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Statistical Literacy: Confounding

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Slides at www.StatLit.org/pdf/2011SchieldUTSA6up.pdf

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Statistical Literacy:

The ability to read and interpret summary statistics in everyday life.

Studies relation between association & causation
Studies full-range of influences on a statistic:
•Context [see the next slide],
•Assembly [choice of definition, etc.] ,
•Randomness,
•Error (bias)
Admonition: "*Take CARE*"

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Take CARE: Context

The influence of factors **taken into account by**
- data broken out by subgroups in tables and graphs
- averages, ratios and comparisons of averages and ratios
- epidemiological models (cf., deaths attributed to obesity)
- regression models and
- the study design (cf., longitudinal vs. cross-sectional; experiment vs. observational study).

The influence of related factors (confounders)
not taken into account in the study and
not blocked by the study design.

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Controlling for a confounder can INCREASE an association

Minnesota has 27% more prison expense than Iowa

State	Total	# Inmates	Per Inmate
MN	$184M	4,865	$37,825
IA	$144M	5,929	$24,286

MN has 18% fewer inmates than IA

MN has 56% more prison expense *per inmate* than IA

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Controlling for a confounder can DECREASE an association

Minnesota has 3.8 times as much prison expense as Maine

State	Total	# Inmates	Per Inmate
MN	$184M	4,865	$37,825
ME	$48M	1,424	$33,711

MN has 3.4 times as many inmates as ME

MN has 25% more prison expense *per inmate* than ME

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Controlling for a confounder can NULLIFY an association

Maryland has 3 times as much prison expense as Kansas

State	Total	# Inmates	Per Inmate
MD	$481M	21,623	$22,250
KS	$159M	7,148	$22,250

MD has three times as many inmates as KS

MD has the same prison expense *per inmate* as KS

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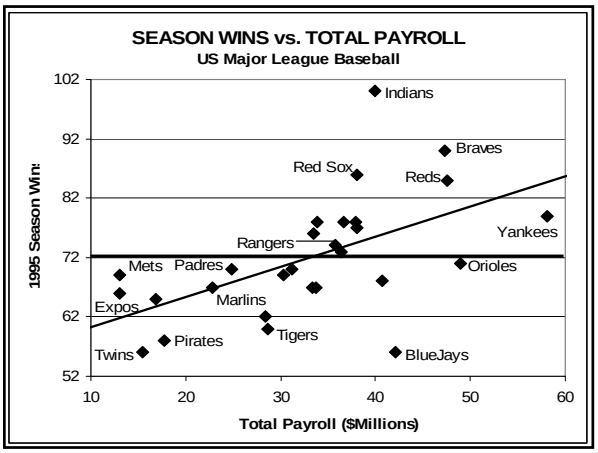
Controlling for a confounder can REVERSE an association

California has 50% more prison expense than New York

State	Total	# Inmates	Per Inmate
CA	$2.9B	136K	$21,385
NY	$1.9B	69K	$28,426

CA has almost twice as many inmates as NY

CA has 25% less prison expense *per inmate* than NY



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Adjusting for Land Size: Standardize on Average Lot

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US SAT-VERBAL SCORES

Average SAT-V	1981	2002	Change	1981	2002
All Test-Takers	504	504	0	100%	100%
White	519	527	8	85%	65%
Black	412	431	19	9%	11%
Asian	474	501	27	3%	10%
Mexican	438	446	8	2%	4%
Puerto Rican	437	455	18	1%	3%
American Indian	471	479	8	0%	1%

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Teaching Testable Confounding

Stories are fun to tell.

But if students can't work problems then you can't put it on the test.

If you don't assess it, students won't learn it.

Can you teach *testable* confounding without covering most of multivariate analysis?

Yes. See Schield (2010, 2006, 2003)

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City Hospital: Hospital of Death??

Hospital	Total	Died	Death Rate
City	1,000	55	5.50%
Rural	1,000	35	3.50%
Both	2,000	90	4.50%

Condition	Total	Died	Death Rate
Good	800	15	1.90%
Poor	1,200	75	6.30%

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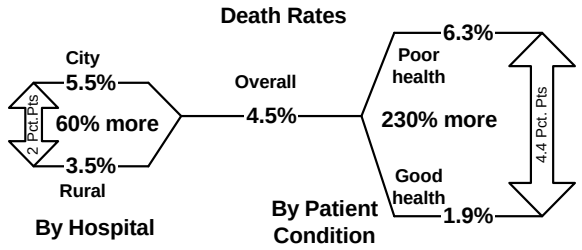
Can this confounder nullify or reverse this association?



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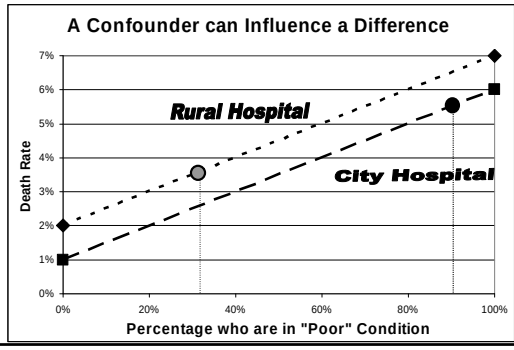
Compare Hospital Death Rates Confounder: Patient Condition



