The Four Horsemen of Validity

Session 6

PMAP 8521: Program evaluation
Andrew Young School of Policy Studies

Plan for today

Construct validity

Statistical conclusion validity

Internal validity

External validity

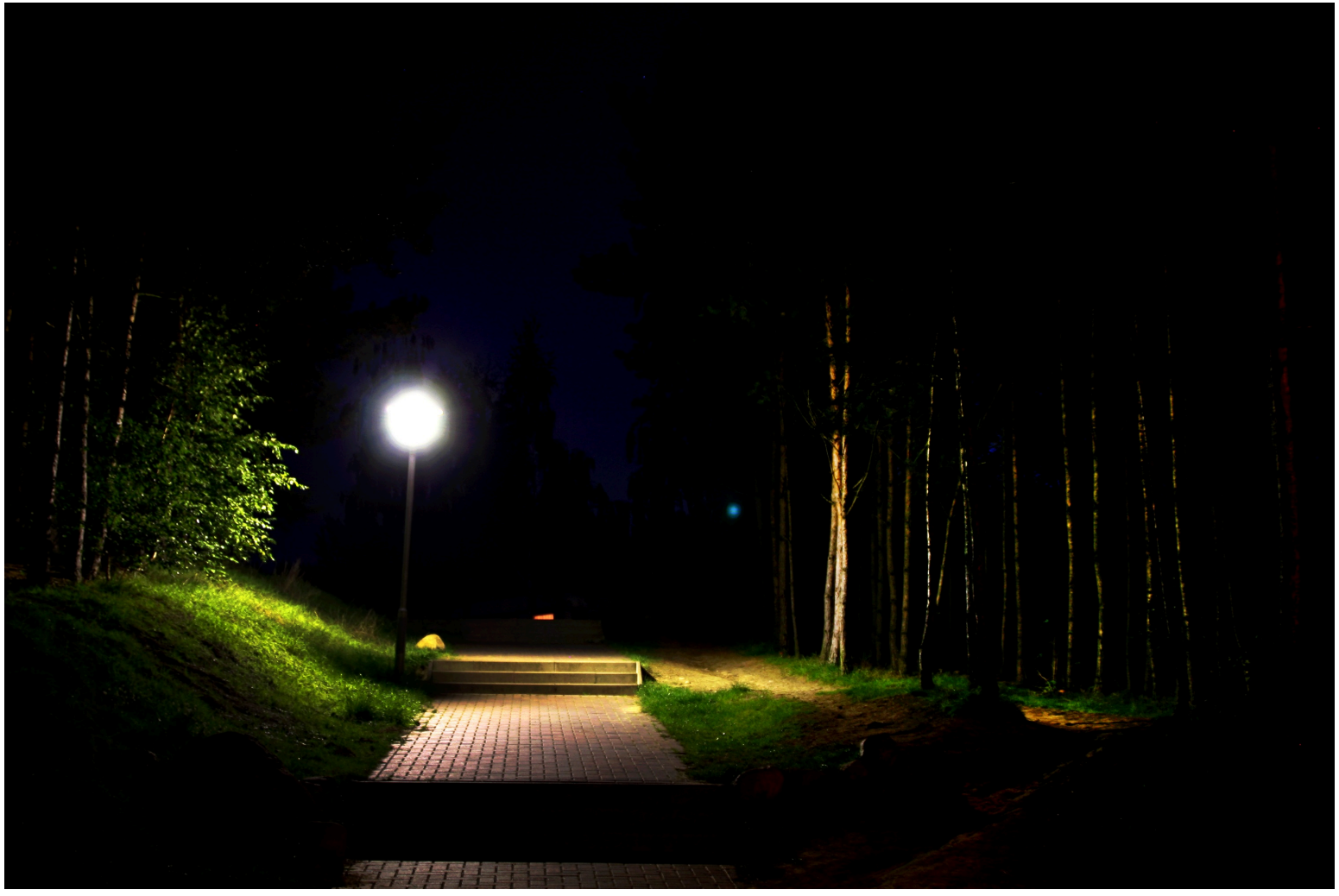
Construct validity

A new program hopes to improve student commitment to school

Participants score 200 points higher on the SAT and have a 0.3 higher GPA, on average

Success! **Success?**

The Streetlight Effect



Construct validity

Are you measuring what you want to measure?

Do test scores measure commitment to school? Teacher performance? Principal skill?

Test scores measure how good kids are at taking tests

This is why we spend so much time on outcome measurement construction!

Statistical conclusion validity

Statistical conclusion validity

Are your statistics correct?

