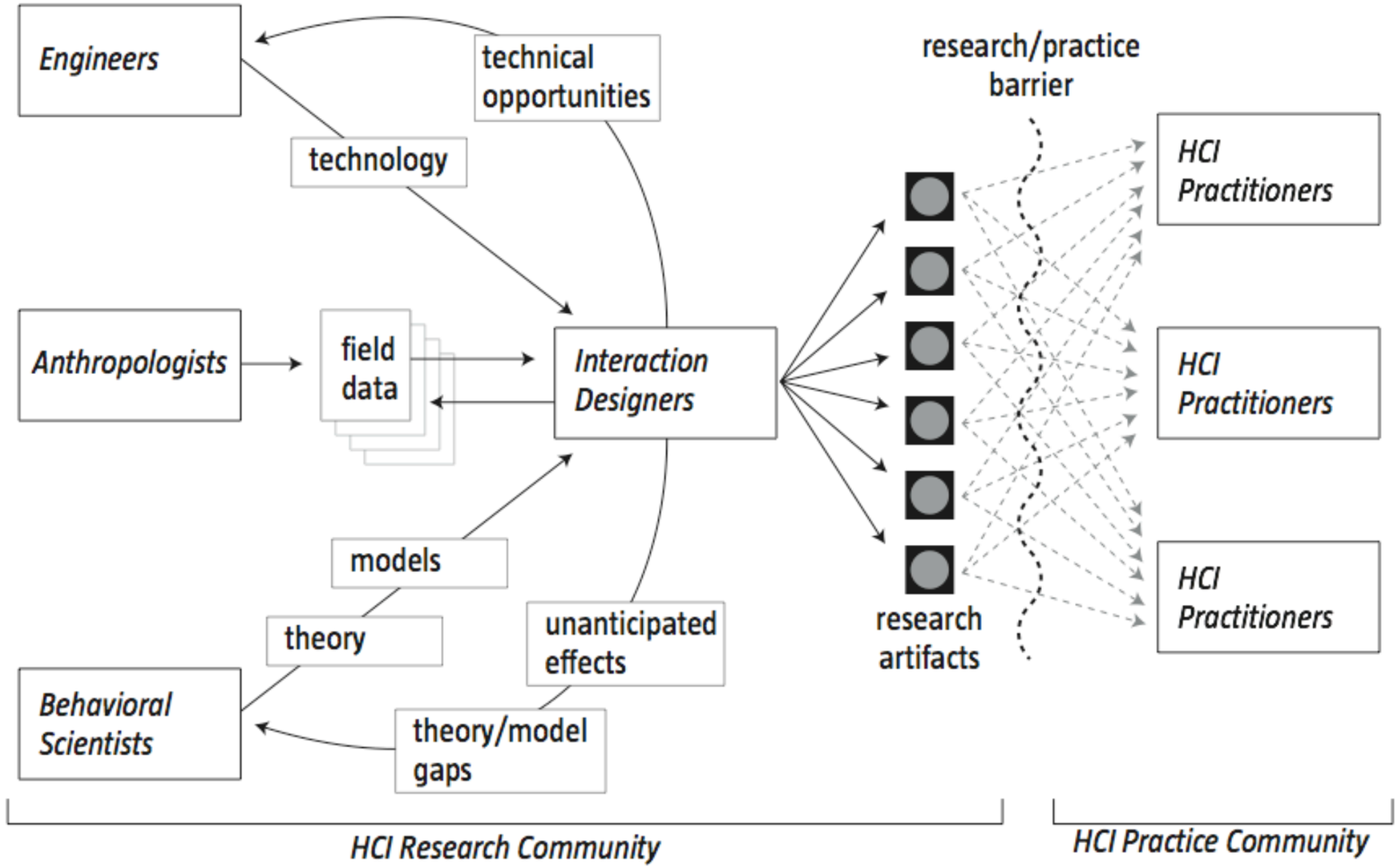


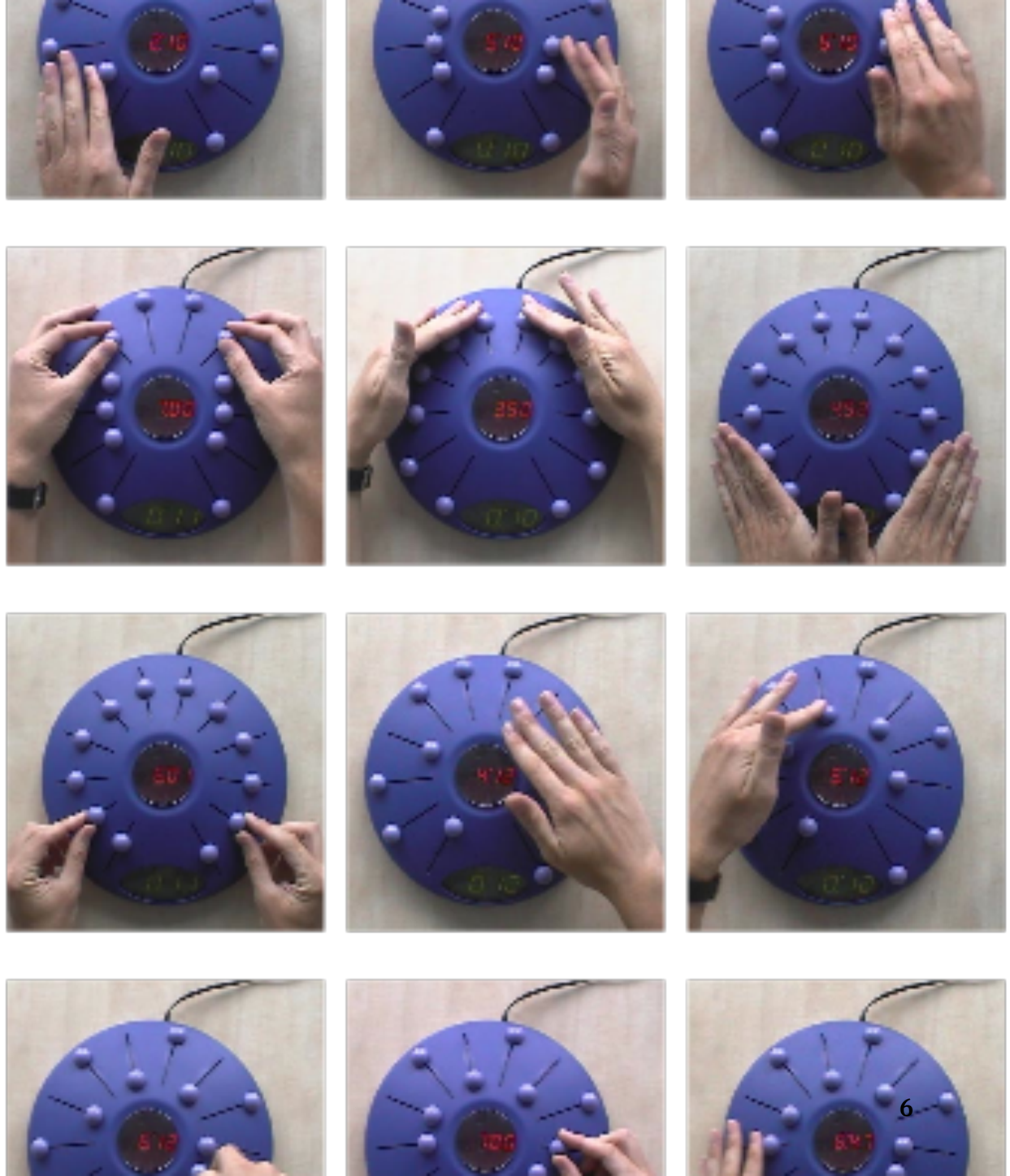
[3] Zimmerman et al., 2007

An Example[4]

How can products get information about how we feel from the way we interact with them?

Wensveen (2005) designed/prototyped an alarm clock with sliders that a user could move with two hands to set a *mood* for the alarm.

Generated knowledge about how emotion can be expressed through tangible interaction.



