

Welcome

Session 2: Designing good research

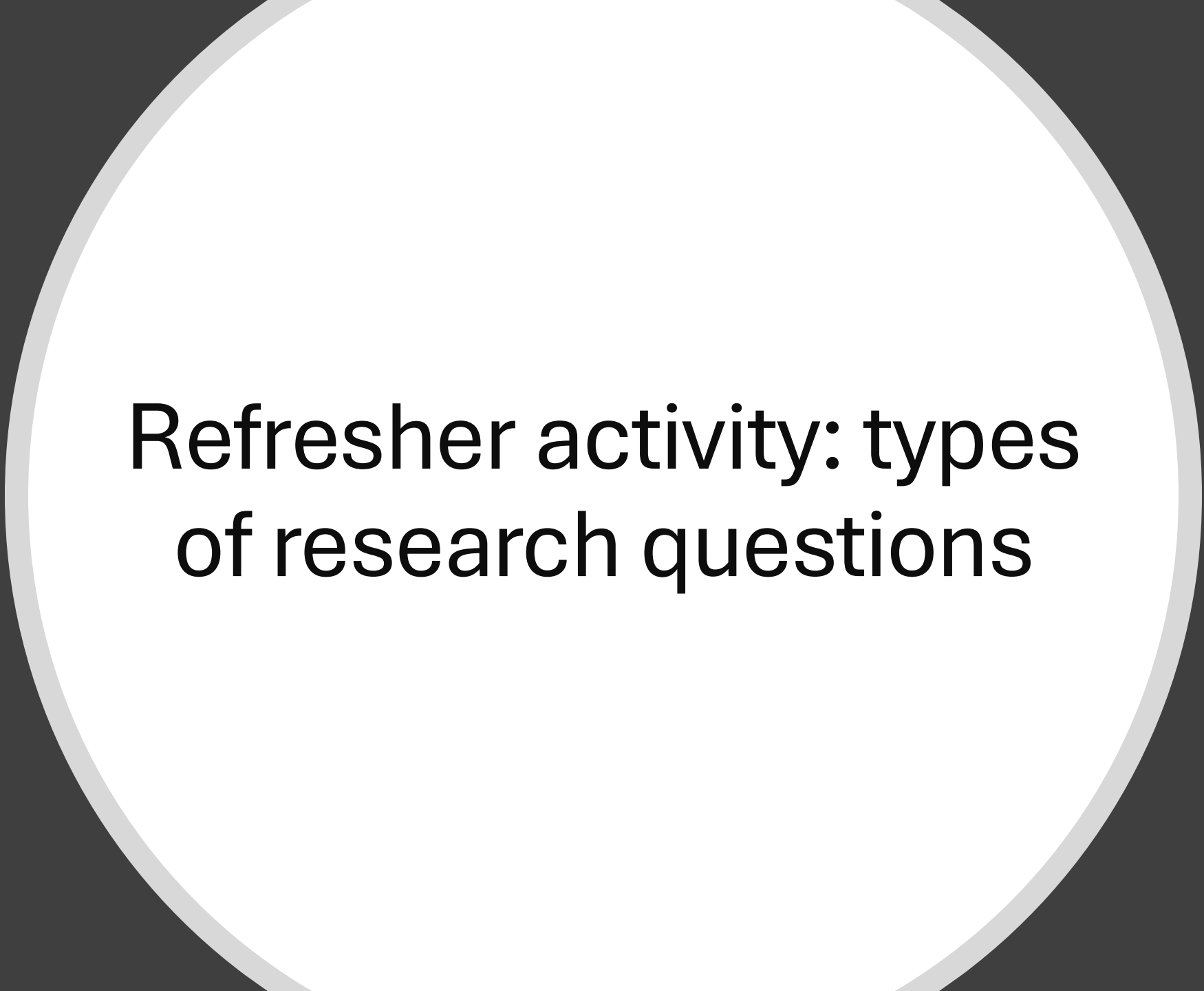


Today's plan

Refresher activity: types of research questions

The assumptions underlying production of knowledge

Three key ideas of good research design: measurement, population & analysis



Refresher activity: types of research questions

Research Briefing | Published: 27 June 2025

People lived high in the mountains in Australia during the last ice age

[Nature Human Behaviour](#) (2025) | [Cite this article](#)

98 Accesses | [Metrics](#)

New archaeological results from the oldest Pleistocene site yet to be identified in high-altitude Australia indicate that human occupation began about 20,000 years ago, during the peak of the last glacial maximum. This site – Dargan Shelter – provides evidence of repeated human movement through and adaption to a periglacial environment in Australia.

A: description because this title seems to be describing where humans lived during a particular period;

It is not interested in the causal effect of one variable on another or predicting one variable from another or intervening.

[nature](#) > [nature human behaviour](#) > [research briefing](#) > article

Research Briefing | Published: 11 June 2025

Online quiz game builds bridges between members of opposite parties

[Nature Human Behaviour](#) (2025) | [Cite this article](#)

135 Accesses | [Metrics](#)

A cooperative online quiz game called Tango reduced partisan animosity, improved democracy-related attitudes and was rated as highly enjoyable by participants. The effects of the quiz game were durable and persisted up to four months, and they were similar for Republican and Democrat players.

A: intervention because this title seems to be describing an activity (an online quiz game) that is aimed to improve something (e.g. perhaps friendliness) between two groups

[nature](#) > [nature human behaviour](#) > [correspondence](#) > article

Correspondence | Published: 22 July 2025

How the four-day working week could affect health

[Sotiris Vandaloros](#) , [Pedro P Barros](#), [Jolene Skordis](#), [Brendan Burchell](#), [Rita Fontinha](#) & [Pedro Gomes](#)

[Nature Human Behaviour](#) (2025) | [Cite this article](#)

23 Altmetric | [Metrics](#)

Evidence suggests that a four-day working week may have positive economic effects. Now it is time to examine the likely effects on public health.

