

# Thesis Seminar

## Hypothesis development

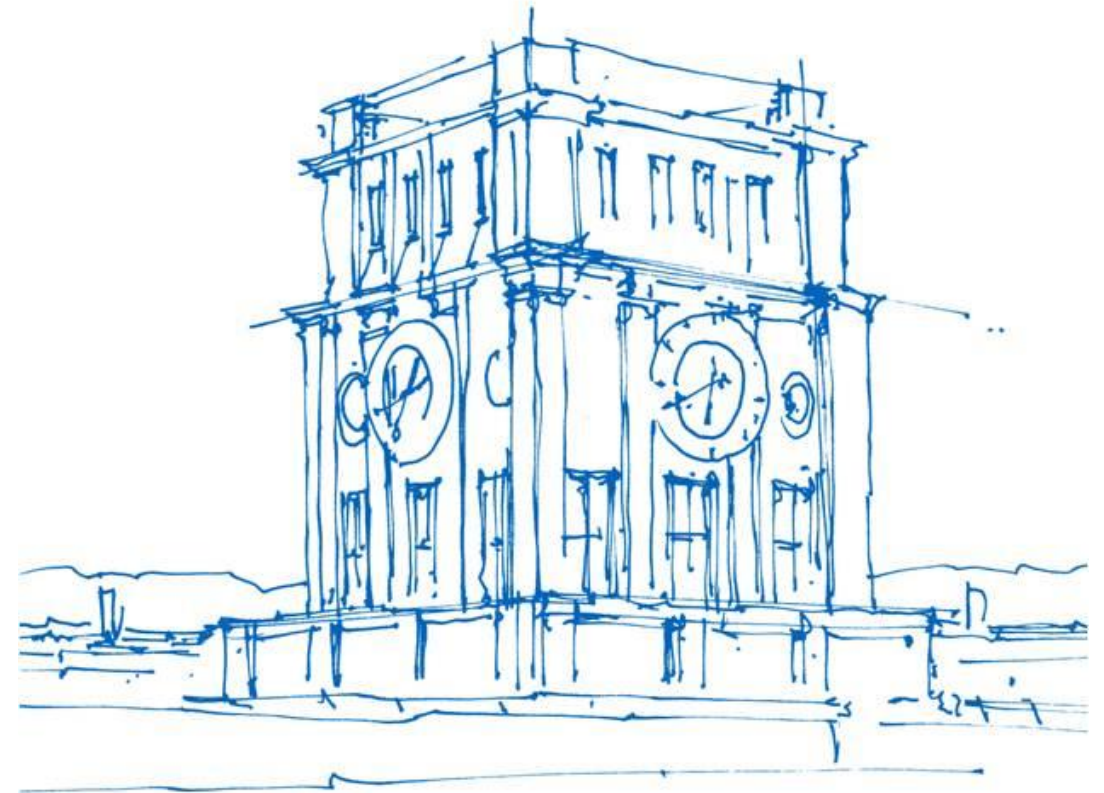
**Dr. Theresa Treffers**

Technical University of Munich

TUM School of Management

Chair for Strategy and Organization

Prof. Dr. Isabell M. Welp



*Uhrenturm der TUM*

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Generating a research topic

(Systematic) literature search – state of research

Identification of research gaps

Formulation of research question

Theory choice

Formulating hypotheses

Planning research design

Pilot study

Data collection

Data analysis

Interpretation of results

Distributing / Communicating results

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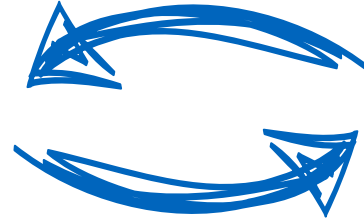
# Hypothesis development



"You are completely free to carry out whatever research you want, so long as you come to these conclusions."

# Deriving your hypotheses

Literature review



Own thinking and  
argument

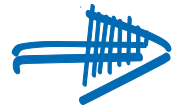


**Theory-based hypotheses**

# What is a (scientific) hypothesis?



# Generating hypotheses



Hypotheses should be **testable and test specific relationships** (conceptual hypotheses not operational)



Hypotheses **should test what they conceptualize** (i.e., operationalized variables should be related to research questions)

# Scientific hypotheses are...

...generally valid assumptions that

- relate to a real-world phenomenon
- derive from a research question
- are not yet tested, but testable
- are falsifiable

 **Hypotheses are assumptions about variables of interest and their relationships (and not always necessary, e.g. explorative approach: how large is x?)**

# Different relationships between variables

## Causal relationship:

Cause-effect relationship: Variable x causes Variable y.

