Human-Computer Interaction

Methodological Choices

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What is research? What are its building blocks?

Research involves the systematic use of theoretical and empirical tools to try to increase our understanding of phenomena or events.

— McGrath, 1995[1]

[1] McGrath, J. E. (1995). Methodology matters: Doing research in the behavioral and social sciences. In *Readings in Human–Computer Interaction* (pp. 152-169). Morgan Kaufmann.

Fundamental Building Blocks

The research process, like a three-legged stool, always depends on materials from all three domains—content, ideas, and techniques.

— McGrath, 1995

All research brings together:

(1) Content *(2) Ideas* *(3) Techniques/procedures*

The Domains of Research

1. Content → **Substantive domain** — Actors and context
2. Ideas → **Conceptual domain** — Behavior or relations
3. Techniques/procedures → **Methodological domain** — Modes and techniques

Techniques

1. **Techniques for measurement:** Measuring some feature of a research situation
2. **Techniques for manipulation:** Systematically varying system components by *giving instruction*, *imposing constraints*, *selecting materials*, *feedback*, *using confederates*
3. **Techniques for controlling impact:** Controlling the impact of *extraneous* features of the situation through *experimental control*, *statistical control*, or *distributing impact* (e.g., randomization)
4. **Techniques for comparison:** Dependent or independent variables to assess *correlation* or *causation*

Limitations

Methods pose opportunities and limitations:

» Might have weaknesses that limit evidence

» Can offset weaknesses by using multiple methods

Expanding Beyond Empirical Research

Frameworks like McGrath and Edmondson & McManus guide **empirical** research.

In HCI, we also use **design-led inquiry** (Research through Design, RtD),* which brings its own criteria for fit.

* We'll learn more about RtD, or in general, design-led inquiry next week.

Making Methodological Choices

Research Strategies

1. Field strategies
2. Experimental strategies
3. Respondent strategies
4. Theoretical strategies

Choosing a Setting[2]

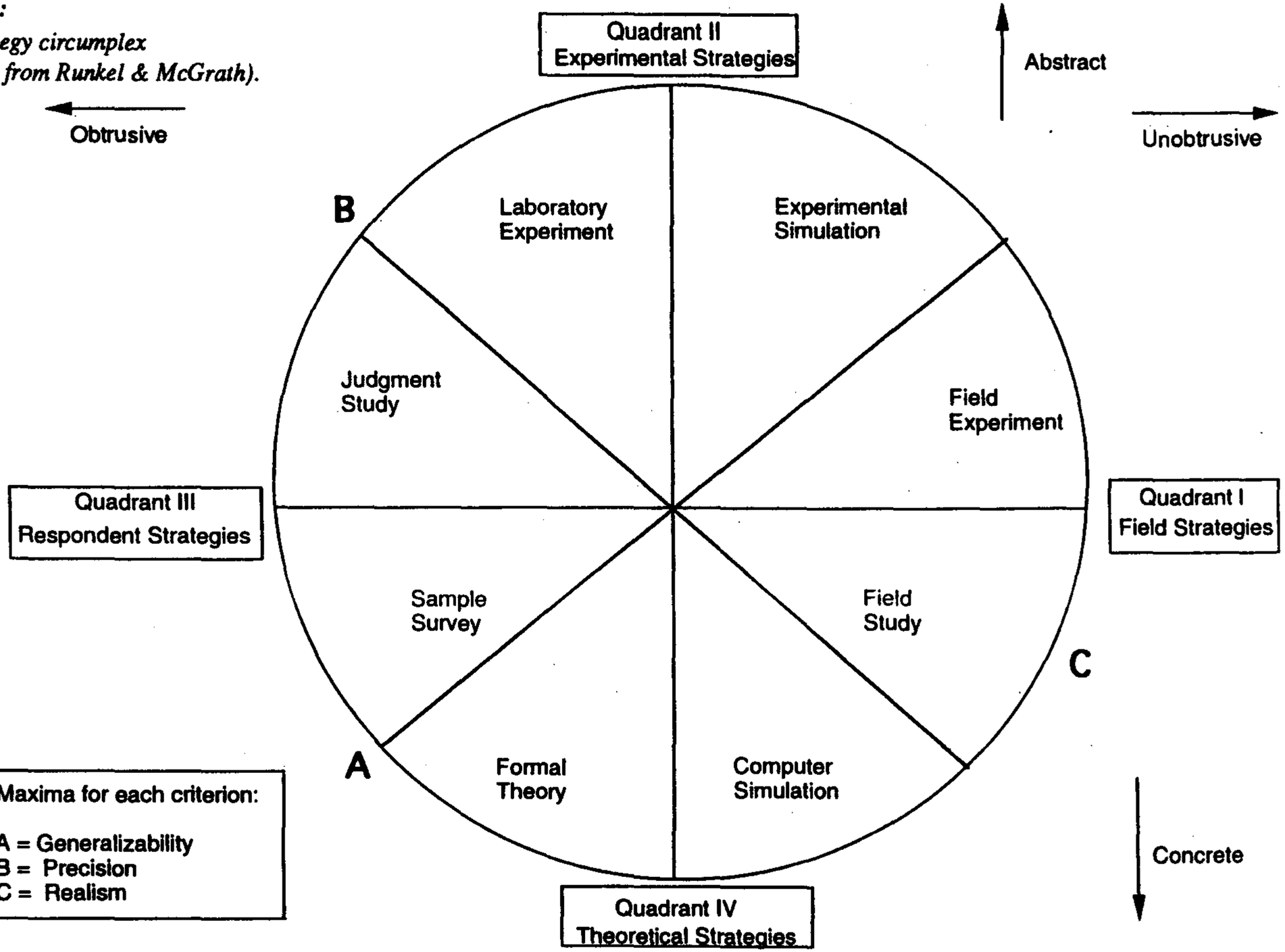
Three key considerations:

1. **Generalizability**
2. **Precision** of measurement
3. **Realism** of the situation

We seek to maximize all three. Not attainable but we do our best!

[2] Image source (next slide): *McGrath, 1995*

Figure 2:
The strategy circumplex
(adapted from Runkel & McGrath).



Design-Based Tradeoffs

Empirical research emphasizes:

» Precision

» Generalizability

» Realism

Research through Design emphasizes:

» Generativity (opening up new possibilities)

» Situated validity (grounded in context)

» Conceptual provocation

Measurements

- **Self-reports** (e.g., survey responses)
- **Observations** by visible or hidden observers (e.g., ethnography)
- **Archival records**, private or public (e.g., geneological data)
- **Trace records** (e.g., clickstream data)

Manipulation

» **Selection:** Varying the population across conditions

» **Direct intervention:** Varying the structure of or processes in a system

» **Indirect inductions:** Evoking varied responses

Things to Consider

» **Randomization**: *True experiments* must involve random assignment of cases to conditions

» **Sampling method**: Generalizability demands getting as close to a *random sample* as possible

» **Validity**: Study designs must maximize *internal validity*, *construct validity*, *external validity*

Summary

Methods dictate the results the researcher will obtain

» Extremely important to report all details of your method

Impossible to maximize all desirable features of a method

» Why we have “limitations” sections in our papers

You need to interpret your results in the light of other related results

» Why we include relevant background in our papers and interpret our results in the light of the results from this background

Questions?

Choosing the Right Method for the Right Research Question

The key to good research lies not in choosing the right method, but rather in asking the right question and picking the most powerful method for answering that particular question.[4]

— Bouchard, 1976

[4] Bouchard, T. J. (1976). Field research methods: Interviewing, questionnaires, participant observation, systematic observation, unobtrusive measures. Handbook of industrial and organizational psychology, 1, 363.

Elements of a Research Project[5]

Internal consistency among elements of a research project:

1. Research question
2. Prior work
3. Research design
4. Contribution to literature

[5] Image source (Next slide): Edmondson, A. C., & McManus, S. E. (2007). Methodological fit in management field research. *Academy of management review*, 32(4), 1246-1264.

