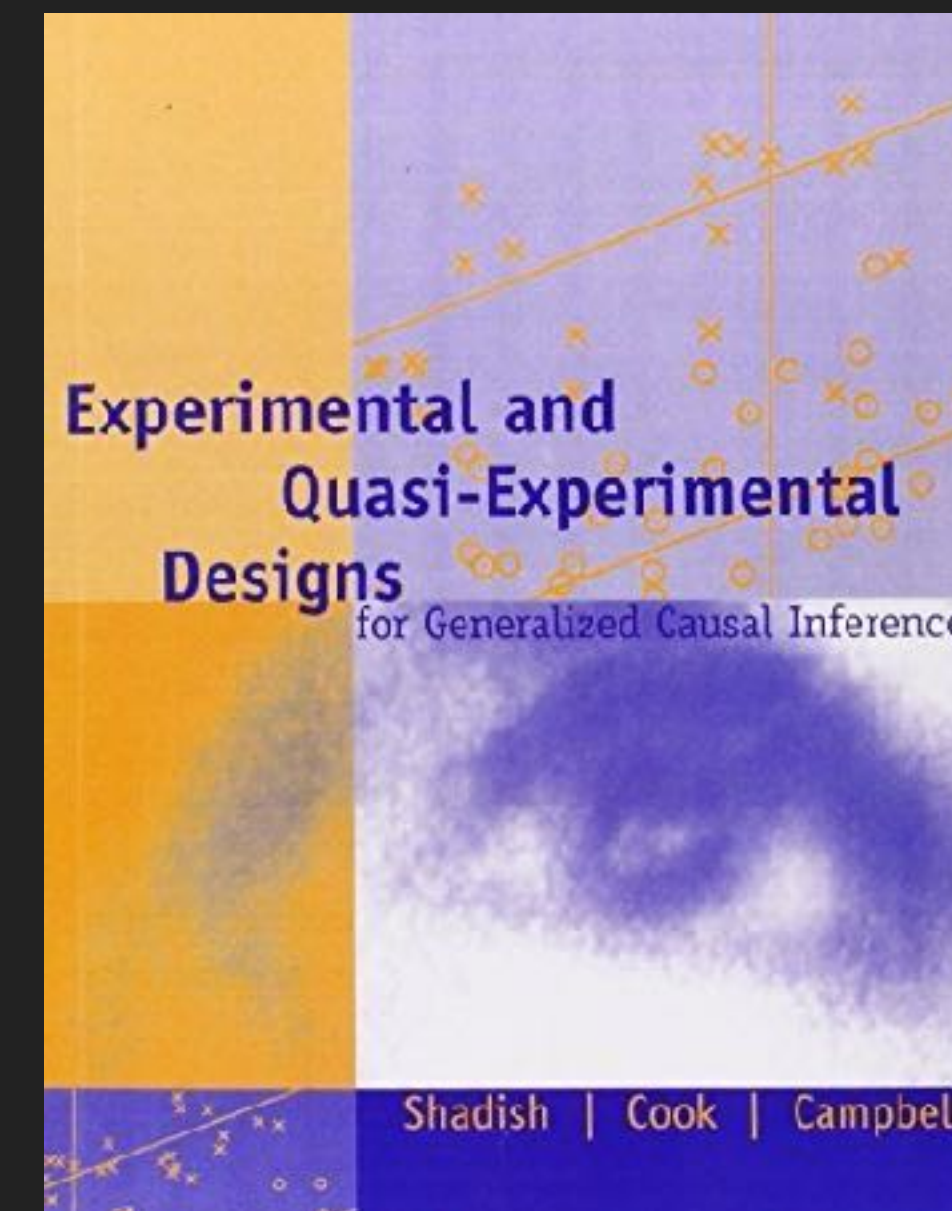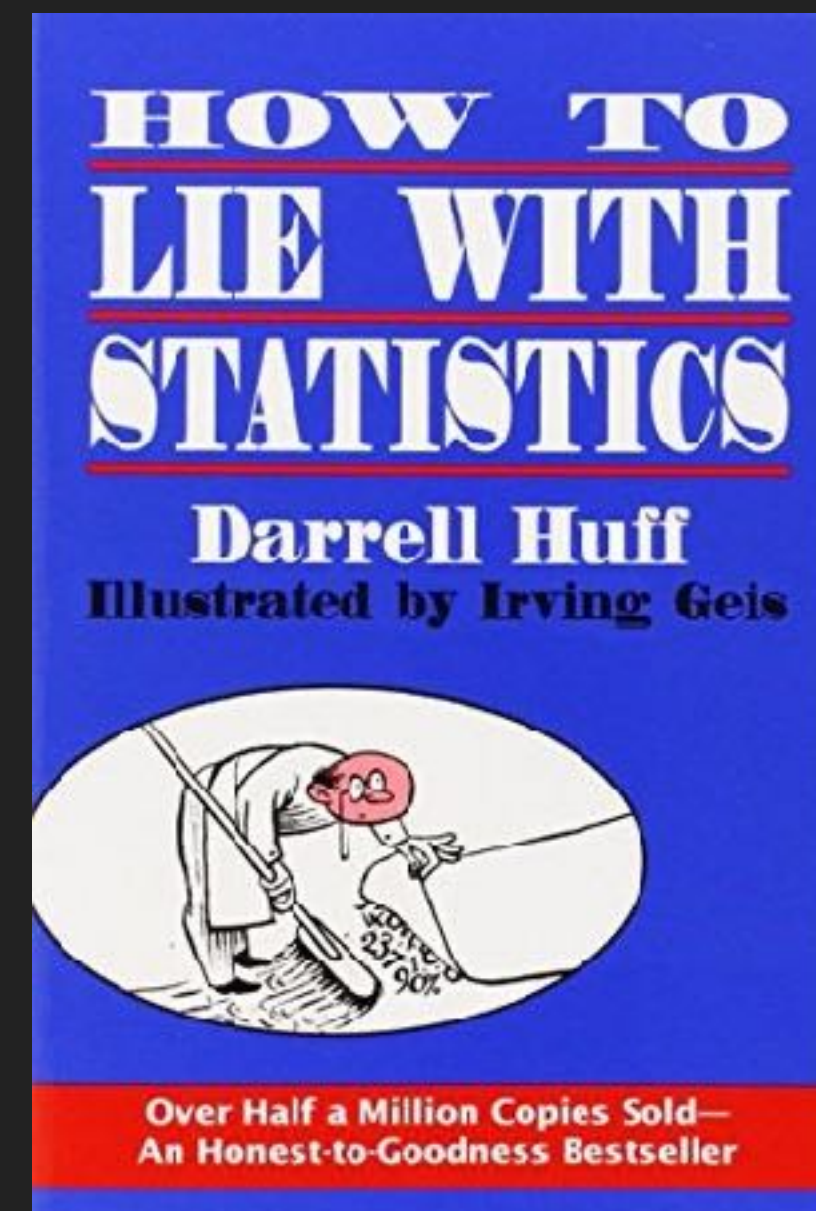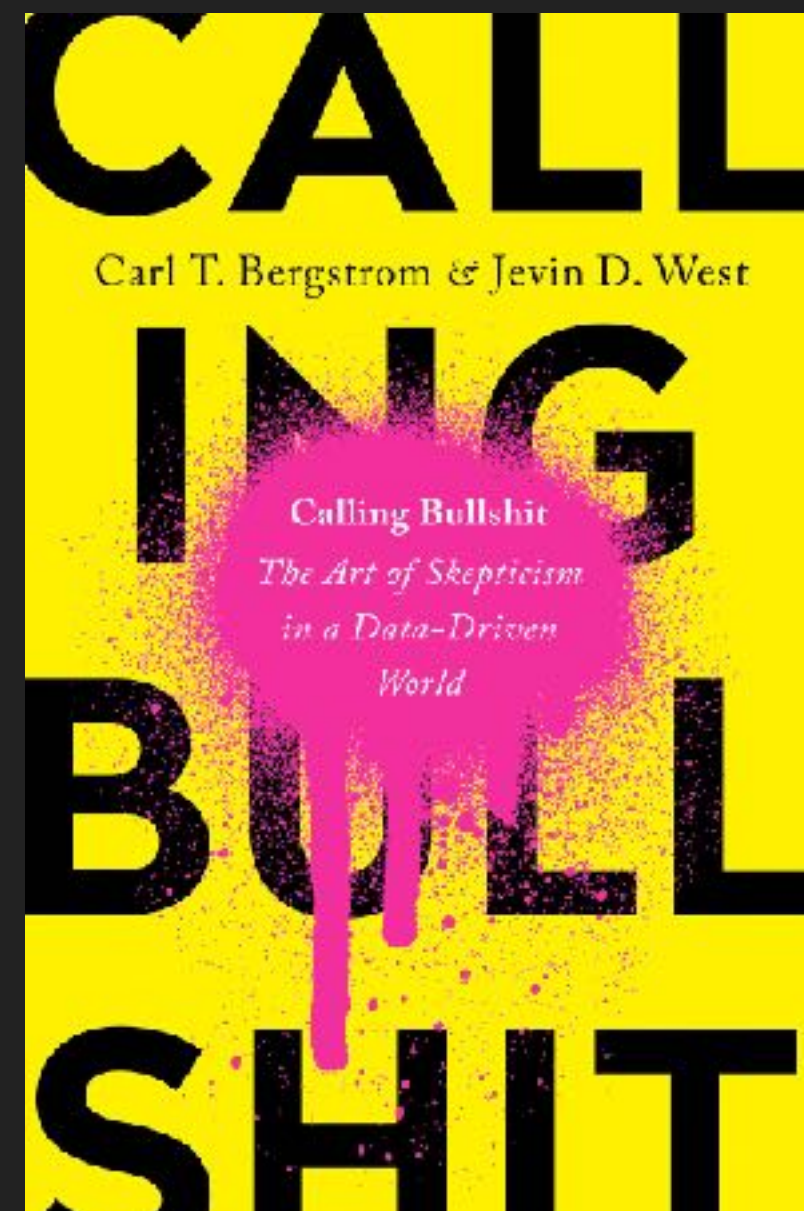17-803 Empirical Methods

