

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

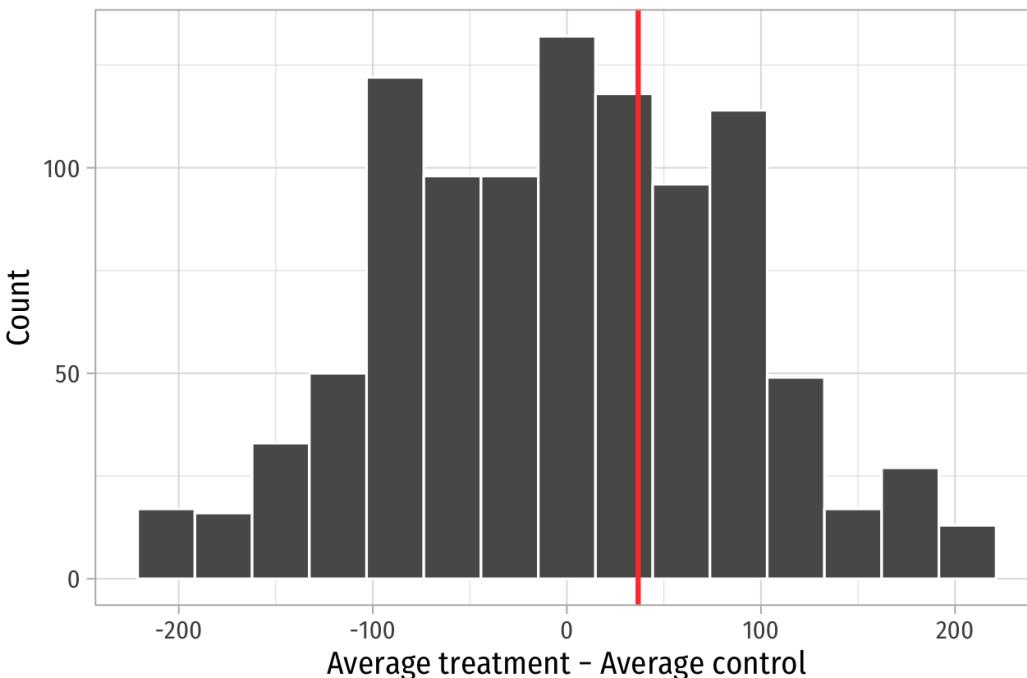
Person	Group	Before	After	Difference
295	Control	122.09	229.04	106.95
126	Treatment	205.60	199.84	-5.76
400	Control	133.25	130.40	-2.85
94	Treatment	270.11	206.56	-63.54
250	Control	344.37	222.89	-121.49
59	Treatment	312.41	268.06	-44.35

