CONSTRUCTOR UNIVERSITY

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Causal Inference and Quasi-Experimental Research Designs

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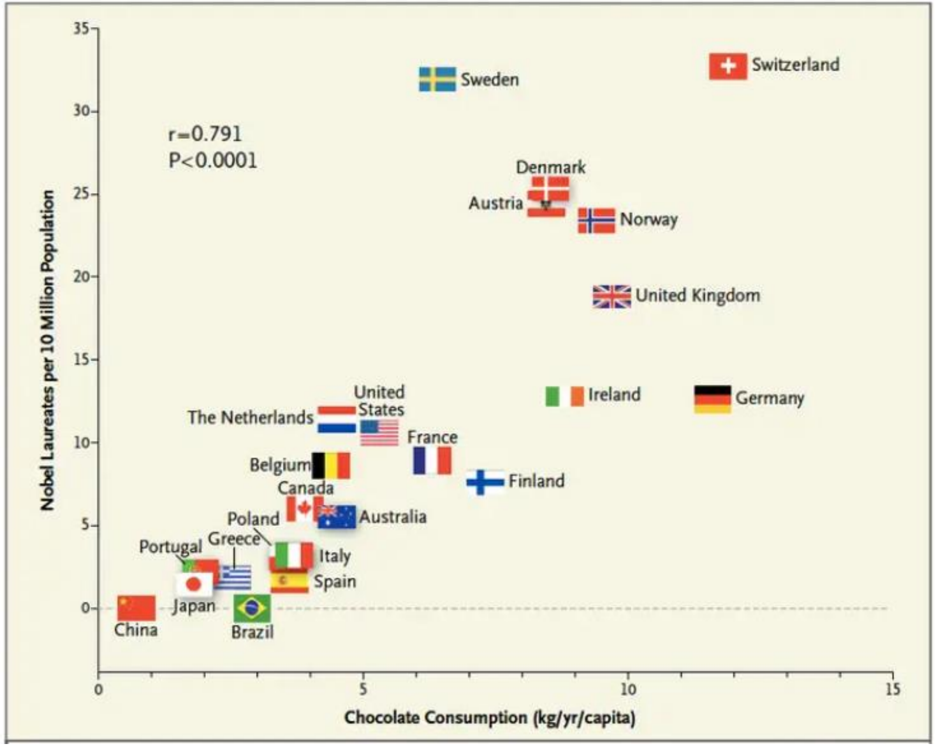
constructor.
university

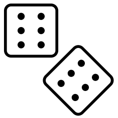
«Correlation does not imply causation»

What do you see in this graph — a correlation or a causal relationship?



If we take this relationship at face value, what policy would you propose to increase Nobel Prize winners in your country?

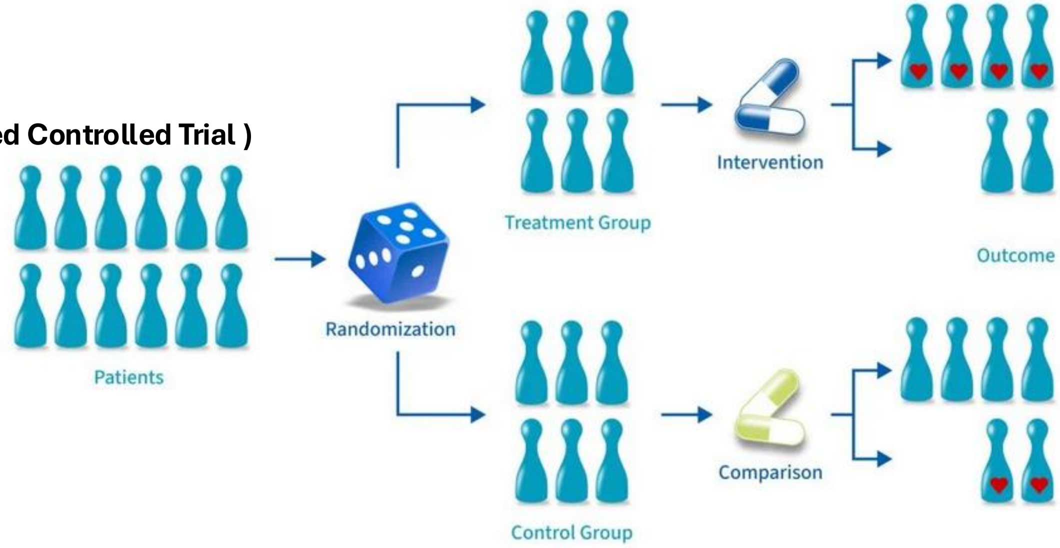
Gold Standard to Detect Causalities: Randomization