- Statistical power
- Violated assumptions of statistical tests
- Fishing and p-hacking
- Spurious statistical significance

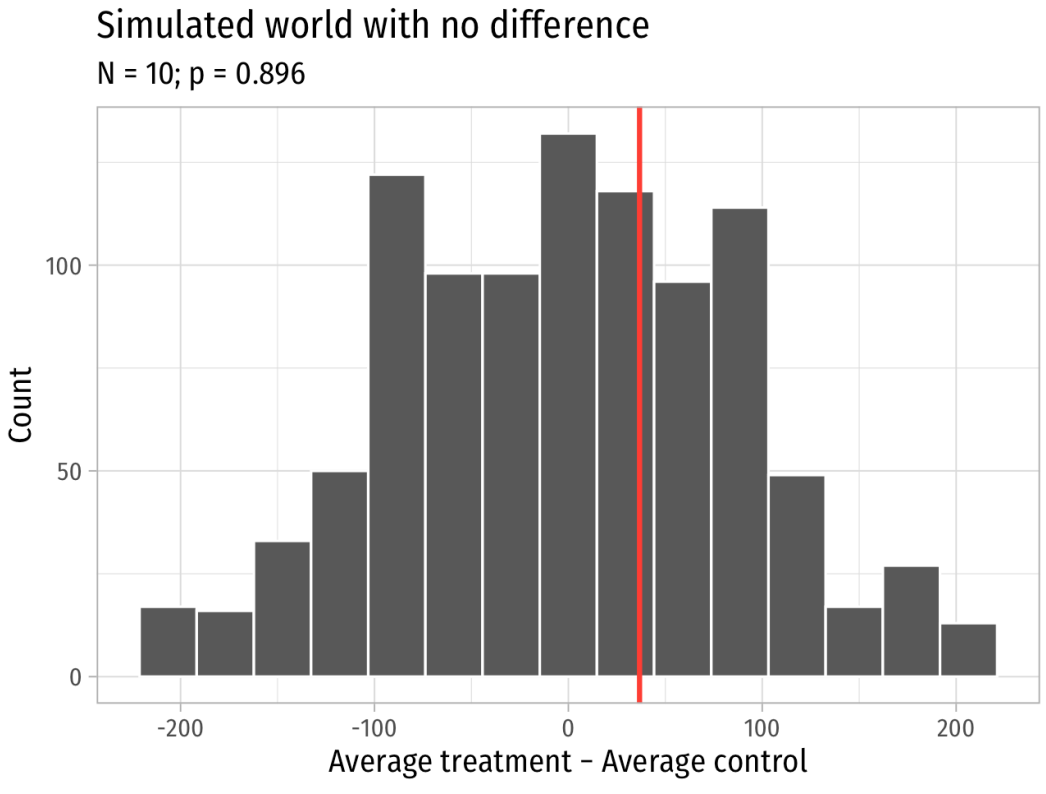
Power

A training program causes incomes to rise by $40

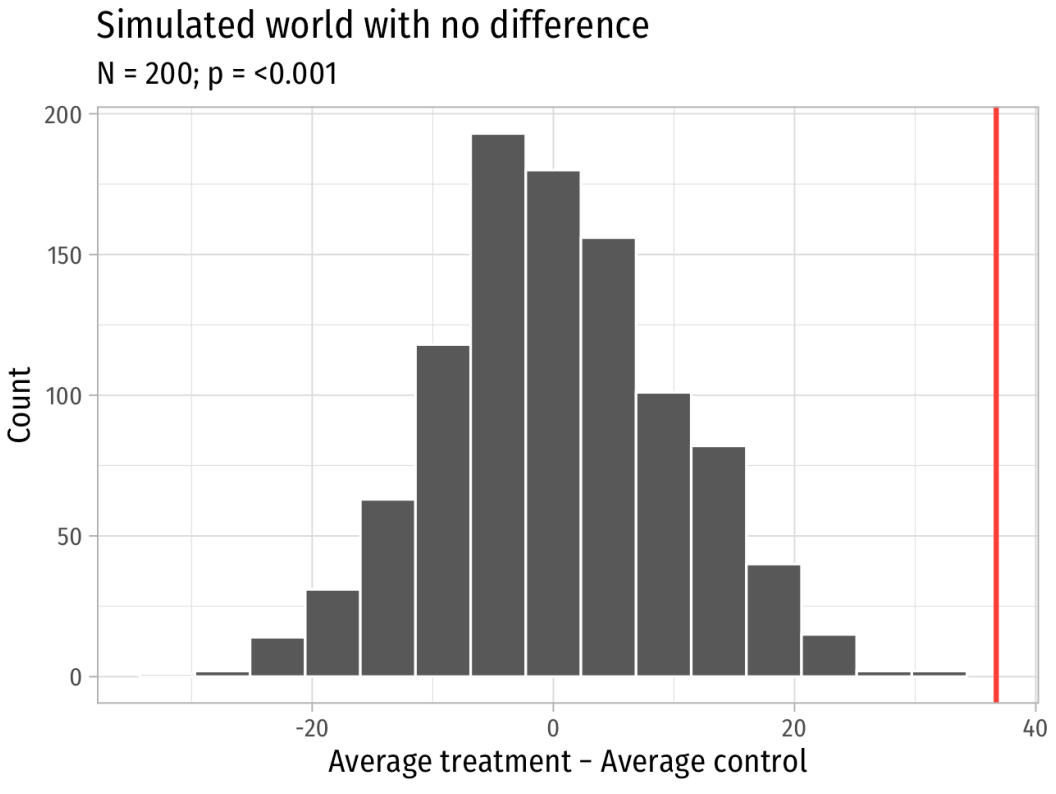
Person	Group	Before	After	Difference
295	Control	122.09	229.04	106.95
126	Treatment	205.60	199.84	-5.76
400	Control	133.25	130.40	-2.85
94	Treatment	270.11	206.56	-63.54
250	Control	344.37	222.89	-121.49
59	Treatment	312.41	268.06	-44.35