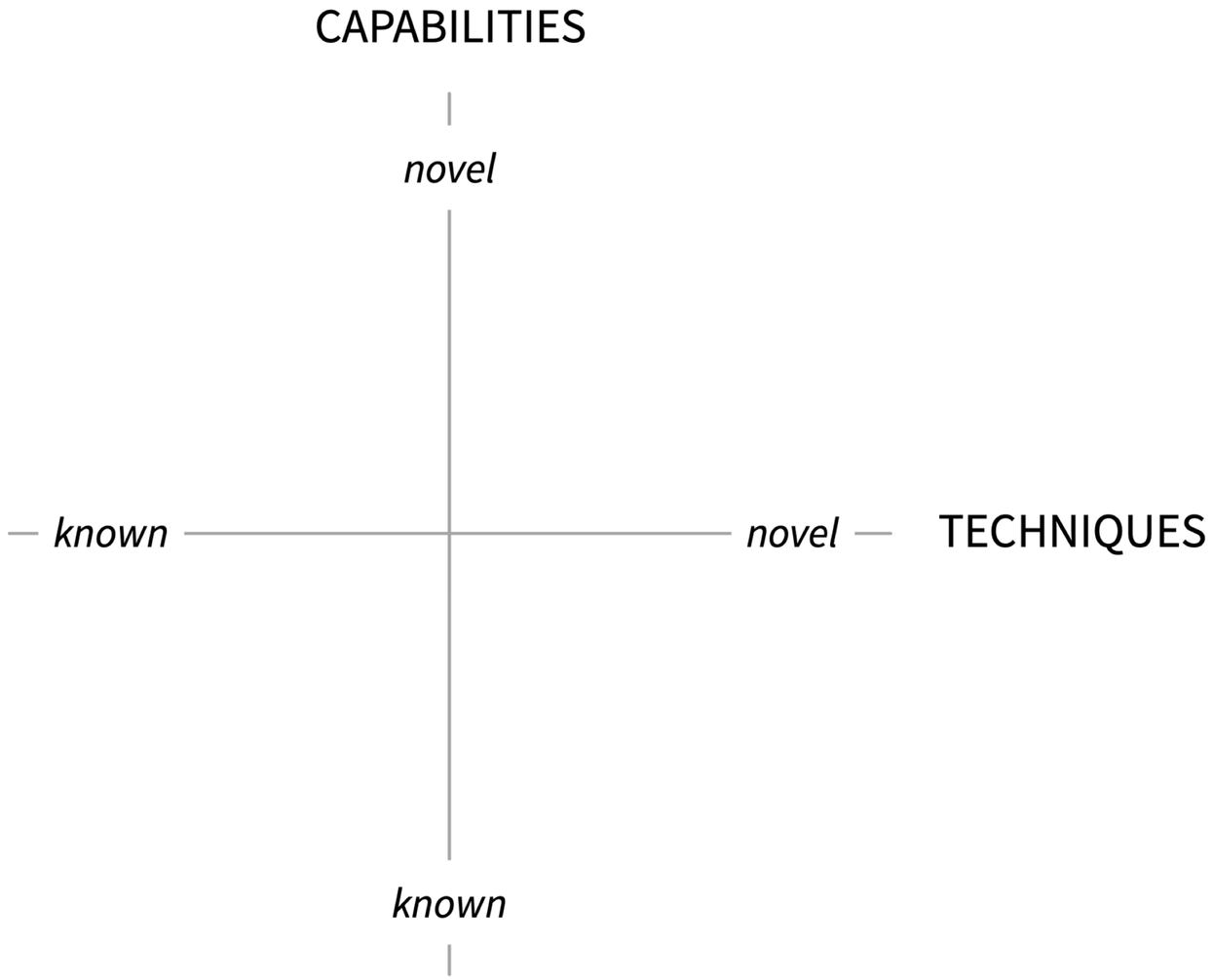
[4] Image source

HCI Systems Research

HCI systems research seeks to discover **new techniques** for building systems or **new capabilities** for systems that open up opportunities for new interaction.

Contribution can be in techniques, which enable new systems, and capabilities, which enable new interactions.

HCI systems research is a type of design-based contribution, using primarily *prototyping* techniques instead of primarily *design* techniques.



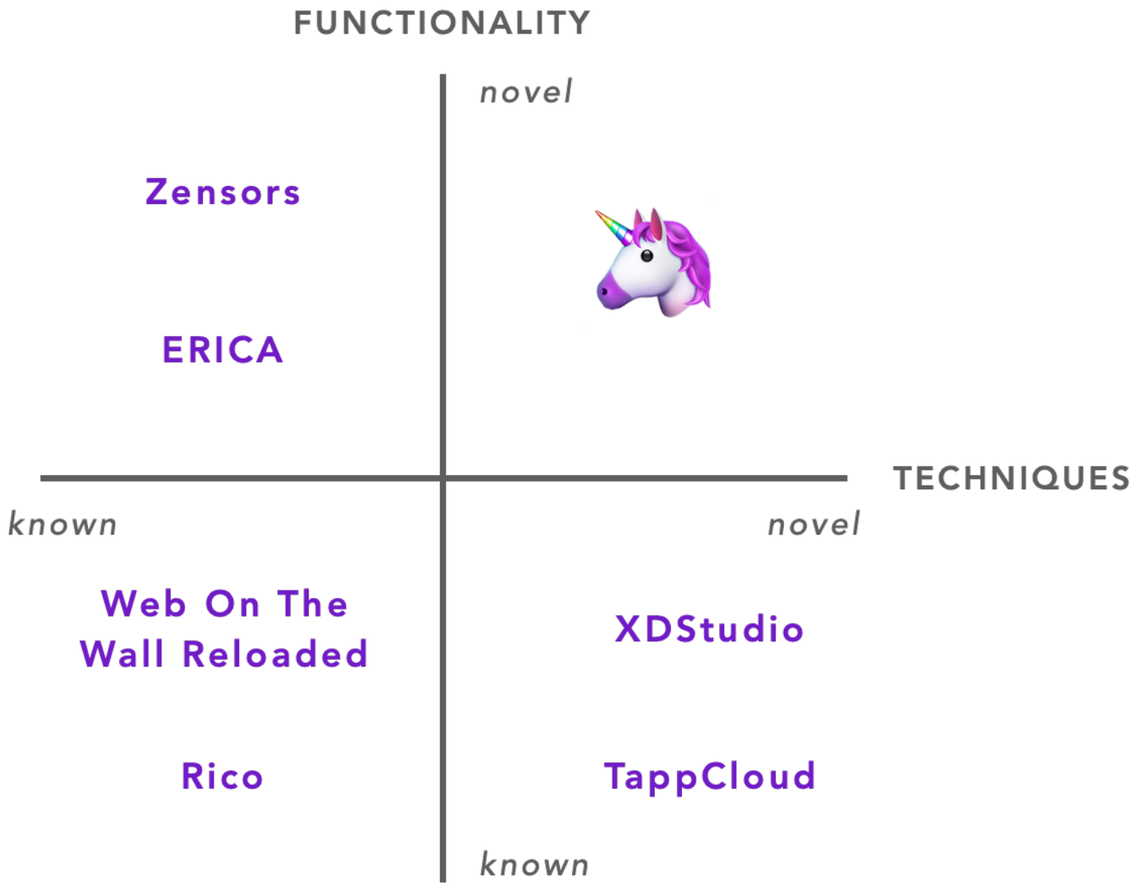
Examples[5]