Idea

- individuals are **randomly assigned** to **treatment** and **control group** (e.g. flipping a coin or random generator).
- this ensures that groups are as similar as possible in all aspects.
- like a laboratory science, we want to change only one factor to analyze its impact.

Example:
Medical RCT (Randomized Controlled Trial)



Source:
www.simplypsychology.org

Some Problems and Challenges with RCTs

ethical, moral, and legal concerns

- studies on risky behavior.
- development economics.

practical and logistical challenges

- high cost in terms of time and money.
- exception: experiments in computer labs or online experiments.

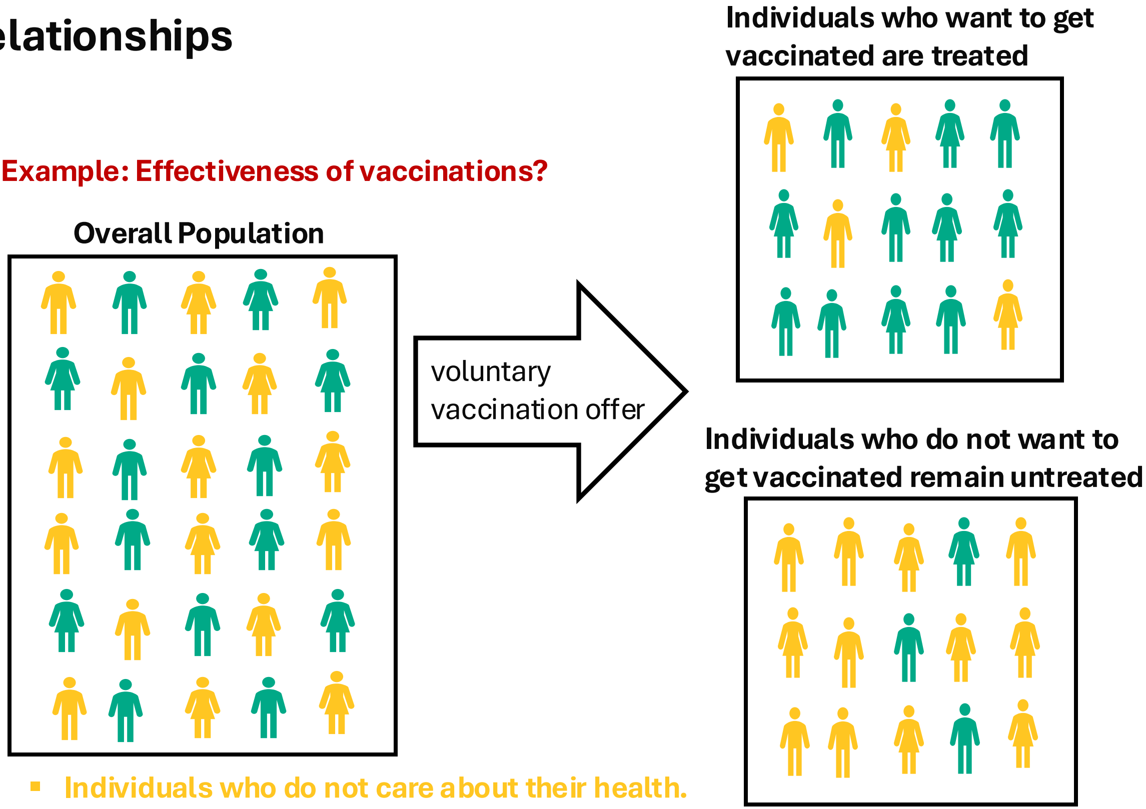
behavioral adjustments of participants (Hawthorne effect)

- study participants change their behavior as a result of being observed (rather than as a result of the intervention).