Bogdan Vasilescu, Institute for Software Research

Designing Experiments (Part I)

Thursday, March 11, 2021

Outline for Today

▸ Left-over kickoff presentations

▸ Lies, damned lies, and statistics (part I)

▸ Experimental design

▸ Two ~~victims~~ volunteers to present a paper next week

Numbers and Nonsense

Drink Hot Cocoa Before Bed?

▸ "99.9% caffeine-free"

▸ 20-ounce Starbucks coffee:

  ▸ 415 milligrams of caffeine.
  ▸ ~21 mg caffeine per ounce.
  ▸ 1 fl oz water weighs ~28 grams.
  ▸ Thus, Starbucks drip coffee is ~0.075% caffeine by weight.

▸ Strong coffee is also 99.9% caffeine free!

Tweet About Your Work?

Tweeting about research results in three times more citations

Social media is proven to help share new science with the public

Dori Grijseels
Neuroscience
University of Sussex

Unsplash

An important part of science is sharing the findings, both with the general public, and with fellow scientists. The main method of sharing science is done by writing articles that are published in academic journals. However, most people are not subscribed to the *Annals of Thoracic Surgery*, and thus may not be aware of the latest articles that came out. This means that a lot of articles never reach the general public, or sometimes even fellow scientists. A new study by the Thoracic Surgery Social Media Network shows that tweeting might be the solution.

