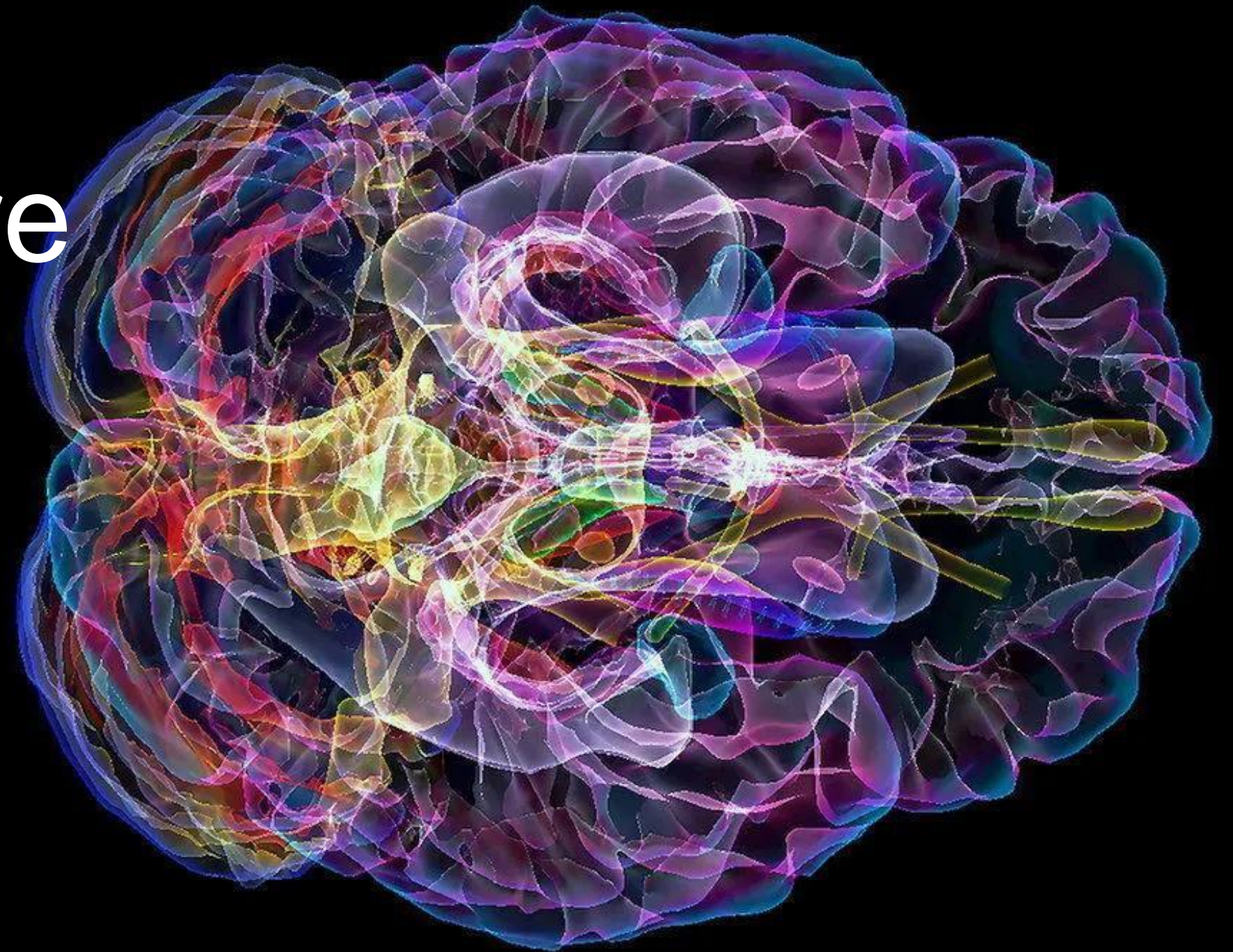


Trust Me, I'm Lying:

The Problems of Science in Healthcare

with Dr. Dylan Callier
TravCon 2023





New Medical Nomads

About me

ORIGINAL RESEARCH

VARIATION IN MEDIAL AND LATERAL GASTROCNEMIUS MUSCLE ACTIVITY WITH FOOT POSITION

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ABSTRACT

Background: The gastrocnemius has two heads, medial gastrocnemius (MG) and lateral gastrocnemius (LG); little is known how they contract with different foot positions. The MG is more frequently strained than the LG; and gastrocnemius activation pattern altered by foot position may play a role in injury. Leg exercises often use a toe-in versus toe-out foot position to isolate one gastrocnemius head over another.