» Novel capabilities using known techniques

» Known capabilities using known techniques

» Known capabilities using novel techniques

» Novel capabilities using novel techniques 🦄



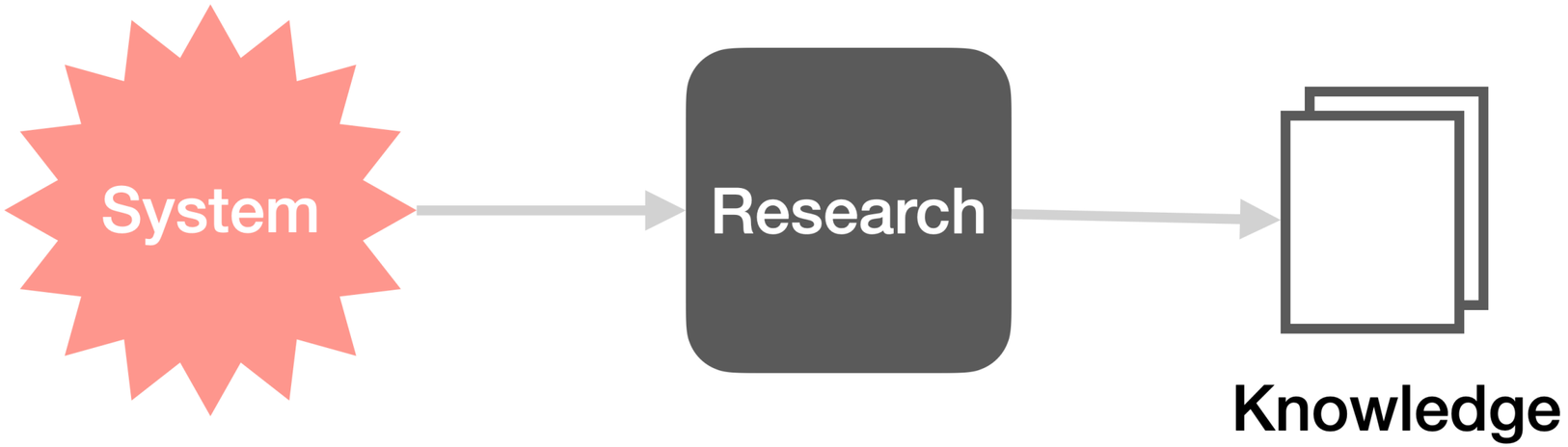
[5] A Note from the UIST 2021 PC Chairs

Systems Research vs. Engineering

Is systems research merely engineering?

No, it is not merely engineering, but engineering is needed.

Similar to design-based research.



When should I do design-based research?

When to Choose Research through Design

You should consider RtD if:

» Your research question is about possibilities ("what could be?") rather than existing phenomena.

» Existing theory is nascent or fragmented (no well-developed constructs to test).

» You want to generate concepts, frameworks, or exemplars rather than validate measures.

» Your contribution will be artifacts-as-arguments (Zimmerman & Forlizzi).

» You aim to provoke reflection, critique, or speculation.

