Statistical Literacy: Teaching

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Birds of a Feather:
www.StatLit.org/pdf
/2022-Schield-ASA-BOF Slides.pdf

Statistical Literacy: Confounder-Based

Background:
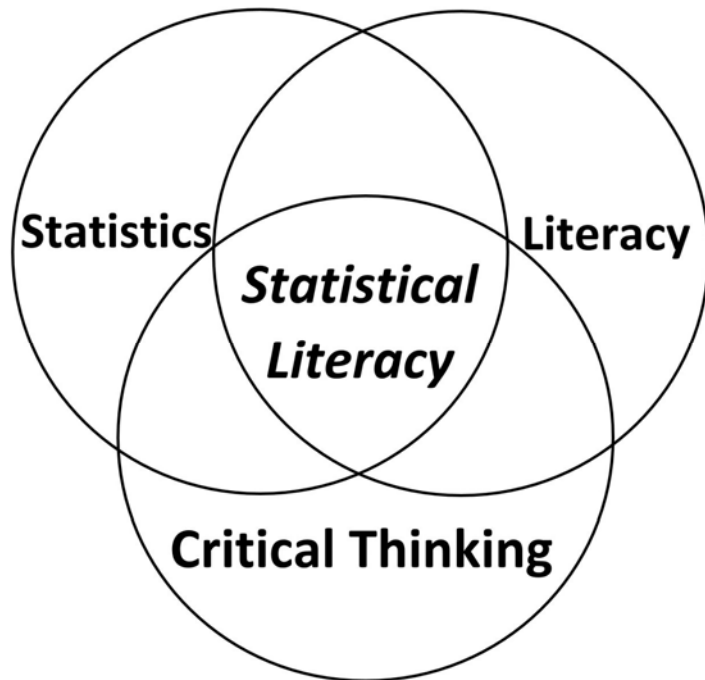
Slides
Statistical Literacy: UNM First Year Results
www.StatLit.org/pdf/2022-Schield-ASA-Slides.pdf
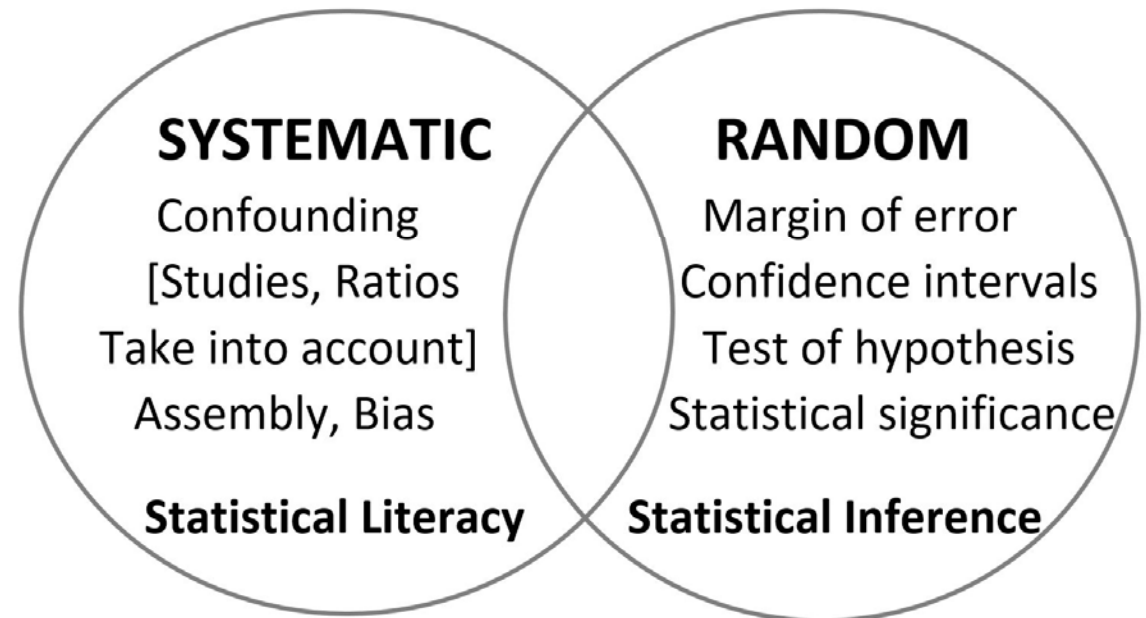

