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Copernicus Institute of
Sustainable Development

Theory and methods in innovation systems

Frank van Rijnsoever

Aims

- Acquaint you with the role of theory and methods in scientific research.
- Talk about the differences between ‘good’ and ‘bad’ theory.
- Talk about you the link between theory and methods.
- Give an overview of methods in innovation systems.

Some discussion questions

- What is theory?
- Why do we use theory?
- What kind of theories do you use?

Theory: why and what?

Some definitions:

"Theory is important to the social researcher because it provides a backcloth and rationale for the research that is being conducted. It also provides a framework within which social phenomena can be understood and the research findings can be interpreted" - (Bryman, 2008: p. 6)

"Theories are analytical tools for understanding, explaining, and making predictions about a given subject matter (Source: Wikipedia)".

Element of theory:

- Concepts/variables
- Logical non-contradictory hypotheses
- Explanatory mechanisms

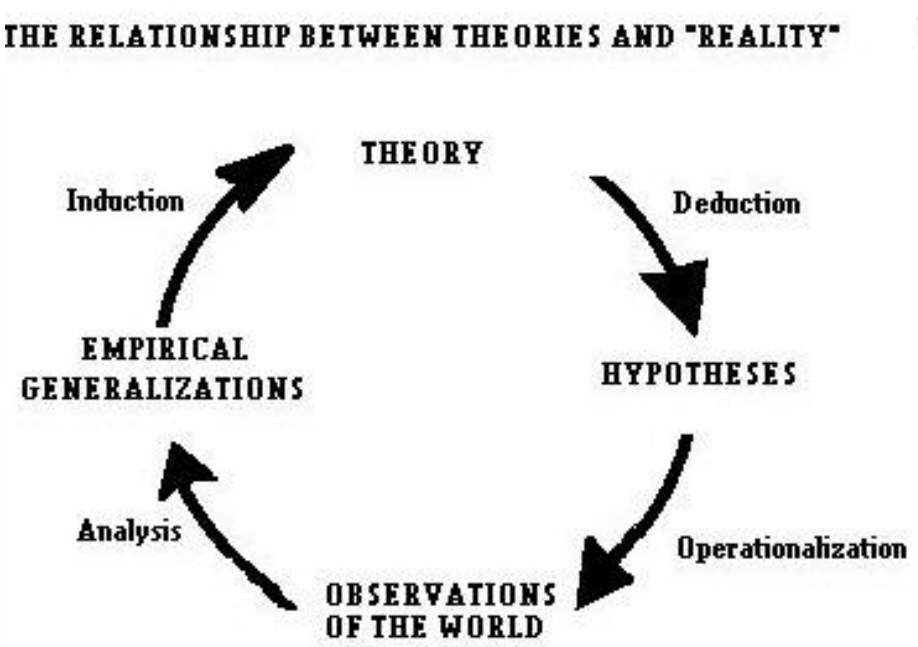
How is theory created

Deductivism:

-explicit hypothesis to be confirmed or rejected
-quantitative research
-trial and error

Inductivism:

-generalizable inferences from observations
-qualitative research /grounded theory
-finding a pattern



Hypotheses and falsification (Popper 1959)

- Probabilistic approach in the social sciences

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Stages of theory development

Descriptive

Predictive

- Empirical observations
- Derive concepts or constructs
- Framework for interpretation

Induction

- Explore relationships
- Make formal hypotheses
- Formulate coherent theory
- Test implications

Deduction

Example hypothesis

Assuming all other things equal:

- **If A increases, then B** [increases or decreases], **because…**[give and argument].

- ***The diversity of project partners*** *has a* ***positive association*** **with the technological variety of a project**, ***because*** **diverse partners bring to the project their unique resources, knowledge and skills, which can be combined to form novel concepts. This increases technological variety.**

