Research Strategy

RSM 321 (Lecture 8)

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Outline

- Introduction on study designs
- Basics of the experimental study design
- Validity in experimental design

Study design or research strategy

A study design is the way the research project will be done (a blueprint or detailed plan or strategy for how a research investigation is to be completed)

Study design or research strategy

- Types of study design taught in this course
  - Experiment
  - Cross sectional
  - Longitudinal
  - Case study
- Choice between study designs is determined by
  - Kind of hypotheses/research question
  - Money, time, resources, ethical issues
    - These determine number of contacts in time, sample size, depth of inquiry
    - Ethics often necessitate cross sectional or longitudinal research instead of experiment

Experimental research design

The Experiment

- Purpose of an experiment:
  - To investigate a causal relationship between two (or more) variables
- Way of establishing a causal relationship:
  - Manipulation of the independent variable by the researcher (Kumar: intervention)
  - Random assignment of the research units to the groups
    (See Kumar p. 114: Random design)
  - Control of all other conditions *(ideally)*
- Origin:
  - Natural sciences like chemistry, biology, etc.

Conditions for the use of an experiment

- The researcher is able to manipulate the independent variable X

- The time-lag between a change in X and a change in Y is relatively short

- There are no ethical objections (regarding possible physical and/or psychological harm) to conducting the experiment

Basic experimental design

(Kumar: before and after design, p. 116)

- Manipulate the independent variable
- Use a pre-test as a point of reference to check whether the manipulation of X leads to a change in the value of Y

Time	t_1		t_2
Group I	O_1	X	O_2

t = time of observation
O = observation of dependent variable Y
X = independent variable

Can you be sure that a change in the value of the dependent variable is caused by X and not by an external event?

Control group design

(Kumar p. 117)

- To filter out the influence of external events (or: extraneous variables) we may add a control group

Time	t_1		t_2
Group I	O_1	X	O_2
Group II	O_3		O_4

t = time of observation
O = observation (of value of dependent variable Y)
X = independent variable

Can you be sure that a change in the value of the dependent variable is not due to (systematic) differences between the groups?

Randomized control group design

(Kumar: control group design + random design)

- To filter out the influence of external events (or: extraneous variables): CONTROL GROUP
- To filter out the influence of differences between groups caused by chance

Time		t_1		t_2
Group I	R	O_1	X	O_2
Group II	R	O_3		O_4

t = time of observation
O = observation (of value of dependent variable Y)
X = independent variable
R = randomization

Can you be sure that a change in the value of the dependent variable is caused by X and not by increased awareness after being exposed to the pre-test?

Randomization and matching

(Kumar p. 100)

- Aim: to create equivalent groups
- Randomization
  - research units assigned to the groups by means of a lottery system. (Every unit has an equal and independent chance of becoming part of the experimental or control group)
- Matching is an alternative procedure to create equivalent groups
  - Pairs of subjects are formed on the basis of similarity on one or more variables. One subject is randomly assigned to the experimental group, the other to the control group.

Randomization and matching

When to use randomization and matching:

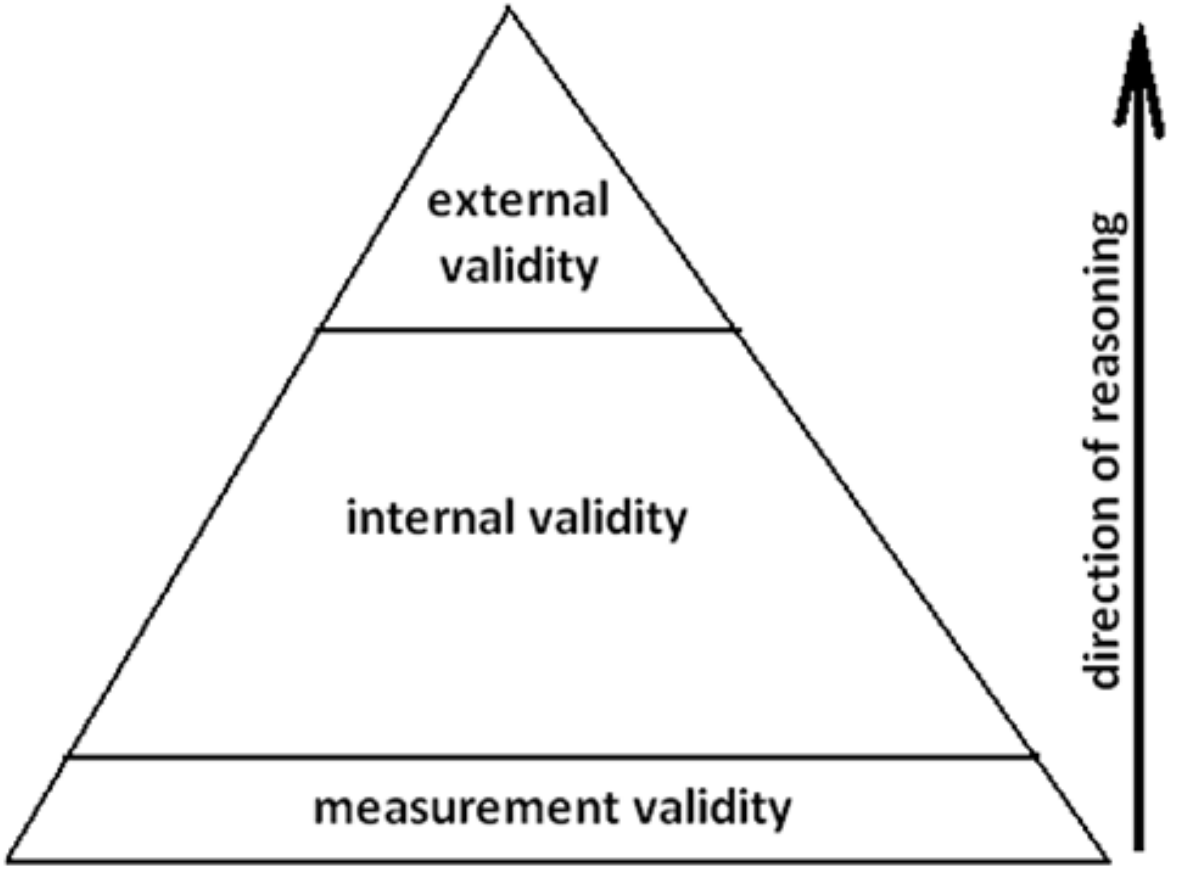
- **Matching**
  - Small N
  - Requires additional measurements of confounding variables (i.e. variables that may effect the cause, the effect, or both)