A: explanation because this title seems to be interested in the causal impact of the 4-day work week on health. It is not describing because it is trying to understand a causal impact between two variables that is not observed – you can't "see" how having a 4 day work week will impact health. A describing question would be "Which countries have a 4-day work week currently & what are their rates of depression?"

[nature](#) > [scientific reports](#) > [articles](#) > article

Article | [Open access](#) | Published: 14 July 2025

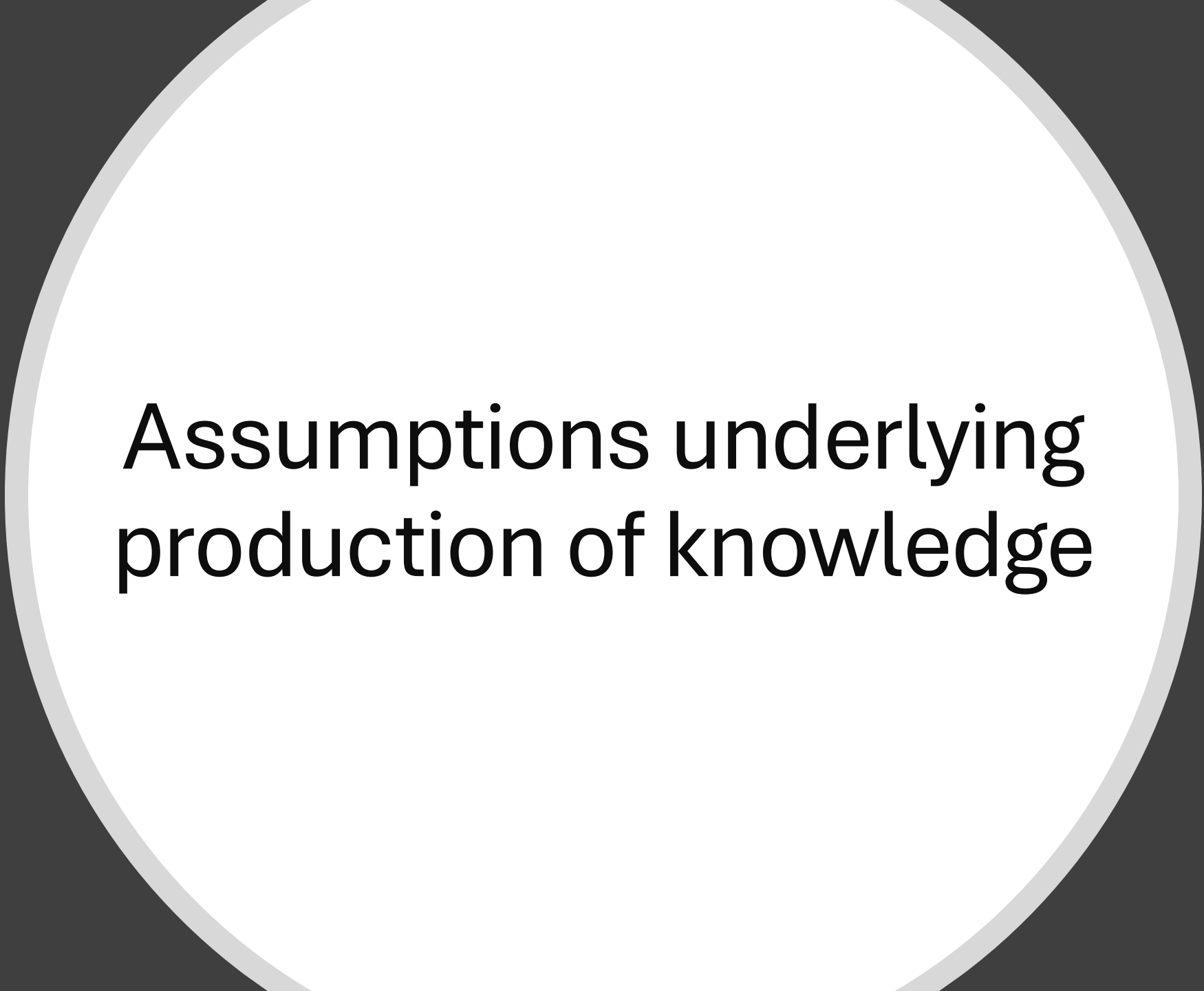
How to predict early mortality in patients with metastatic melanoma

[Qiusheng Guo](#), [Xianmei Lv](#), [Zengpai Zheng](#) ✉ & [Gaochen Lan](#) ✉

[Scientific Reports](#) **15**, Article number: 25395 (2025) | [Cite this article](#)

645 Accesses | [Metrics](#)

A: predicting because this title seems to be trying to predict something (risk of death) in patients with cancer. It is not explaining because the use of the word predict signals that not all variables will CAUSE death (e.g., gender could predict early death because of lower access to healthcare but gender does not CAUSE early death)



Assumptions underlying
production of knowledge

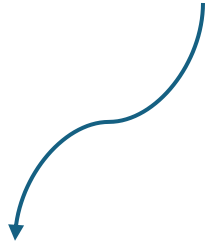
What assumptions do these methods make?

Research Question	Proposed Method
Which personality traits make an individual pursue a helping profession?	Interview people who are in a helping profession to ask them what they think
How many women experience depression and anxiety during their pregnancy in India?	Use standardized questionnaires with pregnant women in India to measure depression & anxiety
Do self-compassion programs improve the psychological wellbeing of Indian IT employees?	Conduct brain scans of people pre and post the self-compassion program to note changes
How does childhood trauma cause mental health problems in later life?	Observe some people with & without childhood trauma for many years & see if the group with childhood trauma develops mental health problems