Bad example hypothesis

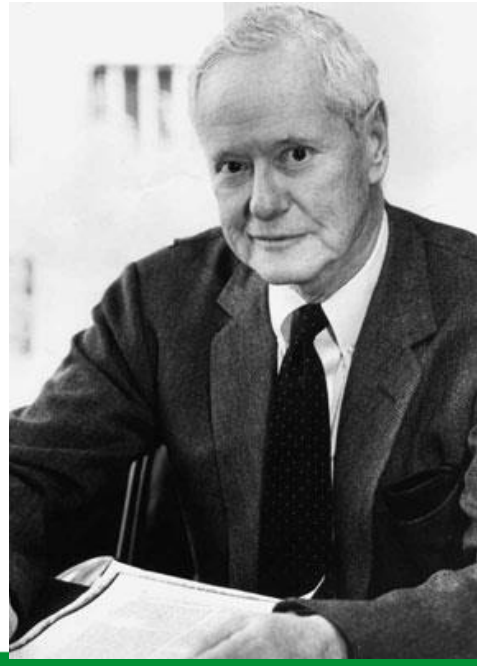
Assuming all other things equal:

- ***The diversity of project partners*** *has a* ***positive association*** **with the technological variety of a project,** ***because*** **this has been found by earlier studies (see Laursen and Salter, 2006; Nieto and Santamaría, 2007; Nooteboom, 2000; Ruef, 2002).**

Good theories: Beauty (Lave and March, 1975)

Level of abstraction

- **Simple:** Parsimonious: *Less = More!*
- **Fertile:** Broadly applicable
  - "Grand theories" (also general theories)
    - Abstract, difficult to apply
  - "Middle range theories" (Merton 1967)
    - For example: Innovation sciences
  - "Empirical findings"
    - For example: long lists of institutions
- **Surprise:** Unexpected findings



Good theories: Truth (Lave and March, 1975)

- **Correct**
  - Fits with empirical observations
- **Testable**
  - Falsifiable
    - Try to disprove theories!
  - Consider alternative models
  - Non-circular

"When the Rain Dance ceremony is properly performed, and all the participants have pure hearts, it will bring rain"

"See, here's where you screwed up."

Surprise (Lave and March 1975: pp69-70)

"Suppose that each couple agreed (knowing the relative value of things)
to produce children (in the usual way)
until each couple had more boys (the ones with penises) **than girls** (the ones without).

And further suppose that the probability of such coupling (technical term)
resulting in a boy (the ones with) **varies from couple to couple,**
but not from coupling to coupling for any one couple.

And (we still have a couple more)
that no one divorces (an Irish folk tale)
or sleeps around (a Scottish folk tale)
without precautions (a Swedish folk tale).

And that the expected sex (technical term) **of a birth if all couples are producing equally is half male, half female** (though mostly they are one or the other).

Question: (Are you ready?)
What will be the ratio of boys (with) **to girls** (without) **in such a society?**

Answer: The sweet truth is (given the supposings)
that we will end up with more girls (without) **than boys** (with).
(That's beauty, baby.):"

Some examples of surprise

- Boysngirls
- El Farol Bar, Santa Fe
- Segregation models

See Netlogo: http://ccl.northwestern.edu/netlogo/

- More today!

How good are our theories?

Theory	Stage	Elements				Truth			Beauty		
		Concepts	Hypo-theses	Expla-nation	Induction/ Deduction	Correct	Falsi-fiable	Alterna-tives	Simple	Fertile	Surprise
NIS											
TIS											
MLP											
…											

Methods: Putting theories to the test

- *What do we need to test or develop our theory?*
- **A strategy to collect..**
- **…data…**
  - from the right sources, such as…
  - oral interviews, documents, written questionaires, databases, observations..
  - collected in an appropriate manner,
- **…to measure our concepts/variables…**
  - either pre-or post theorizing,
  - in a reliable and valid manner
- **…and to conduct an analysis…**
  - Suited to the data and theory
- **…to draw conclusions**
  - and answer a research question

Two research strategies

Quantitative

- measurement of social variables
- common methods: *surveys* and *experiments*
- numerical and statistical data
- deductive theory testing (see Popper)
- positivist or realist epistemology: natural science methods
- objectivist view of reality as external to social actors

Qualitative

- understanding the subjective meanings held by actors (interpretivist epistemology)
- common methods: interviews, ethnography
- data are words, texts and stories
- inductive approach: theory emerges from data,
- interpretivist epistemology
- social constructionist ontology

Quality criteria (Stanley and Cambell, 1966)

- Measurement (Internal reliability)
- Replication (External reliability)
- Causality (Internal validity)
- Generalization (External validity)

Or if you're qualitative (Guba & Lincoln, 1994)

