Study Design

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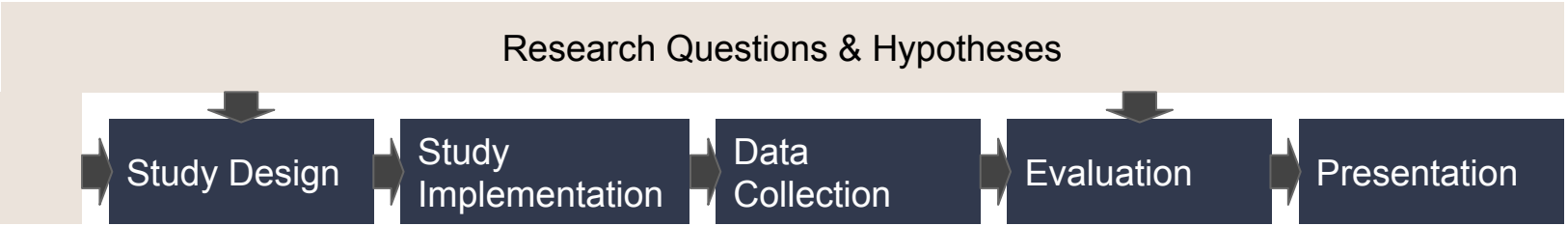
Research-Design

Research-Design = logical structure of the investigation
Research-Methods = specification of data collection mode

Rf. (1, 10, 16)

Evaluation Process:

Rf. (2)



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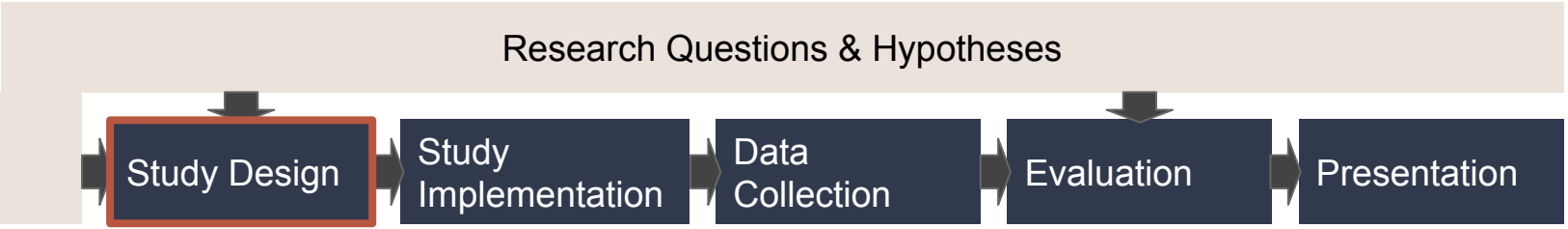

General Terms

Independent Variables

- manipulated / changed by the experimenter
- is assumed to have direct effects on dependent variable
- in well-designed studies:
  IV as only relevant difference between experimental and control groups

AND

Dependent Variables

= “Responsive Variable”

- Variable being tested and measured in an experiment
- “dependent” on independent variable

Rf. (7, 8, 9)

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AND

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= “Response Variable”
- Variable being tested and measured in an experiment
- “dependent” on independent variable

CONDITIONS

INFLUENCE

Rf. (7, 8, 9)

Example – Independent vs. Dependent Variable

“In an experiment, we want to investigate how different teaching methods affect students' grades at the end of a semester at university.”

Example – Independent vs. Dependent Variable

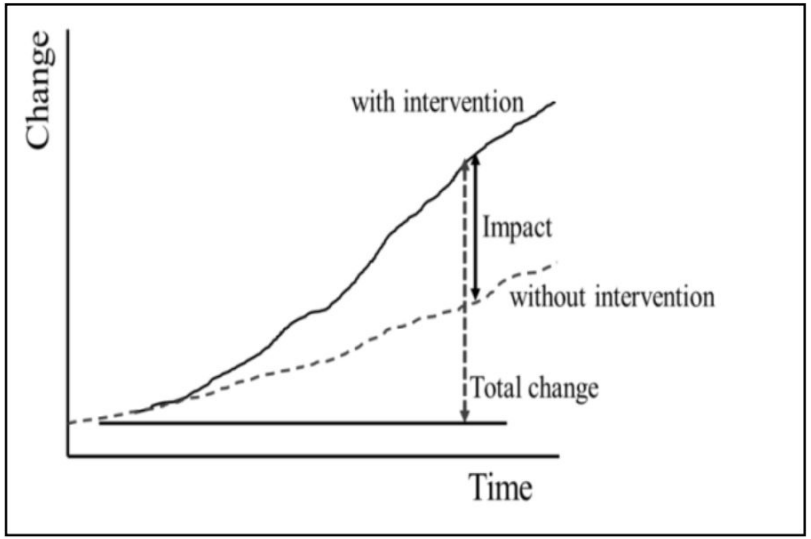
independent variable

"In an experiment, we want to investigate how **different teaching methods** affect **students' grades** at the end of a semester at university."