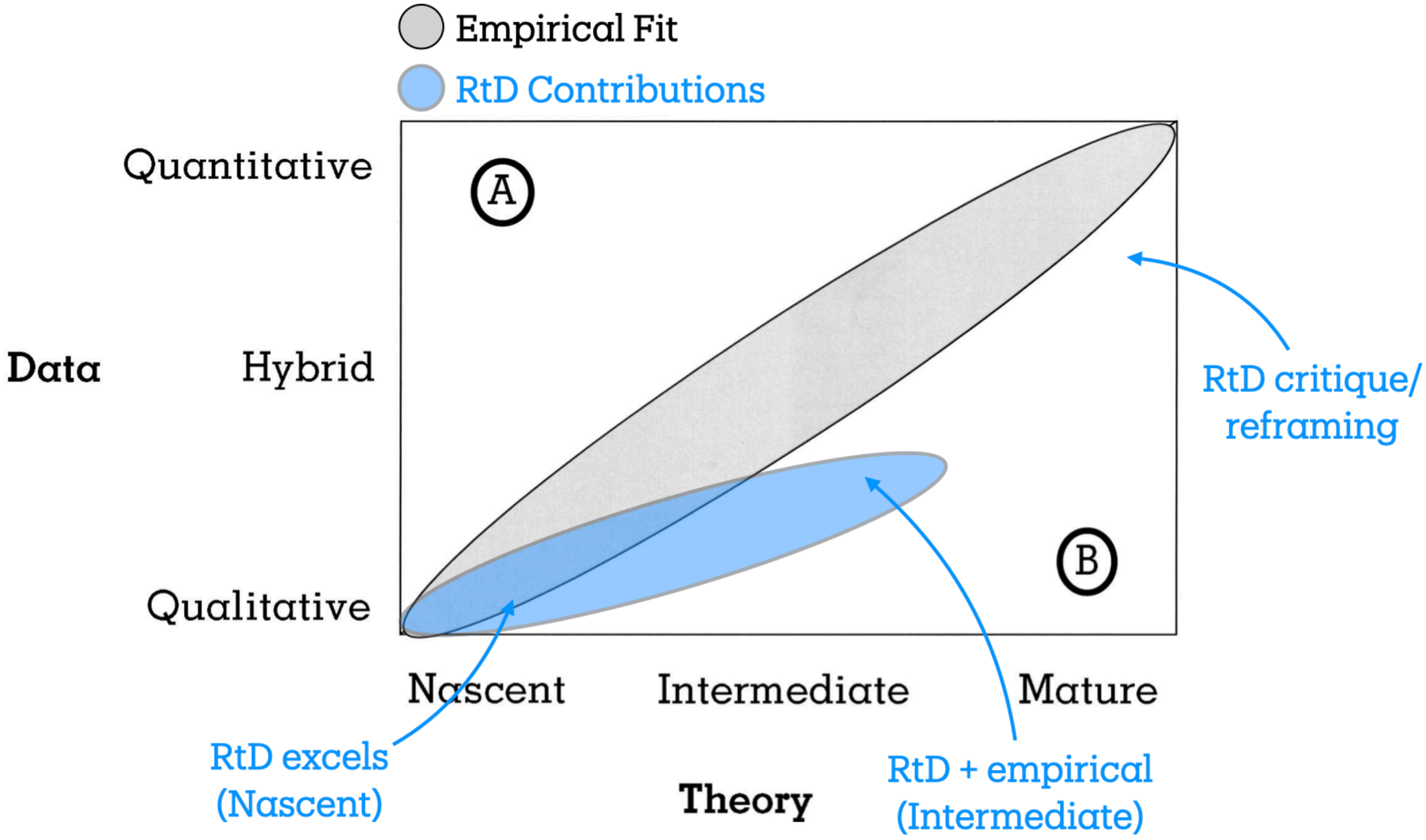
When Not to Choose RtD

RtD may not be a good fit if:

» The field already has mature constructs that need refinement or validation.

» Your question is about causal relationships or generalizable behavioral effects.

» The audience expects quantitative measures of effect (e.g., in usability, metrics studies).


Empirical Fit
RtD Contributions
Quantitative
Data
Hybrid
Qualitative
A
B
RtD critique/
reframing
Nascent
Intermediate
Mature
RtD excels
(Nascent)
Theory
RtD + empirical
(Intermediate)

How do I conduct research through design?

Research Questions in RtD

Often framed as:

» "How might we...?" (design problem framing)

» "What new interaction possibilities can we reveal by building...?"

» "What does this artifact teach us about people, technology, or contexts?"

Process of RtD

1. **Problem framing:** Identify an open or ill-structured space.
2. **Iterative design + prototyping:** Create artifacts that embody a perspective.
3. **Deployment or evaluation in context:** Observe how people interact, reflect on outcomes.
4. **Knowledge articulation:** Translate artifacts into design knowledge (principles, frameworks, exemplars).

What Counts as Data in RtD

- Prototypes and artifacts.
- Observations and reflections from deployments.
- Designer's annotated process, sketches, iterations.
- Critiques (academic, practitioner, or user communities).

Types of Contributions in RtD

» **Conceptual:** new constructs, vocabularies.