Research Question	Proposed Method	Assumption
Which personality traits make an individual pursue a helping profession?	Interview people who are in a helping profession to ask them what they think	That people can accurately & without bias report their own personality traits
How many women experience depression and anxiety during their pregnancy in India?	Use standardized questionnaires with pregnant women in 4 cities of India to measure depression & anxiety	That a standardized questionnaire can capture everyone's experience of depression or anxiety in the same way That 4 cities of India capture a representative sample for India
Do self-compassion programs improve the psychological wellbeing of Indian IT employees?	Conduct brain scans of people pre and post the self-compassion program to note changes	That brain scans will accurately reflect changes in wellbeing
How does childhood trauma cause mental health problems in later life?	Observe some people with childhood trauma for many years & see if they develop mental health problems	That people without childhood trauma have not developed mental health problems (no control group)

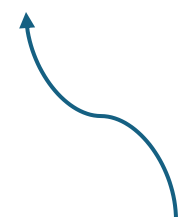
All research assumes an
underlying idea of how knowledge
is produced

There is an objective cause-and-effect or a truth that we are aiming to find out



*Does exposure to violent video games **increase** aggressive behavior in teenagers?*

*How do teenagers **experience** the impact of violent video games on their behavior?*



Teenagers' experience can be subjective and those subjective experiences are what we are interested in and what matters. We do not believe that there is a "cause" that is invisible to them.



Three key ideas of good research design

Supposing my research question is “How many people aged 20-30 have depression in India?” and I use a standardized questionnaire with 7 items to measure depression, what are the assumptions I am making?



Assumptions about measurement

- A set of 7 questions with limited ratings can adequately measure the construct of “depression”
- That all people are able to self-report adequately and in the same way e.g. same understanding of language, same rating styles

Measurement

*Whether the method you're using
adequately measures the
construct you're interested in*

A photograph of a doctor in a white lab coat and stethoscope measuring a patient's blood pressure. The doctor is on the right, leaning over the patient on the left. The patient is wearing a light blue shirt and has a blood pressure cuff on his arm. The background shows a clinical setting with shelves of medical supplies and a clock on the wall. The text "Even things that are seemingly simple to measure are not that simple..." is overlaid on the left side of the image.

Even things that
are seemingly
simple to
measure are not
that simple...

Depression

Violence

Poverty

*It's even trickier when we measure
abstract and/or complex concepts
like we often do in mental health or
social science*

Trauma

Good health

Quality of life

Measurement: which method?

Brain scans

Structured interviews

Biological material measures
e.g. levels of inflammation

Observation by independent observer

Questionnaires

Participant observation

Semi-structured interviews

Ecological momentary assessment

Experimental measures

Supposing my research question is “How many people aged 20-30 have depression in India?” and I send my questionnaire to 1000 people whom I know in Mumbai and Delhi, what are the assumptions I’m making?



Assumptions about representativeness

- Because we will almost never be able to measure the entire population, we take a sample
- Population of India = 1.3 billion
- My sample = 1000
- I am assuming that my sample is representative of the population

Inference or statistical generalizability

Whether you can infer from your sample to your population of interest (“generalize”).



Image created by DALL-E

Inference: key statistical concept

Average depression score in my sample of 1000 people	Average depression score in India
19	???

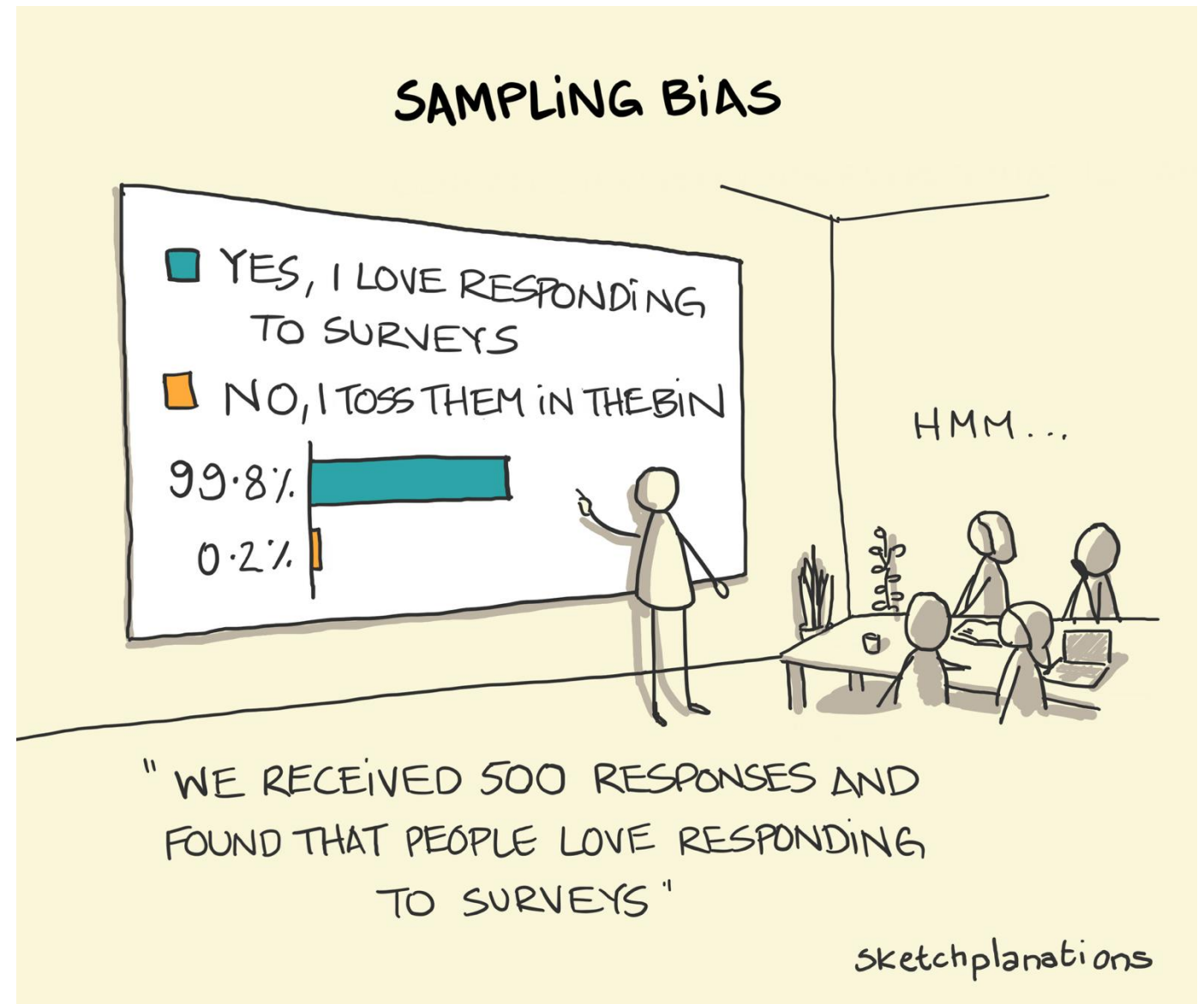
This is a statistic

This is a parameter

This acts as an estimate
of a parameter or a
“parameter estimate”

