

Causal thinking

Logan and Scott's wedding

Maxim Massenkoff

Today's talk

Causal inference.

1. The Problem
2. Bold Experiments
3. Natural Experiments
The Incredible Regression Discontinuity

The Problem

We want to understand causal relationships in our world

- ▶ Is this protein shake energizing my workouts?
- ▶ Will a dating coach improve my life? (Not a question. **Yes.**)

Bigger picture:

- ▶ Does money improve schools?
- ▶ Does prison cause crime?
- ▶ Does unemployment insurance increase unemployment?

The Problem

1. Everything bad is correlated

And its corollary:

- 2 Everything good is correlated

Ask: What's the counterfactual?



WebMD @WebMD · Apr 26

...

People who ate french fries or hash browns 2 to 3 times a week were more likely to die early, according to one study.



1.7K

8.3K

3.2K

Everything Good Is Correlated

Growing up in a house full of books is major boost to literacy and numeracy, study finds

Research data from 160,000 adults in 31 countries concludes that a sizeable home library gave teen school leavers skills equivalent to university graduates who didn't read



In causal inference, we seek **exogenous variation**

Differences in the **treatment** that happen by random chance

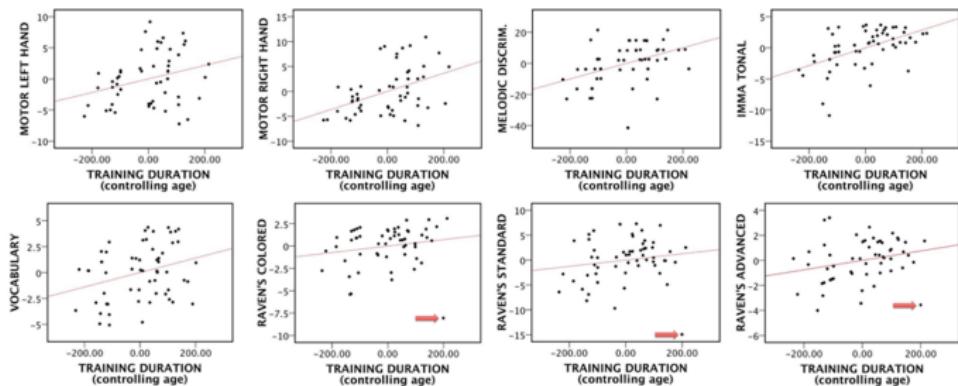
We can run experiments (randomized controlled trials)