Power

Survey 10 participants

Simulated world with no difference

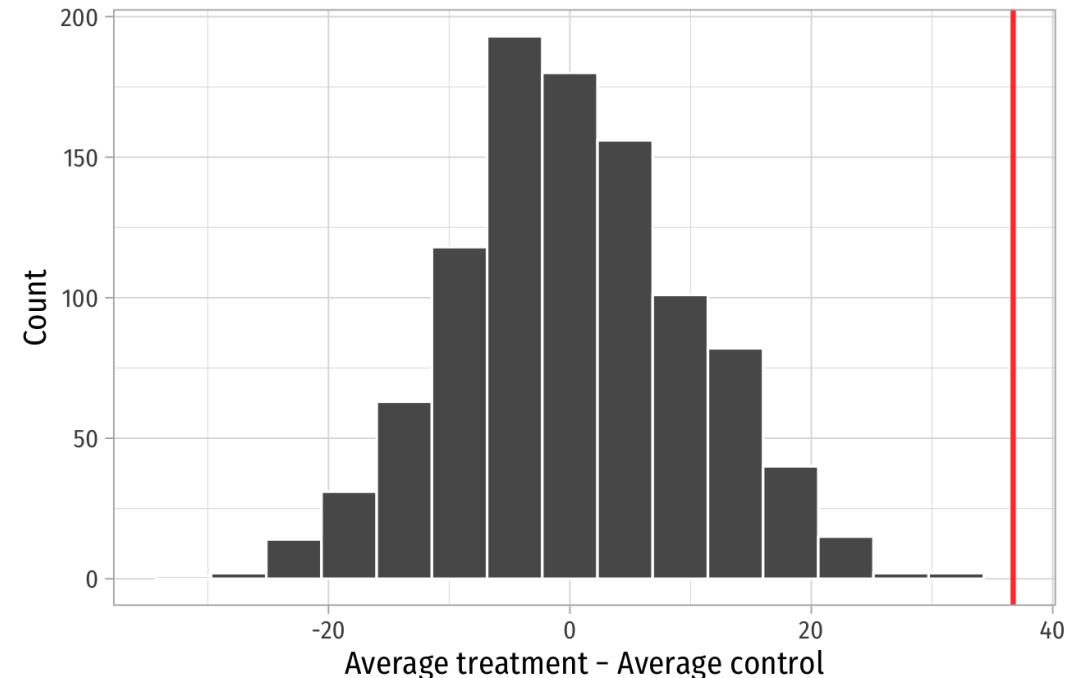
N = 10; p = 0.896



Survey 200 participants

Simulated world with no difference

N = 200; p = <0.001



What's the right sample size?

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

statistical power calculator



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?

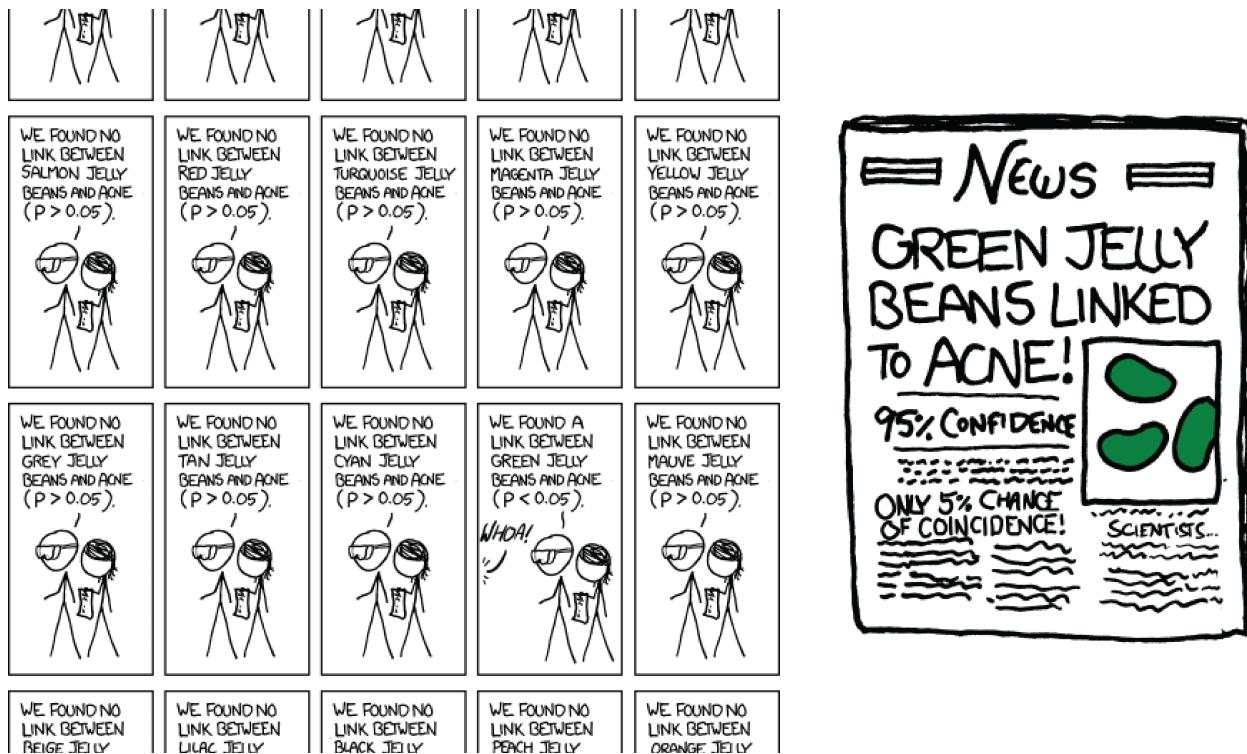
Given how you've defined your terms, does the economy do better, worse or about the same when more Democrats are in power? Each dot

- 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

Contamination

Measurement error

Hawthorne

John Henry

Time frame

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?