- **Randomization**
  - Large N
  - No knowledge of possible confounding variables exist

Validity

- Measurement validity
  - Are you measuring what you want to measure?
- Internal validity
  - Within the limits of your research, are the conclusions that you draw correct?
- External validity
  - Can you export your conclusions outside of your research setting?

Validity


external validity
internal validity
measurement validity
direction of reasoning

Validity issues/biases in experiments

- E → Extraneous (not measured) variables
  - External events that occur between pre- and post test (e.g., history)
  - Dealing with people/animals: maturation
- P → Pretest effect
  - Existing situation is changed by taking pretest
  - Learning effect (information in pretest)
  - "Instrument decay"
- P * X → Interaction pre and/or post-test and intervention
  - Learning effect (pretest and intervention combined)

Interaction effect

We speak of an *interaction effect* (statistical term!):

- If the effect of the combination of two variables (or conditions) is larger or smaller than simply the sum of the separate effects.
  - Example: the pre-test and the experimental condition each have their own effects, but exposure to both the pre-test AND the experimental condition renders more effect than only adding up the separate effects.

Solomon Four-Group Design

- To filter out the influence of the pre-test (or: reactive effect) we add two groups which are not exposed to the pre-test

Time		t_1		t_2
Group I	R	O_1	X	O_2
Group II	R	O_3		O_4
Group III	R		X	O_5
Group IV	R			O_6

t = time of observation
O = observation (of value of dependent variable Y)
X = independent variable
R = randomization

THIS IS THE 'ULTIMATE' EXPERIMENTAL DESIGN THAT IS ABLE TO ASSESS THE INFLUENCE OF THE EFFECT OF THE EXPERIMENTAL CONDITION, EXTRANEOUS EVENTS, PRE-TEST EFFECTS AND also INTERACTION EFFECTS!

True experiment

Solomon Four-Group Design

Time		t_1		t_2
Group I	R	O_1	X	O_2
Group II	R	O_3		O_4
Group III	R		X	O_5
Group IV	R			O_6

Underlying idea for dependent observed variable Y:

$$O_2 = O_1 + \Delta(X) + \Delta(P) + \Delta(E) + \Delta(X * P)$$
$$O_4 = O_3 (= O_1) + \Delta(P) + \Delta(E)$$
$$O_5 = O_1 + \Delta(X) + \Delta(E)$$
$$O_6 = O_1 + \Delta(E)$$

Most threats to internal validity can be identified or estimated! But how about interaction of intervention X and external factors $\Delta (X \times E)$?

Validity of an experiment

- Internal validity of an experiment
  - Is change in the independent variable (i.e. the intervention) really the cause of the change in the dependent variable?

- External validity of an experiment
  - Can the conclusions of the research be generalized outside the experimental situation?

Experimental artefacts

Artefacts:

- Experimenter effect (wishful thinking)
  - Different treatment of experimental/control groups, e.g., when the experimental group gets extra attention besides the intervention
- Placebo effect
  - Effect of getting "extra attention"
- People: contagion
  - Effect of experimental and control groups communicating

Possible solutions:

- Blind / double blind

Exercise

- Have a look at your research units and at the (in)dependent variables in your specific research questions.
- Formulate (if necessary: **re**formulate) a specific research question that is suitable for an experimental research design.

N.B.: a research question is only appropriate for an experimental design if it is possible that the researcher manipulates the independent variable!

- What will be the treatment (or the intervention) in your experiment?

Thank YOU

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Questions??