Papers:
Teaching Confounding:
www.StatLit.org/pdf/2021-Schield-USCOTS.pdf

Less than a 30% overlap;
More confounding than inference

Statistics

Statistical Literacy

Literacy

Critical Thinking

STATISTICS STUDIES VARIATION
Two kinds of variation

SYSTEMATIC

Confounding
[Studies, Ratios
Take into account]
Assembly, Bias

Statistical Literacy

RANDOM

Margin of error
Confidence intervals
Test of hypothesis
Statistical significance

Statistical Inference

Statistics: The Four Essentials	
1	Statistics are numbers *in context*
2	Statistics are *socially constructed*
3	Statistics can be *influenced*
4	*With statistics,* **"Take Care"***!!!*

Statistics can Be Influenced

Q. Best advice when dealing with statistics?

A. "Take CARE". Statistics can be influenced.

All influences are grouped into four categories:

C: Confounding: Confused by related factors

A: Assembly: how things are defined, counted, etc.

R: Randomness

E: Error (including bias)

Admonition: "Take CARE"

Students like "CARE". It gives them a structure.

When asked to rank what idea they considered the most valuable, students chose "Take CARE".

Today's student need to study Statistics

Disparities in

- Education, suspensions and graduation
- Policing, crime, sentencing and prison
- Wages, income, assets, loans and wealth
- Health, health care, homicides and deaths

Disparities by

gender, race, ethnicity, religion, politics, age, etc.

All of these rely on statistics: social statistics.

Confounding: Qualitative

Association: *People who read home and fashion magazines are more likely to get pregnant than people who read car and sport magazines.*
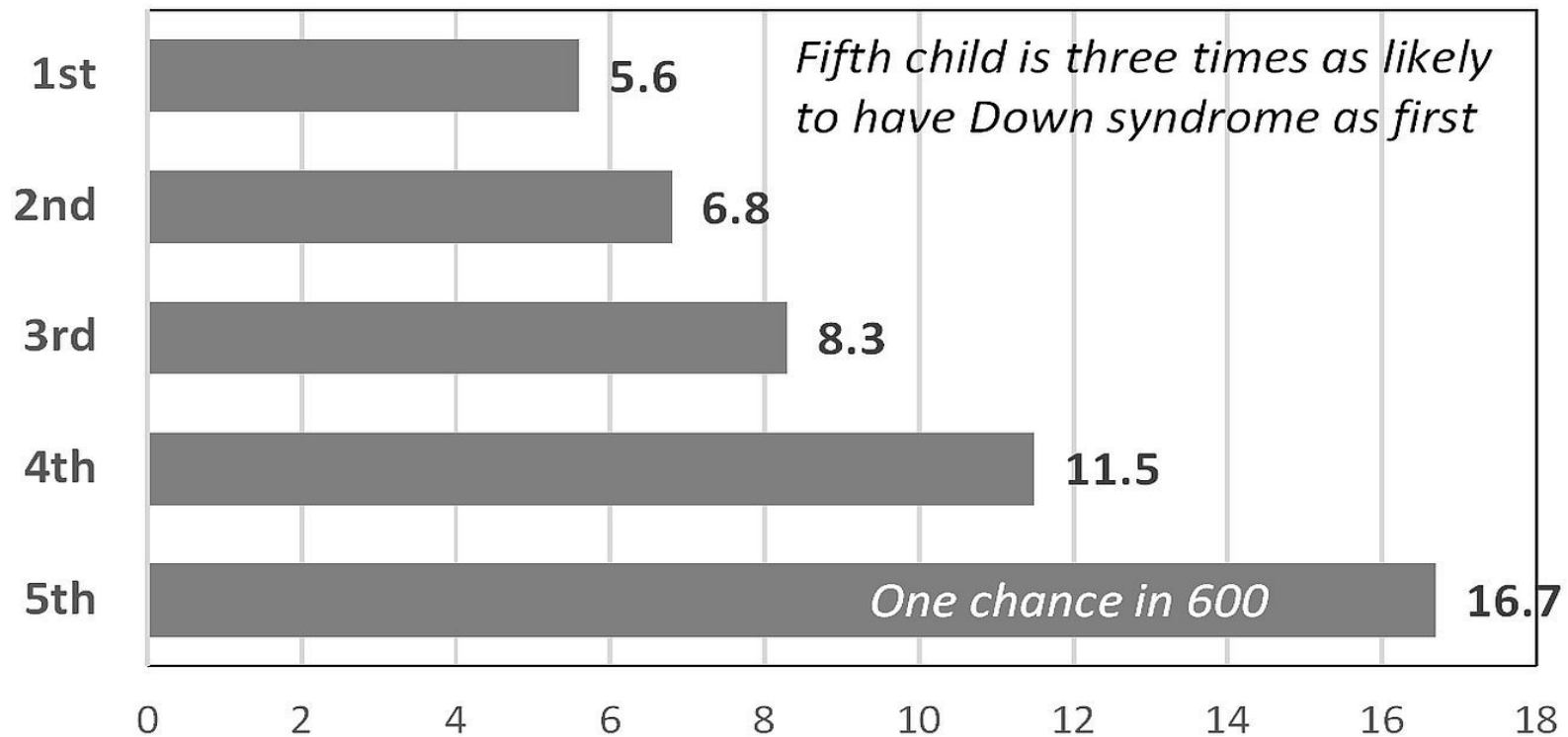
We know that pregnancy isn't caused by magazines. We know that only women can get pregnant.