Power

Survey 10 participants

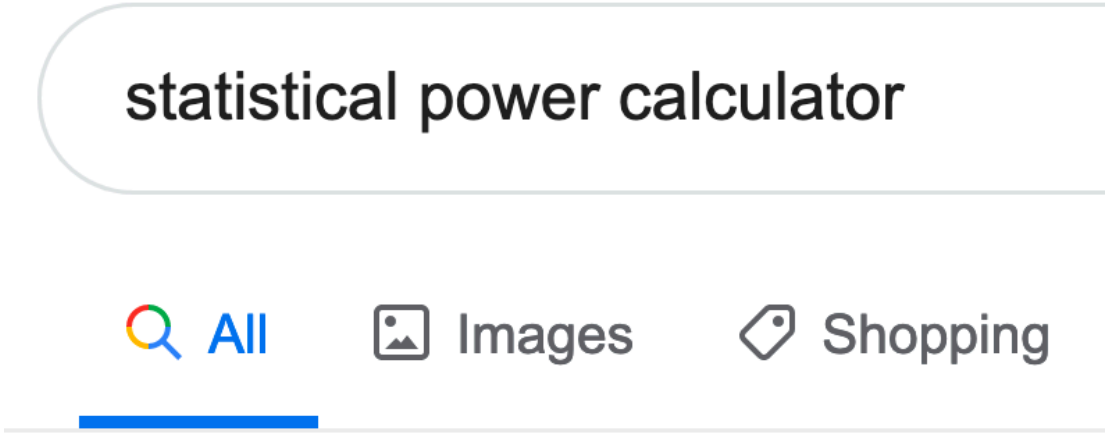


Survey 200 participants



What's the right sample size?

Use a statistical power calculator to make sure you can potentially detect an effect



Test assumptions

Every statistical test has certain assumptions

For instance, for OLS:

Linearity **Homoscedasticity** **Independence** **Normality**

Make sure you're doing the stats correctly

Fishing and p-hacking

Wouldn't it be awesome to run thousands of models with different combinations of variables until you find coefficients that are statistically significant?

Don't!

Hack Your Way To Scientific Glory

You're a social scientist with a hunch: **The U.S. economy is affected by whether Republicans or Democrats are in office.** Try to show that a connection exists, using real data going back to 1948. For your results to be publishable in an academic journal, you'll need to prove that they are "statistically significant" by achieving a low enough p-value.

1 CHOOSE A POLITICAL PARTY

Republicans | Democrats

2 DEFINE TERMS

Which politicians do you want to include?

3 IS THERE A RELATIONSHIP?

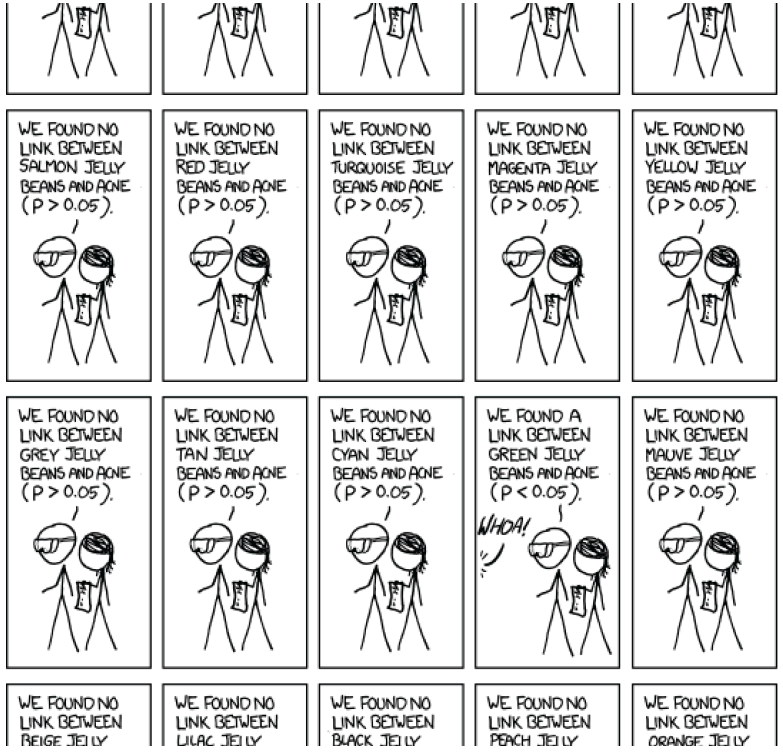
Given how you've defined your terms, does the economy do better, worse or about the same when more Democrats are in power? Each dot