Element	Description
Research question	• Focuses a study • Narrows the topic area to a meaningful, manageable size • Addresses issues of theoretical and practical significance • Points toward a viable research project—that is, the question can be answered
Prior work	• The state of the literature • Existing theoretical and empirical research papers that pertain to the topic of the current study • An aid in identifying unanswered questions, unexplored areas, relevant constructs, and areas of low agreement
Research design	• Type of data to be collected • Data collection tools and procedures • Type of analysis planned • Finding/selection of sites for collecting data
Contribution to literature	• The theory developed as an outcome of the study • New ideas that contest conventional wisdom, challenge prior assumptions, integrate prior streams of research to produce a new model, or refine understanding of a phenomenon • Any practical insights drawn from the findings that may be suggested by the researcher

What about Research through Design?

"Design can produce knowledge through artifacts that embody, question, and extend theory."
— Zimmerman & Forlizzi, 2010[3]

RtD is strongest when asking *"what could be"* rather than *"what is."*

[3] Zimmerman, J., & Forlizzi, J. (2014). Research through design in HCI. In J. Olson & W. Kellogg (Eds.), Ways of Knowing in HCI (pp. 167–189). Springer.

How do we pick the right method?

Determining *Methodological Fit*

Proposion:[4] Choose your method based on **the state of current theory**

» A given, fixed context in which new research is developed

» The only element over which the researcher has no control

» From *mature* to *nascent*

[4] Bouchard, T. J. (1976). Field research methods: Interviewing, questionnaires, participant observation, systematic observation, unobtrusive measures. Handbook of industrial and organizational psychology, 1, 363.

State of Theory: *Nascent* 👶

Nascent theory:

» Proposes tentative answers to novel questions

» Suggests new connections among phenomena

State of Theory: *Intermediate* 👨

Intermediate theory:

» Presents provisional explanations of phenomena

» Introduces a new construct

» Proposes relationships between new and existing constructs

» May be made up of testable hypotheses and tentative construct

State of Theory: *Mature* 👴

Mature theory:

» Presents well-developed constructs and models

» Has been studied over time with increasing precision by a variety of scholars

» Consists of points of broad agreement

RtD in the Fit Framework

» **Nascent**: RtD excels at exploring new framings and envisioning possible futures.

» **Intermediate**: RtD complements empirical work by embodying constructs in artifacts.

» **Mature**: RtD offers critique, provocation, and reframing of blind spots in established theory.

How does the state of theory affect research design?

Research Questions

» **Nascent**: Open-ended inquiry about a phenomenon of interest

» **Intermediate**: Proposed relationships between new and established constructs

» **Mature**: Focused questions and/or hypotheses relating existing constructs

Types of Data Collected

- **Nascent**: Qualitative, initially open-ended data that need to be interpreted for meaning
- **Intermediate**: Hybrid (both qualitative and quantitative)
- **Mature**: Quantitative data; focused measures where extent or amount is meaningful

Data Collection Methods

- **Nascent**: Interviews; observations; obtaining documents or other material from field sites relevant to the phenomena of interest
- **Intermediate**: Interviews; observations; surveys; obtaining material from field sites relevant to the phenomena of interest
- **Mature**: Surveys; interviews or observations designed to be systematically coded and quantified; obtaining data from field sites that measure the extent or amount of salient constructs

Data and Knowledge in RtD

RtD produces:

- **Artifacts and prototypes** as arguments
- **Design knowledge**: frameworks, principles, exemplars
- **Validity** through reflection, critique, and use — not replication

Constructs & Measures

- **Nascent**: Typically new constructs, few formal measures
- **Intermediate**: Typically one or more new constructs and/or new measures
- **Mature**: Typically relying heavily on existing constructs and measures

Goals of Data Analysis

» **Nascent**: Pattern identification

» **Intermediate**: Preliminary or exploratory testing of new propositions and/or new constructs