The Problem of Identifying Causal Relationships from Observational Data (w/o randomisation)

- **treatment** uptake or exposure is typically **not random**.
  - ➢ this leads to **selection bias**!
  - ➢ **observational data** usually show **correlations**, but not causal relationships.

Example: Effectiveness of vaccinations?



- Individuals who do not care about their health.
- Individuals who care about their health.

Why is this problematic?
It leads to **wrong conclusions, poor decisions** and ultimately to **inferior outcomes**.
➢ 🏛️ 💼 🧑‍⚕️ 🧍

Problem: selection into treatment based on individual health consciousness.
➢ a comparison of the two groups would misestimate the effectiveness of vaccinations.

Ways to Overcome Selection Bias

Idea: control for “omitted” factors that drive selection.

- include these drivers as control variables in your regression.
  - but almost always impossible to control for all confounding factors.
  - arbitrary inclusion of control variables can introduce “collider bias” through “bad controls”.

Better solution: use of **quasi-experimental research designs**.

- research methods to detect causalities with observational data.
  - they mimic the experimental idea of random assignment to treatment and control group.

Quasi Experiments

- approximate randomized experiments by using **exogenous variation** from real-world contexts **to infer causality**.

- exploit **naturally occurring** or **policy-induced** variations that mimic **randomization.**
    - situations where units (individuals, regions, firms, etc.) are exposed to a treatment for reasons outside their control.
    - units cannot select into treatment.

Most prominent **quasi-experimental research designs**:

- Regression discontinuity designs (**RDD**).
- Difference-in-Difference (**DiD**) approaches.
- Instrumental Variables (**IV**).

Regression Discontinuity Designs (RDD)

- leverage cutoff regulations or thresholds to assign participants to treatment or control groups.
- **idea**: compare individuals just below and just above the cutoff.
  - at the cutoff, only the treatment changes — other factors remain essentially constant.

Example from my own research:

ELSEVIER

Journal of Health Economics
Volume 81, January 2022, 102555

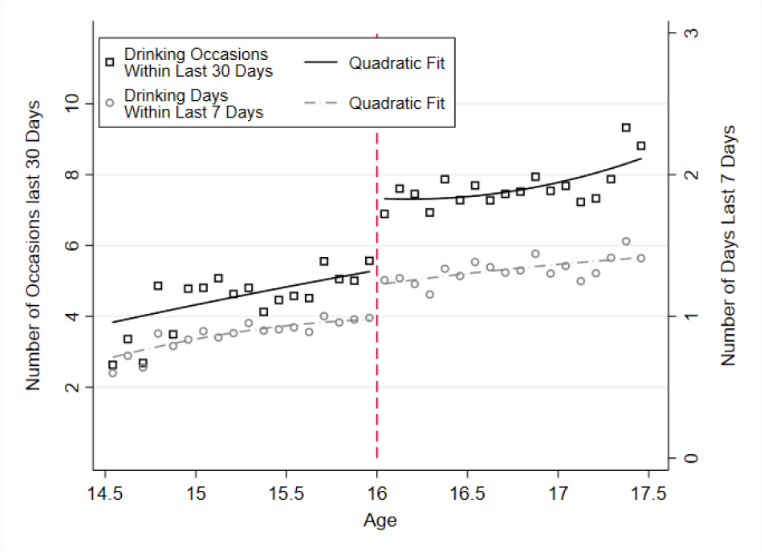
Underage access to alcohol and its impact on teenage drinking and crime ☆