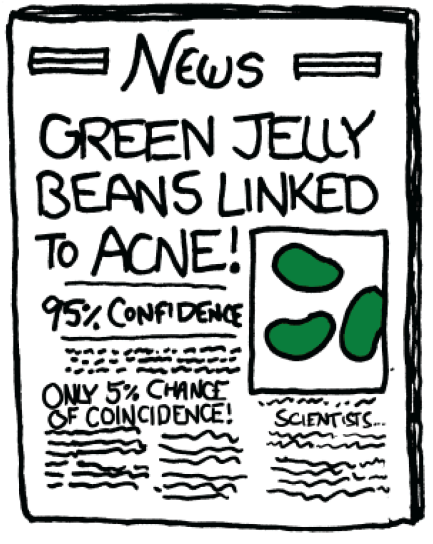
4 IS YOUR RESULT SIGNIFICANT?

If there were no connection between the economy and politics, what is the probability that you'd get

Spurious statistical significance

If *p* threshold is 0.05 and you measure 20 outcomes, 1 will likely show correlation by chance





Internal validity

Internal validity

Omitted variable bias

Selection | Attrition

Trends

Maturation | Secular trends | Seasonality | Testing | Regression

Study calibration

Measurement error | Time frame

Contamination

Hawthorne | John Henry | Spillovers | Intervening events

Selection

If people can choose to enroll in a program, those who enroll will be different from those who do not

How to fix

Randomization into treatment and control groups

Selection

If people can choose when to enroll in a program, time might influence the result

How to fix

Shift time around

ELSEVIER

The Journal of Socio-Economics 35 (2006) 326–347

The Journal of Socio-Economics

www.elsevier.com/locate/econbase

Does marriage make people happy, or do happy people get married?