## Correlation:

Variables x and y occur together: if variable x is high (low), variable y is high (low).

## Coincidence:

Variables x and y occur independently.



# Causal Hypotheses



## **Mono causal explanations:**

Changes in the dependent variable of interest are caused by one independent variable.

## **Multicausal explanations:**

Changes in the dependent variable of interest are caused by more than one independent variable.

# Different types of hypotheses

## Difference Hypotheses

Bavarians are smarter than Berliners ;)

## Relational Hypotheses

The more students learn for the exam, the better their grades

## Causal Hypotheses

Physical activity reduces heart attack risk

Existential claims such as "There are students who are always attentive in lectures" are very difficult to refute because it is impossible to study all the students everywhere

Can-claims, such as "In case of heavy cigarette consumption can cause a heart attack" is also not falsifiable. Every possible event, whether a smoker gets an infarct or not, agrees with the Can clause. The sentence is always true and tautological

## Differences

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There is a difference of at least two groups in one or more independent variables.

 Group 1 is different than group 2 in variable X.

Hypothesis testing through analyzing means and variances.

## Relation

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There is a relation between at least two variables.

 The higher variable x, the higher (lower) variable y.

Hypothesis testing through (correlation and) regression analysis.

# How is a scientific hypothesis transformed into a statistical hypothesis?



# Statistical Hypotheses

A scientific hypothesis is transformed into a statistical hypothesis by expressing the assumption in quantitative terms.

## Statistical hypotheses are statements of probability:

- They are not falsifiable through single cases (probability models allow the probability of error).
- They cannot be verified or proofed, as ALL existent cases would need to be included

Hypothesis testing requires test criteria (for example, statistical significance).

# (Un)directed and (un)specific hypotheses

- Undirected hypotheses only assert the existence of any difference or relationship. Important for significance check(s)
- Example of a directed hypothesis: "If people are taught with Method A, they will show better learning performance than people who are taught by Method B."
- Nonspecific hypotheses do not say anything about the size of the alleged difference, whereas specific hypotheses specify the size.
- Example of a specific (and directed) hypothesis: "If people are taught with Method A, they will achieve at least a 20% better learning performance than people who are taught according to Method B." (Practical meaning, only possible with known effect sizes)

# Example 1

**Research question:** Do unit leaders differ from department leaders in their job satisfaction?

## To be defined:

- Theoretical background
- What is job satisfaction → construct
- How can you measure job satisfaction → construct operationalization

## Statistical hypothesis:

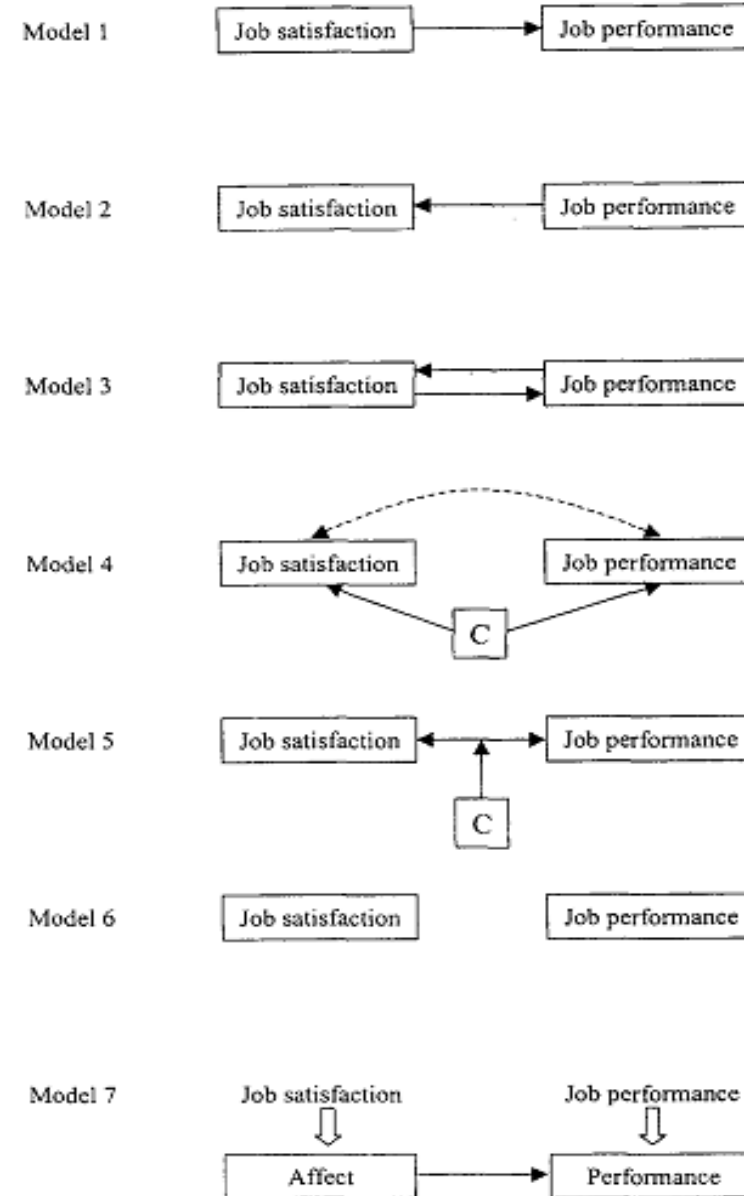
**Null hypothesis** (equality): There is no difference between unit leaders and department leaders in their job satisfaction.