https://massivesci.com/notes/tweet-science-communication-research-public/

Monday, June 29, 2020 3:40 PM

Tweeting about research results in three times more citations

Social media is proven to help share new science with the public

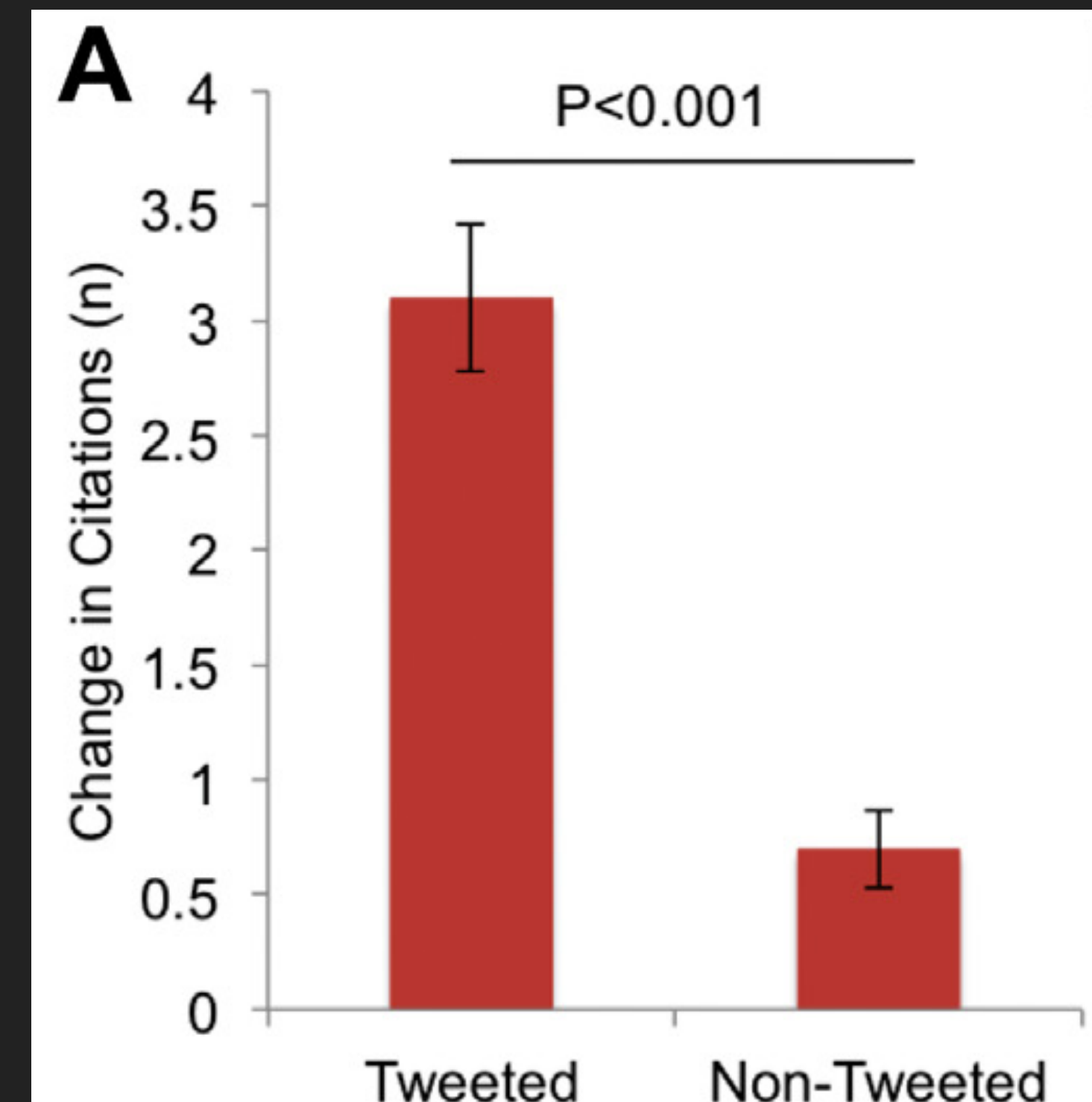**Dori Grijseels**
Neuroscience
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https://massivesci.com/notes/tweet-science-communication-research-public/
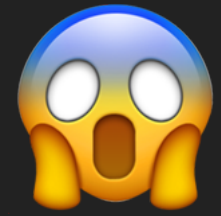
Tweet About Your Work?

Meanwhile:

Luc, J. G., Archer, M. A., Arora, R. C., Bender, E. M., Blitz, A., Cooke, D. T., ... & Antonoff, M. B. (2021). Does tweeting improve citations? One-year results from the TSSMN prospective randomized trial. The Annals of Thoracic Surgery, 111(1), 296-300.
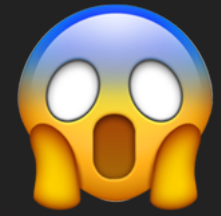
Selection Bias

The Friendship Paradox

😱 **Most likely, the majority of your friends have more friends than you do**
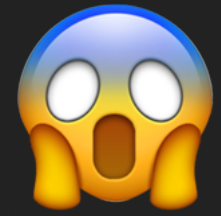
The Friendship Paradox

😱

Most likely, the majority of your friends have more friends than you do

▸ Suppose you follow Rihanna and 499 other people on Twitter.

▸ Rihanna has over one hundred million followers.

▸ The 500 people you follow will average at the very least 100,000,000 / 500 = 200,000 followers—far more than you have.

Most people have fewer friends than their average (mean) friend has.

The Friendship Paradox

😱

Most likely, the majority of your friends have more friends than you do

▸ 84 percent of Facebook users have fewer friends than the median friend count of their friends.

🤯 Most people also have fewer friends than their <u>median</u> friend has.

Do You Often Have To Wait a Surprisingly Long Time for the Next Bus To Arrive?

▸ Suppose that buses leave a bus stop at regular ten minute intervals.

▸ If you arrive at an arbitrary time, how long do you expect to wait, on average?

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5 minutes?

Do You Often Have To Wait a Surprisingly Long Time for the Next Bus To Arrive?

▸ What if buses leave every ten minutes on average – but traffic forces the buses to run somewhat irregularly?

▸ Sometimes the time between buses is quite short; other times it may extend for fifteen minutes or more.

▸ Now how long do you expect to wait?