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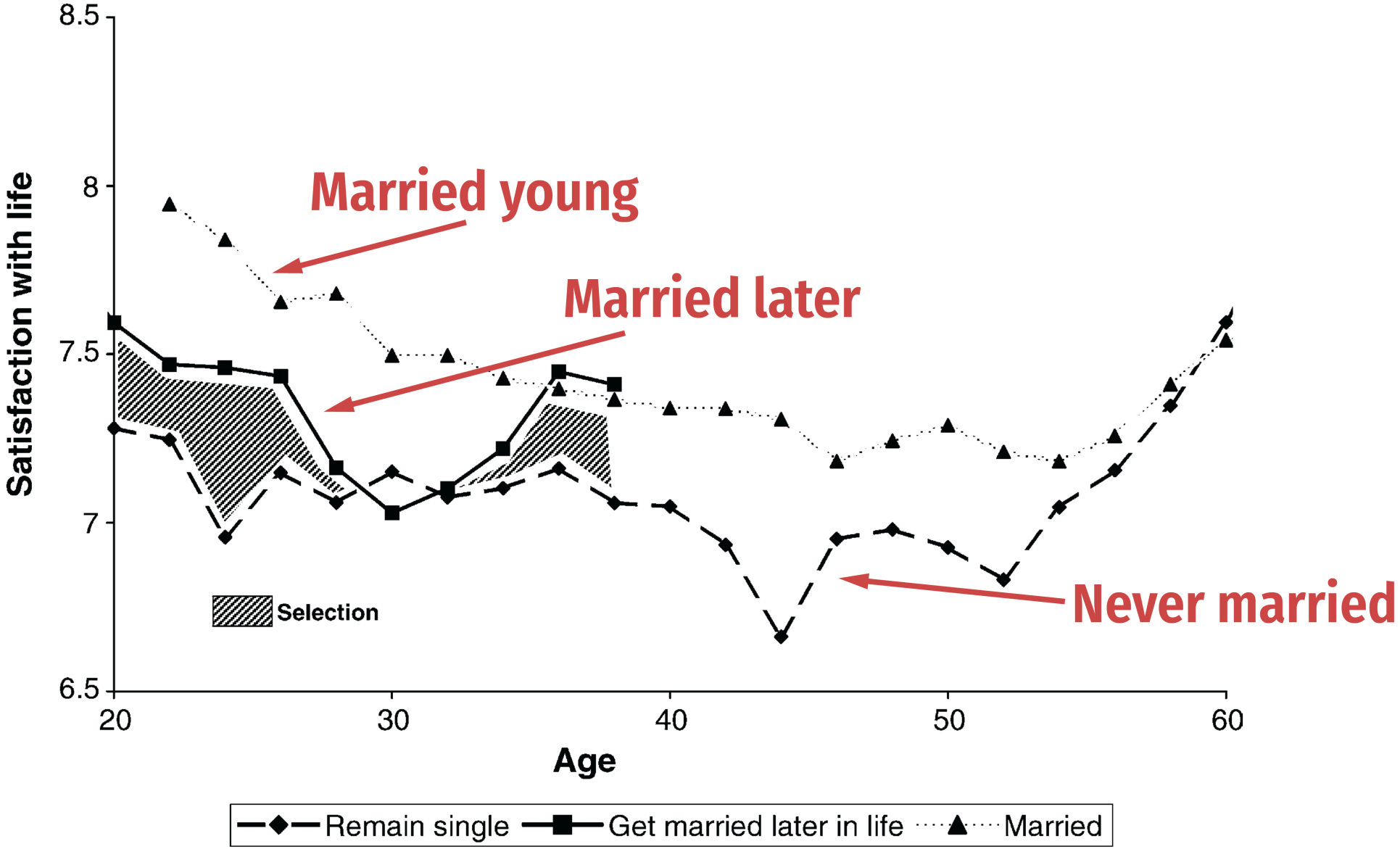
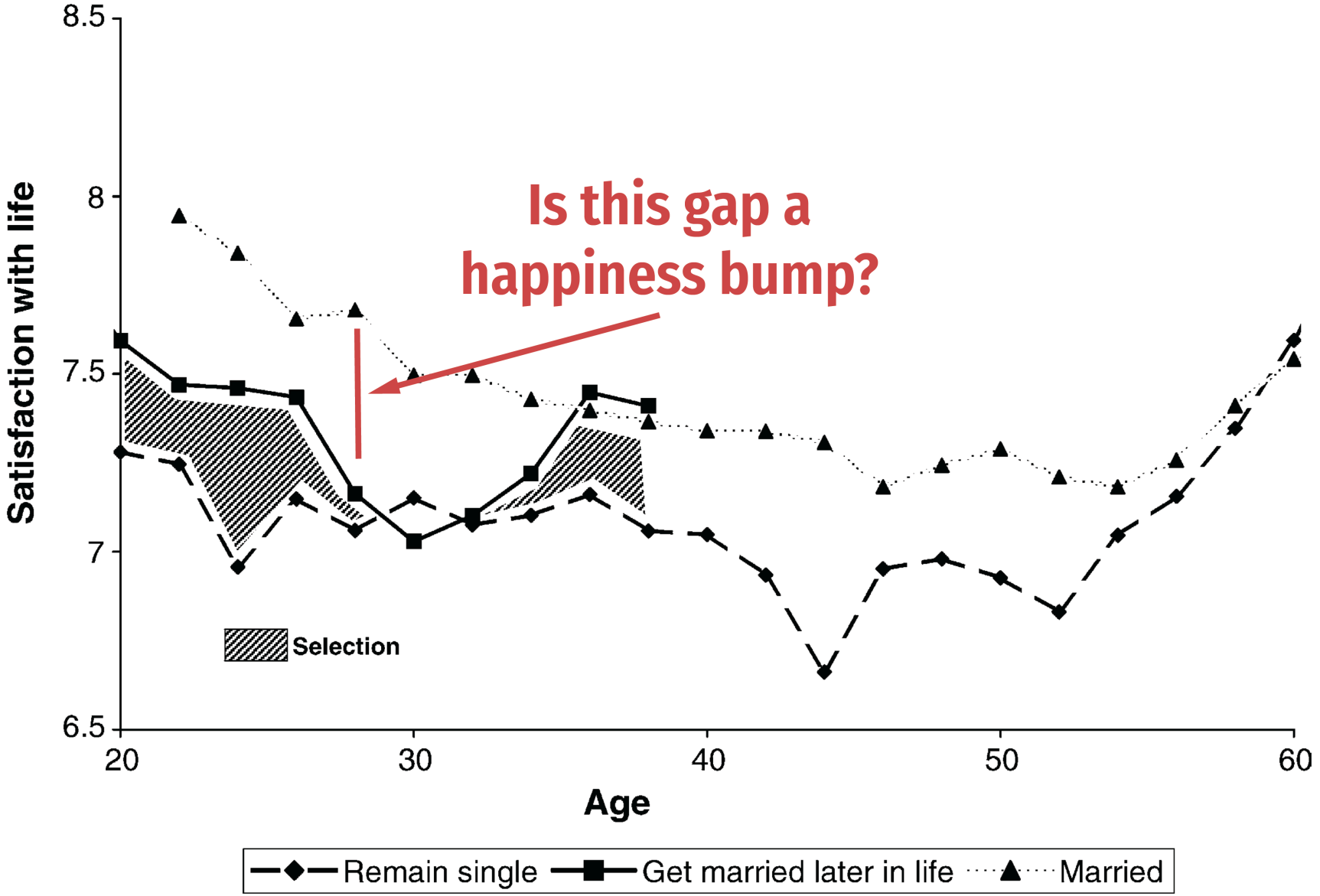
University of Zurich, Switzerland

Received 4 June 2003; accepted 12 October 2004

Abstract

This paper analyzes the causal relationships between marriage and subjective well-being in a longitudinal data set spanning 17 years. We find evidence that happier singles opt more likely for marriage and that there are large differences in the benefits from marriage between couples. Potential, as well as actual, division of labor seems to contribute to spouses' well-being, especially for women and when there is a young family to raise. In contrast, large differences in the partners' educational level have a negative effect on experienced life satisfaction.