Or find random variation in nature

Bold Experiments

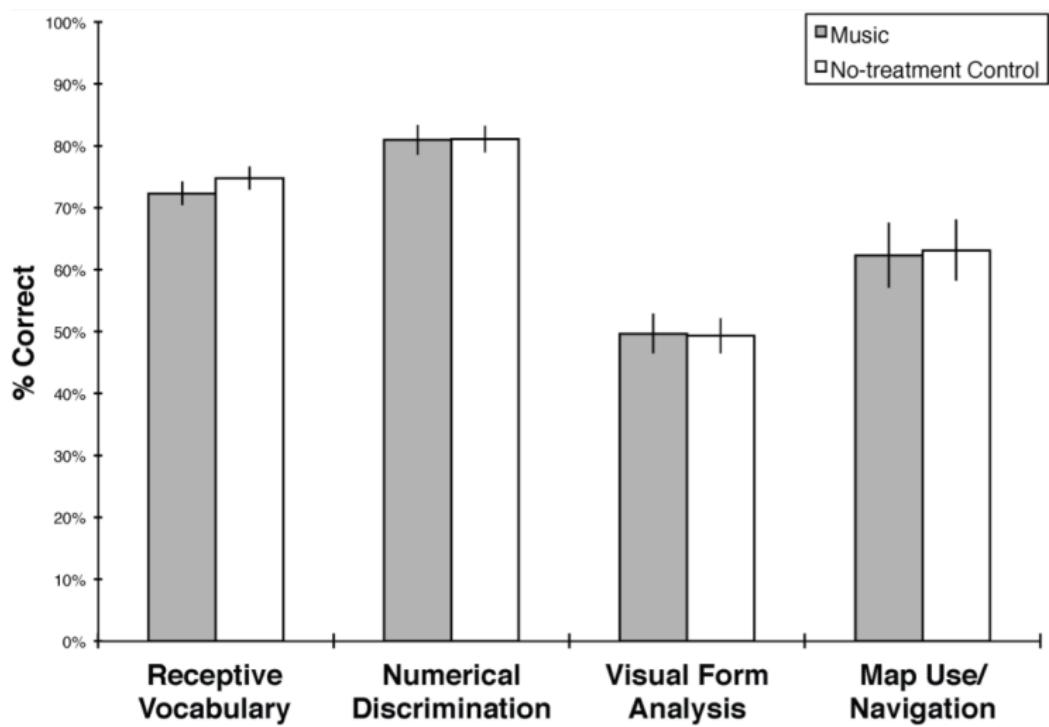
Re: everything good is correlated

Music education



“While these results are correlational only, the strong predictive effect of training duration suggests that instrumental music training may enhance auditory discrimination, fine motor skills, vocabulary, and nonverbal reasoning.”

Music RCT



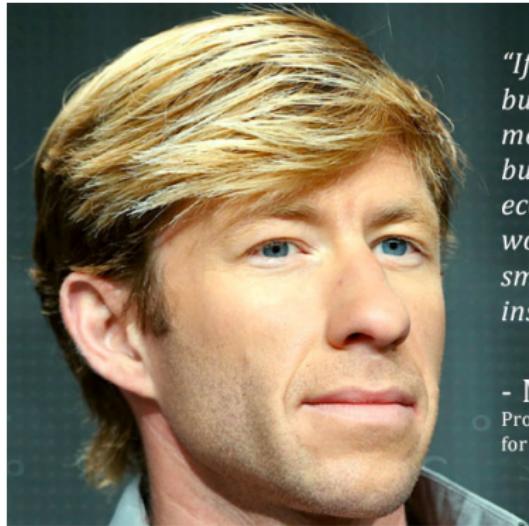
The Building Strong Families Program

Marriage counseling (by government) in 12 locations with 5,000 couples designed by luminaries like the Gottmans

No effects on happiness in relationships and staying together

Props to them for randomizing!

The causal effect of sleep

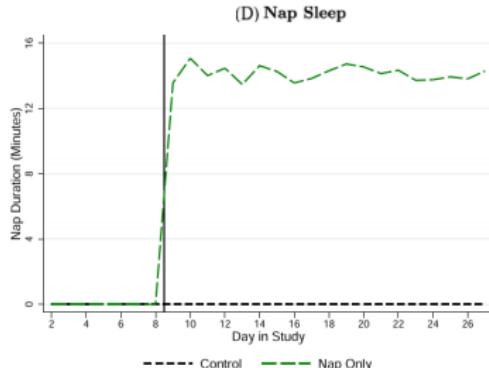
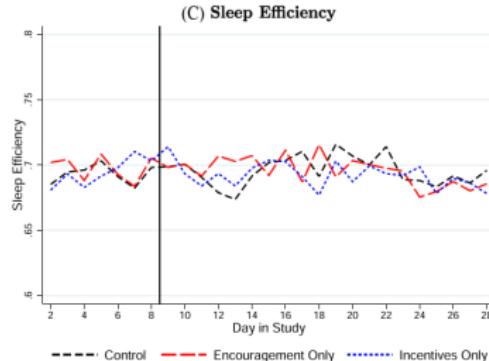
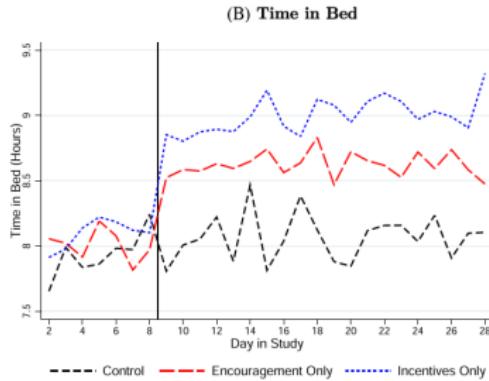
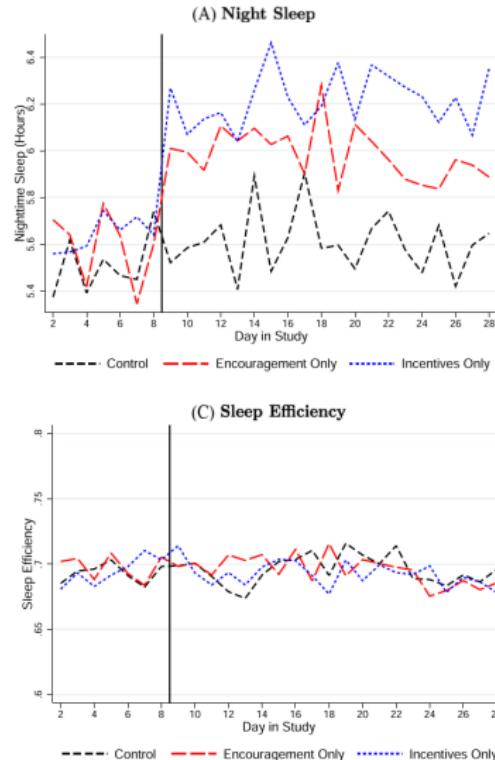


