

# CISC-810: Research Foundations

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# What is Research?

- Gaining *understanding* of a phenomenon
- A piece of the puzzle of description, explanation, prediction, control

# By Purpose

<b>Descriptive</b>	polls, surveys, demographics, attitudes, counts, frequencies, case studies
<b>Relational</b>	what variables are related, in what direction, to what degree
<b>Causal</b>	causal evidence, degree, direction, prediction

# By Inquiry Mode

- **Quantitative** – primarily numerical, accuracy of measurement, experimental design, structure, statistics are not required but are commonly used tools, ...
- **Qualitative** – observation, case studies, ethnography, un-structured – *to establish variation in a phenomenon without quantifying it*, ...

# By Control

- **Experimental** – manipulation (at least one variable) and assignment of subjects
  - Quasi-experimental – no random assignment
- **Non-experimental** – observation, lack of control condition, extant data

# Research *Clusters*

- Pieces tend to go together
- But they don't really *have* to...

# Mixed Methods

Method	Characteristics
Field Work	Qualitative, Observation, Descriptive, Exploratory
Survey	Qualitative or Quantitative, Descriptive, Relational
Experiment	Quantitative, Experimental Control, Causal
Nonreactive Studies / Extant data	Quantitative, Descriptive, Exploratory, Relational
Modeling and Simulation	Quantitative, Qualitative, Descriptive, Exploratory, Relational

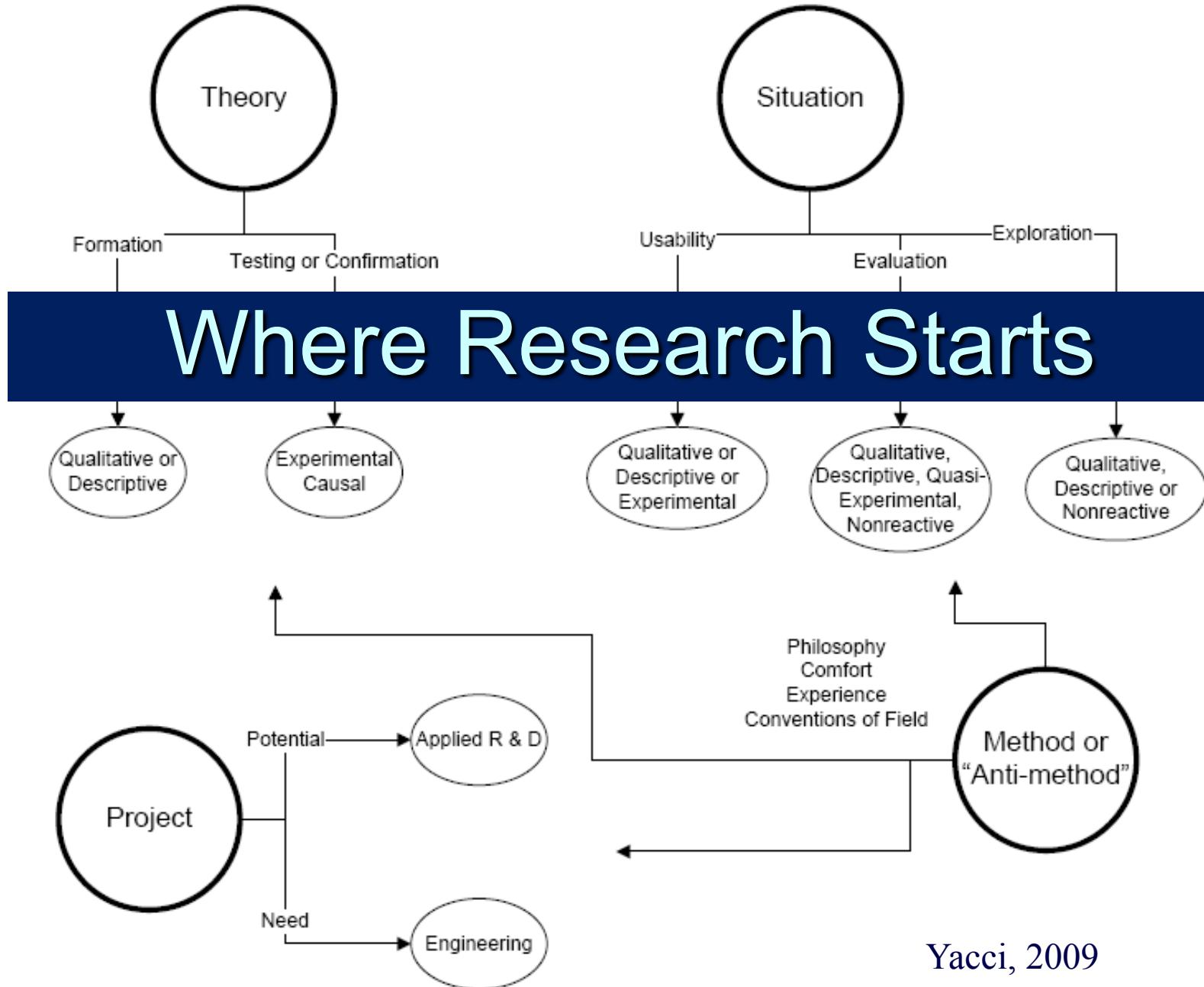
\* Based on Brewer, J & Hunter A. (2006)