Married young
Married later
Never married
Satisfaction with life
8.5
8
7.5
7
6.5
Selection
20
30
40
50
60
Age
Remain single
Get married later in life
Married


Is this gap a
happiness bump?
Satisfaction with life
8.5
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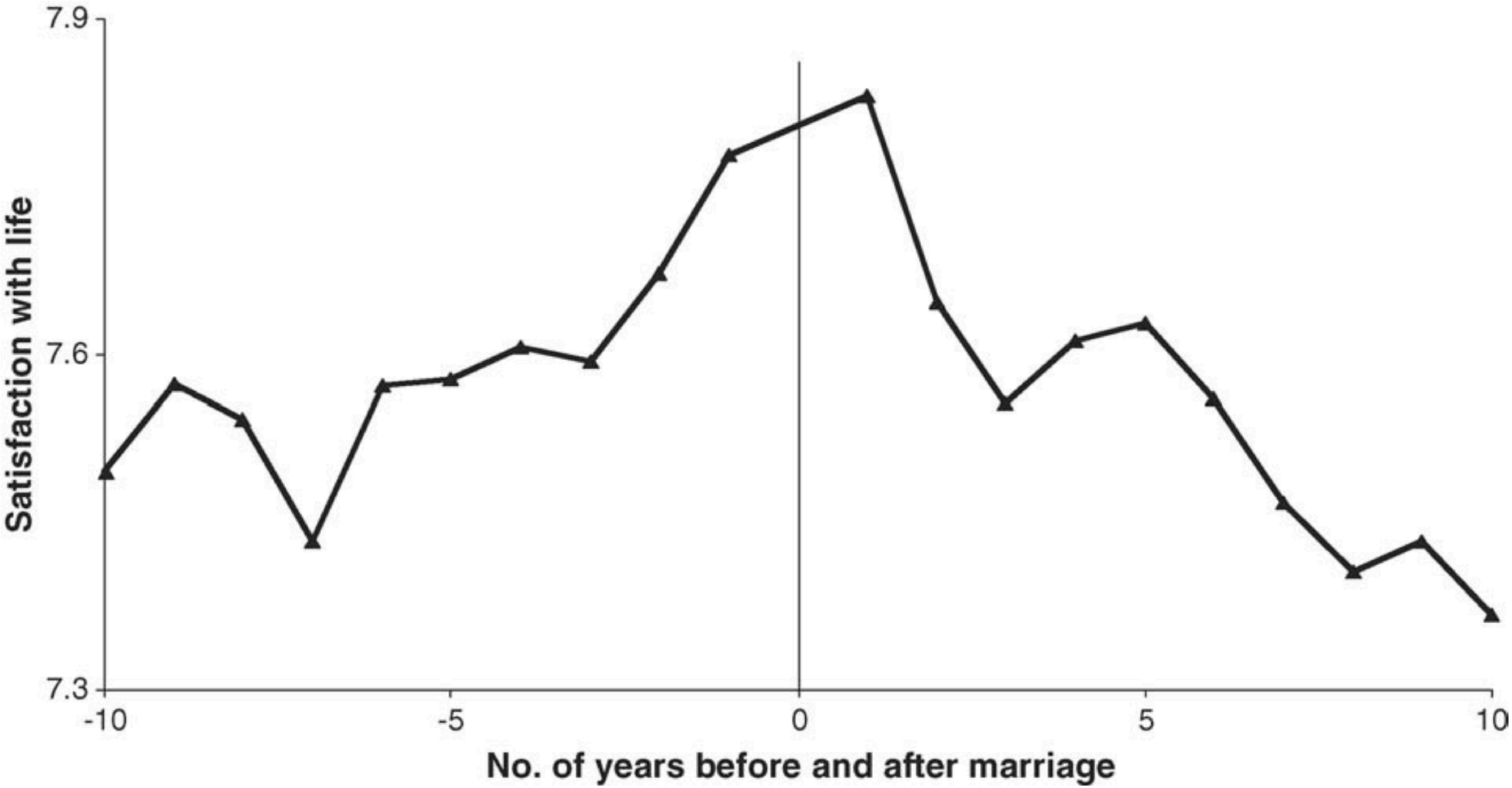
Age
Selection
Remain single
Get married later in life
Married


7.9
7.6
7.3
Satisfaction with life
-10
-5
0
5
10
No. of years before and after marriage

Attrition

If the people who leave a program or study are different than those who stay, the effects will be biased

How to fix

Check characteristics of those who stay and those who leave

Fake microfinance program results

ID	Increase in income	Remained in program
1	$3.00	Yes
2	$3.50	Yes
3	$2.00	Yes
4	$1.50	No
5	$1.00	No