Purpose: The purpose of this study was to determine the electromyographic gastrocnemius muscle activity in the toe-out and toe-in foot positions during weight bearing and non-weight bearing activities. The hypothesis was that a toe-out foot position would elicit greater MG than LG activity; while the toe-in position would elicit greater activity in LG than MG in both weight bearing and non-weight bearing (NWB) positions.

Study Design: A cross-sectional study of young adults.

Methods: Thirty-three participants were recruited. Surface electrodes were placed on the bellies of the MG and LG. The gastrocnemius muscle was tested in toe-in and toe-out foot positions using two different tests: a standing heel-rise and resisted knee flexion while prone. Electromyographic activity was normalized against a MVIC during a heel raise with a neutral foot position. A 2x2x2 (Foot Position x Test Position x Muscle) ANOVA was used to determine if differences exist in activity between the MG and LG for toe-in versus toe-out standing and prone test positions.

Results: Significant test position main effect ($F [1,32] = 86.9; p < .01$), significant muscle main effect ($F [1,32] = 5.5; p < .01$), and significant foot position x muscle interaction ($F [1,32] = 14.58; p < .01$) were found. Post hoc tests showed differences between MG and LG in toe-out position ($t = 3.10; p < .01$) but not in the toe-in for both test positions ($t = 1.27; p = 0.21$).

Conclusions: With toe-out, the MG was more active than LG in standing and prone; no difference was noted between MG and LG in toe-in for either position.

About this Session

- A critical review on science practices, not meant to discourage from best practices
- Not a deep dive on statistics! Not needed to recognize "bad science"

Content

- A Review of Individual Bias
- Problems in Science
- Specific Problems in Healthcare Science
- Solution
- Recap

Outcomes:

- Learners will be able to give 2 examples why a statistically significant conclusion is more likely to be published than a non-statistically conclusion.
- Learners will be able to explain why a study with a small number of participants is less reliable than a large study.

COIN FLIP!

WHY DOES UNDERSTANDING THE SCIENCE MATTER?

- Optimal clinical decisions for autonomous clinicians
- (Honest) Informed Consent
- Optimal Patient Education

PROBLEMS WITH INDIVIDUALS (AKA BEING HUMAN)

TRUTHS

Objective

- What is observed with a small and decreasing range of uncertainty.

Personal

- A belief held that is either unknown, unfalsifiable, or has large uncertainty.

TRUTHS

Objective

- Gravity
- Hand-washing
- All Swans are White

Personal

- God created the universe
- My deceased loved ones look after me
- All Swans are White

BIAS

- Affinity Bias
- Conformity Bias
- Confirmation Bias
- Dunning-Kruger Effect
- Anchoring
- -ism's (race, sex, age)
- Halo effect
- Anchoring
- Selection Bias
- Hindsight Bias

*HOW TO IDENTIFY BIAS: 14 TYPES OF BIAS - 2023. MASTERCLASS.

WHAT HAPPENED?



JULY 16TH, 1969. IMAGE CREDIT: NASA

Patients & Media

"As Evidence Based Medicine became more influential, it was also hijacked to serve agendas different from what it originally aimed for." "Science denialists and quacks are also flourishing and leading more people astray in their life choices, including health. EBM still remains an unmet goal, worthy to be obtained."

*EVIDENCE BASED MEDICINE HAS BEEN HIJACKED: A REPORT TO
DAVID SACKETT. 2016

PROBLEMS WITH SCIENCE

GAME!

2, 4, 8

"Good Science" aims to disprove an idea/theory.

The longer an idea lasts this barrage of tests and time, the uncertainty of that theory shrinks.

Theories are not "proven," they can only withstand the test of time.

A tested theory with no statistical significance tells us just as much, if not more, as a study with statistical significance.