# Nonreactive Research?

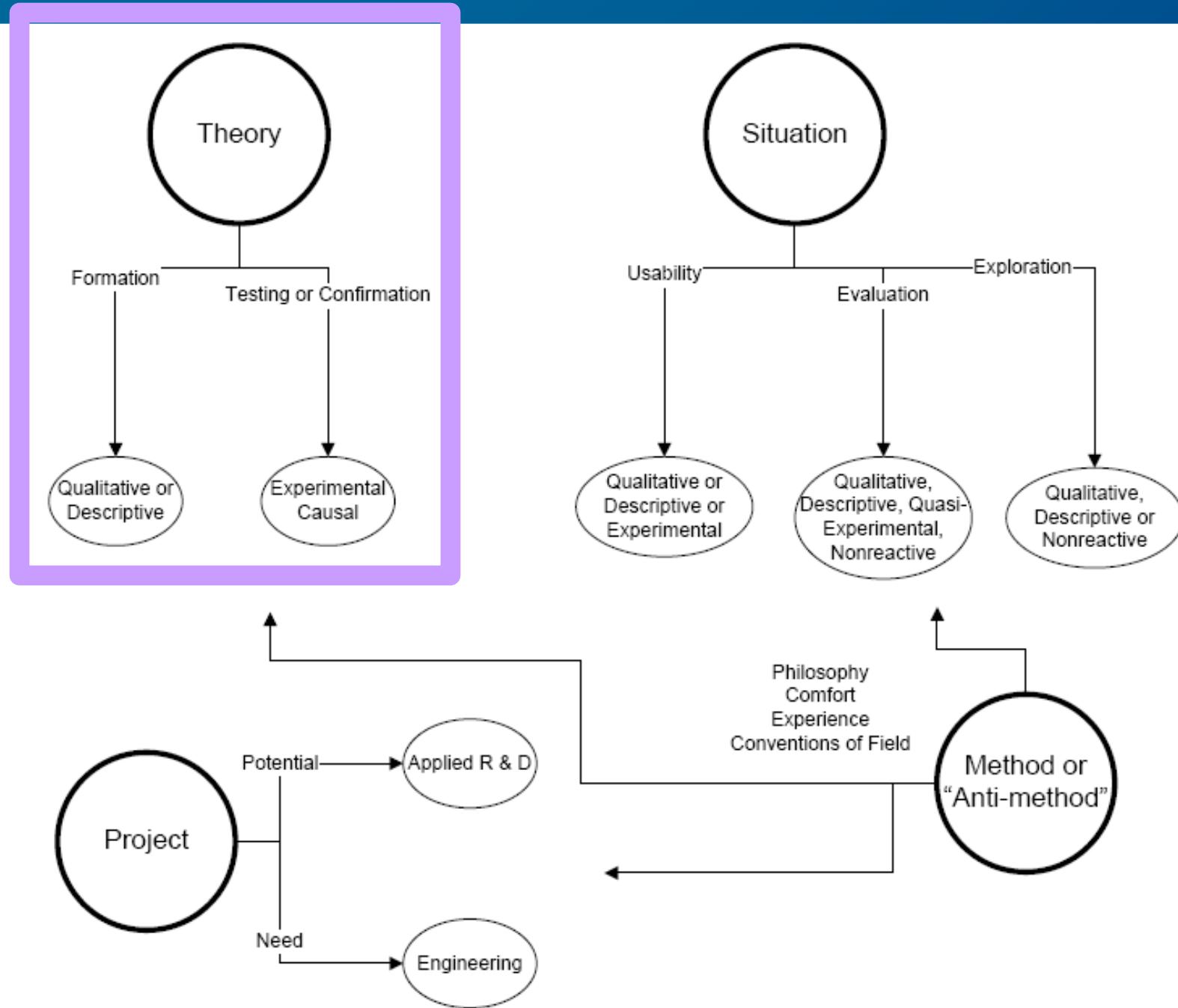
- Secondary records, physical evidence, extant records and byproducts, *outcroppings*
  - The use of secondary data to conduct research so that direct contact with subjects does not influence their behavior.
  - Increasingly relevant in computing research