Fabian T. Dehos

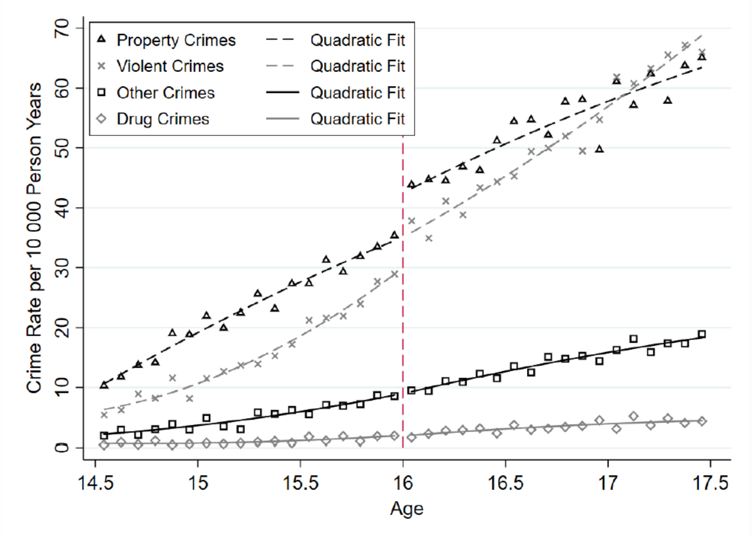
idea: compare drinking and crime behavior around an age-based discontinuity.

- confounding factors remain constant.
- what changes is access to alcohol.
- one obtains causal estimates of the drinking-crime relationship.

Underage Access to Alcohol and Its Impact on Teenage Drinking and Crime



Age profile of **Drinking Frequency** around age 16



Age profile of **Criminal Engagement** around age 16

- crimes under the influence of alcohol

Difference-in-Difference (DiD)

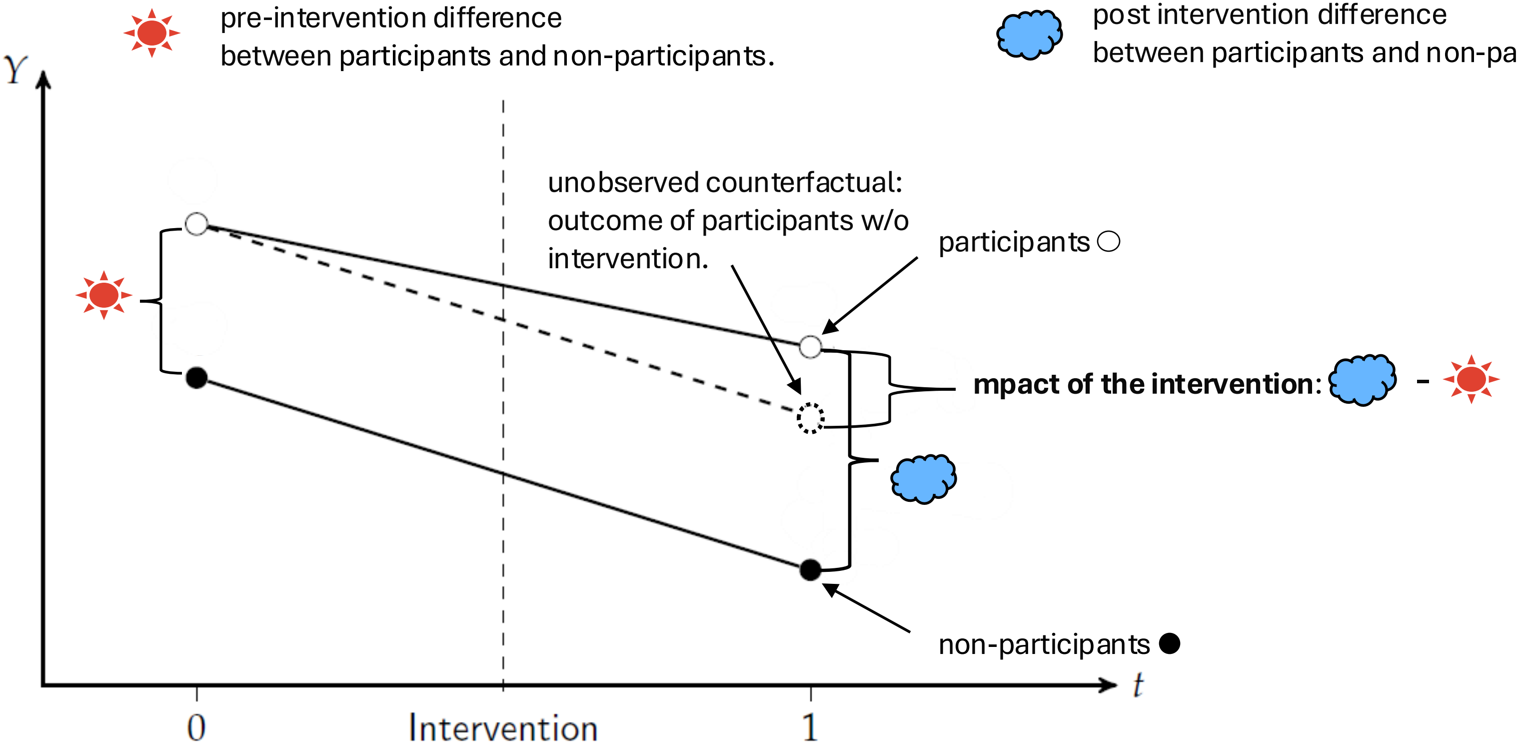
you often see the acronyms **DD**, **Diff-in-diff**, or even **DnD.**