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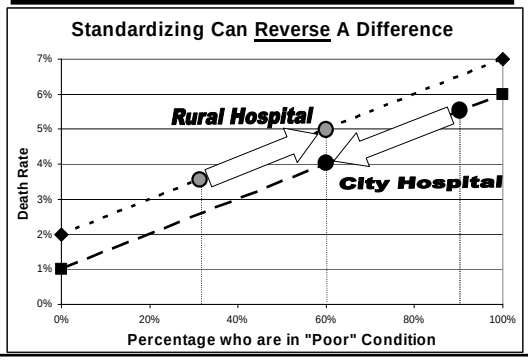
Standardize on combined confounder percentage



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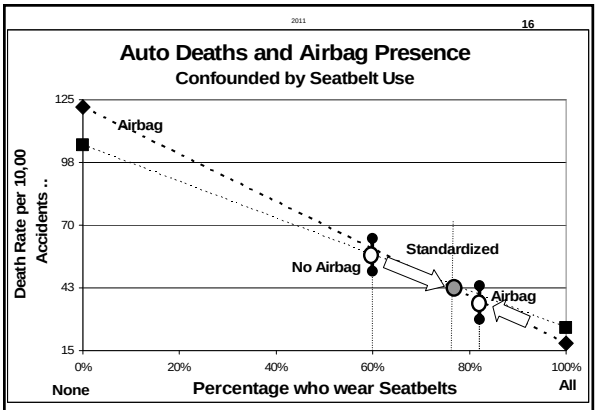

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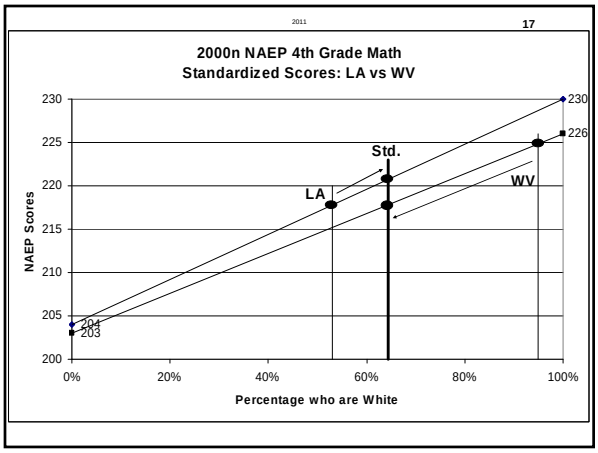

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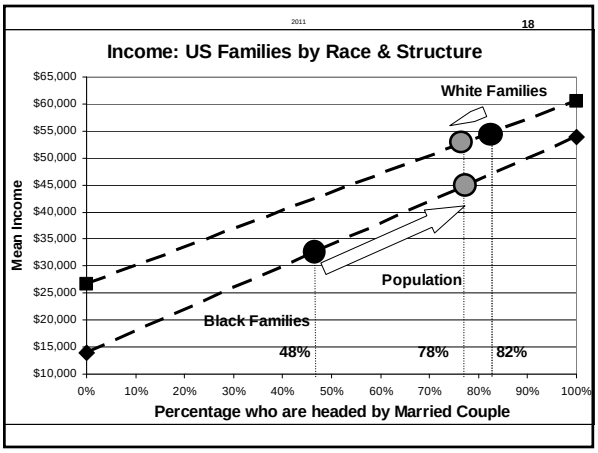

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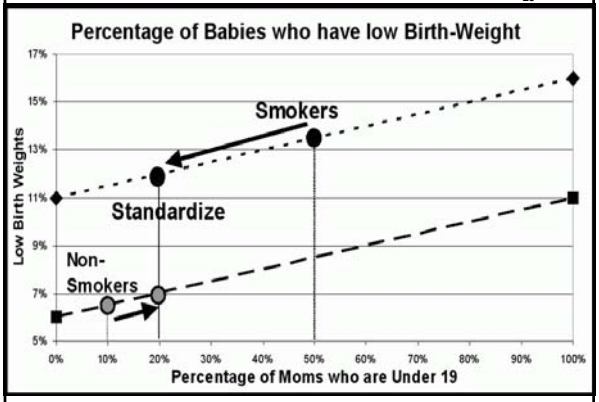

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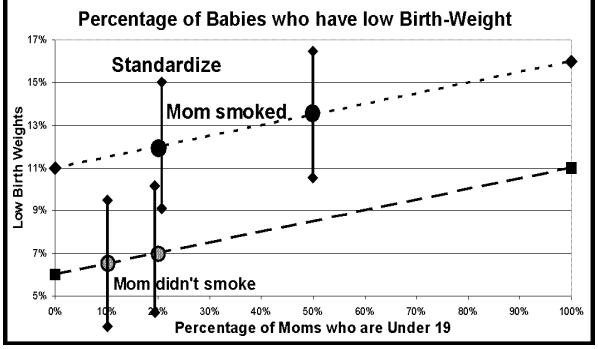
Controlling Can Change Statistical Significance



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Confounding Is Important for Our Students

As sample sizes increase, the effect size that is statistically-significant decreases.

Today, one can "buy" statistical significance.

Observational studies are more common than clinical trials for most students taking statistics: business, sociology, social work, economics, criminal justice, etc.

For most students today, confounding is more influential than chance.

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Confounding Is Important for Informed Citizens

Most news stories involving statistics involve observational studies.

Most policy debates involve questions about the influence of plausible confounders.

Read Jessica Utt's 2010 ICOTS paper: "*Unintentional Lies in the Media: Don't Blame Journalists for What we don't Teach.*"

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Conclusion

To help students see the value in statistics, statistical educators must show students how confounders can influence statistical associations and can change statistical significance.

And they must do so in ways that are accessible and testable in the first course.

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