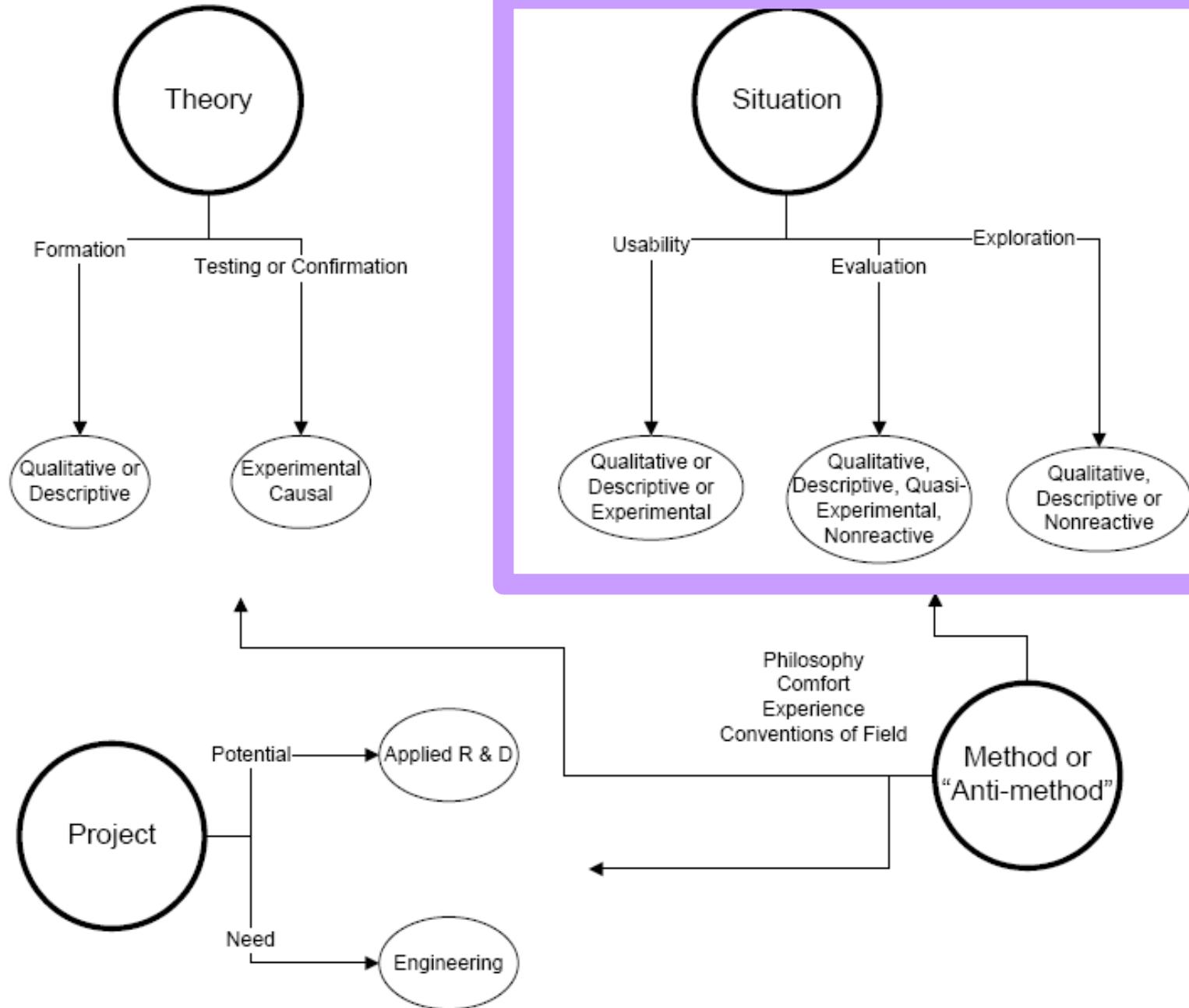
# Time in Research

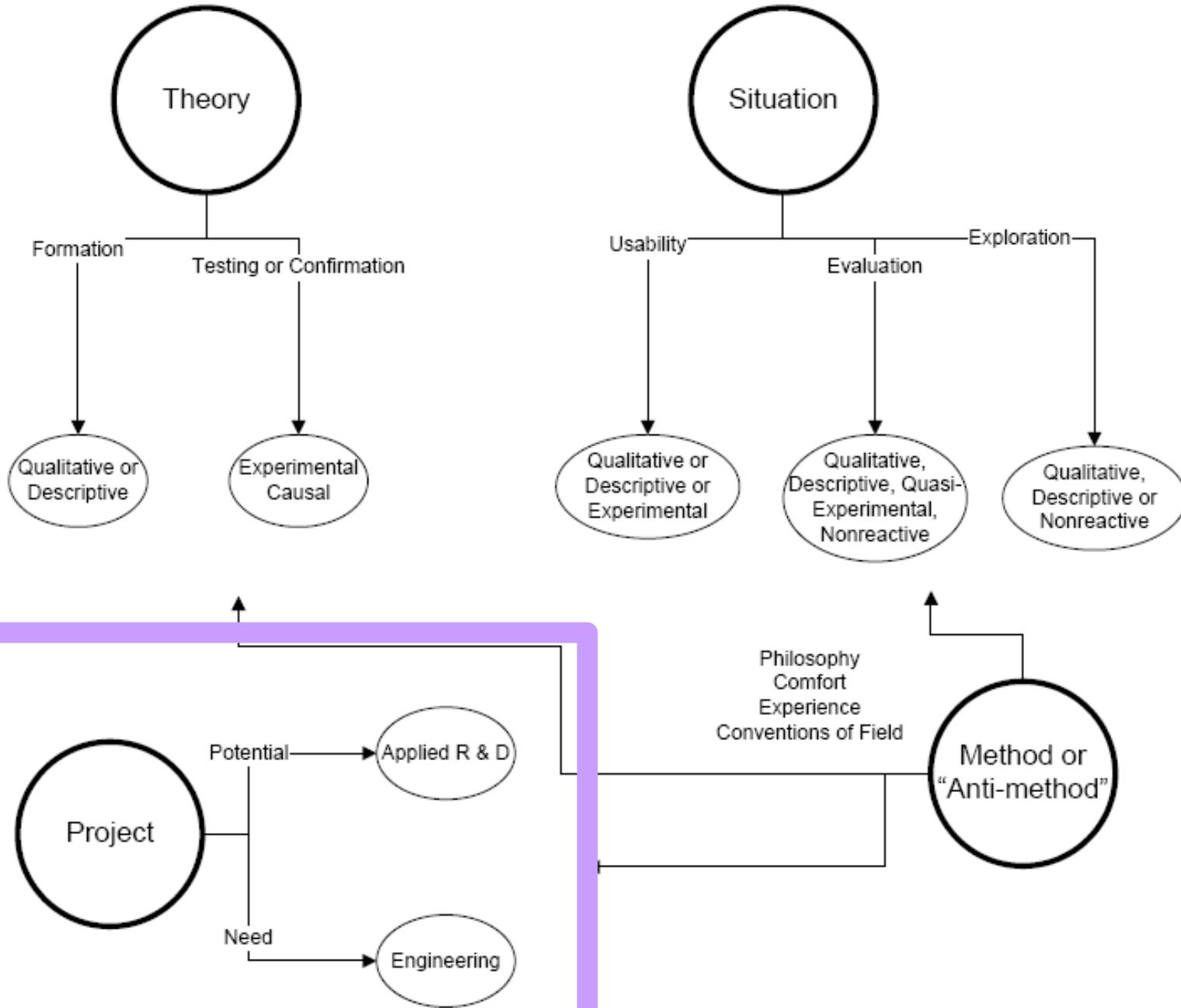
- **Cross-sectional**: a singular *slice* of whatever - a *snapshot*
- **Longitudinal**: two or more measurements at different times
  - Repeated measures: same subject measured multiple
  - Time-series