No statistical significance = Null

Statistical significance = Suggestive eyebrows and a gesture "look over here"

HARKing

H ypothesis

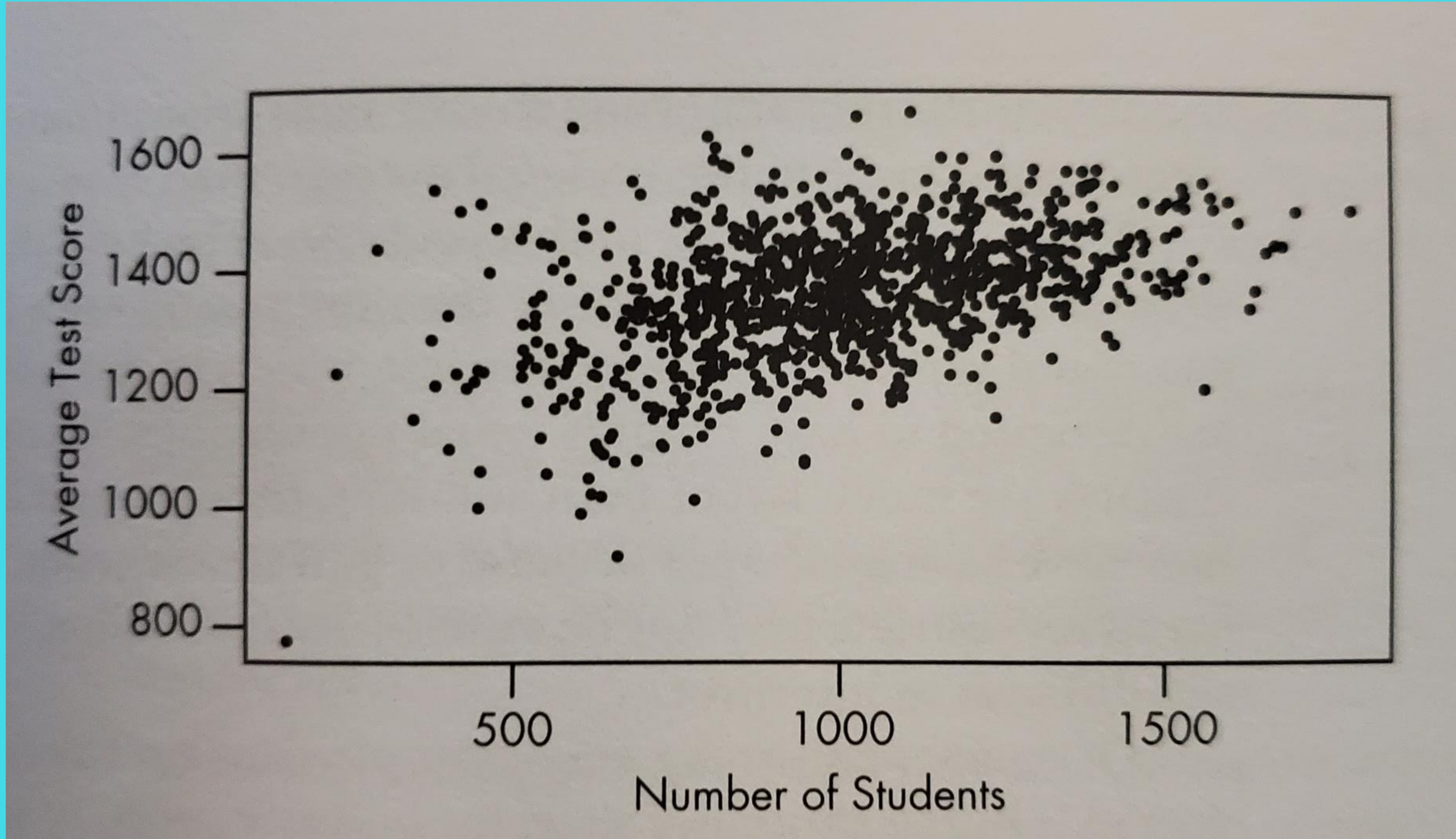
A fter

R esults are

K nown

Renal Cancer vs Small Towns

Public School Test Scores vs Small Towns



*STATISTICS DONE WRONG BY A. REINHART FIGURE 2-4

POWE

- Statistical Power = $\frac{1}{R}$ How many participants are needed to avoid a high risk of a false conclusion
- The math is complex, but the more variables that are being tested, the larger amount of participants are needed
- Most studies struggle with being powered appropriately.