"If we all slept enough? ...our healthcare burden would plummet, we would have better mental health and fewer suicides... our business would be more productive, global economies would be healthier, our roads would be safer and our children would be smarter.... sleep is the very best health insurance policy you could ever wish for."

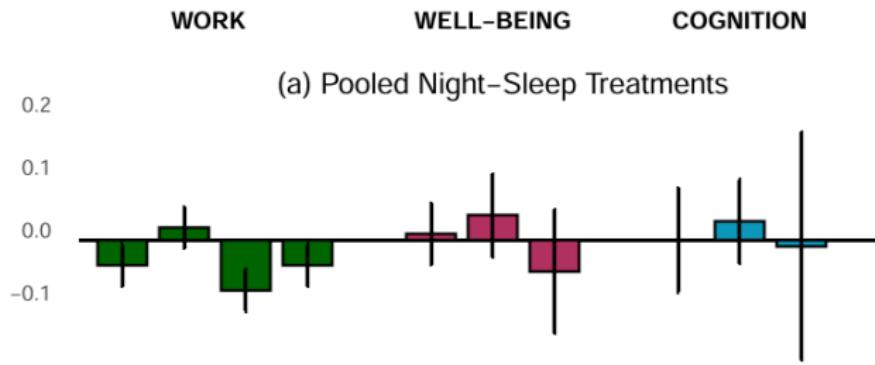
- Matthew Walker PhD

Professor of Neuroscience & Founder and Director of the Center for Human Sleep Science, University of California, Berkeley

The causal effect of sleep

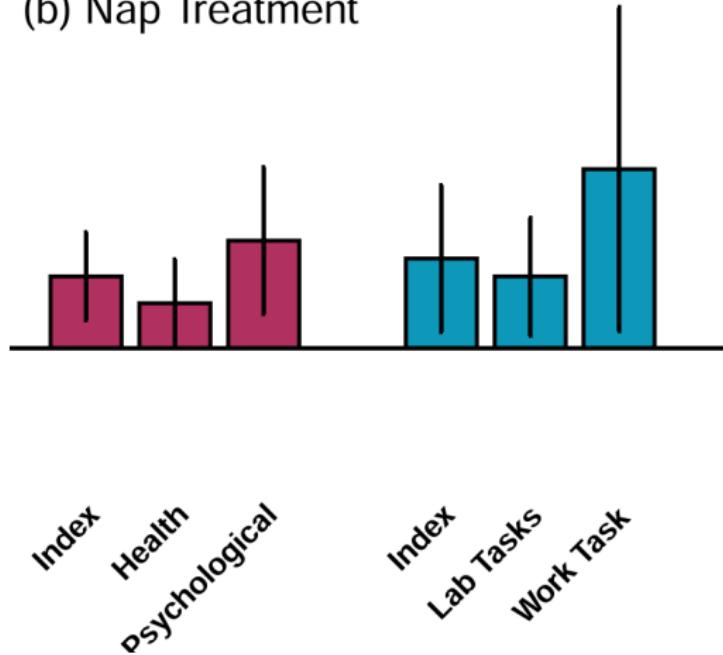


The causal effect of sleep



Naps?!

(b) Nap Treatment



Stretching

- ▶ **Cochrane review:** “The evidence from randomised studies suggests that muscle stretching, whether conducted before, after, or before and after exercise, does not produce clinically important reductions in delayed-onset muscle soreness in healthy adults.”