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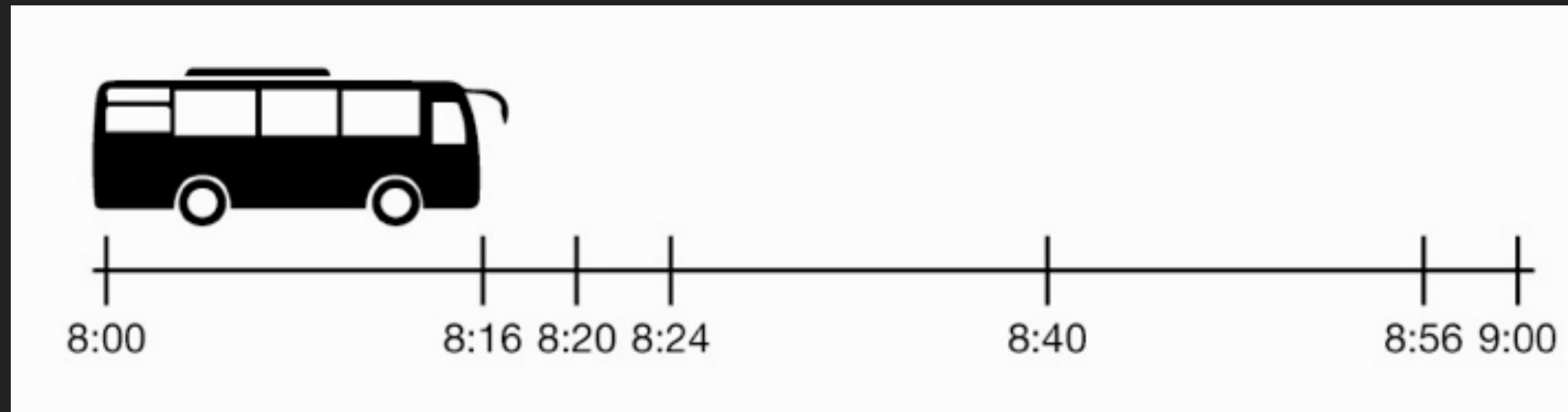
▸ Now how long do you expect to wait?

5 minutes?

Do You Often Have To Wait a Surprisingly Long Time for the Next Bus To Arrive?

▸ You are more likely to arrive during one of the long intervals than during one of the short intervals.

▸ As a result, you end up waiting longer than five minutes, on average.

~~5 minutes?~~

Do You Often Have To Wait a Surprisingly Long Time for the Next Bus To Arrive?
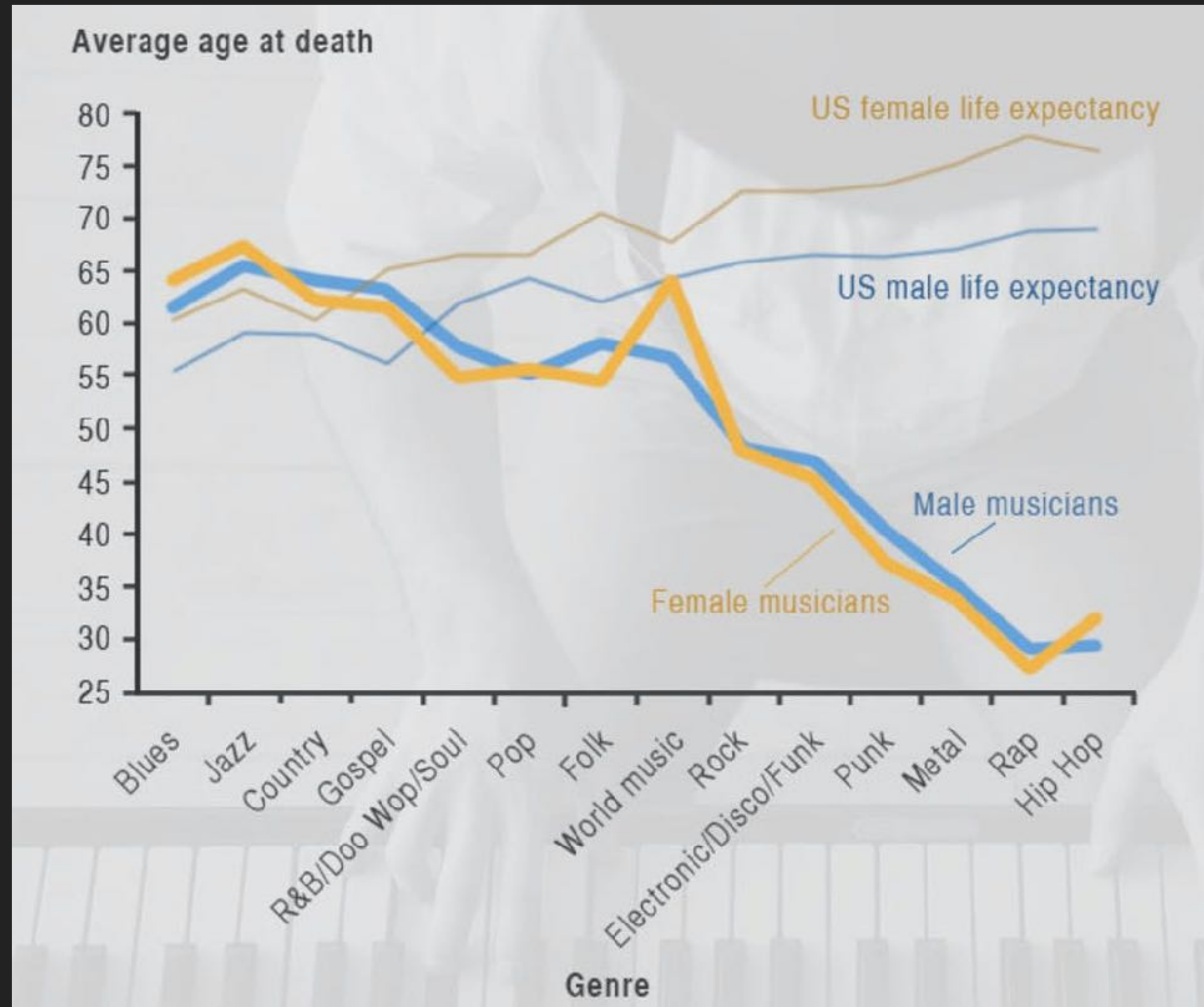

▸ 80% chance of arriving during one of the long intervals

  ▸ wait 8 minutes on average.

▸ 20% chance of arriving during one of the short intervals

  ▸ wait 2 minutes on average.