ATE with attriters = $2.20

ATE without attriters = $2.83

Maturation

Growth is expected naturally

e.g. programs targeted at childhood development contend with the fact that children develop on their own too

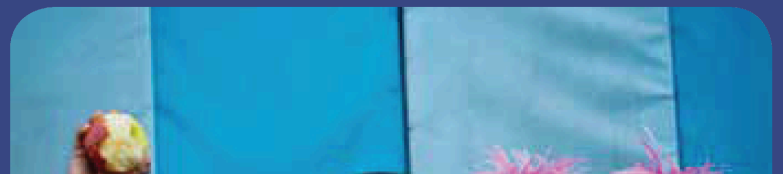
How to fix

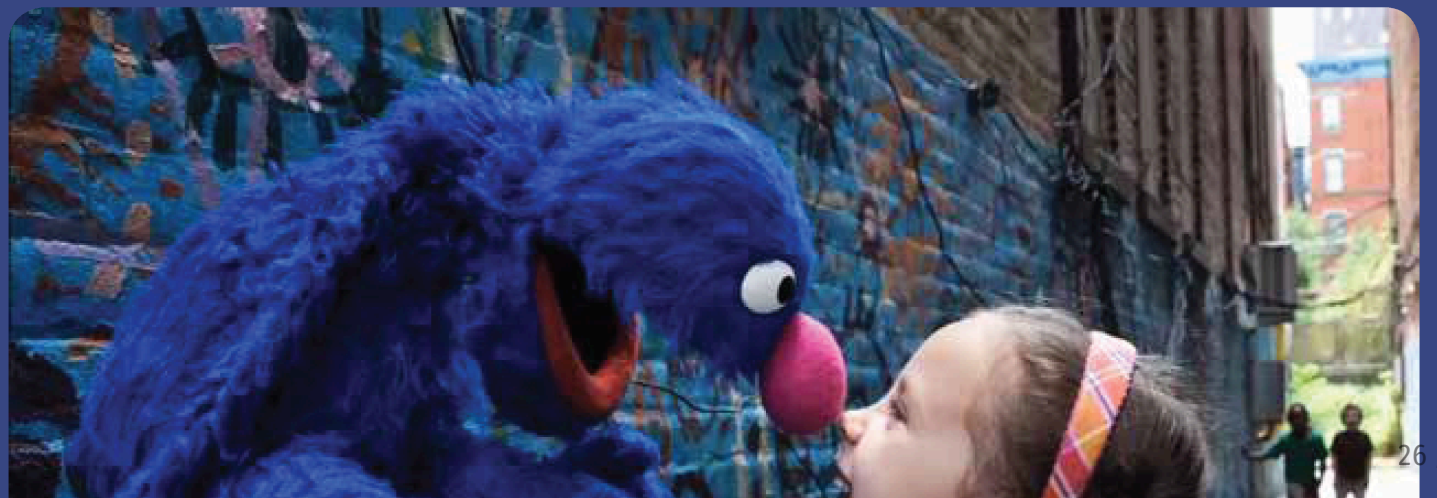
Use a comparison group to remove the trend

New Study Finds Sesame Street Improves School Readiness

Research coauthored by Wellesley College economist **Phillip B. Levine** and University of Maryland economist **Melissa Kearney**, finds that greater access to Sesame Street in the show's early days helped children do better in school.

When Sesame Street first aired in 1969, five million children watched a typical episode. That's the preschool equivalent of a Super Bowl every day.