These are cases where it was ethical/practical to randomize people

Many tough questions require...

Natural experiments

Case in point: Criminal justice

The policy issue

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US prisons

Why are so many people dying in US prisons and jails?

The number of Americans dying while incarcerated has surged while the US prison population has increased by 500% over the last 40 years

Michael Sainato

Sun 26 May 2019 02.00 EDT

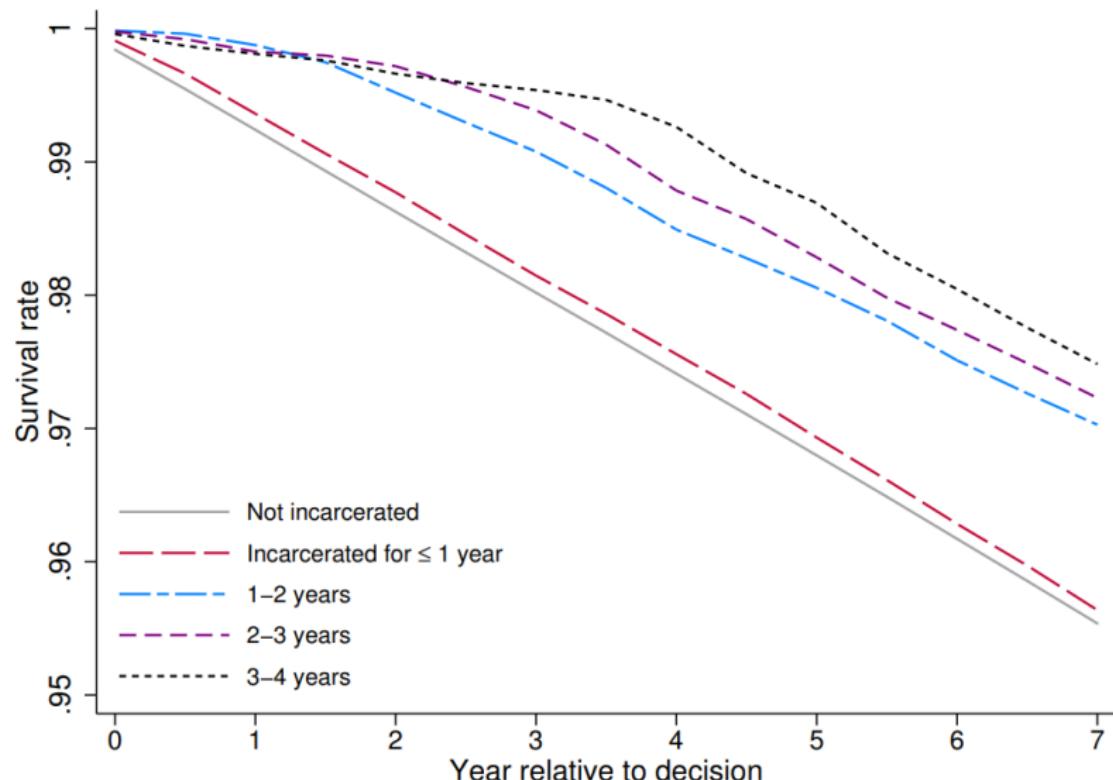


Correlational evidence:

“...exposure to incarceration was associated with a significant increase in mortality...”

Causal evidence

Figure 2: Survival rates by sentence length



Why?

- ▶ Lower risk of homicide, suicide, drug overdose, car accidents
- ▶ State-mandated medical check-ups
- ▶ Doesn't mean that prison is good

The policy issue

Correlational evidence:



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Hidden Consequences: The Impact of Incarceration on Dependent Children

Children of incarcerated parents face profound and complex threats to their emotional, physical, educational, and financial well-being.

Judge strictness

Defendants in Ohio are **randomly assigned** to judges

Judges vary in their **strictness**

The approach: what happens to kids whose **parent** gets a **strict judge**?