**Alternative hypothesis** (assumption to be tested): There is a difference between unit leaders and department leaders in their job satisfaction.

The goal of an empirical study is **testing the probability of these two hypotheses** and which hypothesis can be provisionally accepted or rejected.

# Example 2

- At least 7 models to describe the relationship between employee satisfaction and their job performance
- There is evidence for all models, none is empirically supported or rejected
- Model 6 has the lowest evidence
- A meta-analysis over  $k = 321$  correlation coefficients ( $N_{ges} = 54471$ ) shows an average correlation between employee work satisfaction and their job performance  $r = .30$ .





# Hypotheses formulation

## The information content of a hypothesis generally increases with the number of falsification options!

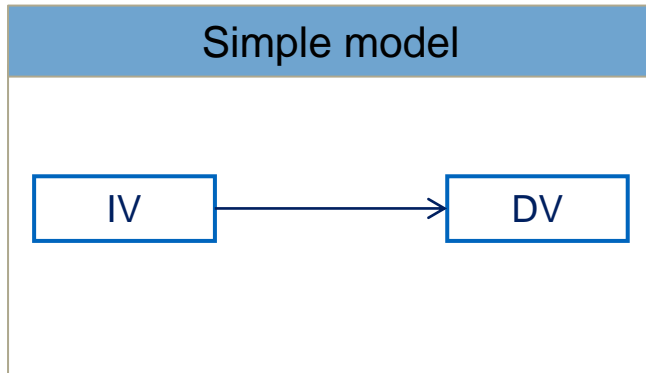
The information content of a hypothesis increases with a generalisation of the **If Components** (independent variables)

- If the supervisor praises his employees in public, they will work differently.
- If any company member praises employees in public, they will work differently.
- If anyone praises employees in public, they will work differently.

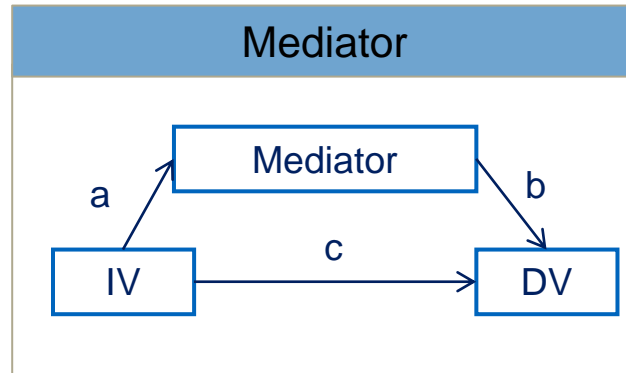
The information content of a hypothesis increases with a specification of the **Then Components** (dependent variables)

- If the supervisor praises his employees in public, then they will work differently.
- If the supervisor praises his employees in public, then they will work harder.
- If the supervisor praises his employees in public, then they will work 35% harder.

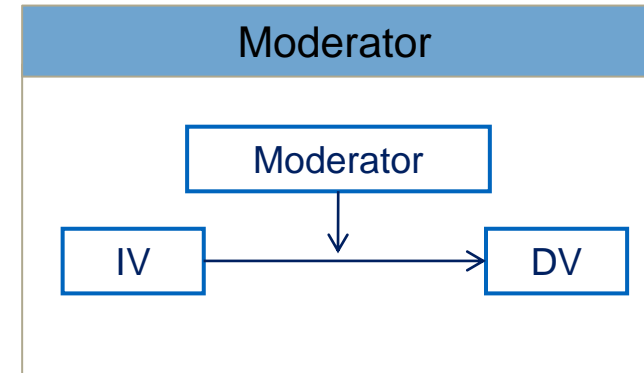
# Different types of research models



IV influences DV



Are there third variables through which the IV influences the DV?



Are there third variables that qualify the relationship between IV and DV?