Alois Stutzer^{*,1}, Bruno S. Frey¹

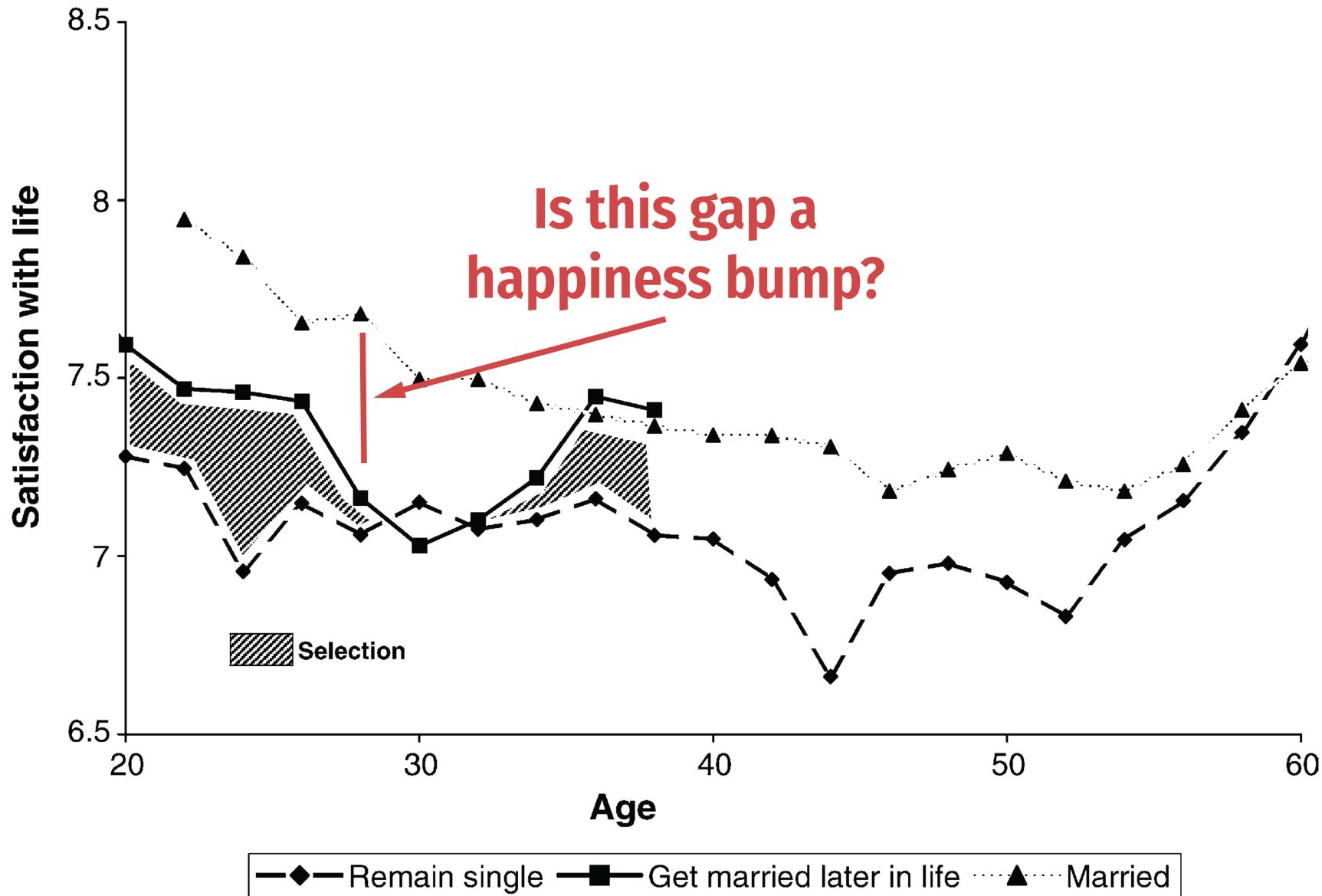
University of Zurich, Switzerland