We quickly recognize that women are more likely to read home and fashion magazines than men.

QED. This association is confounded by gender.
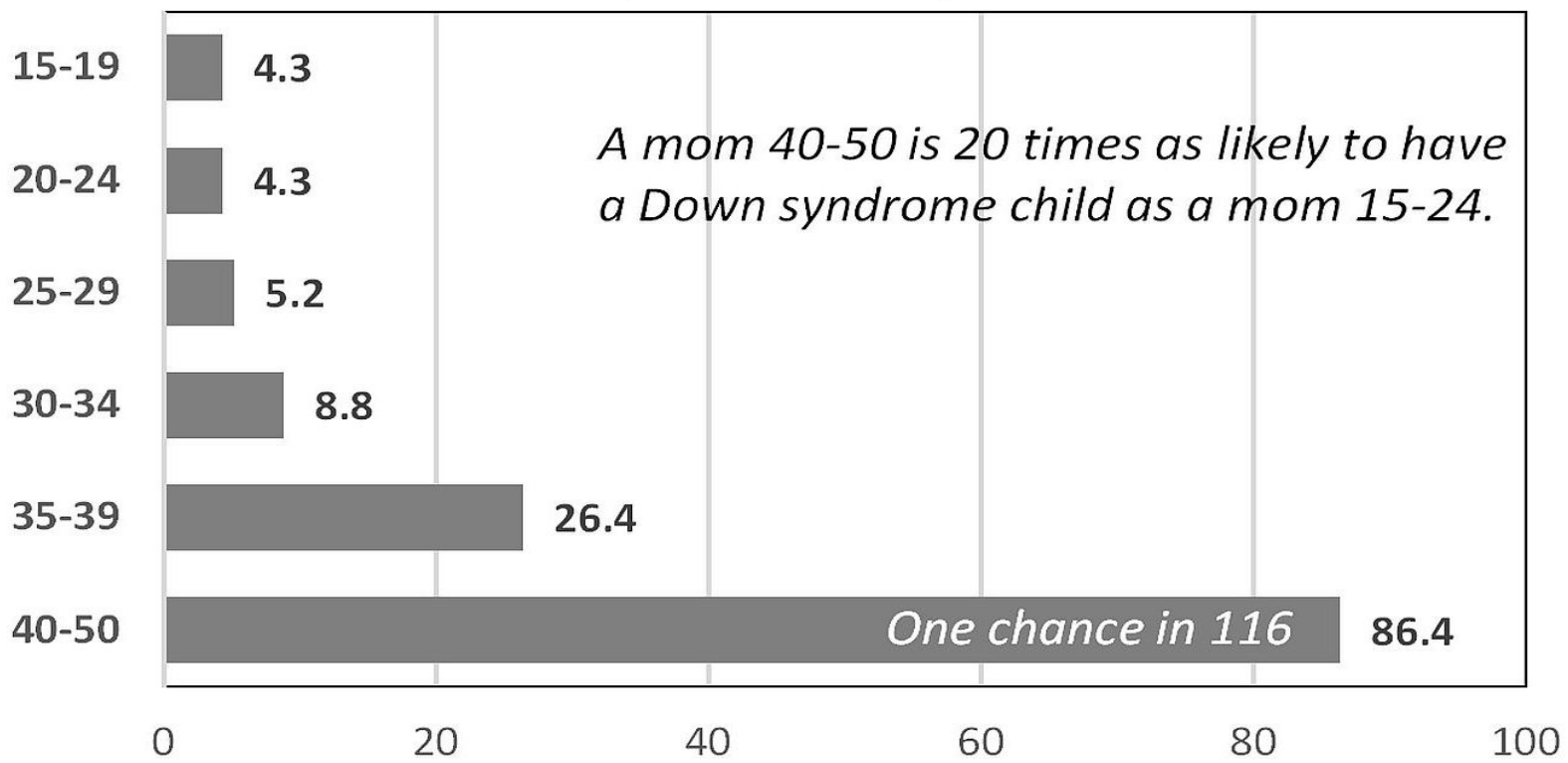
Confounding:
Quasi-quantitative