dependent variable

Causality

- fundamental part of result measurement
- shows impact of specific intervention on target population
- “Problem of attribution”:
  Is it possible to attribute observed improvement to activities performed?



Causality and attribution

Rf. (1)

Validity

- Results show what they are supposed to show
- valid measurement is generally reliable
- do results correspond well with previous research?

Reliability

- Results can be reproduced in repeated research
- reliable research not always valid
- are results consistent?

Rf. (11)

Internal Validity

- Cause-effect relationship between variables *within* the study
- event / manipulation of event → change in behaviour
- achieved, if no other factors influence change

External Validity

- general applicability *outside* of the study
- avoid artificial situation, unusual or too small group of participants

Within-Subject-Design

VS

Between-Subject-Design

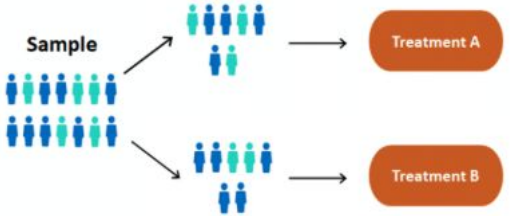
Rf. (2)

- each subject has to perform **all given conditions** / treatments
- analysis of the results of all conditions tested from the same participant

Rf. (12)

Rf. (2)

- each subject has to perform **only one specific condition**
- comparison of results across these different groups previously defined



Rf. (12)

Within-Subject-Design

VS

Between-Subject-Design

- **Advantages**
  - Internal validity not dependent on random assignment
  - In many cases: considerable increase in statistical power
- **Disadvantages**
  - Confounding factors in identification, due to exposure of subjects to multiple treatments
  - Order of exposure influences reference and classification of treatments

- **Advantages**
  - Higher external validity (in settings where individual has only one decision to make)
  - Statistically easy to perform as long as groups are randomly assigned.
- **Disadvantages**
  - usually no natural anchor
    → Results can inherently miss important and real patterns.
  - have severe limitations in terms of testing large parameter sets
  - Necessary: trade-off between statistical power and the number of variants we can test

Rf. (1)

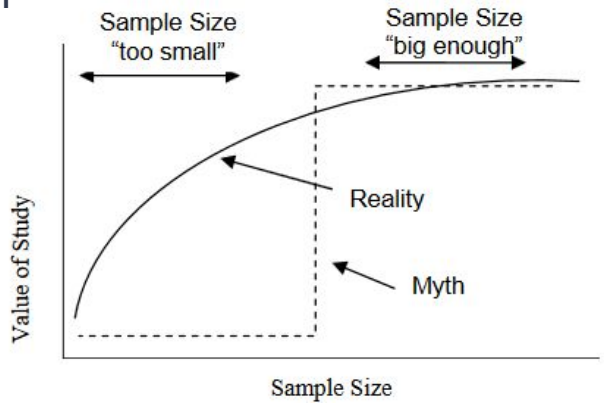
Methods of sampling

Goal: external validity → *representative* sample of the population

Sample size: the more, the more valid, but no clear threshold
Goal: statistically usable data

Demographic data: age, gender, occupation,...

target population → sampling frame → random/non-random?
→ sample size (e.g. through power analysis, saturation, ROI)
→ select sampling units



Rf. (4)