▸ Average overall wait time: (0.8 × 8) + (0.2 × 2) = 6.8 mins
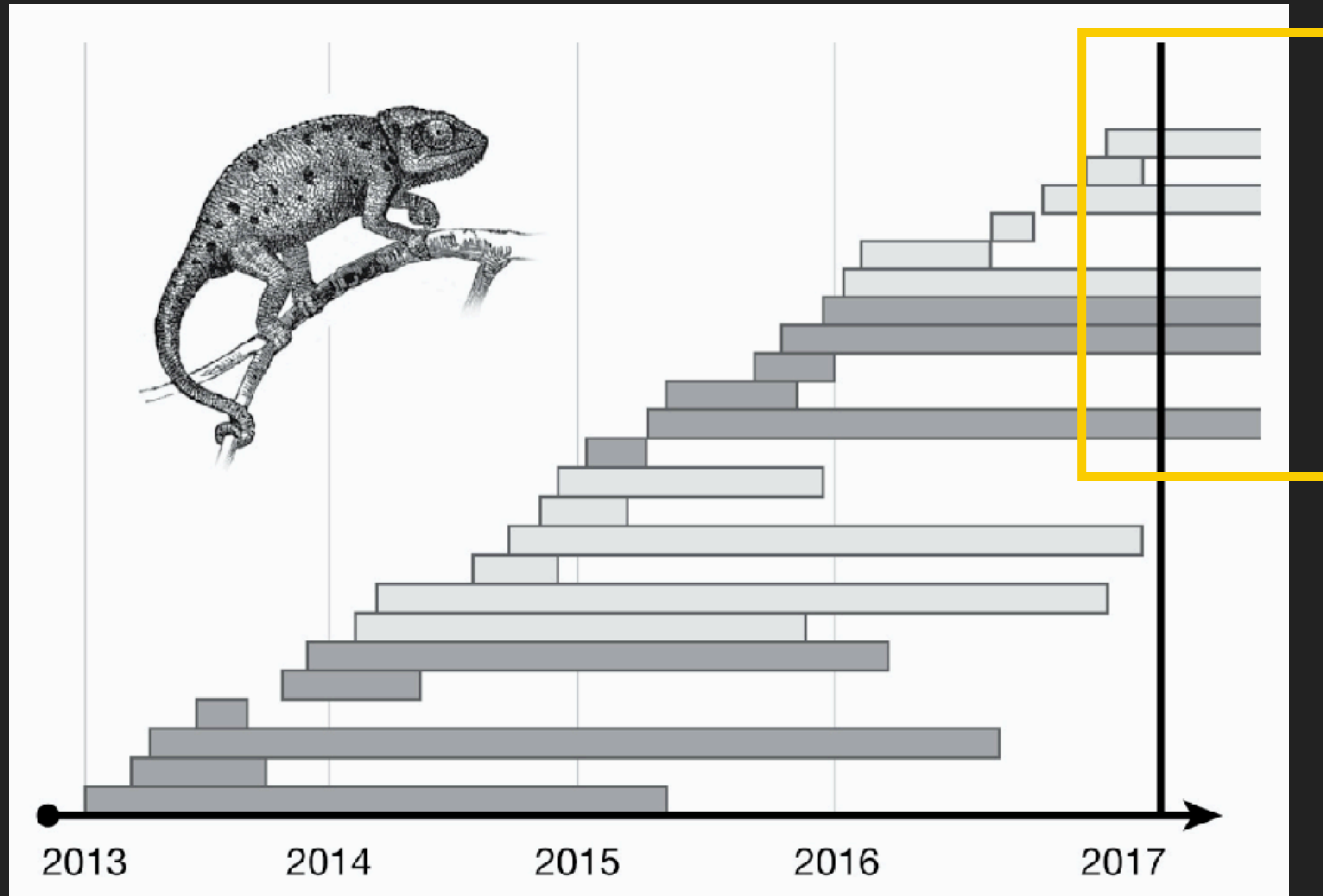
Observation Selection Effect

▸ Driven by an association between the very presence of the observer and the variable that the observer reports.
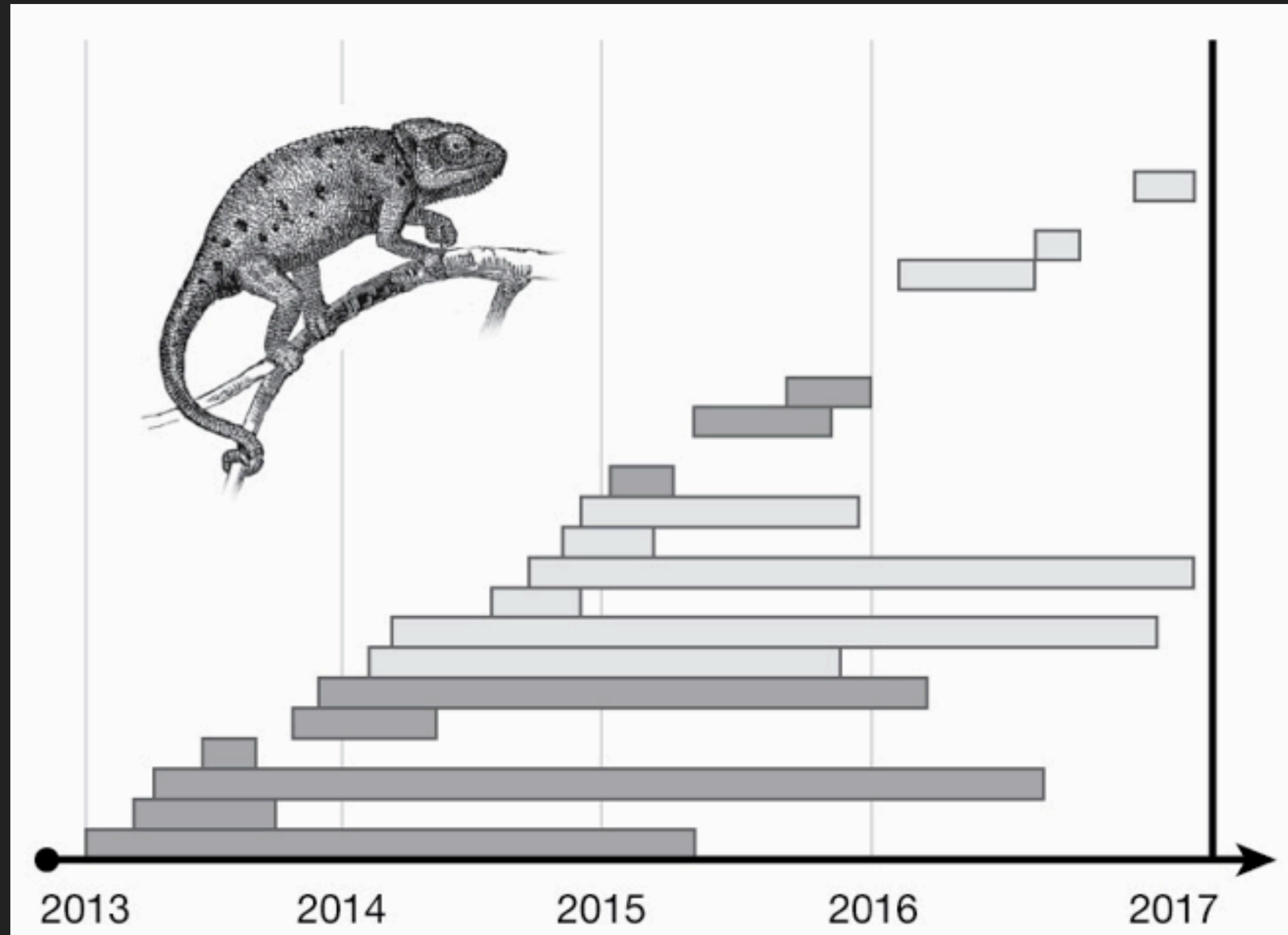
Age of Death and Musical Genre