» **Mature**: Formal hypothesis testing

Data Analysis Methods

» **Nascent**: Thematic content analysis coding for evidence of constructs

» **Intermediate**: Content analysis, exploratory statistics, and preliminary tests

» **Mature**: Statistical inference, standard statistical analyses

Theoretical Contribution[6]

» **Nascent**: A suggestive theory, often an invitation for further work on the issue or set of issues opened up by the study

» **Intermediate**: A provisional theory, often one that integrates previously separate bodies of work

» **Mature**: A supported theory that may add specificity, new mechanisms, or new boundaries to existing theories

[6] Image source (next slide): *Edmondson & McManus, 2007*

State of Prior Theory and Research	Nascent	Intermediate	Mature
Research questions	Open-ended inquiry about a phenomenon of interest	Proposed relationships between new and established constructs	Focused questions and/or hypotheses relating existing constructs
Type of data collected	Qualitative, initially open-ended data that need to be interpreted for meaning	Hybrid (both qualitative and quantitative)	Quantitative data; focused measures where extent or amount is meaningful
Illustrative methods for collecting data	Interviews; observations; obtaining documents or other material from field sites relevant to the phenomena of interest	Interviews; observations; surveys; obtaining material from field sites relevant to the phenomena of interest	Surveys; interviews or observations designed to be systematically coded and quantified; obtaining data from field sites that measure the extent or amount of salient constructs
Constructs and measures	Typically new constructs, few formal measures	Typically one or more new constructs and/or new measures	Typically relying heavily on existing constructs and measures
Goal of data analyses	Pattern identification	Preliminary or exploratory testing of new propositions and/or new constructs	Formal hypothesis testing
Data analysis methods	Thematic content analysis coding for evidence of constructs	Content analysis, exploratory statistics, and preliminary tests	Statistical inference, standard statistical analyses
Theoretical contribution	A suggestive theory, often an invitation for further work on the issue or set of issues opened up by the study	A provisional theory, often one that integrates previously separate bodies of work	A supported theory that may add specificity, new mechanisms, or new boundaries to existing theories

Empirical & Design Methods Together

Many projects cycle between methods:

» RtD → Generates new questions, concepts, artifacts

» Empirical → Evaluates, validates, refines

» RtD → Builds on refined constructs, opens new directions

Putting it All Together[7]