- **Trustworthiness** (scientific quality)
  - Credibility =internal validity, internal reliability
    - respondent validation
    - triangulation
  - Dependability = reliability
    - auditing research process
  - Transferability =external validity
    - thick description
  - Conformability =objectivity
    - not overly value-laden

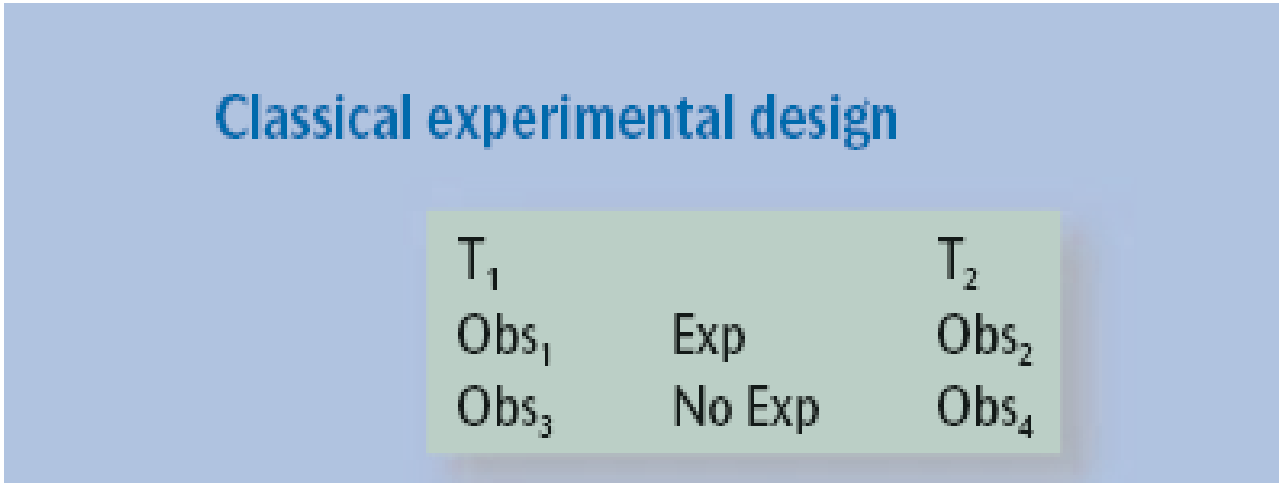
- **Authenticity** (political impact of the research) -> Debated!!
  - Fairness
  - Ontological (improving understanding of participants)
  - Catalytic
  - Educative
  - Tactical (empowerment of participants)

What is a research design?

- A structure or framework to guide data collection and analysis

Experimental design

- to establish causal relationship between independent and dependent variables
- IV manipulated; all other variables held constant
- random assignment of subjects to experimental and control groups
- rarely used in innovation research -
  - either impractical or unethical

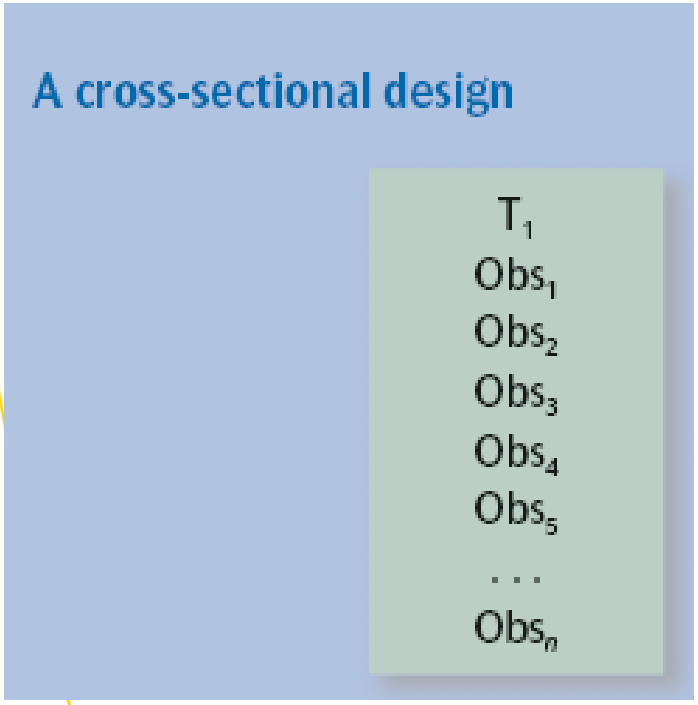


Cross-sectional design/survey

- **collection of data from more than one case at a single point in time**
  - shows variation between individuals, families, firms, groups or nations
- **quantifiable data**
  - patterns of association between variables
- **includes surveys**
  - e.g. Health and Lifestyle survey, opinion polls, Community Innovation Survey (CIS) etc.
- **existing data and documents**
  - Chamber of Commerce or expert journals, Web of Science
- **non-manipulable variables**