Rap and hip-hop musicians die at about half the age of performers in some other genres?

Imagine You Are Tracking the Life Cycle of a Rare Chameleon on Madagascar

What to do about individuals not yet dead at the end of the study period?

Imagine You Are Tracking the Life Cycle of a Rare Chameleon on Madagascar
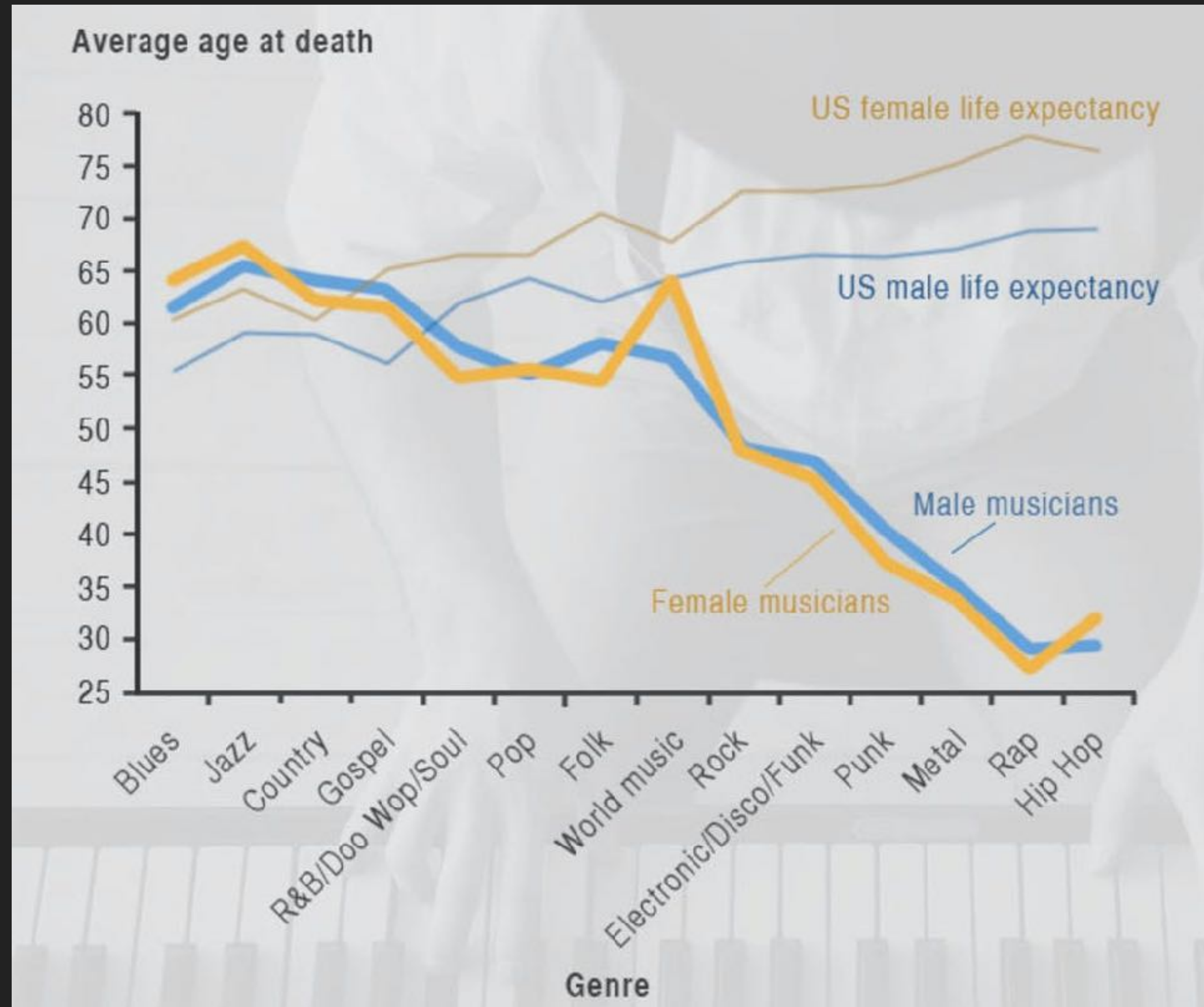

Maybe the safest thing to do is to throw out those individuals from your data set entirely?