Down Syndrome: Cases per 10,000 Births
By Child's Birth Order

Fifth child is three times as likely to have Down syndrome as first

Birth Order	Cases
1st	5.6
2nd	6.8
3rd	8.3
4th	11.5
5th	*One chance in 600* 16.7

Schield (2017): www.StatLit.org/pdf/2017-Schield-Downs-Syndrome-Slides.pdf

Statistics can be Confounded Down Syndrome

Down Syndrome: Cases per 10,000 Births By Mom's Age

Age	Cases
15-19	4.3
20-24	4.3
25-29	5.2
30-34	8.8
35-39	26.4
40-50	One chance in 116 86.4

A mom 40-50 is 20 times as likely to have a Down syndrome child as a mom 15-24.

Schield (2017): www.StatLit.org/pdf/2017-Schield-Downs-Syndrome-Slides.pdf

Confounding Quantitative: Can Work Problems

Covid vaccinated cases are 2.4 times as likely to die as are unvaccinated cases.

Covid Death Rates Per Case		
	Crude Rate	# Cases
Unvaccinated	**0.17%**	151,052
Vaccinated	**0.41%**	117,114
41/17 = 2.4		UK NHS 2021

This result is unexpected. Doesn't make sense.

Covid Death Rates by Age

Covid Death Rates Per Case				Death Rates by Age	
	Crude Rate	# Cases		<50	50+
Unvaccinated	**0.17%**	151,052		0.03%	5.96%
Vaccinated	**0.41%**	117,114		0.02%	1.68%
41/17 = 2.4		UK NHS 2021			

Who are LESS likely to die?

Under 50: Vaccinated.   50+? Vaccinated

Confounder: "It's the mix!"

Elderly: 23% of vaccinated, 2% of unvaccinated

Covid Death Rates: Weighted Averages

Covid Death Rates per Case	<50	50+	Crude All		Fraction of Cases <50	50+	All
Un-vac	0.03%	5.96%	**0.17%**		0.977	0.023	1.000
Vaccinated	0.02%	1.68%	**0.41%**		0.767	0.233	1.000
0.17% = 0.977*0.03% + 0.023*5.96%					0.885	0.115	1.000

This *crude comparison* is true by misleading.

Confounder: "It's the mix!"

Older: 2.3% of unvaccinated, 23% of vaccinated

Covid Death Rates: Standardized

Standardize: use combined mix: 11.5% are old

Covid Death Rates per Case			Crude	Fraction of Cases			Adjusted
	<50	50+	All	<50	50+	All	Standard
Un-vac	0.03%	5.96%	**0.17%**	0.977	0.023	1.000	**0.71%**
Vaccinated	0.02%	1.68%	**0.41%**	0.767	0.233	1.000	**0.21%**
0.17% = 0.977*0.03% + 0.023*5.96%				0.885	0.115	1.000	
0.41% = 0.767*0.02% + 0.233*1.68%				**0.21%**=.885*.02%+.115*1.68%			
		Ratio	2.4	Ratio	10.2	Ratio	3.4