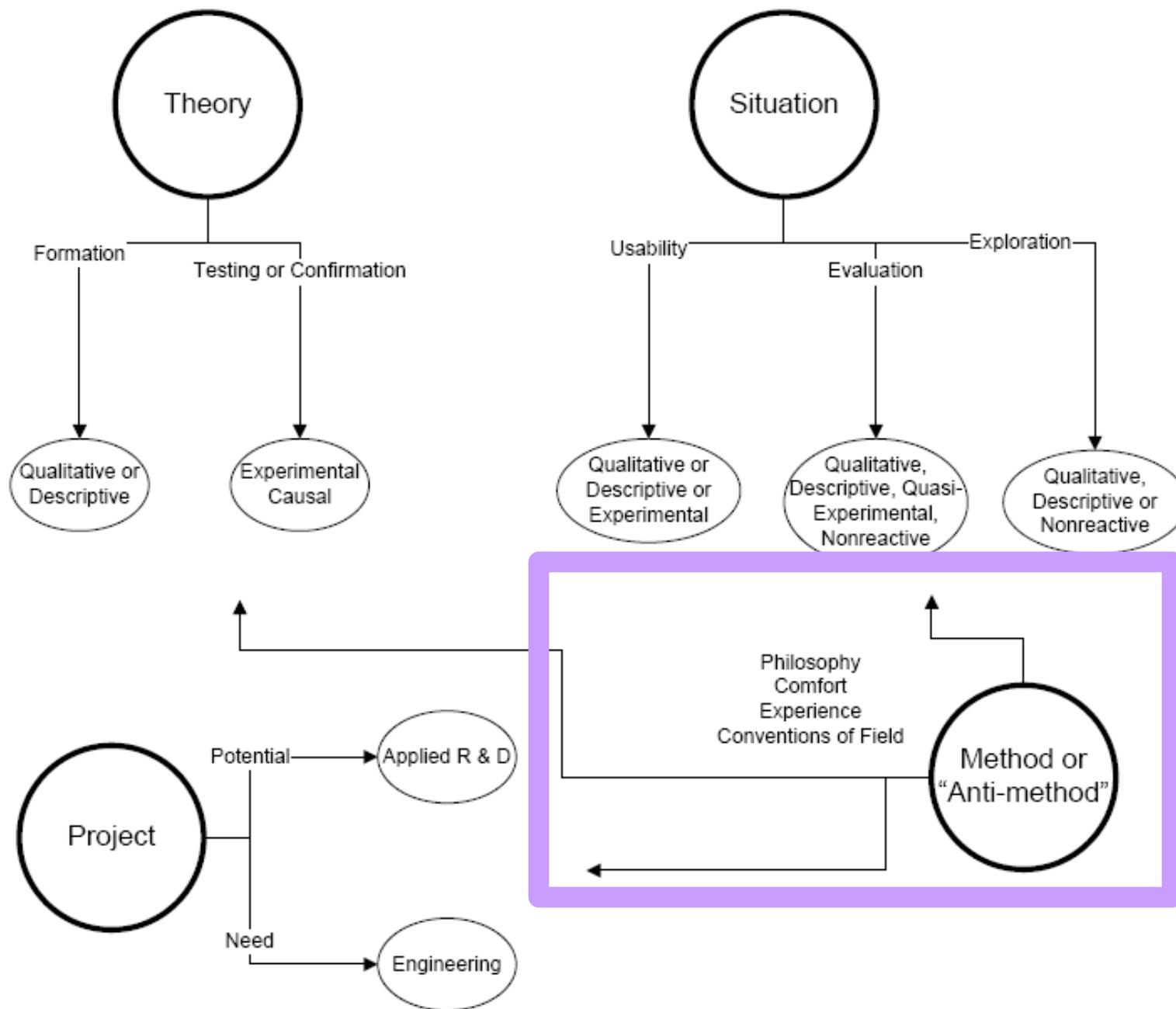


Yacci, 2009









# Science

- The discovery and description of *regularities* in the universe, the world, and in living organisms.
- The development of theories to explain these regularities. (Thomson Learning)
- Based on *empirical data* – based on experience, observation, detectable in the world
- Objective and replicable



## **empirical definition**

**em·piri·cal** (em pír'i kəl)

*adjective*

1. relying or based solely on experiment and observation rather than theory *the empirical method*

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Real data, not just expert's ideas

# Goals of Science

- Discover Regularities
  - Describe Behaviors
- Discover Laws
  - Search for Causes

# Theories

- Explanations for the regularities that we discovered, not just the data:
  - Data: reading ability is positively correlated with weight in US students grade 1-6.

