

Research Methods: Study Design and Validity

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Learning Goals

- Understand
 - Four fundamental concerns in the design of research studies: Sampling, Measurement, Design, and Analysis
 - The concept of validity and how decisions in study design relate to different types of validity
- Be able to
 - Approach the design of research studies in a structured manner
 - Analyse the design of research studies and discuss potential threats to validity

Study design

- We know now about different research methods from which we can choose in accordance with the questions we have
- But what decisions do we face for the detailed design of a study?
 - Who or what do we study? Who or what do we include?
 - What data do we collect about them, and how?
 - What is the structure and procedure for the study?
 - How will the collected data be analysed and interpreted?

Study design

Concern	Decisions to make
Sampling	Who/what do we study: what is the “unit of analysis”? How will individual units be selected from a population of interest?
Measurement	What measures will be used? What data will be collected for each of the individuals studied, and how?
Design	What is the structure, procedure or protocol for the study and for generating data?
Analysis	How will the data be analysed?

Sampling

- Selecting units from a population of interest
 - To then study the *sample*
 - e.g. participants for a usability study of a user interface
 - e.g. consumer products to study inflation rate
- Theoretical population: who/what do we want to generalise to?
- Study population: what population can you get access to
- Sampling frame: how do you pick from them
- Sample: who/what is participating in your study

Sampling Methods

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- Probabilistic sampling
 - Maximise chances that the sample will be representative
 - Random, systematic, stratified
 - Required sample size can be calculated from target population size, accuracy range and confidence level
 - Purposive sampling (hand-picked)
 - Increase chances that you have 'interesting' samples
 - Convenience sampling
 - Pragmatic choice; might still want to balance to avoid skew
 - e.g. male/female; expert/non-expert (depends on study goals ...)

Sample size: Examples

- 60 out of 70 (85% of population) in this class would have to respond to a survey, to give us 95% confidence that responses are representative, allowing for 5% error
- Would only need 373 responses of 12,000 students (3%) to make a campus-wide survey representative



Sample Size Calculator

How many people do you need to take your survey? Even if you're a statistician, determining sample size can be tough. To make it easy, try our sample size calculator. We give you everything you need to calculate how many responses you need to be confident in your results.

Calculate Your Sample Size:

Population Size:	<input type="text" value="70"/>
Confidence Level (%):	<input type="text" value="95"/>
Margin of Error (%):	<input type="text" value="5"/>

CALCULATE

Sample Size:

60



Sample Size Calculator

How many people do you need to take your survey? Even if you're a statistician, determining sample size can be tough. To make it easy, try our sample size calculator. We give you everything you need to calculate how many responses you need to be confident in your results.

Calculate Your Sample Size:

Population Size:	<input type="text" value="12000"/>
Confidence Level (%):	<input type="text" value="95"/>
Margin of Error (%):	<input type="text" value="5"/>

CALCULATE

Sample Size:

373

Measurement / Data Collection

- Process of making and recording observations
- Implementation of measures, or some means for taking measurements (e.g. questionnaire)
- Levels of measurement
 - Nominal/Categorical, Ordinal, Interval, Ratio data
 - Implies different ways in which data can be analysed
 - what statistics can be used

In-your-Head vs. in-the-World

- In research, it helps to clearly separate
 - what's in your head (theoretical)
 - what's in the world (observable)
- Research starts in your head ...
 - Ideas, constructs and propositions
- but is carried out in the world
 - Variables that can be observed and measured



Measurement: Operationalisation

- Process of translating theoretical constructs (in-your-head) into manifestations that can be manipulated and/or observed (in-the-world)
 - Choosing variables/measurements that represent constructs
- Example: study of social network edge prediction
 - Proposition: people who talk about the same topics connect to each other
 - How can we measure 'people who talk about the same topics'?
 - Derive keyword distributions for each user
 - Calculate the similarity between users' distributions

Design / Procedure

- Are the participants/units grouped?
 - Within-subjects design: same group of users given same treatment
 - Between-subjects design: users/units are split into groups
- What treatment is given and how?
 - What are participants asked to do?
 - What information are they given?
 - What is the study protocol – sequence of events and timing
- What is the setup? What apparatus is used? What are the conditions?
- How are variables manipulated, controlled and observed? How is data recorded?