We put confidence intervals to indicate the
uncertainty of the estimate

Sampling bias



Choosing a representative sample

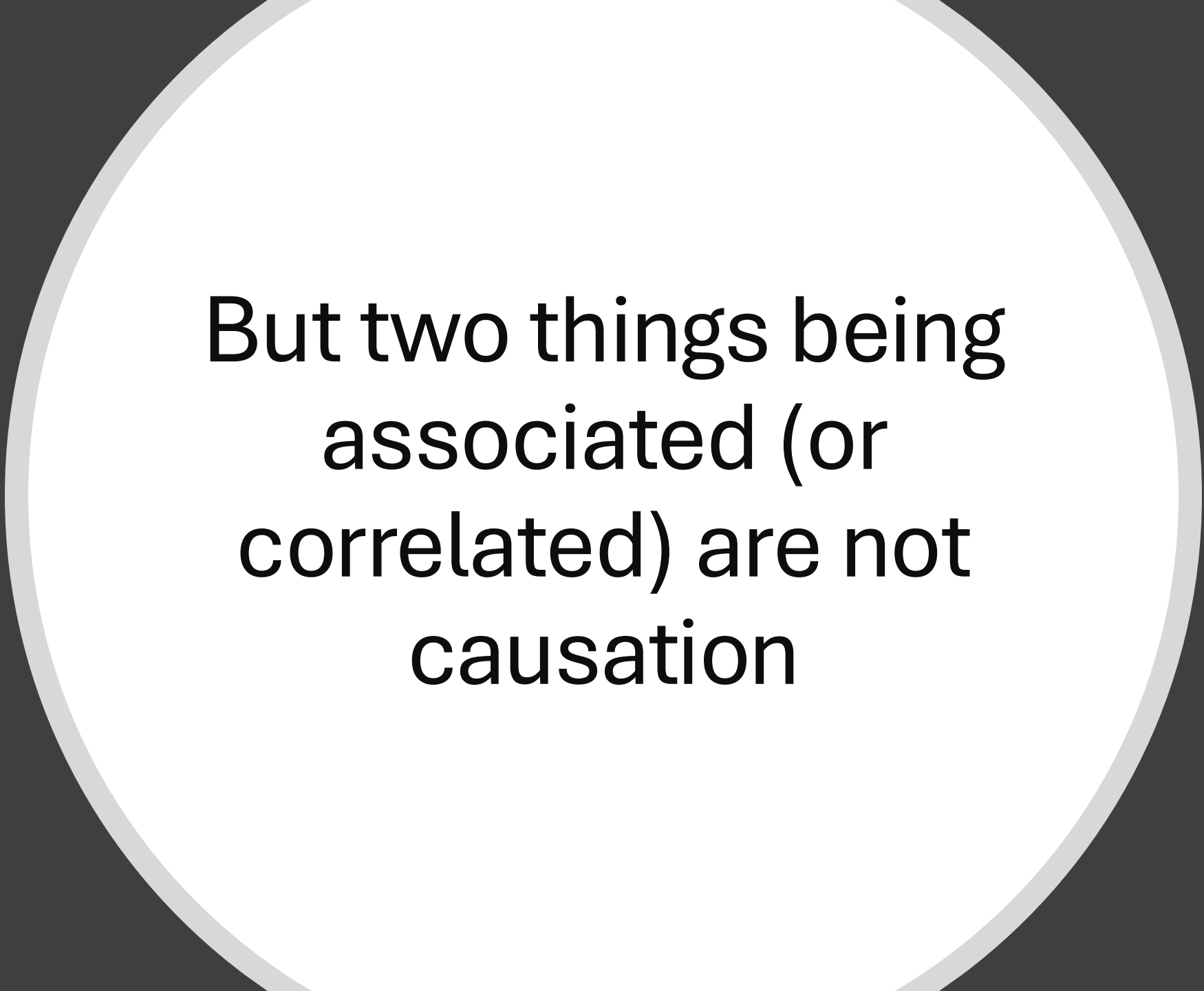
- “Representative” in terms of: age, sex, gender, SES, ethnicity, sexual orientation, disability
 - (1) To measure depression, I must sample adequately from different strata who may vary in depression rates (*if women have exactly the same experience of depression as men, then it does not matter even if I sample a 1000 men....but they don't!*)
 - (2) But this changes if your research question is more focused i.e. you have said you only want to measure depression rates in women
- Big cohort studies may use “random” sampling to achieve representative sampling: random dialling; using census records

Supposing my research question is “Does smoking cause depression?” and I find out that people who smoke are more likely to be depressed than people who don’t smoke. Can I conclude that smoking causes depression?

In quantitative research the idea of causality is important.

We want to find out the cause of something so we can address it.