After controlling for age, unvaccinated cases are 3.4 times as likely to die as are vaccinated cases.
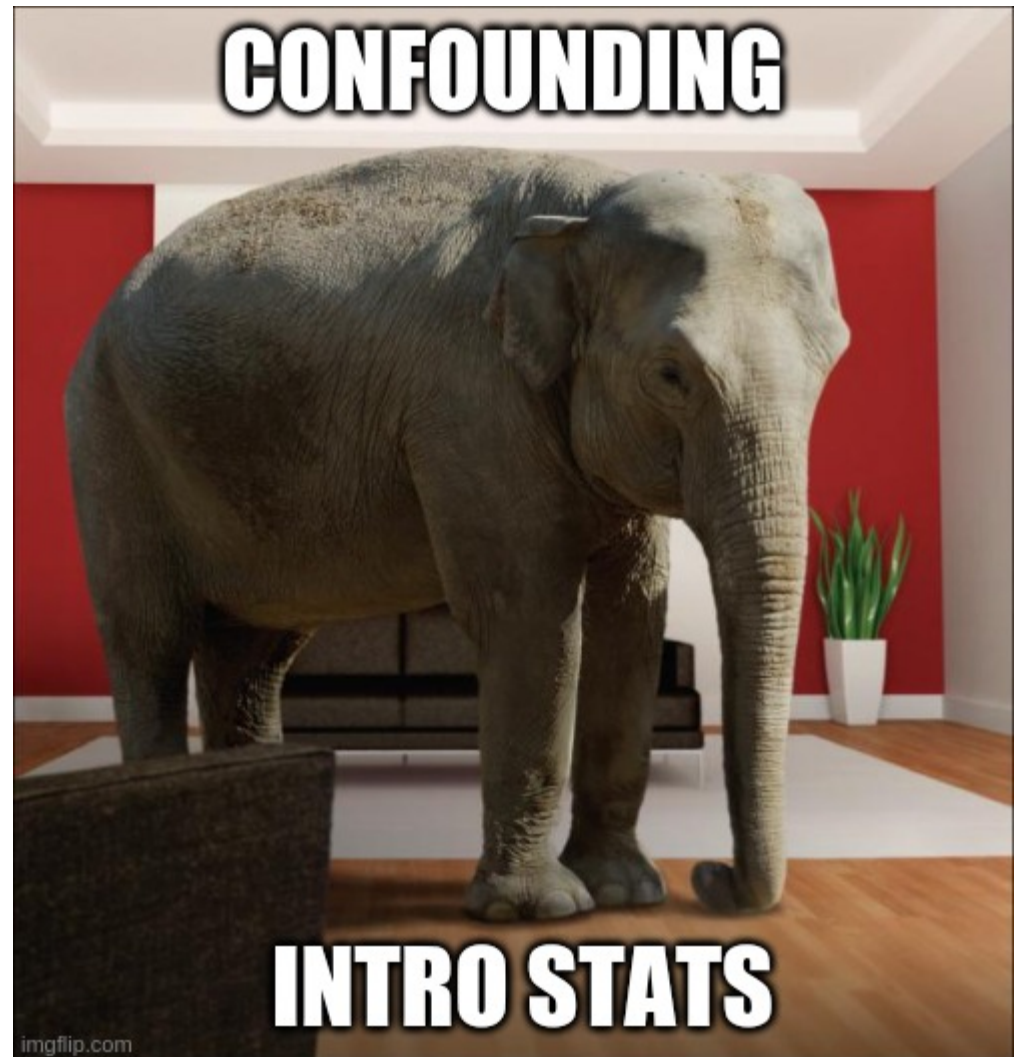
Confounding is the elephant in observational statistics

Teachers know it.

Not in intro. statistics or research methods.

It should be taught in an introductory course.