- **Popular in innovation studies**

Survey: Cross-sectional design

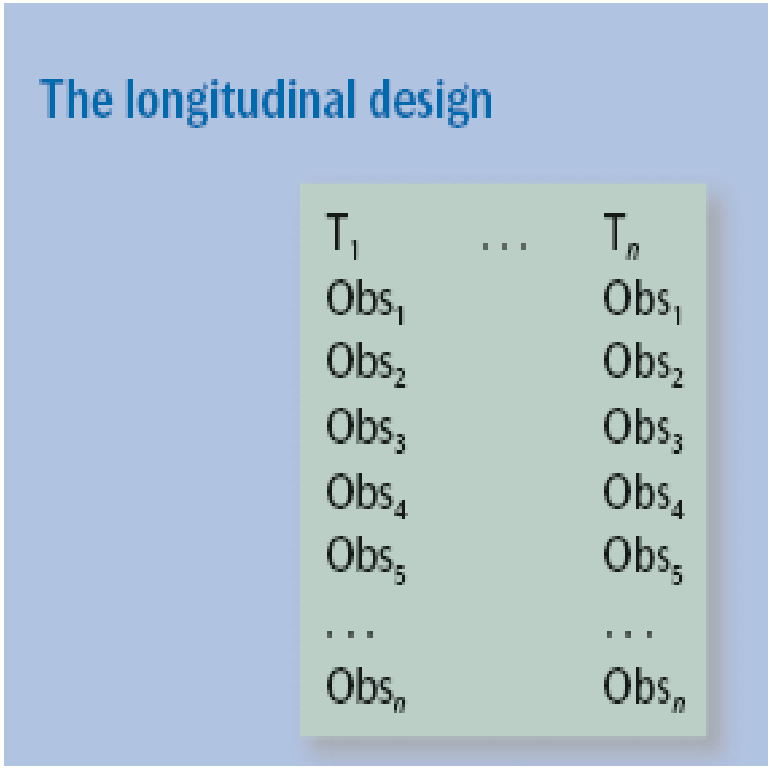


The data rectangle in cross-sectional research

	Obs_1	Obs_2	Obs_3	Obs_4	. . .	Obs_n
$Case_1$						
$Case_2$						
$Case_3$						
$Case_4$						
$Case_5$						
. . .						
$Case_n$						

Survey: Longitudinal design

- survey of the **same sample** on **more than one occasion**
- shows areas of social change over time
- infer causal effects from T1-->T2
- problems
  - attrition
  - panel conditioning
  - Control



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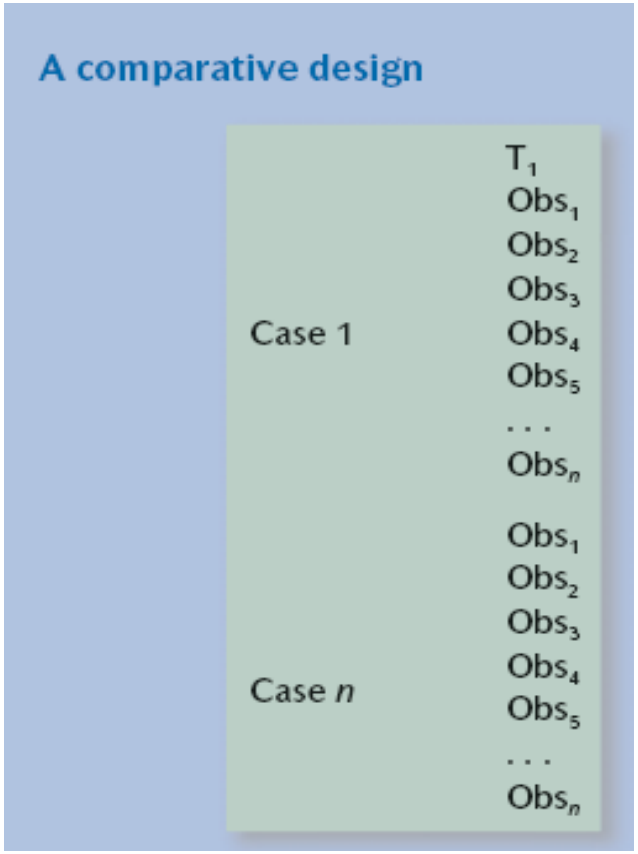
Case study design