Or we want to find out if a treatment works (“causally” leads to positive outcome)

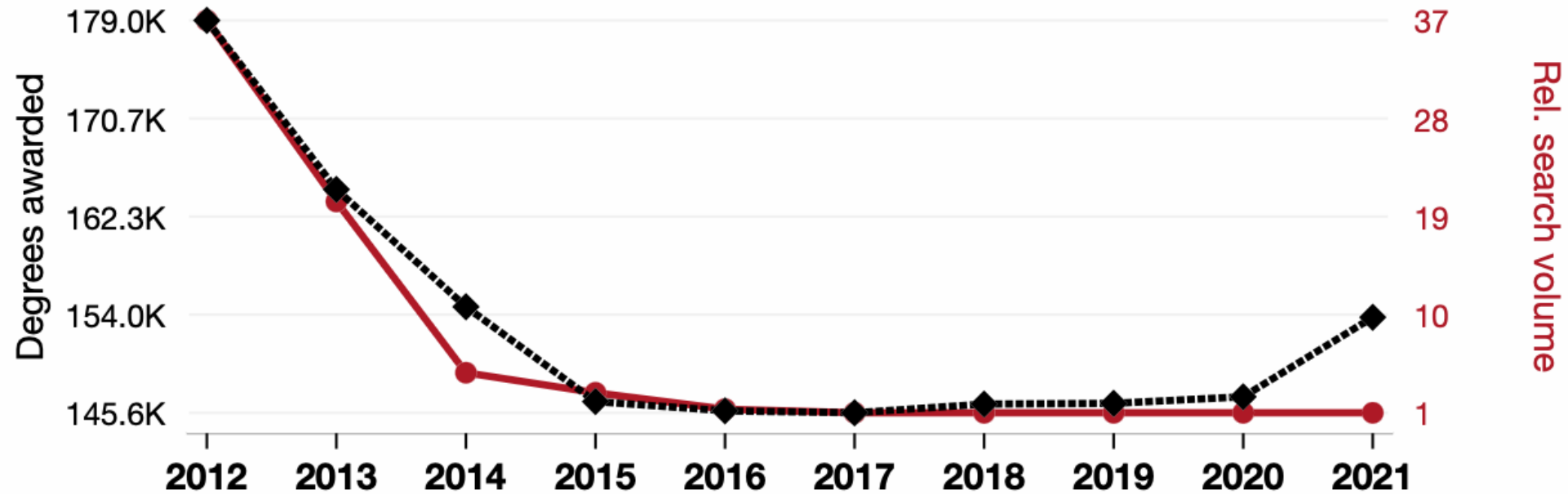


But two things being
associated (or
correlated) are not
causation

Master's degrees awarded in Education

correlates with

Google searches for 'Gangnam Style'



◆ Master's degrees conferred by postsecondary institutions in Education · Source: National Center for Education Statistics

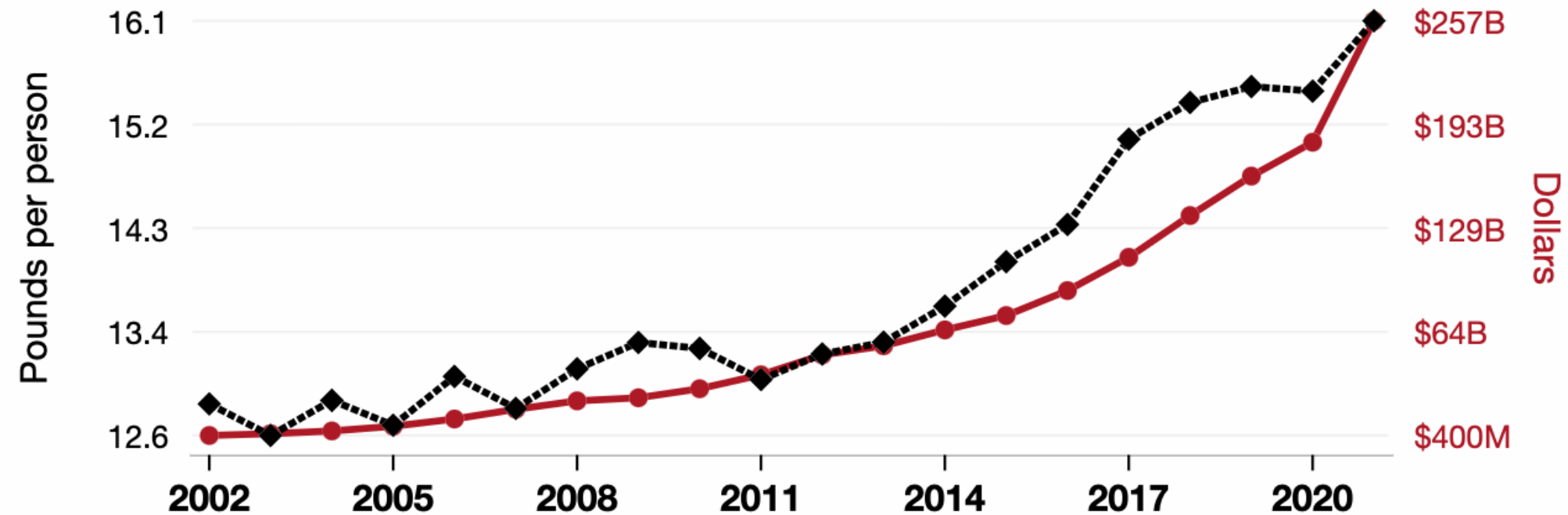
● Relative volume of Google searches for 'Gangnam Style' (Worldwide, without quotes) · Source: Google Trends

2012-2021, $r=0.967$, $r^2=0.935$, $p<0.01$ · tylervigen.com/spurious/correlation/2163