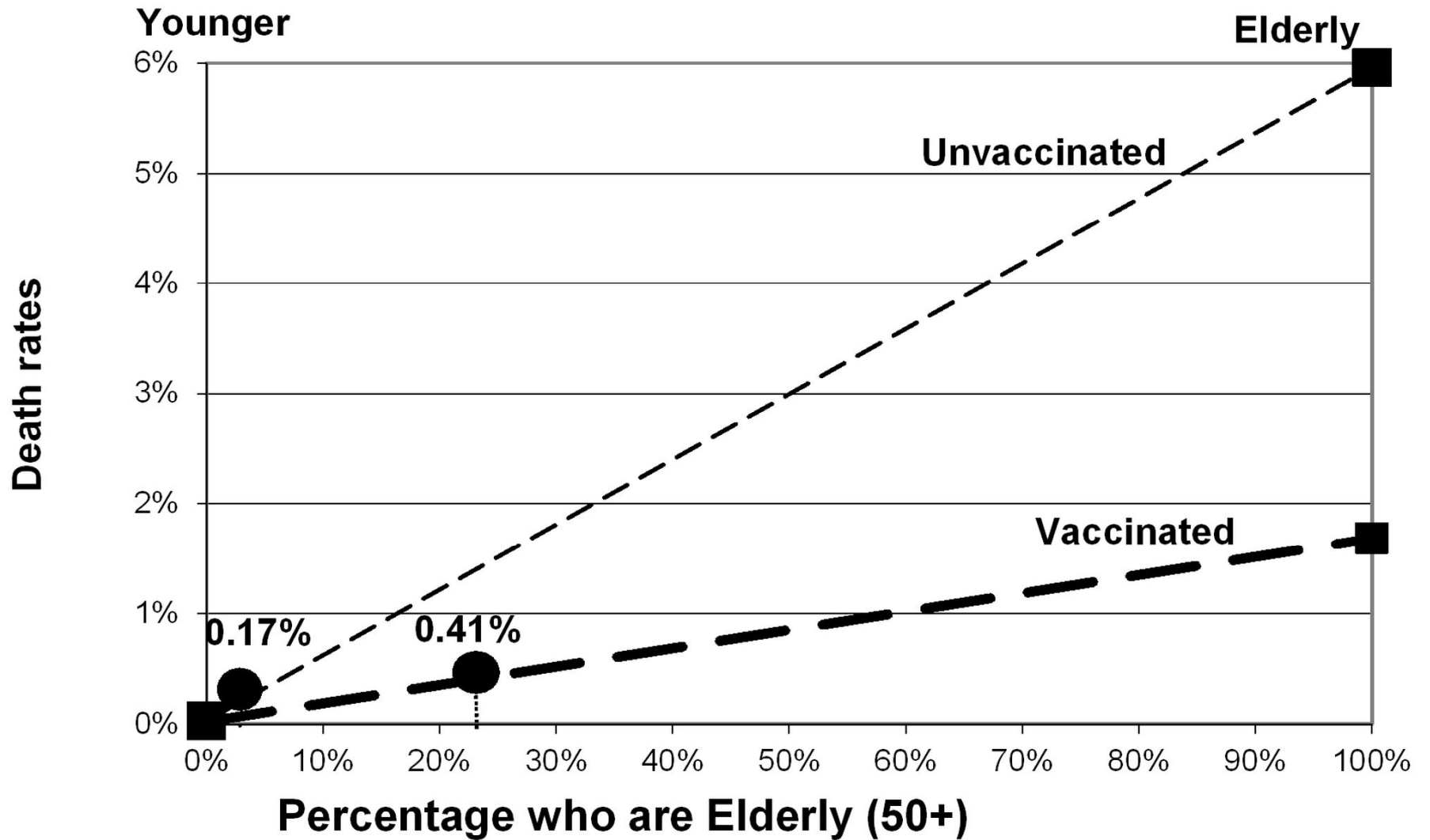There isn't time in traditional statistics.
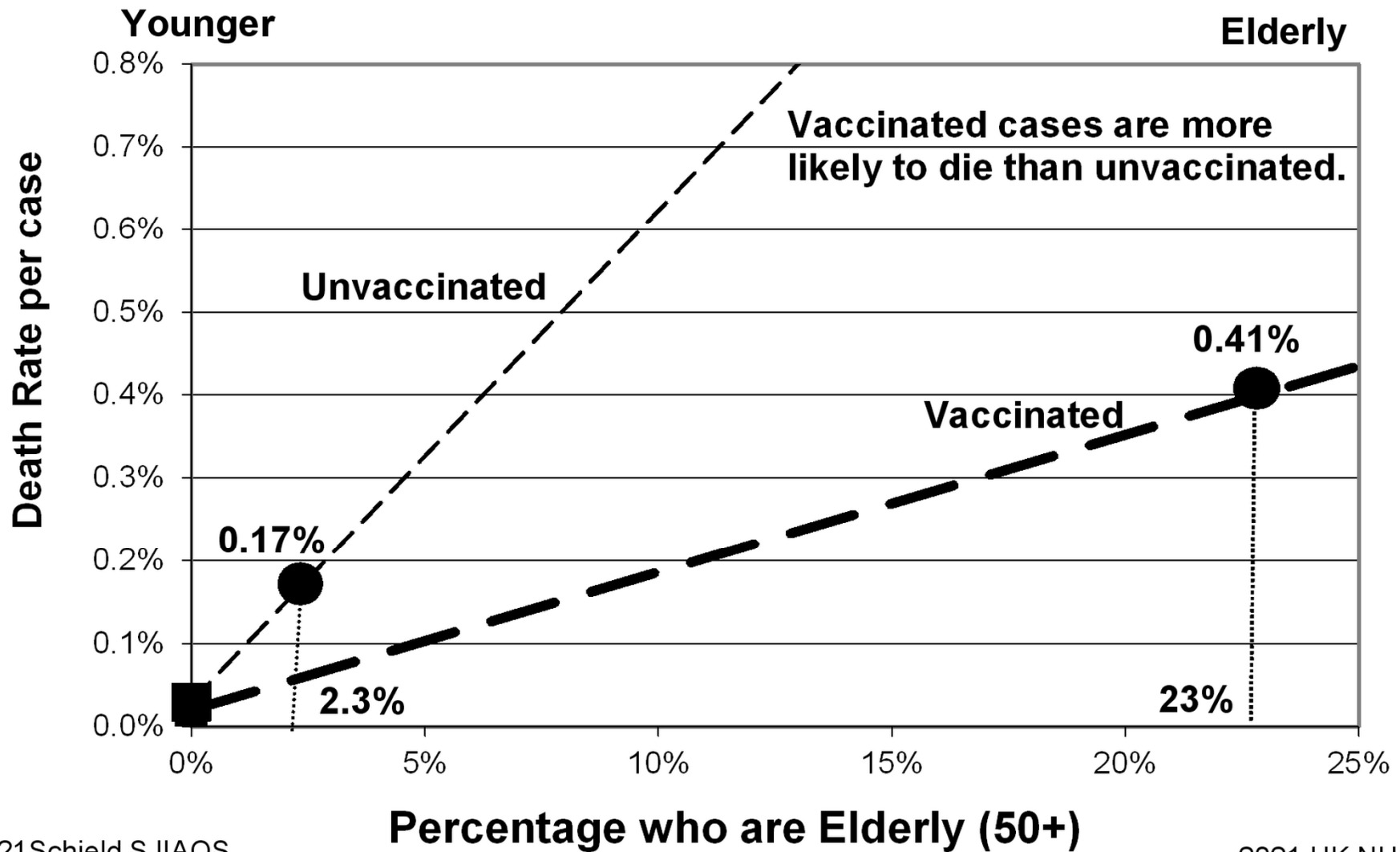
Confounding: Taking into Account