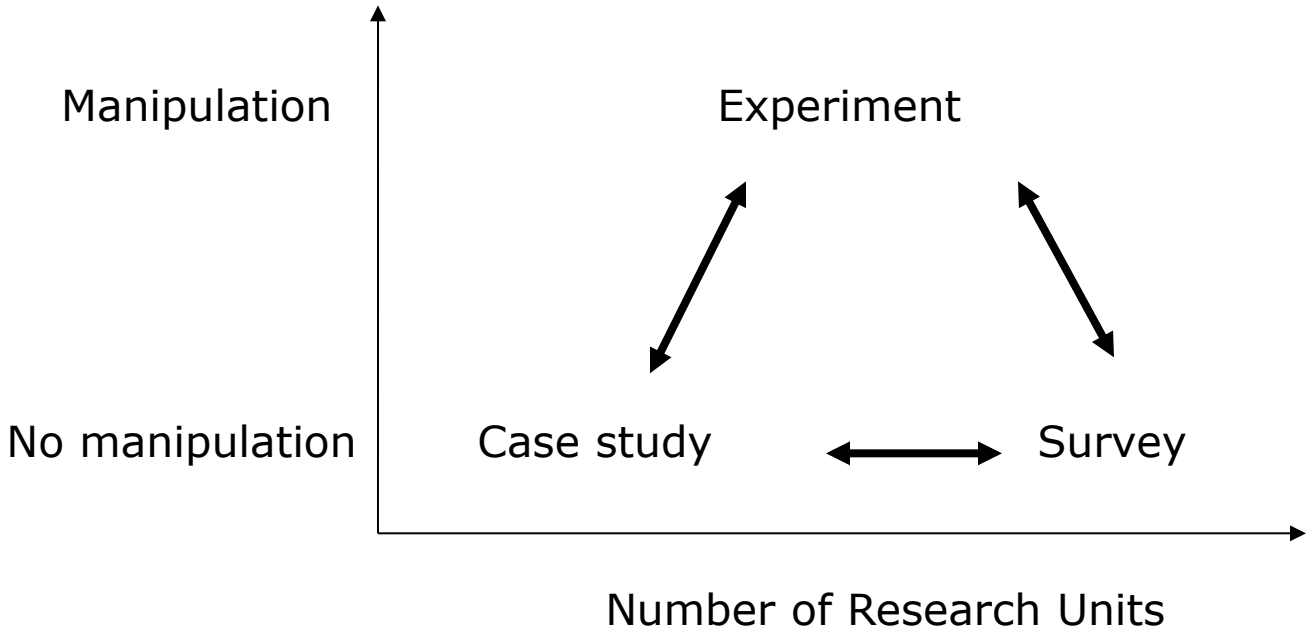
- **detailed and intensive analysis of one case**
  - e.g. a specific person, event, organization or community
- **often involves qualitative research**
- **case is the focus of interest in its own righ**
  - location/setting just provides a background
  - importance of context
- **types of case**: critical, unique, extreme, revelatory, exemplifying
- **useful for falsification and getting tentative ideas**
- **problems**
  - objective measurement (interpretation)
  - generalizability

Case Study: Comparative design

- using the same methods to compare two or more meaningfully contrasting cases
- can be qualitative or quantitative
- includes multiple cases
- problem of translating research instruments and finding comparable samples