P-Value

- Used to demonstrate risk of a "false positive"
- P-value less than 0.05 is generally accepted for a statistically significant result
- **P-value of 0.05 means a 5% probability or 1 / 20 chance that the result is a false positive

P-Hacking

- Looking at **many, many variables** without adjusting the power will lead to greater chance of a P-value less than 0.05 and giving a false positive
- The **dichotomization** of study groups in an already poorly powered study will do the same (gender, height cut-off, weight cut-off)
- Collect **just a few more data points** until the P-Value crosses the threshold

TORTURE THE DATA,
UNTIL IT
CONFESSES!

It's like throwing a bunch of darts at the board until hitting the center and claiming you only threw that dart!



P-Hack Game!

Skittles cause _____.

Headline! New Discovery from
TravCon 2023

Blue Skittles cause _____ with
95% Confidence!

REPRODUCIBILITY CRISIS

HOW BAD CAN IT BE?

Open Science Collab Study from Science Magazine

- Found and replicated 100 studies in the field of psychology exactly the same as published.
- 97% of the original studies had statistically significant results.
- 36% of the replicated studies had statistically significant results.

OPEN SCIENCE COLLABORATION. ESTIMATING THE
REPRODUCIBILITY OF PSYCHOLOGICAL SCIENCE.
SCIENCE. 2015
[HTTPS://DOI.ORG/10.1126/SCIENCE.AAC4716](https://doi.org/10.1126/science.aac4716) (2015)

Other Barriers to Reproducibility

- Publication Bias - Positive Results are more exciting! "There is no cost to getting things wrong, the cost is not getting them published." Brian Nosek
- Physical Journals have word limitations and the full story is unable to be told

Other Barriers to Reproducibility

- Some research journals do not consider reproduced studies. Considered "Old News"
- Data isn't readily shared as many researchers would rather spend time on their own publications, and data becomes lost over time. Tedious to Collect.

Low Hanging Fruit for science claims

- Are they measuring what they are claiming to measure?
- The 'It Works' Test

PROBLEMS WITH HEALTHCARE SCIENCE

"A single person's testimony or experience has much greater effect on us than we would like to admit. We don't trust data as eye witness or singular testimony..."

You remember the hits and forget the misses."

Neil Degrasse Tyson



APPLICATION COMMONLY STATED
TO TAKE UP TO
17 YEARS

BALAS E, BOREN S: MANAGING CLINICAL
KNOWLEDGE FOR HEALTH CARE
IMPROVEMENT. IN YEARBOOK OF MEDICAL
INFORMATICS. 2000

"File Cabinet Studies"

SOLUTIONS?

Non-Profits and Organizations

- Companies like Dryad attempting to help by recovering data from old floppy-disks and harddrives to revive old data.
- Online journals being used to where a character max is no longer needed as is for physical journals.
- PLOS ONE, BioMed Central, and Trials are open-access and peer reviewed, but do not reject for "uninteresting findings"

Despite the current landscape and flaws of modern science in healthcare, this remains the best way for us to understand what is best for our patients and to offer better care.

RECA

P

- One study should not change the entire way you treat.
- Beware of studies a small group of participants and studies that do not include how they powered their study.
- Hold studies and reviews that conclude "no significance" to a higher relevance than "significance"
- Clinical Practice Guidelines and Systematic Reviews are the full-time clinicians best options to stay on top of best practices.

REFERENCES

- Reinhart, A. (2015). Statistics done wrong: The woefully complete guide. No Starch Press.
- J.P.A Ioannidis "Why Most Published Research Findings Are False." PLOS Medicine 2, no. 8 (2015)
- K.S. Button, J.P.A. Ioannadis, C. Mokrysz, B.A. Nosek, J. Flint, E.S.J. Robinson, and M.R. Munafò. "Power Failure: why small sample size undermines the reliability of neuroscience." Nature Reviews Neuroscience 14 (2013)
- How to identify bias: 14 types of bias - 2023. MasterClass. <https://www.masterclass.com/articles/how-to-identify-bias>
- Taubes G. Epidemiology faces its limits. Science. 1995
- Open Science Collaboration. Estimating the reproducibility of psychological science. Science. 2015 <https://doi.org/10.1126/science.aac4716> (2015)
- Balas E, Boren S: Managing clinical knowledge for health care improvement. In Yearbook of Medical Informatics. (2000)
- <https://www.Clinicaltrials.gov>
- <https://www.osf.io>