"Taking into account" the influence of a related factor means converting a mixed-fruit comparison (apples and oranges) into a same fruit comparison (apples and apples).

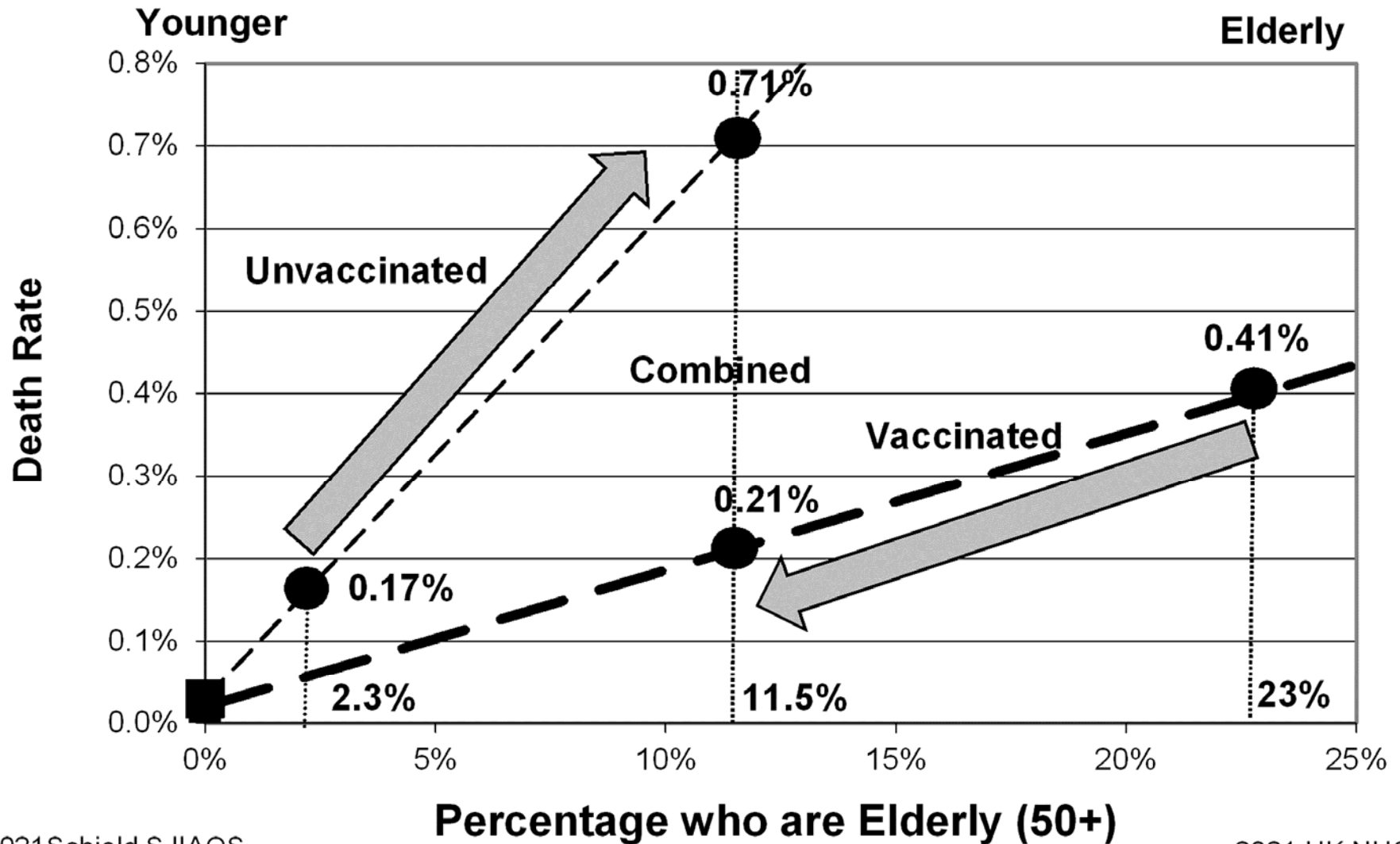Taking into account can reverse the direction of a comparison: Simpson's paradox.