American cheese consumption

correlates with

Google's Annual Global Revenue



◆ Per capita consumption of American cheese in the US · Source: USDA

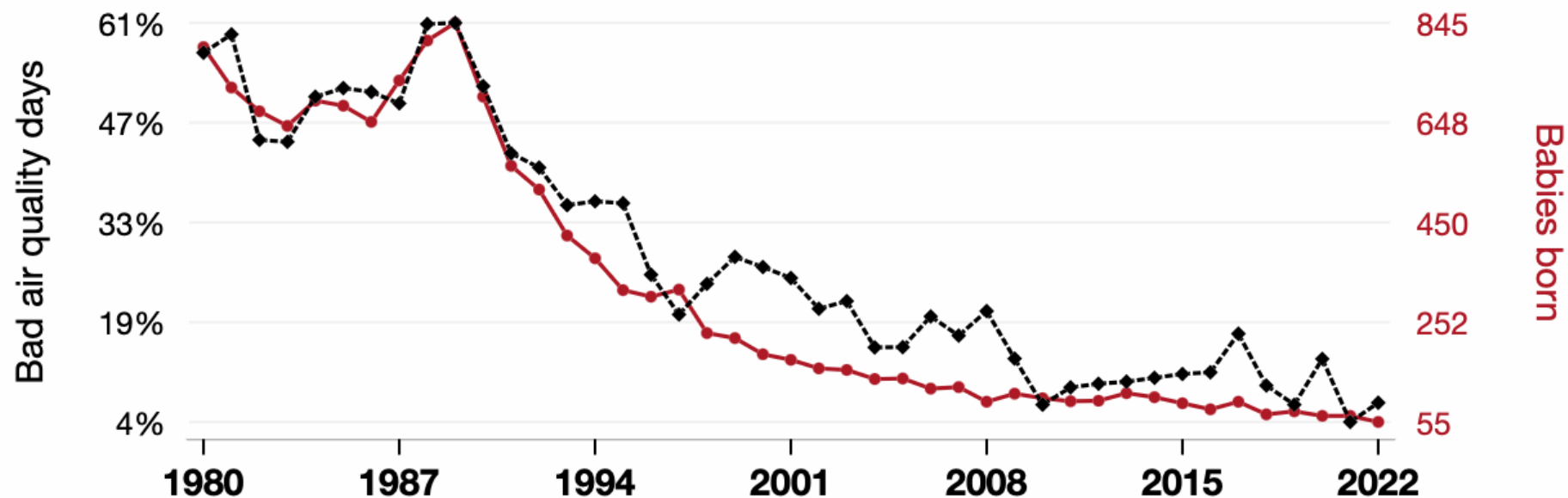
● Google's Annual Global Revenue · Source: Statista

2002-2021, $r=0.964$, $r^2=0.929$, $p<0.01$ · tylervigen.com/spurious/correlation/1199

Air pollution in San Diego, California

correlates with

Popularity of the first name Kirk



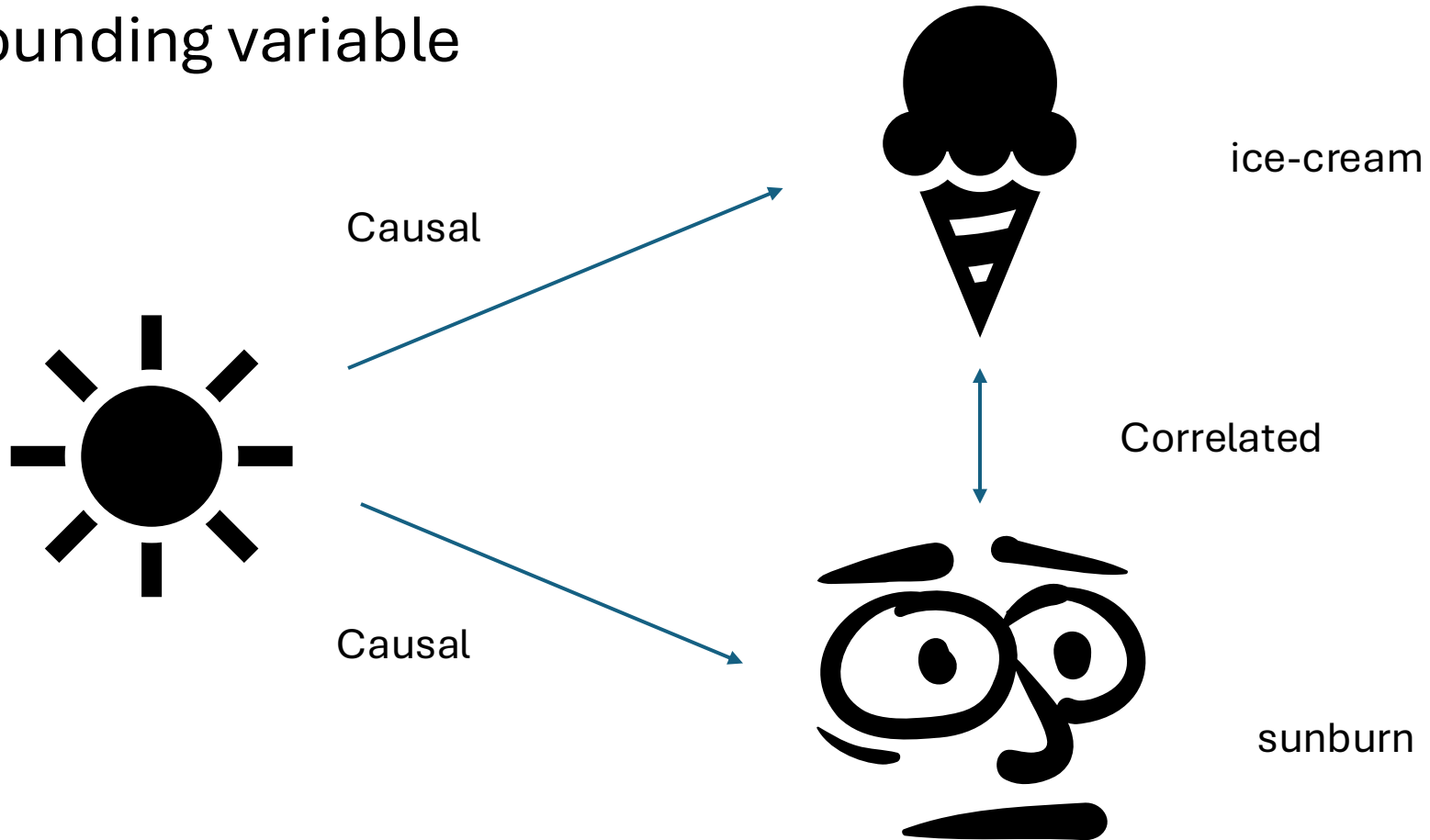
◆--- Percentage of days with air quality at 'unhealthy for sensitive groups' or worse in San Diego-Carlsbad, CA · Source: Environmental Protection Agency