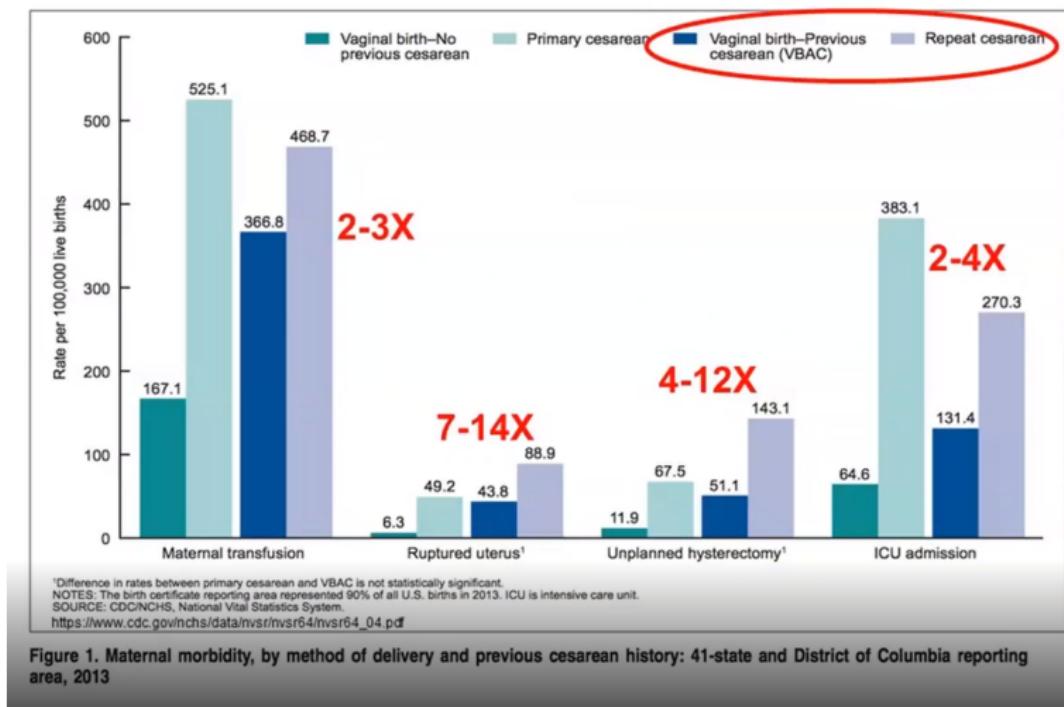
Table 4: Effect of parental incarceration on child criminal activity

	Extensive margin (=1)		
	Charged	Convicted	Incarcerated
	(1)	(2)	(3)
<i>Panel A: OLS Criminal activity before age 25 (OLS with no controls)</i>			
Parent incarcerated (=1)	0.024*** (0.005)	0.024*** (0.005)	0.015*** (0.004)
Index <i>p</i> -value			0.000
Dependent mean	0.325	0.247	0.124
Observations	83,532	83,532	83,532
<i>Panel B: Criminal activity before age 25 (IV)</i>			
Parent incarcerated (=1)	-0.066** (0.030)	-0.055** (0.027)	-0.049** (0.020)
Index <i>p</i> -value			0.011
Dependent mean	0.325	0.247	0.124
Observations	83,532	83,532	83,532

Another study based on institutional differences: c-sections

C-sections

Correlational evidence:



C-sections are often *caused* by a medical issue. Reverse causality!

David Card et al: look at moms who got c-sections **by virtue of living next to a hospital that does a lot of them**

Causal effects of a c-section

It's basically a wash

Fewer dangerous outcomes for the baby, but more lung issues

No difference in the hospital stay for moms

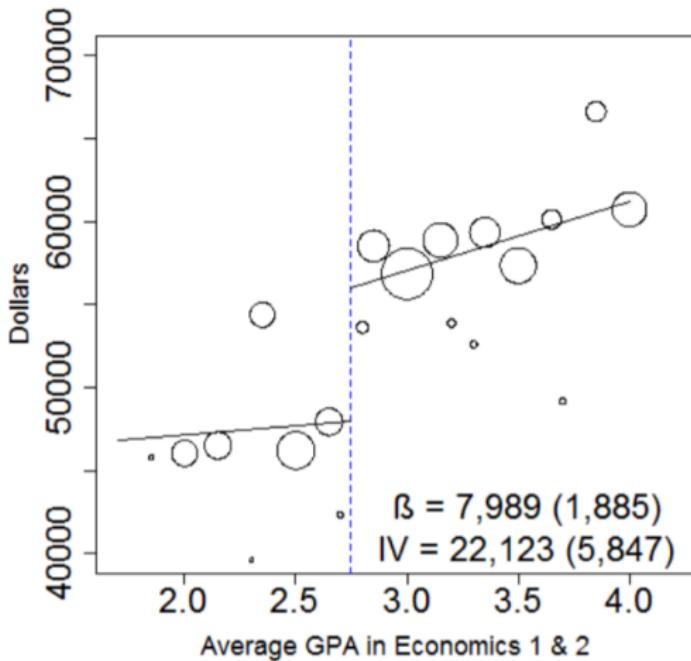
BUT: There appear to be important effects on **subsequent births...**