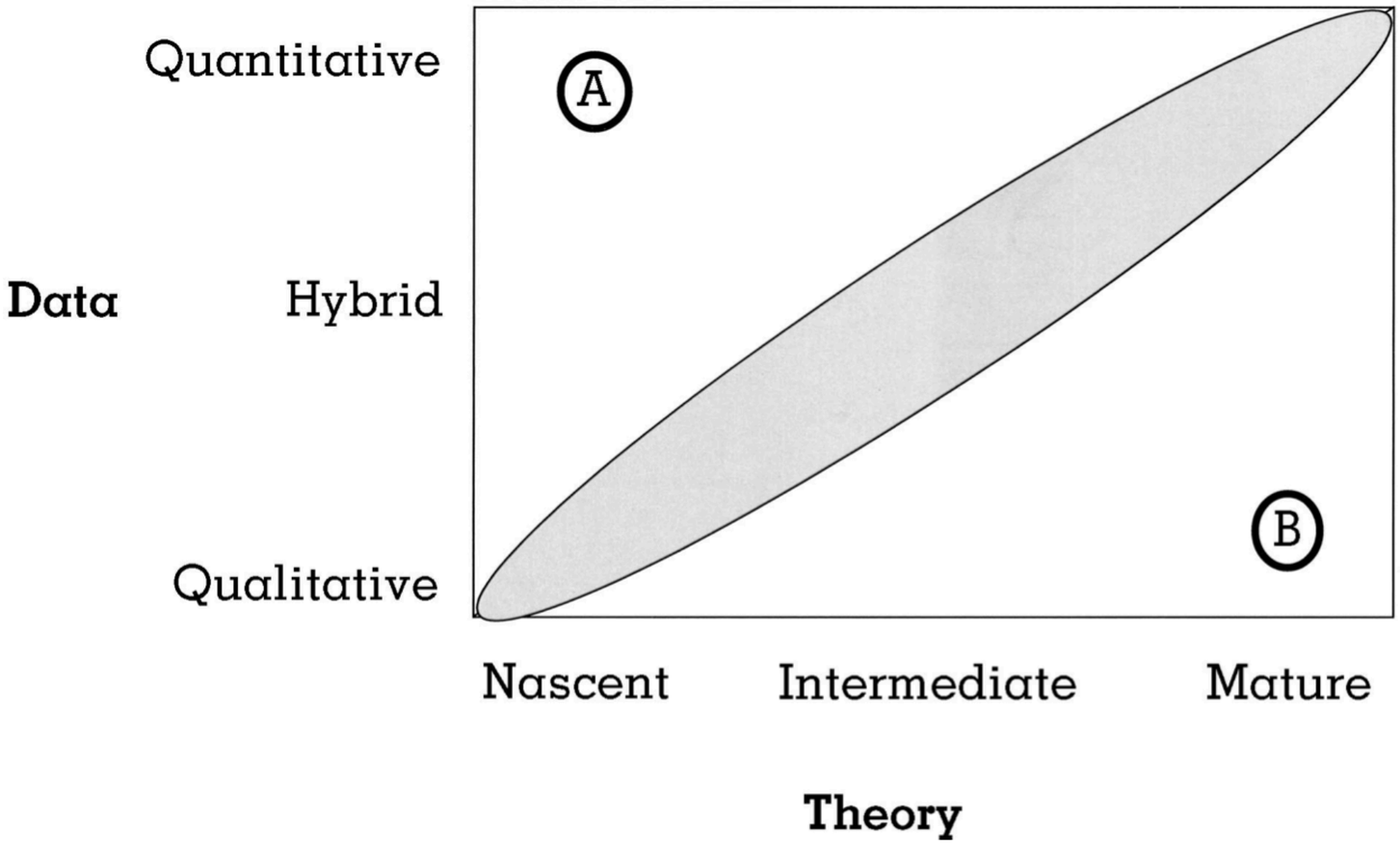
Good fit lies in the diagonal.

Exceptions include:

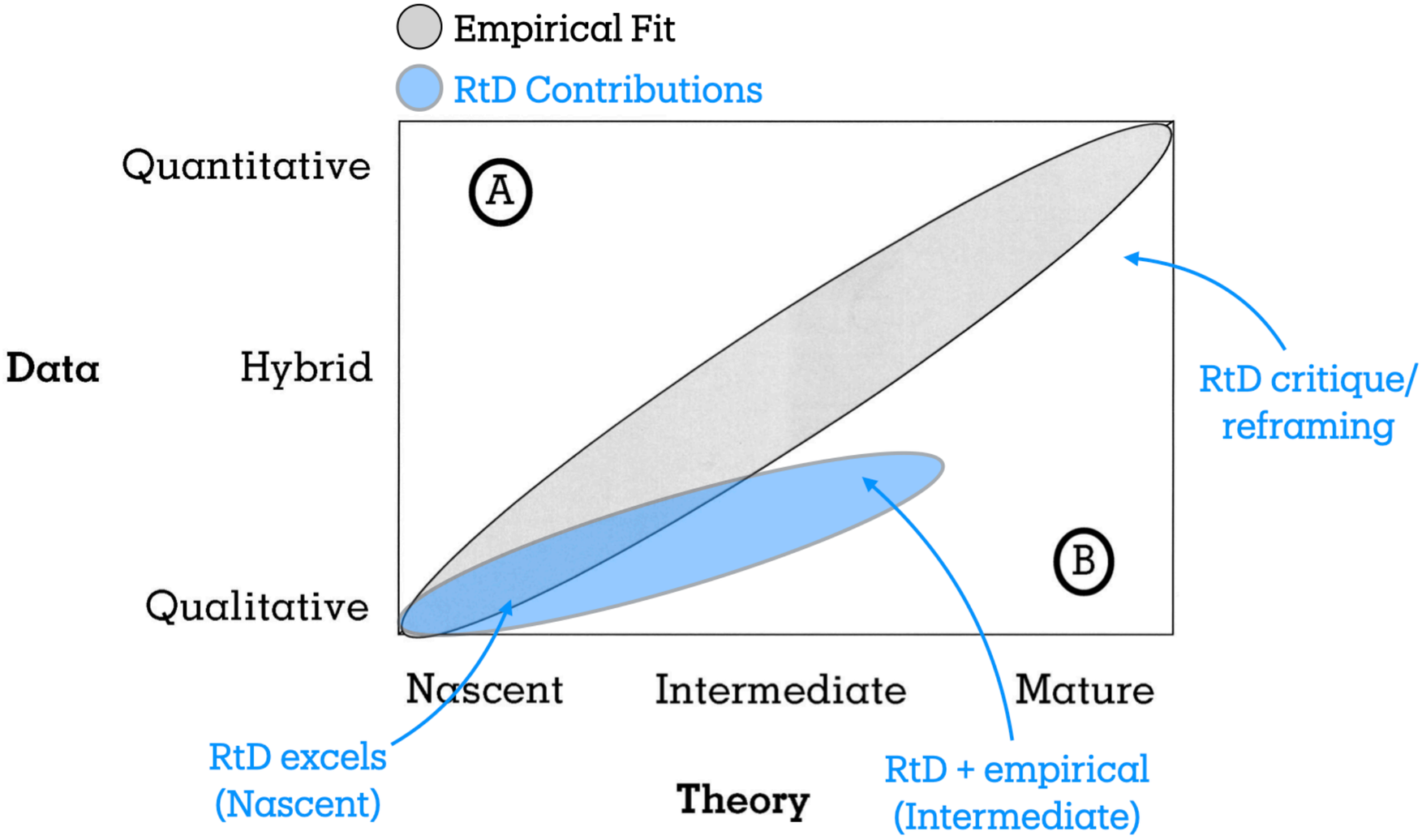
» (A) Nascent theory, quantitative data: e.g., quantitative ethnography

» (B) Mature theory, qualitative data: e.g., new approaches to an old problem

[7] Image source (this, next slide): *Edmondson & McManus, 2007*


Quantitative
Data
Hybrid
Qualitative
A
B
Nascent
Intermediate
Mature
Theory

With design-led inquiry, RtD extends the diagonal by generating new framings (nascent, intermediate) and critiquing mature theory.


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

What are problems with poor fit?

Prior Work on Research Question	Data Collection and Analysis	Problems Encountered	Outcome
Mature: Extensive literature, complete with constructs and previously tested measures	Qualitative only	**Reinventing the wheel:** Study findings risk being obvious or well-known	Research fails to build effectively on prior work to advance knowledge about the topic
	Hybrid	**Uneven status of evidence:** Paper is lengthened but not strengthened by using qualitative data as evidence	
Intermediate: One or more streams of relevant research, offering some but not all constructs and measures needed	Quantitative only	**Uneven status of empirical measures:** New constructs and measures lack reliability and external validity and suffer in comparison to existing measures	Results are less convincing, reducing potential contribution to the literature and influence on others' understanding of the topic
	Qualitative only	**Lost opportunity:** Insufficient provisional support for a new theory lessens paper's contribution	
Nascent: Little or no prior work on the constructs and processes under investigation	Qualitative only	**Fishing expeditions:** Results vulnerable to finding significant associations among novel constructs and measures by chance	Research falls too far outside guidelines for statistical inference to convince others of its merits
	Hybrid	**Quantitative measures with uncertain relationship to phenomena:** Emergent constructs may suggest new measures for subsequent research, but statistical tests using same data that suggested the constructs are problematic	

Questions

Assignment[8]

Choosing the Right Method for Research Scenarios

[8] Activity Handout