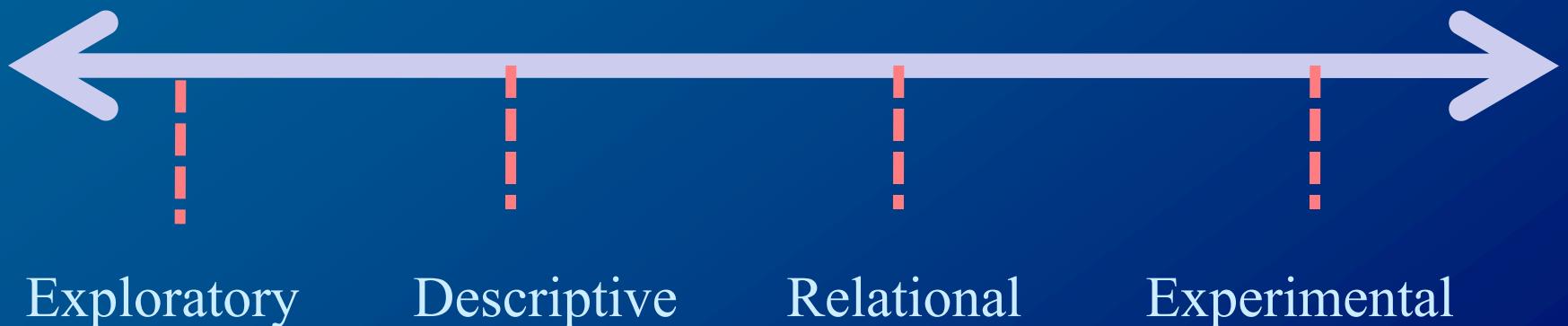
# Theories

- Explanations for the regularities that we discovered, not just the data:
  - Data: reading ability is positively correlated with weight in US students grade 1-6.
    - *Because students are not hungry, they can devote full attention to the abstraction of reading?*
    - *A protein found in heavy students enables better synaptic connections?*

# Studies → Theory

Theory  
building

Theory  
validation



# Correct Theories?

- Theory is our *best* explanation of phenomena at any point in time
- They are likely to be replaced at some time with other theories
- Theories are never *proven correct* – there is evidence to support them, or they are disconfirmed

# Why

- It only takes one case to prove a universal statement is wrong!



# Descriptive

- Darwin describes animals on islands as a prelude to evolution
- We need to determine how people *use* cell phones before we improve them
- We are interested in the current % of female students at RIT

# Remember

- Generic methods
  - survey, experiment, modeling, case-control, etc.
- Part of the process of science/research
  - observe, explain, predict, control

# Relational (Case-Control)

- Are natural disasters related to an increased sense of community?
- Is there a relationship between cell phone use cancer?
- Are women more likely to stay at RIT after 2 years of study?

# Causal

- Will exposure to water cause a cell phone to cease functioning?
- Will *algorithm X* improve software load time more than *algorithm Y*?

# Induction vs Deduction

- Induction: particular to general
  - bottom up
- Deduction: general to particular
  - Top down
- Often somewhere in-between

# Induction

## *Theory-Building*

- Qualitative Research
  - grounded theory
- Observation
  - frequency counts
- Survey Research