» **Practical:** design guidelines, principles.

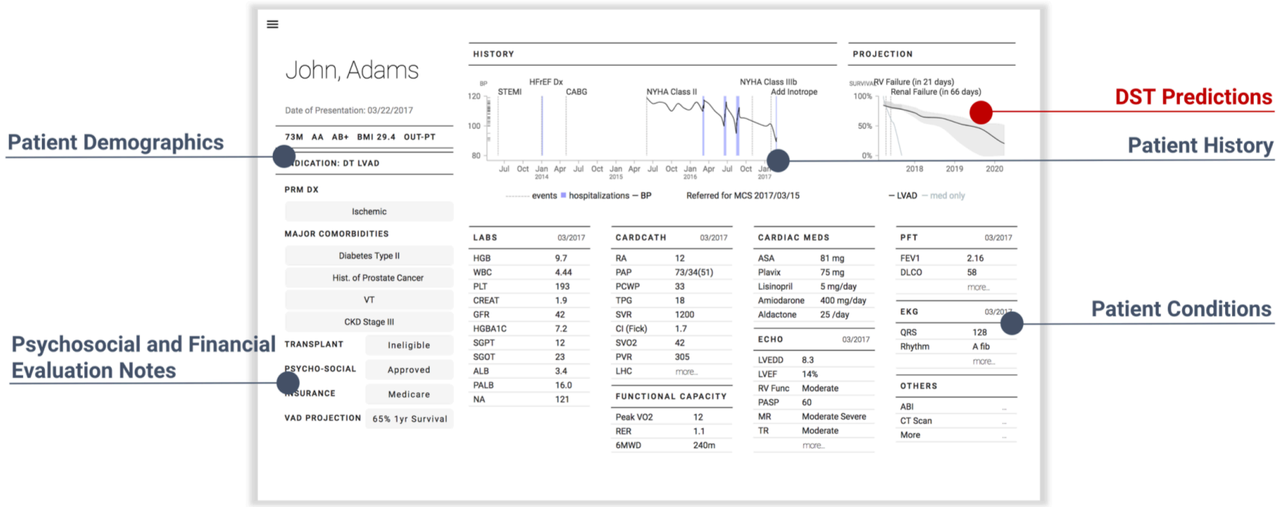
» **Critical/speculative:** provocative visions, critique of assumptions.

» **Exemplars:** well-documented artifacts that embody theory.

What are some RtD examples?

#1: Unremarkable AI[6]

- **Problem framing:** Why clinical decision support tools fail in practice; how to fit AI into clinicians' workflow.
- **Design:** DST embedded in automatically generated patient slides; subtle placement of predictions to be "unremarkable."
- **Evaluation:** Field deployment across 3 hospitals; interviews and observed meetings.
- **Knowledge:** Concept of "unremarkable AI" — designing AI to blend into routines.



[6] Yang, Q., Steinfeld, A., & Zimmerman, J. (2019). Unremarkable AI: Fitting intelligent decision support into critical, clinical decision-making processes. CHI 2019.

#2: Exploring the Use of Robots for Diary Studies[7]

- **Problem framing:** How to collect longitudinal, in-the-wild HRI data; limits of traditional diary methods.
- **Design:** Diary Robot system (Misty II) as an interactive, conversational diary.
- **Evaluation:** In-home deployment with families; compared robot, text, and audio diaries.
- **Knowledge:** Robots can elicit richer, more natural self-disclosures; design implications for robot-mediated data collection.

[7] Xu, H., & Mutlu, B. (2025). Exploring the use of robots for diary studies. HRI 2025.