Covid Death Rates: Crude

Covid Death Rates: Standardized

University of New Mexico is offering a new course!

Taught 7 sections in 2021-22

Statistical Literacy

UNM UNIVERSITY CATALOG

MATH 1300 (3)

Participants will study the social statistics encountered by consumers. Investigate the story behind the statistics. Study the influences on social statistics. Study the techniques used to control these influences. Strong focus on confounding.

Meets New Mexico General Education Curriculum Area 2: Mathematics and Statistics.

Statistical Literacy Textbook:
Eight Chapters

1. The story behind the statistics
2. Comparisons, CARE solutions
3. Understanding Measurements
4. *Percent/Percentage grammar*
5. *Rate & Chance grammar*
6. *Likely grammar*
7. Interpreting confusing ratios
8. Randomness

Statistical Literacy

2022: Seeing the story behind the statistics

Milo Schield
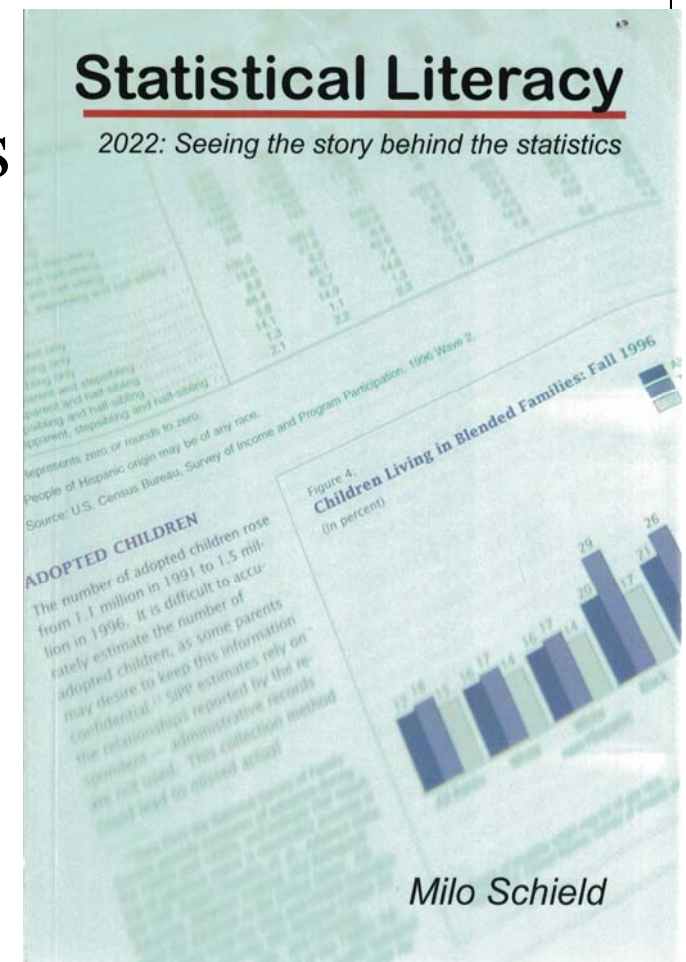
4. Student Evaluations
www.statlit.org/UNM.htm

"I've despised every other math class I've ever taken but this one is actually enjoyable. It also seems more useful than any math course I've ever taken."

"I enjoyed critical thinking and the news stories. Both provide beneficial knowledge I will take with me into my everyday life."

4. Student Evaluations Fall S1
www.statlit.org/UNM.htm

"This course is an answer to my prayers, I am a music major and horrible at math so fulfilling my math requirement has been hard.

This is the first math class I actually liked. I loved the format; the material is about things I can apply to everyday life.

The textbook is fantastic and helped me a lot...

I would recommend this class for anyone."

Conclusion

Statistical Literacy involves statistics, writing and critical thinking. This course is very different from a typical mathematics course.

Statistical Literacy must be tailored to the students involved. First year-students are very different from Seniors or Honors students.

Students see value in taking Math1300. To help their students think critically about statistics, other colleges should offer Statistical Literacy.