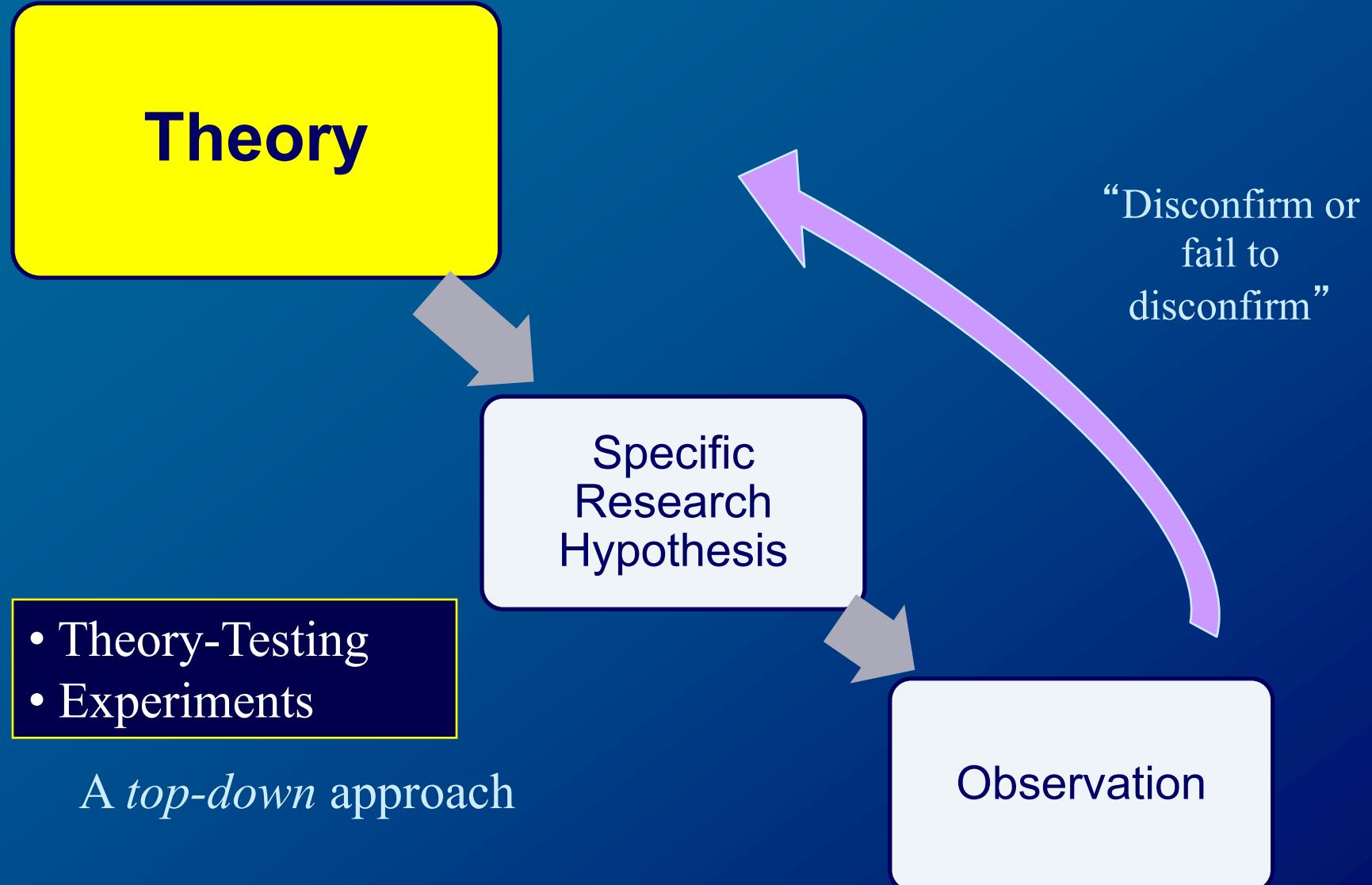
**Observations**

Pattern

Theory or  
Hypothesis

*A bottom-up approach*

# Deduction



<b>THEORY</b>	Media affects learning
<b>RESEARCH HYPOTHESIS</b>	Putting slides on PowerPoint will convey more information than identical slides on an overhead projector.
<b>OBSERVATION</b>	Observe the amount of information that is retained by subjects when presented with each type of slide

# Homework

- Reading: *Trochim & Donnelly*
  - Foundations:
    - Conceptualizing
    - Evaluation Research

# Homework

- Cooking assignment #3:
  - Now you have cooked *your favorite dish* twice, using *your own* and *someone else's* recipes.
  - You also have some experiences/opinions on the taste of the dishes.
  - The next natural step is simple, right? Based on your experiences and *desired* taste, modify/improve/revolutionize the recipe and cook the dish for the 3<sup>rd</sup> time!
  - Write it up.
  - Due date: September 8.