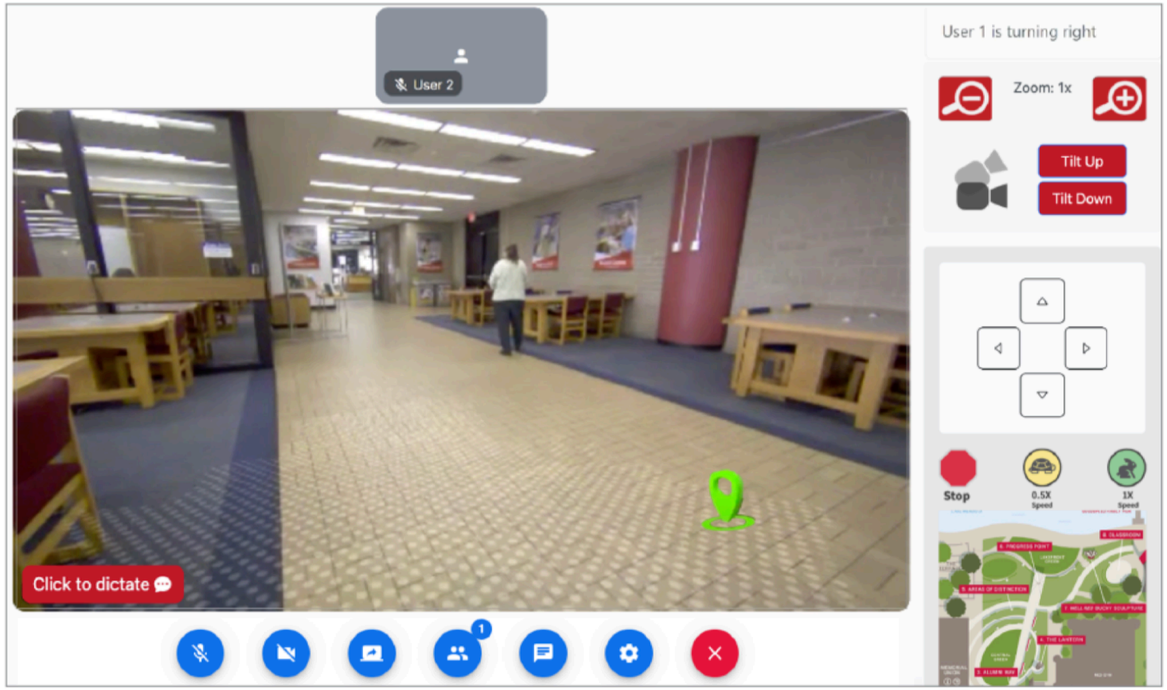
#3: Snackbot[8]

- **Problem framing:** How to design for long-term HRI in everyday campus contexts.
- **Design:** Snack-delivery robot; iterative design over 24 months (form, service, sociability).
- **Evaluation:** Wizard-of-Oz trials, feasibility studies, early deployments in university buildings.
- **Knowledge:** Documented holistic design process; service + robot co-design; guidelines for sociable long-term robots.

[8] Lee, M. K., Forlizzi, J., Rybski, P., Crabbe, F., Chung, W., Finkle, J., Glaser, E., & Kiesler, S. (2009). The Snackbot: Documenting the design of a robot for long-term human-robot interaction. HRI 2009.

#4: Designing Telepresence Robots to Support Place Attachment[9]

- **Problem framing:** How telepresence robots can support emotional connection with meaningful places.
- **Design:** Telepresence robot with human vs. AI guides, supporting single vs. multiple users.
- **Evaluation:** Field study with 38 alumni revisiting campus remotely.
- **Knowledge:** Identified personas of remote visitors; design guidelines for supporting place attachment.



A. User Interface

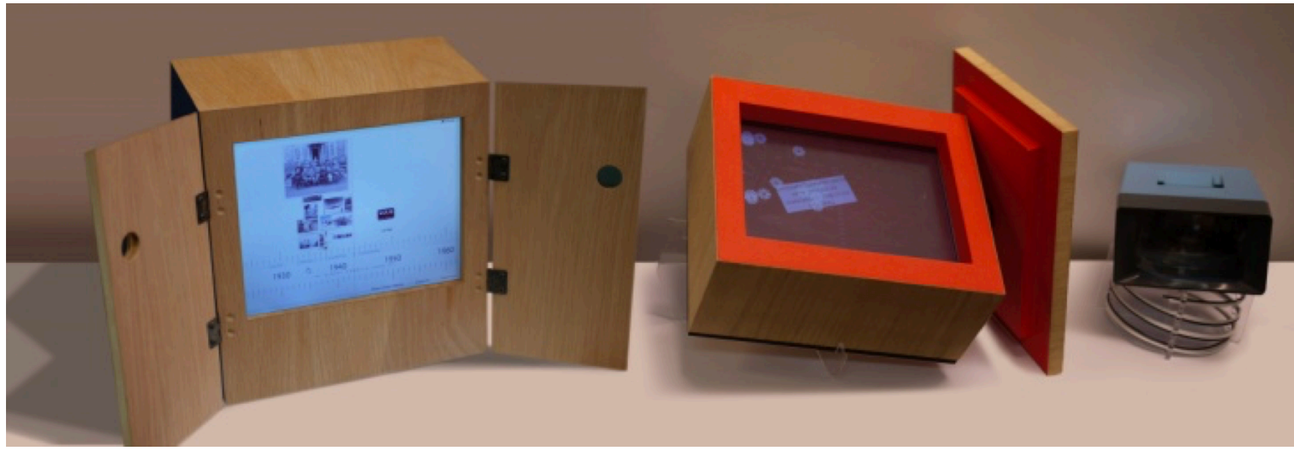
B. With the Human Guide

C. With the Agent Guide

[9] Hu, Y., Zhu, A., Toma, C. L., & Mutlu, B. (2025). Designing telepresence robots to support place attachment. HRI 2025.