●— Babies of all sexes born in the US named Kirk · Source: US Social Security Administration

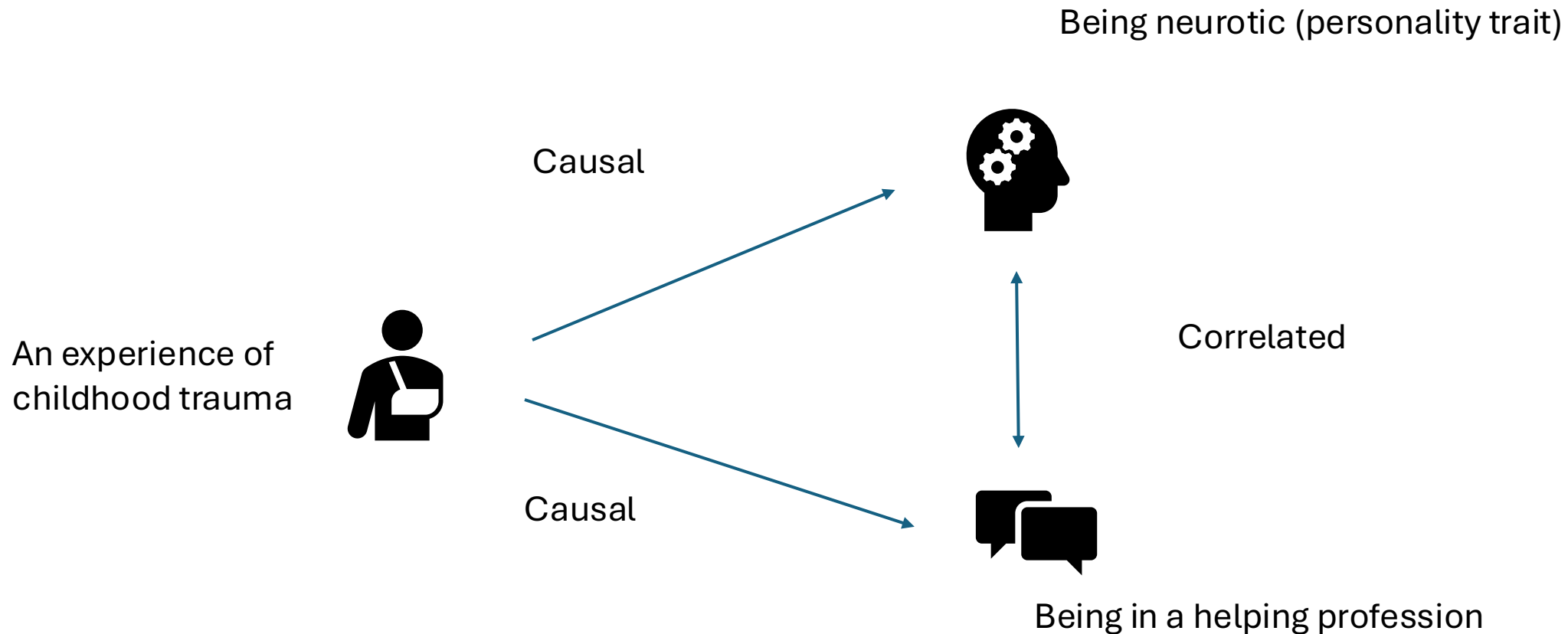
1980-2022, $r=0.972$, $r^2=0.945$, $p<0.01$ · tylervigen.com/spurious/correlation/5949

Why might two constructs be correlated?