Secular trends

Patterns in data happen because of larger global processes

Recessions **Cultural shifts** **Marriage equality**

How to fix

Use a comparison group to remove the trend

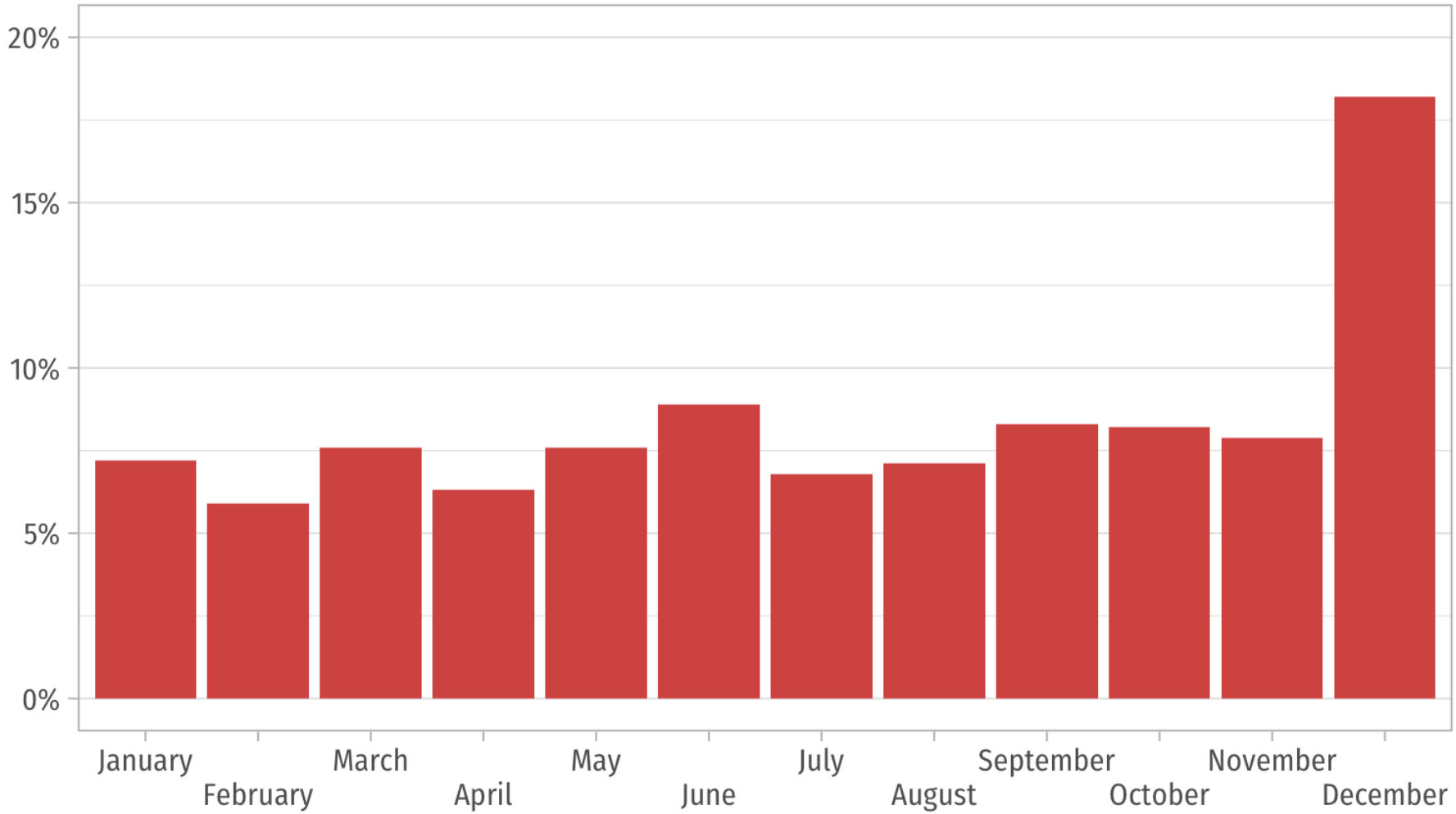
Seasonal trends

Patterns in data happen because of regular time-based trends

How to fix

Compare observations from same time period or use yearly/monthly averages

Charitable giving by month, 2017



Testing

Repeated exposure to questions or tasks will make people improve naturally

How to fix

Change tests, maybe don't offer pre-tests, use a control group that receives the test

Regression to the mean

People in the extreme have a tendency to become less extreme over time

Luck | Crime and terrorism | Hot hand effect

How to fix

Don't select super high or super low performers

Measurement error

Measuring the outcome incorrectly will bias the effect

How to fix

Measure the outcome well

Time frame

If the study is too short, the effect might not be detectable yet; if the study is too long, attrition becomes a problem

How to fix

Use prior knowledge about the thing you're studying to choose the right length

Hawthorne effect

Observing people makes them behave differently

How to fix

Hide? Use completely unobserved control groups

John Henry effect

Control group works hard to prove they're as good as the treatment group

How to fix

Keep two groups separate

Spillover effect

Control groups naturally pick up what the treatment group is getting

Externalities **Social interaction** **Equilibrium effects**

How to fix

Keep two groups separate; use distant control groups

Intervening events

Something happens that affects one of the groups and not the other

How to fix

Internal validity

Omitted variable bias

Selection | Attrition

Trends

Maturation | Secular trends | Seasonality | Testing | Regression

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Fixing internal validity

Randomization fixes a host of issues

- Selection
- Maturation
- Regression to the mean

Randomization doesn't fix everything!

- Attrition
- Contamination
- Measurement

External validity

Generalizability

Are your findings generalizable to the whole population?

Hospital lights increase risk of dying in patients with heart disease

Sunday, September 01, 2019 by: Melissa Smith

Tags: brain inflammation, Cardiac Arrest, cardiovascular disease, death, dim light, heart disease, heart health, hospital lights, hospital rooms, Hospitals, lighting, lights, mortality, research, white light

5,900 VIEWS

Lab conditions vs. real world

Study volunteers are weird

Western, educated, from industrialized, rich, and democratic countries

Not everyone takes surveys

Online surveys

Amazon Mechanical Turk

Random digit dialing

Different settings and circumstances

Does a study in one state apply to other states?

Does the effect from a mosquito net trial in Eritrea transfer to Bolivia?