—> Right-censoring your data

Misleading impression of mortality patterns.

Age of Death and Musical Genre

Rap and hip-hop are new genres.

Most rap and hip-hop stars are still alive today, and thus omitted from the study.

The only rap and hip-hop musicians who have died already are those who have died prematurely.
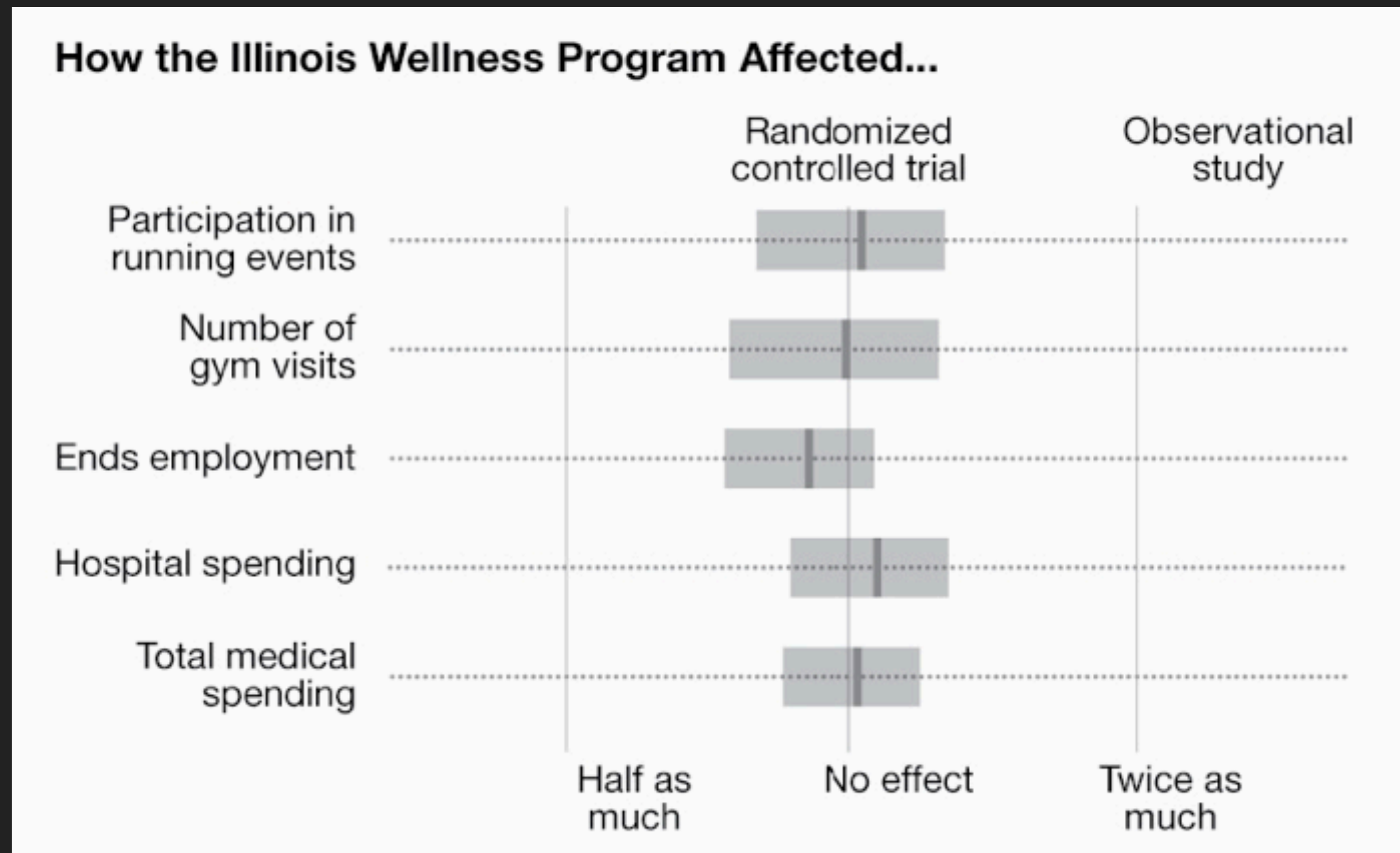
Wellness Programs: Do They Work?

▸ Typical study: compare employees within the same company who did take part in wellness activities with those who did not.