Random Sampling

VS

Non-random Sampling

every unit in population has a chance of being surveyed

Simple random samples
Systematic random sample
Stratified random sample

- impractical
- random != probabilistic

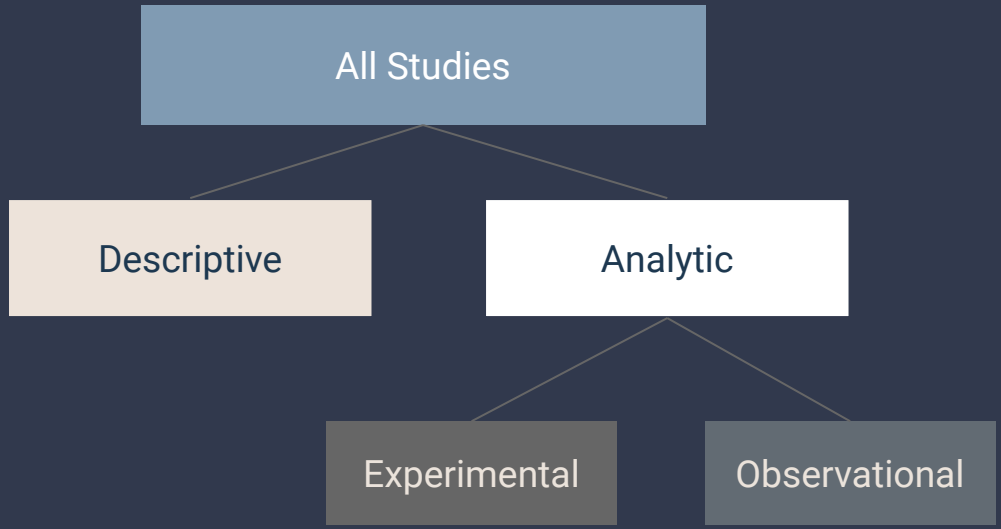
some have **no chance** of selection

Convenience samples
Referral sample
Judgement sample

- can be less statistically representative

Rf. (1)

Study Design Types



Rf. (13)

Analytical
"Why?"

VS

Descriptive
"What?"

Relationship between **Cause and Effect**

answers **why** and **how** is an effect caused

e.g. crossover, cohort

finds causation

confirms/denies a hypothesis

Picture of an **existing situation**:
describes, measures and classifies data

answers **what**, who, where,...

e.g. surveys, case reports

correlation does not imply causation

information to develop a hypothesis

Rf. (14)

Experimental Studies

Conditions:

1. (at least) two experimental groups
→ **treatment & control group**

2. random assignment of subjects to experimental groups
(**randomization**)

3. “manipulation” of independent variable by the researcher
(**experimental stimulus**)

Examples:

- Parallel Group / Randomised Control Trial
- Crossover Design

Rf. (1, 13)

True-Experimental vs. Quasi-Experimental

	True experimental design	Quasi-experimental design
Assignment to treatment	The researcher **randomly assigns** subjects to control and treatment groups.	Some other, **non-random** method is used to assign subjects to groups.
Control over treatment	The researcher usually **designs the treatment**.	The researcher often **does not have control over the treatment**, but instead studies pre-existing groups that received different treatments after the fact.
Use of control groups	Requires the use of **control and treatment groups**.	Control groups are not required (although they are commonly used).

Rf. (18)

Field Study

= conducted in the real world or a natural setting

- resemble situations encounter in daily living
- preserve naturalness of the setting
- participants know / may know that they take place in a study

VS

Controlled Laboratory Research

= conducted in a specific setting designed for research

- controlled investigation
- particular factors / variables manipulated by the researcher to determine changes in the subjects

Rf. (14)

Field Study

- **Advantages**
  - suits for survey
  - generalizability to real-life contexts
  - represent greater variety of situations and environments
- **Disadvantages**
  - subjects not always aware of participating
  - less experimental
  - lack of control
  - impossibility of precisely characterizing the study

VS

Controlled Laboratory Research

- **Advantages**
  - subjects can be selected / placed in conditions more systematically
  - subjects usually know they are participating (disadvantage as well)
  - represent true experimental design
  - reproducibility
- **Disadvantages**
  - may represent an “artificial” environment
  - may influence manner in which subjects behave, and therefore alter results

Rf. (14)

Observational Studies

Conditions:

- **observation** of processes **without** controlling or intervening
- **no separation** between dependent and independent variables
- no clear causality

Types:

- Longitudinal Study (Cohort Study)
- Cross-sectional

Observational Studies – Examples

Longitudinal

21		Q			C
20	L	L, Q	L	L, C	L
19		Q	C		
18		Q, C			
17	C	Q			
Alter/ Jahr	2017	2018	2019	2020	2021

Cohort

Cross-sectional

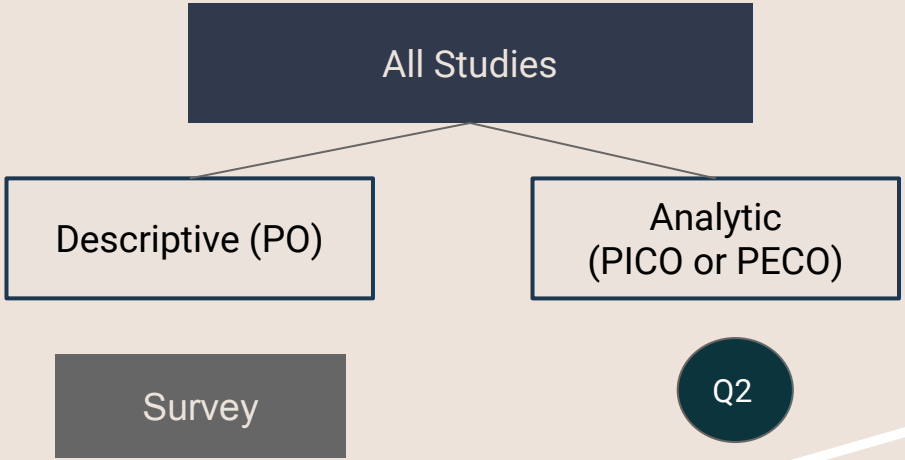
Rf. (14)

All Studies

Q1

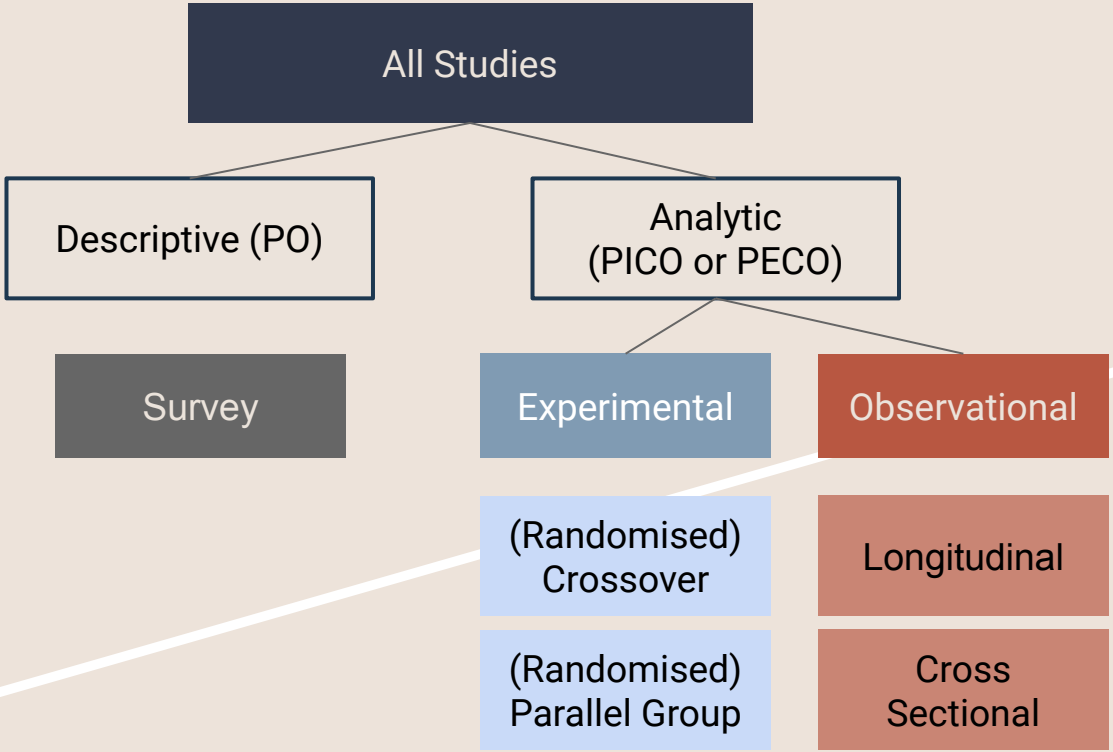
What is the aim of the study?

Rf. (13)



P = defined population
I / E = Interventions / Exposures applied to different groups
C = Comparison, main alternative to the intervention
O = measured outcome, accomplishments, improvements

Rf. (13)



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Rf. (13)

Discussion

What could this Study be built?

Research Question:
Do online classes (in general) in elementary schools have negative effects on the students' mental health?

Break-Out-Rooms

Questions:

- Which study design would you use? Describe advantages and disadvantages?
- What are independent / dependent variables?
- What confounding variables might emerge (impact on causality)?
- How can you ensure internal validity?
- How can you ensure external validity?
- Best option: within-subjects-design or between-subjects-design?

Thank you very much for your Attention !

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