Analysis

- Analysis covers how the researchers look at the data
 - Any qualitative analysis (e.g. identifying categories)
 - Any statistical analysis
- And what they make of the data
 - How they interpret the data in discussion
 - How they reason about the results
 - Conclusions they draw
 - Claims they make

In-your-Head vs. in-the-World

- Research starts in your head
 - Ideas, constructs and propositions (theoretical)
- It gets carried out in the world
 - Variables that can be measured (observable)
 - Hypotheses that can be tested (relationships between variables)
- The results are interpreted in the researcher's head
 - Drawing conclusions
 - Making claims about the research outcome
- How much can we trust those claims to be *valid*?



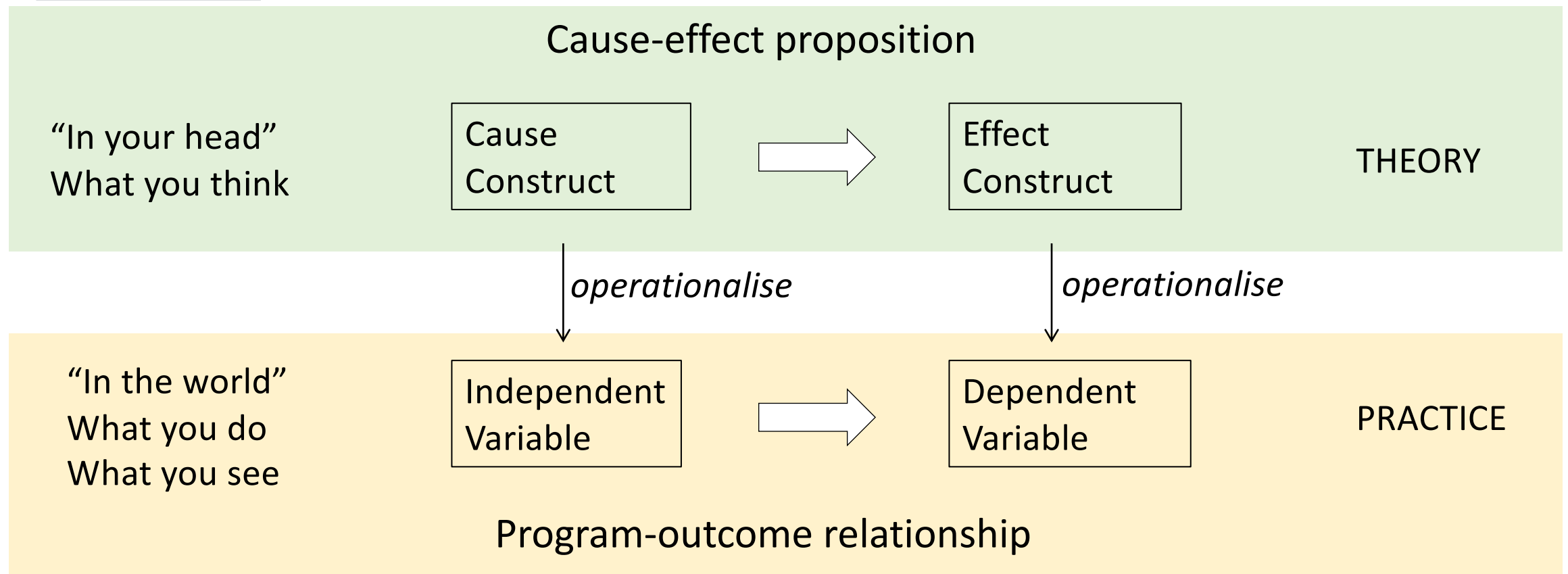
Validity

- Something is valid if it “has a sound basis”
- In empirical research, we are concerned with the validity of statements (propositions), inferences and conclusions
- In closed formal systems, we can provide proves
- In empirical research, we can only reason about how valid a statement is, given the observations on which they are based.
- Validity as “best available approximation of truth”