#5: Technology Heirlooms?[10]

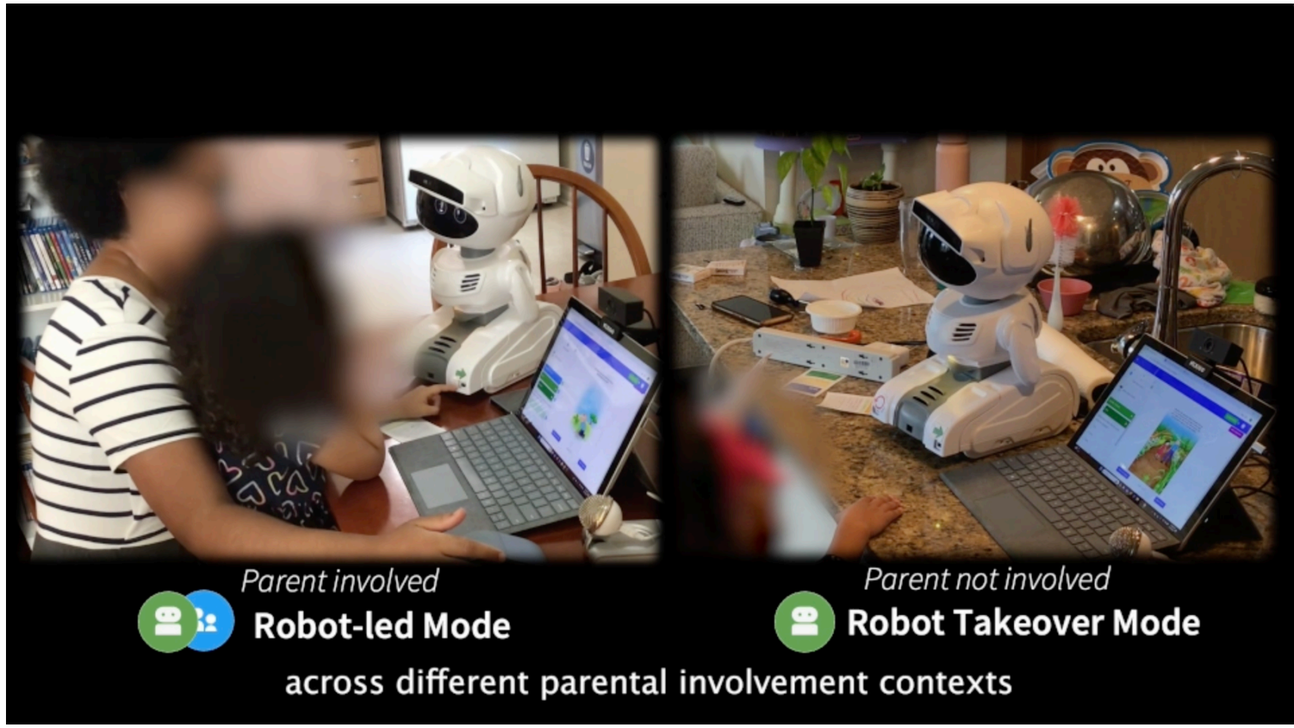
- **Problem framing:** How might technology support passing down and inheriting digital materials?
- **Design:** Three speculative devices (Timecard, BackupBox, Digital Slide Viewer).
- **Evaluation:** In-home interviews with 8 families using devices as probes.
- **Knowledge:** Design considerations & tensions for "technology heirlooms" (stewardship, access, privacy, meaning over time).



[10] Odom, W., Sellen, A., Harper, R., & Thereska, E. (2012). Technology heirlooms? Considerations for passing down and inheriting digital materials. CHI 2012.

#6: SET-PAiREd: Parental Involvement in AI-Assisted Learning Robots[11]

- **Problem framing:** How should AI-robots involve parents in children's learning?
- **Design:** SET cards (scenario kit) + PAiREd prototype (AI-generated lessons, parent-facing controls).
- **Evaluation:** In-home study with 20 families of children (ages 3-5).
- **Knowledge:** Insights on parental roles, friction points, and design guidelines for parent-in-the-loop robot learning.



[11] Ho, H. R., Kargeti, N., Liu, Z., & Mutlu, B. (2025). SET-PAiREd: Designing for Parental Involvement in Learning with an AI-Assisted Educational Robot. CHI 2025.

Assignment

Conduct a mini design-led inquiry, based on speculative design prompts.

1. **Frame the problem:** Clear, thoughtful RQ that demonstrates engagement with RtD principles.
2. **Design and sketch an artifact:** Artifact is imaginative, relevant, and supported by explanation.
3. **Develop an evaluation plan:** Realistic, appropriate, and connected to the RQ/design.
4. **Articulate the knowledge contribution of your design-led inquiry:** Reflection on what is learned, articulated clearly and insightfully.