- combines two approaches/comparisons:
  - **before vs. after** the intervention.
  - **participants vs. non-participants** (treatment vs. control group).

- **idea**: compare changes in outcomes over time between participants and non-participants.

DiD: Basic Setup

- **idea**: compare changes in outcomes over time between participants and non-participants.



Seminal Example: Card and Krueger (1994, AER)

Setting

- in February 1992 **NJ** increased the state minimum wage from $4.25 to $5.05.
- Pennsylvania's (**PA**) minimum wage stayed at $ 4.25.
- the authors surveyed about 400 fast food stores in NJ and PA both before and after the minimum wage increase in NJ.
- the DID-strategy compares the change in employment in NJ to the change in employment in PA.

Result: impact on full-time employment (FTE)

	Stores by state		
Variable	PA (i)	NJ (ii)	Difference, NJ – PA (iii)
1. FTE employment before, all available observations	23.33 (1.35)	20.44 (0.51)	–2.89 (1.44)
2. FTE employment after, all available observations	21.17 (0.94)	21.03 (0.52)	–0.14 (1.07)
3. Change in mean FTE employment	–2.16 (1.25)	0.59 (0.54)	2.76 (1.36)

➢ minimum wage increase **did not lead to job losses.**

Instrumental Variables (IV) Approach

- events or factors that influence whether someone receives treatment, which is beyond the individuals' control.
- like a lottery, this approach aims to mimic random assignment.

Example from my own research

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The Effects of After-School Programs on Maternal Employment

Fabian T. Dehos and Marie Paul

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problem:
attendance in After-School Programs (ASPs) is highly selective.

Idea: exploit expansion of ASPs after the PISA-shock 2021.

- ASP expansion grants were "quasi-randomly" assigned across time and space to schools.
- we use ASP grants as in instrument for ASP attendance.
- instrument changes the probability to attend an ASP, but grants are out of maternal control.

My Contact Details

Do you have any **further questions**?
Do you like to learn more about **quasi experiments?**
Do you like to write an **empirical (data-based) thesis** with me?
👉 **Feel free to reach out!**

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