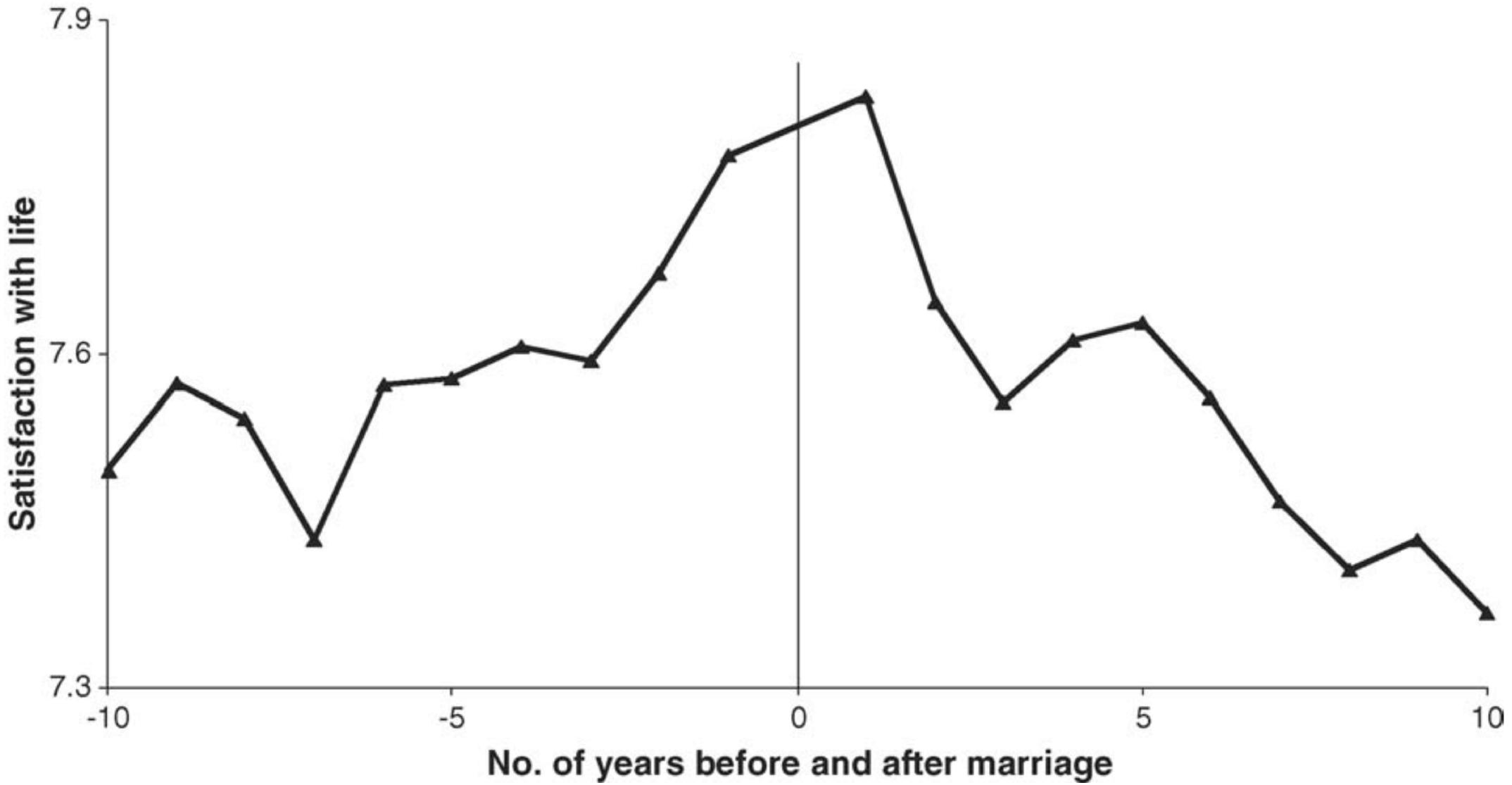
Received 4 June 2003; accepted 12 October 2004

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.