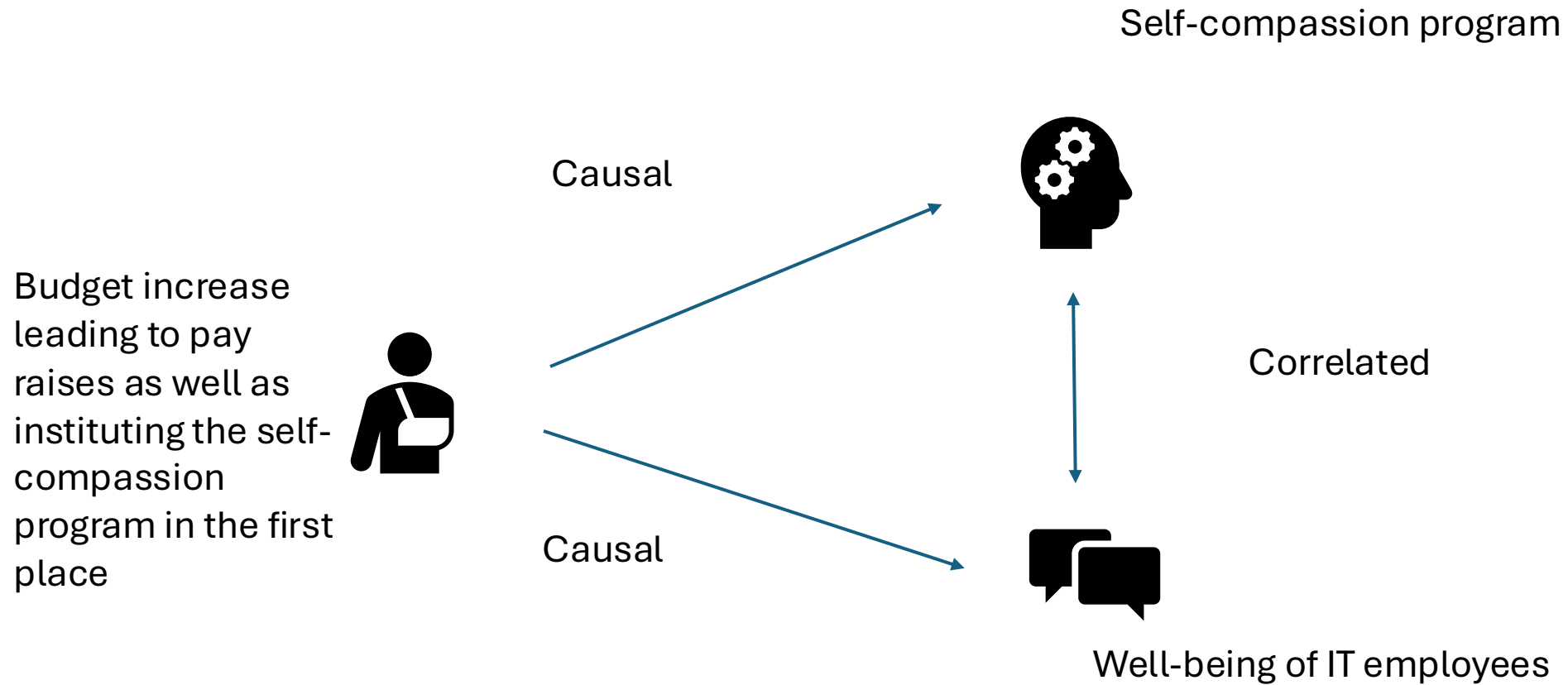
- Random chance
- Confounding variable



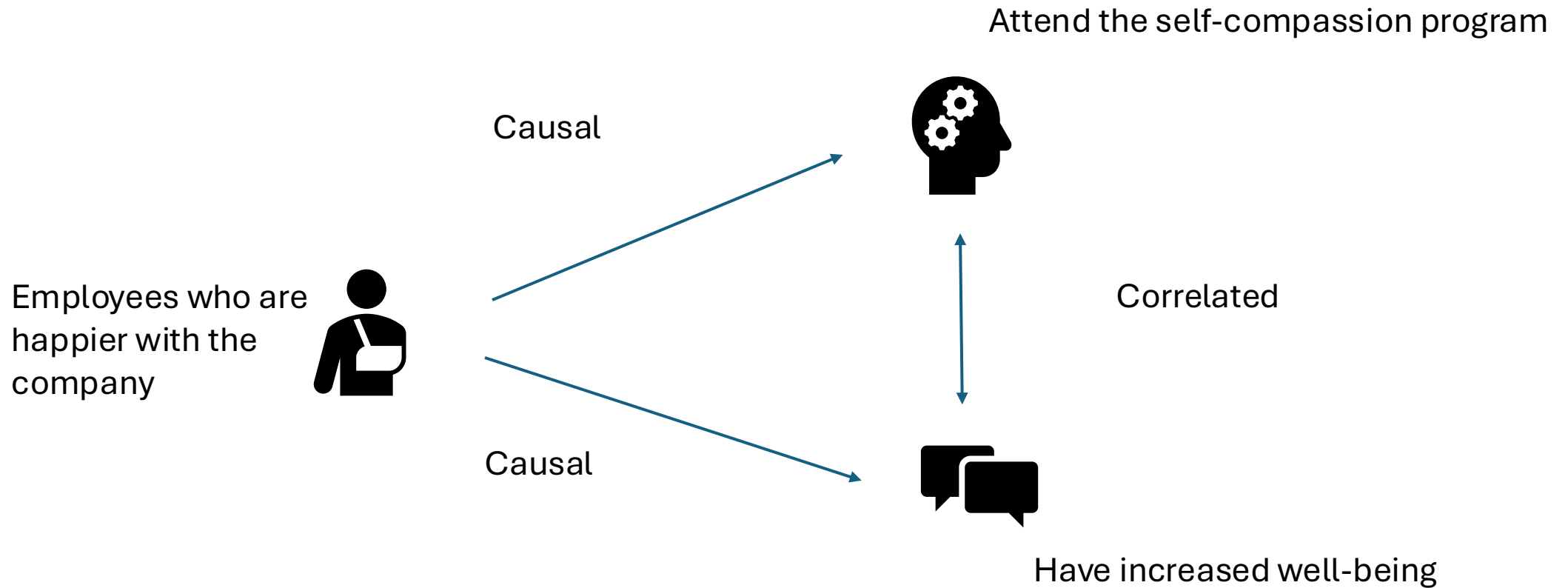
Why might two constructs be correlated?



Why might two constructs be correlated?



Why might two constructs be correlated?



If we are interested in anything causal, good analysis requires us to think of “confounders”

Now let's put it into practice

1. Measurement

- Think of the key constructs you are interested in measuring in your research question

1. Measurement

- Which method is aligned to which construct (that you want to measure)?

2. Population

- Whom do you want the findings to be applicable to? (your population)
- Whom will you actually be able to access? (your sample)

2. Population

- How will you maximize correct inference? (“representativeness”)

3. Analysis

- Does your research question have any causal element?

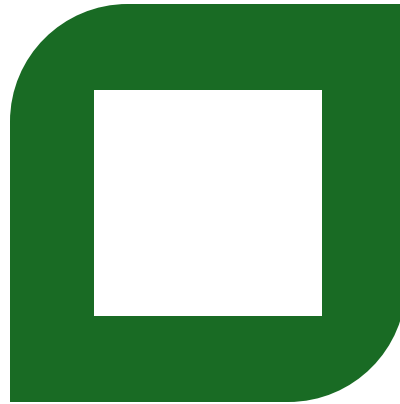
3. Analysis

- What are the key confounders for the relationship you are interested in?

Good research design involves caring about:



MEASUREMENT



POPULATION



ANALYSIS

Next session

In the break, think about which method you would like to use to answer your research question

How you will measure

How you will ensure a representative sample

Are you looking for causality and if yes, how will you ensure this?



Write down your thoughts on these three aspects of research design



We will think about maintaining good research standards



Further
questions/feedback