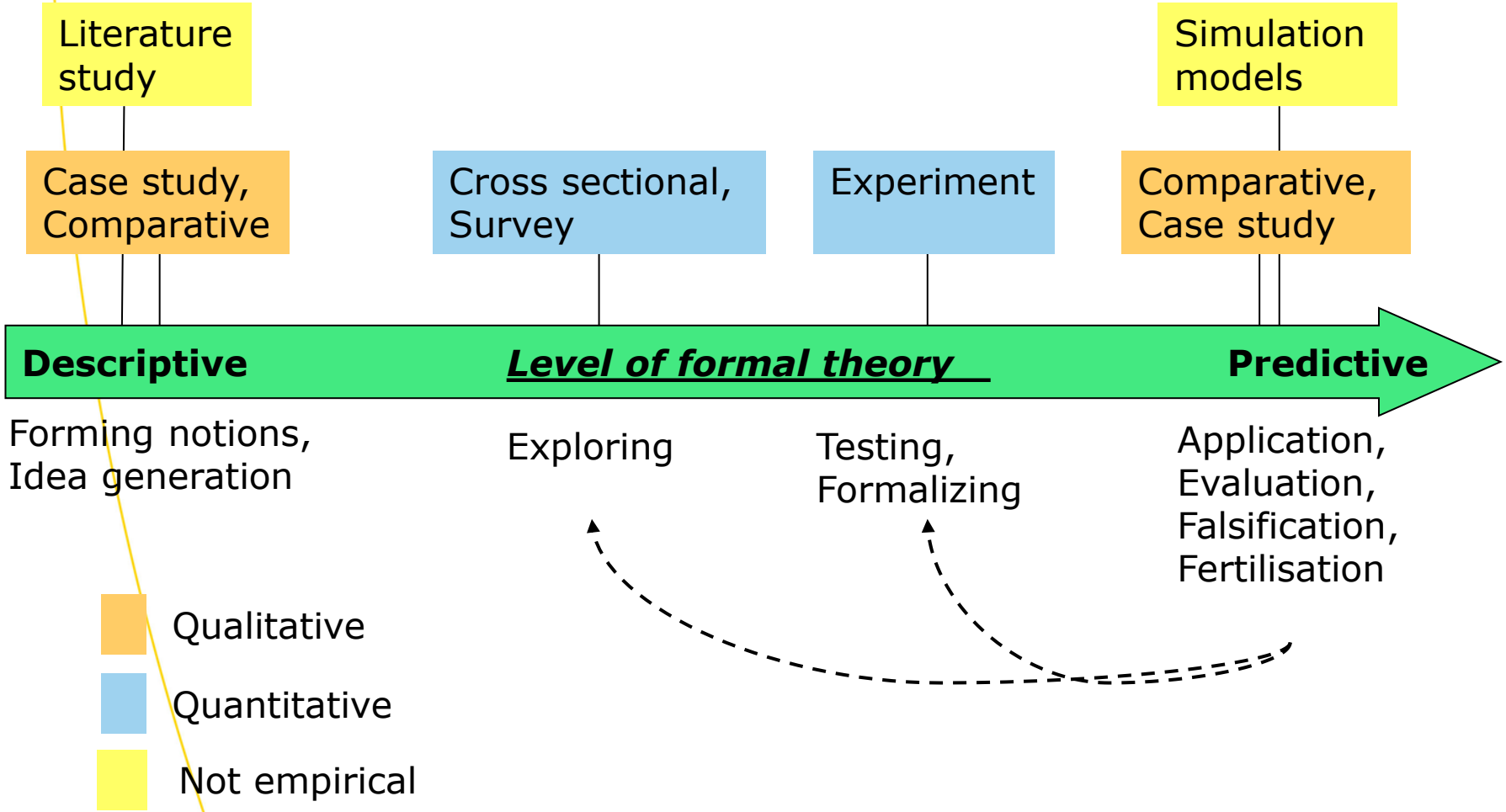


The difference between the designs



- The difference between **survey** and **case study** depends on the number of research units in the sample.
- The difference between an **experiment** and a **survey** or **case study** depends on whether the **independent variable is systematically manipulated** by the researcher.

Research designs and theory development (tendencies)



Some final questions

- What methods are you planning to use/using?
- How do they link to your theory?
  - Do they fit?
- What are strengths and weaknesses of these methods?
- How to deal with weaknesses?

Some points to ask yourself

Research should be:

- Original
  - New research
- Relevant
  - Scientific
  - Practical
- Feasible
  - Researchable
  - Time, data collection
- Using the appropriate theories and methods

What do we want to know?
What do we already know?

Why do we want to know this?

How will we get to know this?

Questions?