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
attritors = \$2.20

ATE without
attritors = \$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

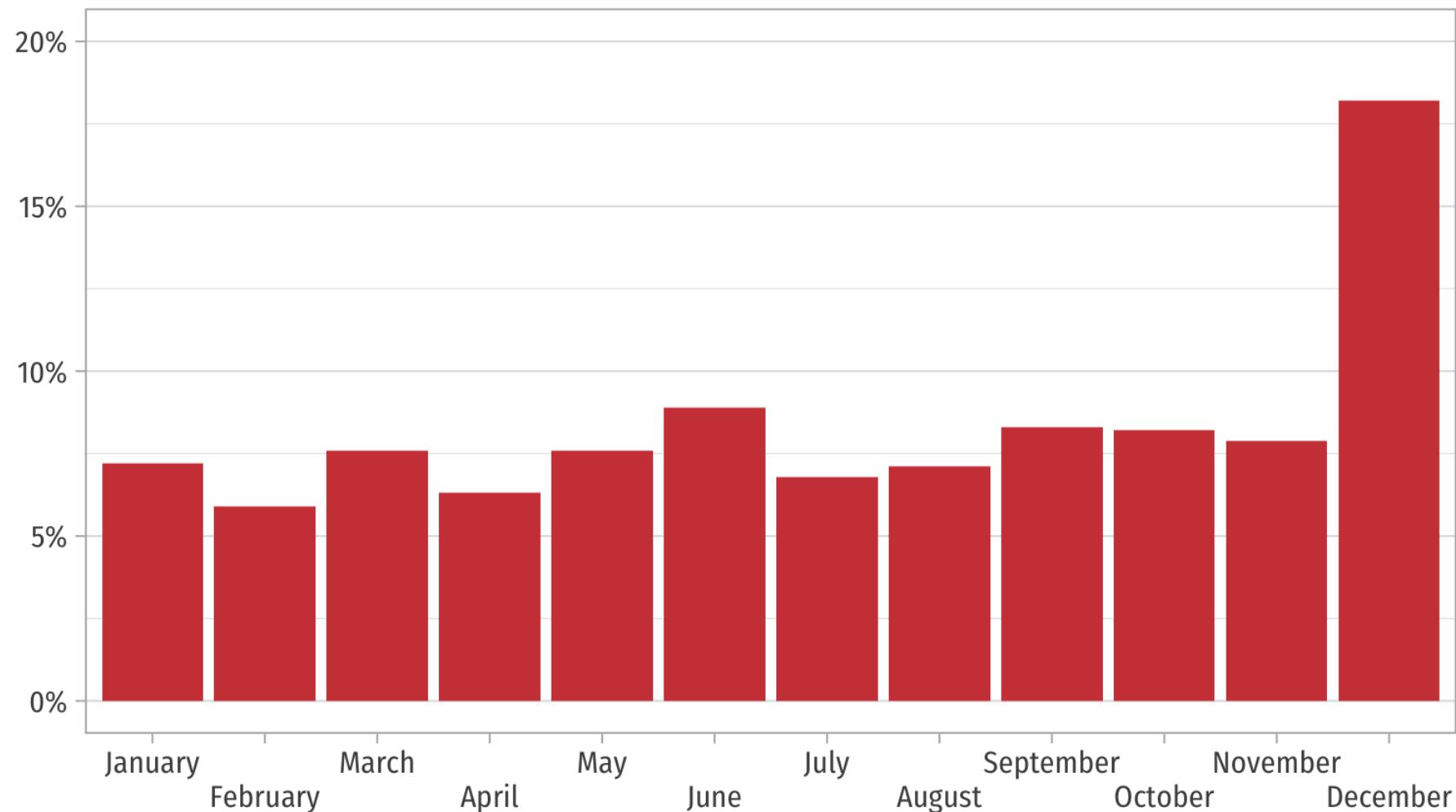
Seasonal trends

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

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Secular trends

Seasonality

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Study calibration

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Hawthorne

John Henry

Time frame

Spillovers

Intervening events

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](#)

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IN MICE



Hospital lights increase risk of dying in patients with heart disease
Hospitals may want to consider changing the lights they use in their rooms, especially for patients who suffered a cardiac arrest. A study published in the...
[naturalnews.com](#)

10:36 AM · Sep 4, 2019 · Twitter Web App

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?