Regression discontinuity

An aesthetically pleasing approach

uses sharp cutoffs to identify causal effects

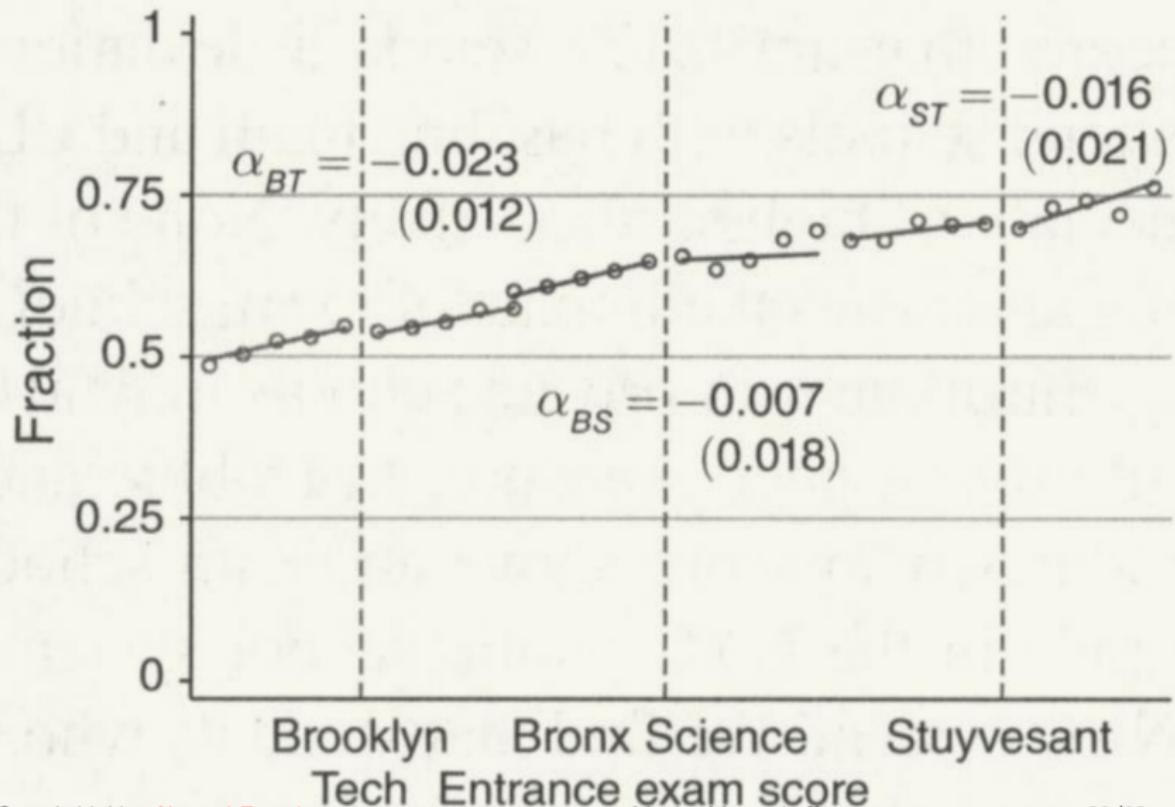
Studying economics



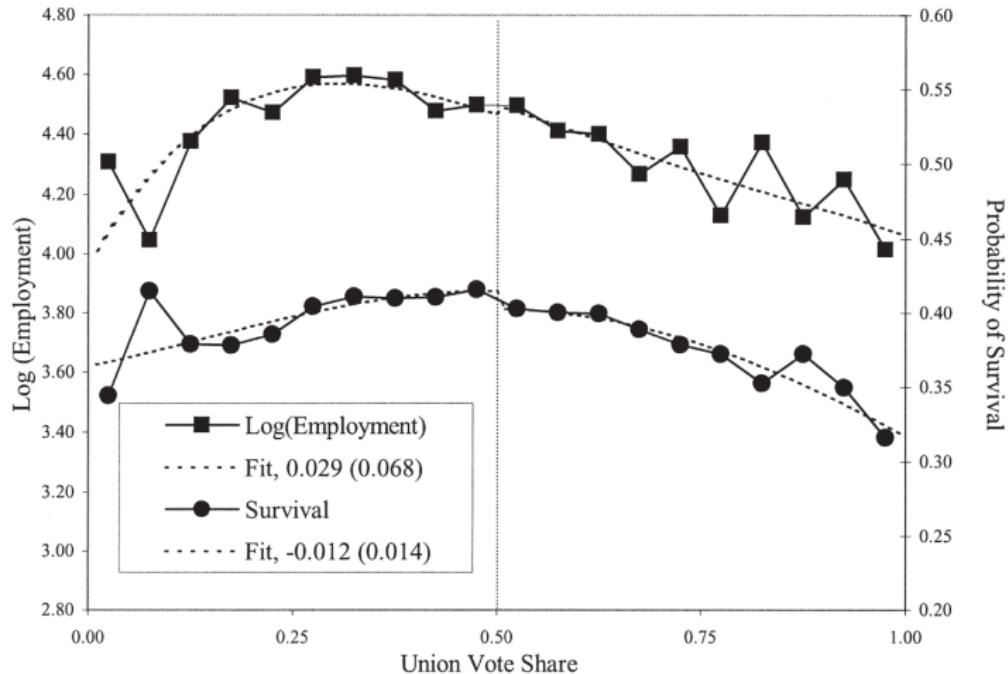