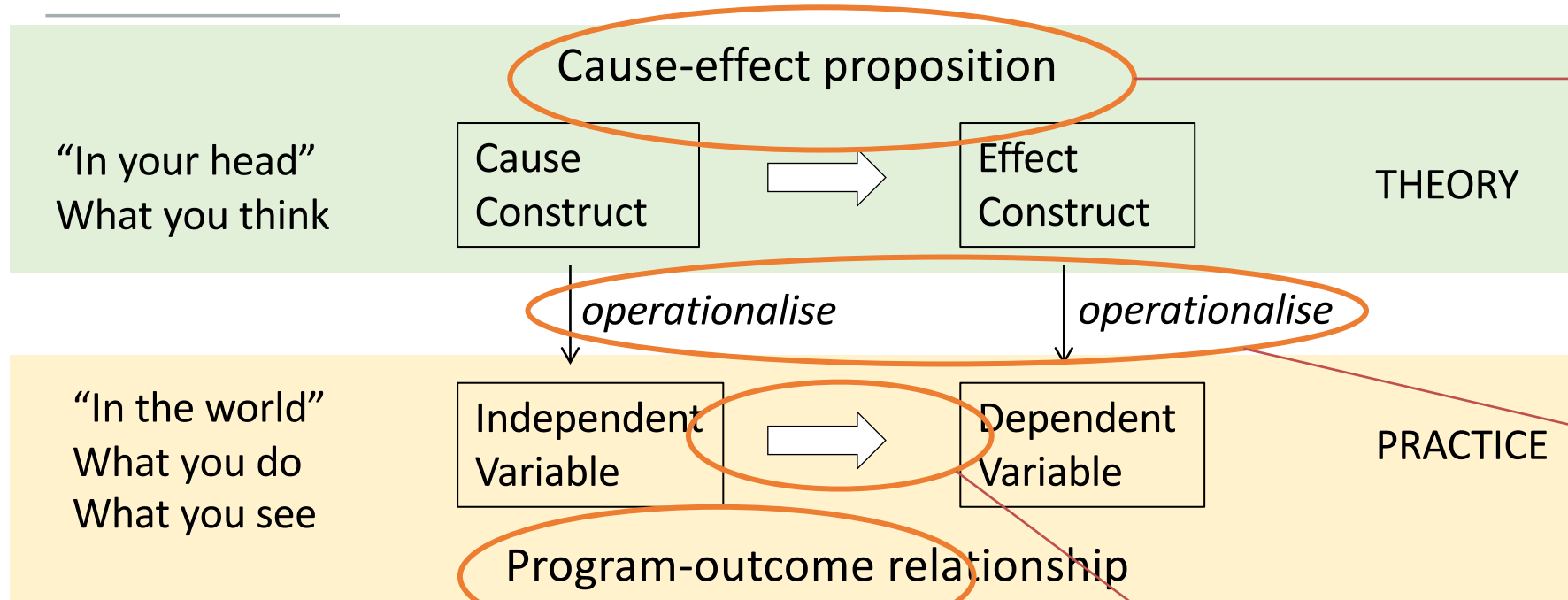
Threats to validity

- Factors that put validity in question
- What could these be?
- What might cast doubt about research results, or claims made?

Operationalisation



Types of validity



External validity: can we generalise to other people, places, times?

Construct validity: can we generalise to the constructs? (do our measures reflect our ideas)

Conclusion validity: is there a relationship between the variables?
Are claims made about this justified?

Internal validity: is the relationship causal?
(or might there a confounding factor?) Are claims made about causes/effects justified?

The Yin and the Yang of Research

External Validity ↔ **Sampling**

Construct Validity ↔ **Measurement**

Internal Validity ↔ **Design**

Conclusion Validity ↔ **Analysis**

- Decisions in study design and how they relate to types of validity

Threats to validity

- Studies always have limitations
 - It is important to understand how they may affect validity

External Validity ↔ **Sampling**

Limitations to generalisability

Construct Validity ↔ **Measurement**

Limitations in how well the data captures the issue

Internal Validity ↔ **Design**

Limitations in the design that may skew outcomes

Conclusion Validity ↔ **Analysis**

Limitations in analysis and interpretation

Reading Assignment and Quiz

- Reading / Quiz: Trochim's Knowledgebase
 - Sampling -> External Validity
 - Sampling -> Sampling Terminology
 - Measurement -> Construct Validity -> Idea of Construct Validity
 - Measurement -> Reliability -> Reliability & Validity
 - Measurement -> Levels of Measurement
 - Design -> Internal Validity
 - Design -> Internal Validity -> Establishing Cause and Effect
 - Analysis
 - Analysis -> Conclusion Validity

Study Design and Validity – Key Points

- Decisions in study design
 - Sampling, Measurement, Design, Analysis
- Validity of outcomes
 - External, construct, internal and conclusion validity
- Studies are never perfect
 - Understanding limitations