▸ Meta-analyses: wellness programs reduce medical costs and absenteeism, generating considerable savings for employers.
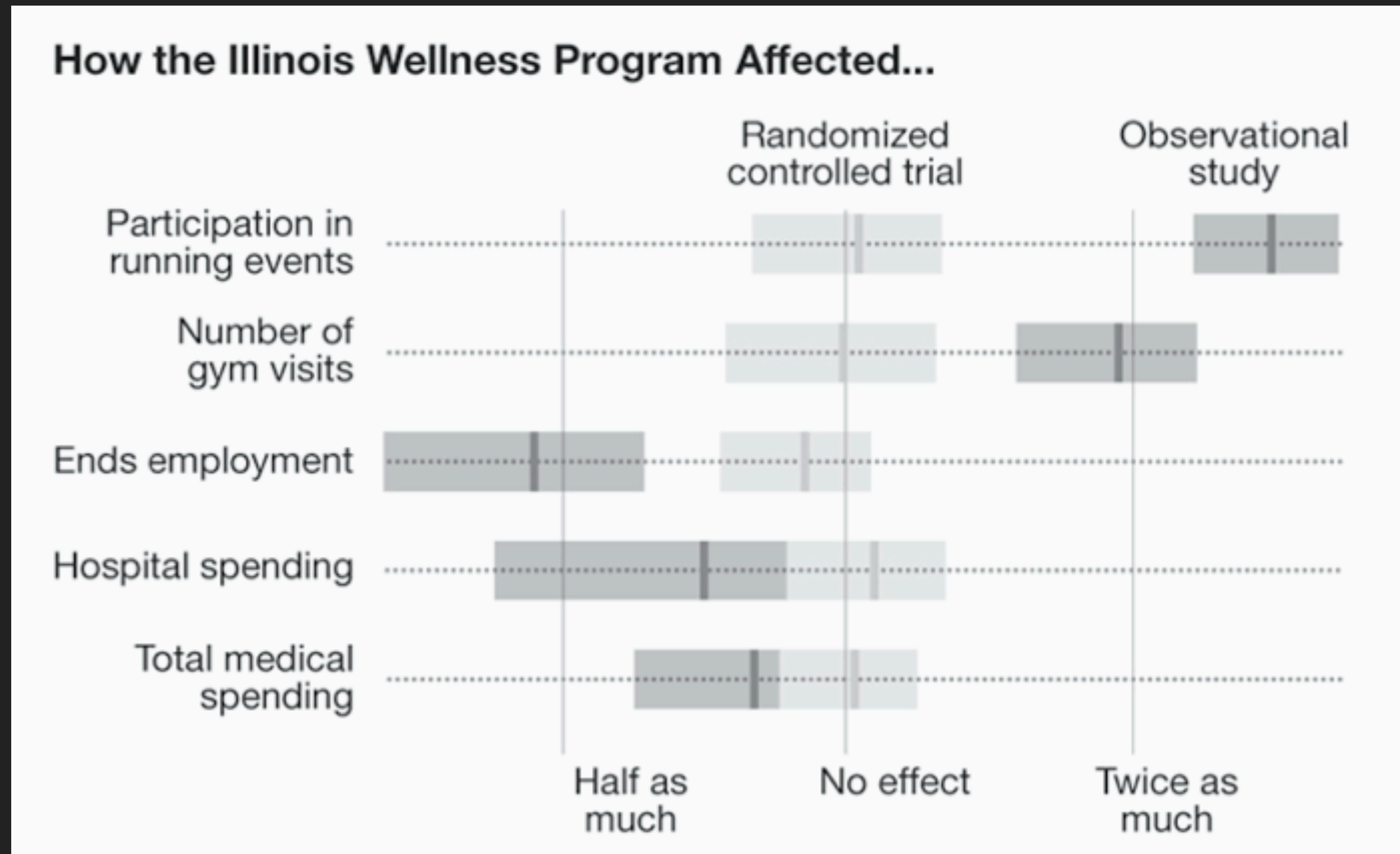
UIUC Study Design

▸ Randomized employees into either a treatment group or a control group.

　　▸ Treatment group: option to participate but not required to do so

　　▸ Control group: not offered an opportunity to take part

▸ Three resulting categories:

　　▸ (T1) people who chose to participate

　　▸ (T2) people who chose not to

　　▸ (C) people who were not given the option to participate in the first place

▸ Analysis:

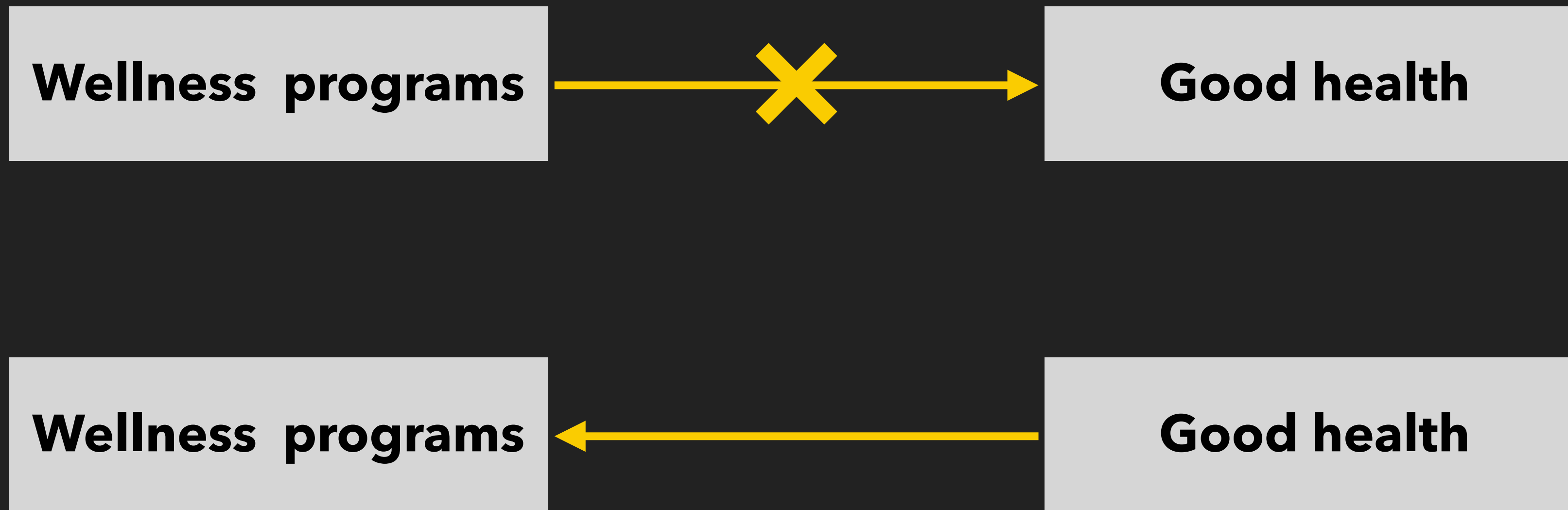　　▸ Comparing health before and after taking part in the study, across groups

T vs C: Being Offered the Wellness Program Had no Effect on Fitness Activities, Employee Retention, or Medical Costs

How the Illinois Wellness Program Affected...

How the Illinois Wellness Program Affected...

UIUC Study Conclusion

. . . to be continued

Credits

▸ Graphics:

  ▸ Dave DiCello photography (cover)

▸ Content:

  ▸ Chapters from Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). Experimental and quasi-experimental designs for generalized causal inference. Wadsworth Publishing

    ▸ Ch1: Experiments and generalized causal inference
    ▸ Ch2: Statistical conclusion validity and internal validity
    ▸ Ch3: Construct validity and external validity
    ▸ Ch8: Randomized experiments

  ▸ Bergstrom, C. T., & West, J. D. (2020). Calling bullshit: the art of skepticism in a data-driven world. Random House.

  ▸ Huff, D. (1993). How to lie with statistics. WW Norton & Company.