(Correlational evidence would have told you this too)

Elite high schools

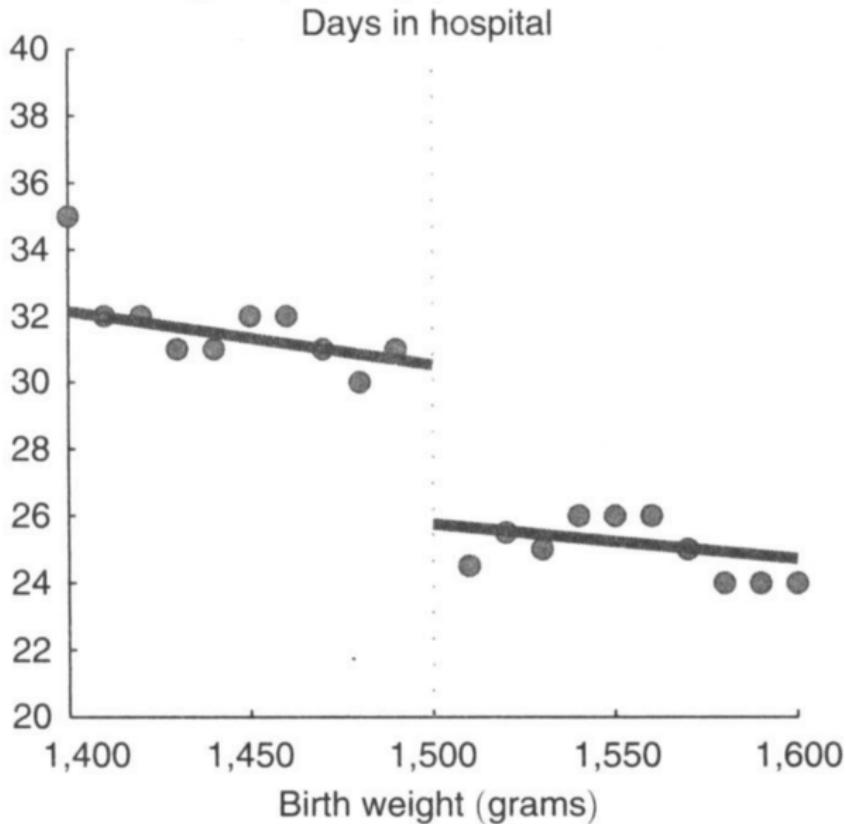
Panel B. Four-year graduation



Union elections



Additional medical care



Additional medical care

