The myth of objectivity: Best Practices in rigor and transparency towards scientific reproducibility

5/9/2022

K-Club

Sponsored by:

EMORY UNIVERSITY SCHOOL OF MEDICINE
Department of Pediatrics

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EMORY UNIVERSITY SCHOOL OF MEDICINE
Department of Medicine

Survey Drawing

K-Club Special:
2022 IDCRC Specialized Pilot Award RFA

Infectious Diseases Clinical Research Consortium

- For Scientists (MD, PhD or equivalent) nearing completion of postdoc or in early faculty positions (Instructor or Assistant Professor)
- Mentored Pilot Research Project awards to enhance the applicant's ability to compete successfully for an independent R- or K-series award (e.g., acquisition of preliminary data, training in grant preparation)
- Provide one-year of funding to support research projects and career development activities
- projects can address a variety of topics, including vaccinology, therapeutics, laboratory studies and statistics

Application Deadline: June 30, 2022 (LOI due 5/16/2022)

https://idcrc.org/training/pilot-grants-program.html

Abstract submission deadline extended to today at 5pm!

Monday May 9th at 5pm

Today's Panelists

Gillian Hue, PhD
Assistant Teaching Professor
Director, Neuroethics Minor, NBB
Emory College

Shasha Bai, PhD
Associate Professor
Director, Pediatric Biostatistics Core
Emory University School of Medicine

Lou Ann Brown, PhD
Professor
Emory University School of Medicine
Director - Office of Postdoctoral Education

Acknowledgements

- **Raymond Dingledine, PhD,** Professor in the Department of Pharmacology and Chemical Biology, Emory University
  - "Why is it so hard to do good science?"
  - Feb 3, 2022, Rigor and Reproducibility webinar series sponsored by Library and Information Technology Services and the WHSC Data Science Initiative
  - https://guides.libraries.emory.edu/rigor-rep#s-lg-box-24857407
- **Nuzzo, R.** How scientists fool themselves – and how they can stop. *Nature* **526,** 182–185 (2015). https://doi.org/10.1038/526182a
- **Ummul-Kiram Kathawalla, Priya Silverstein, Moin Syed,** Easing Into Open Science: A Guide for Graduate Students and Their Advisors, Collabra: Psychology (2021) 7 (1): 18684. https://doi.org/10.1525/collabra.18684

Today's agenda

Part 1 - Introduction on cognitive bias

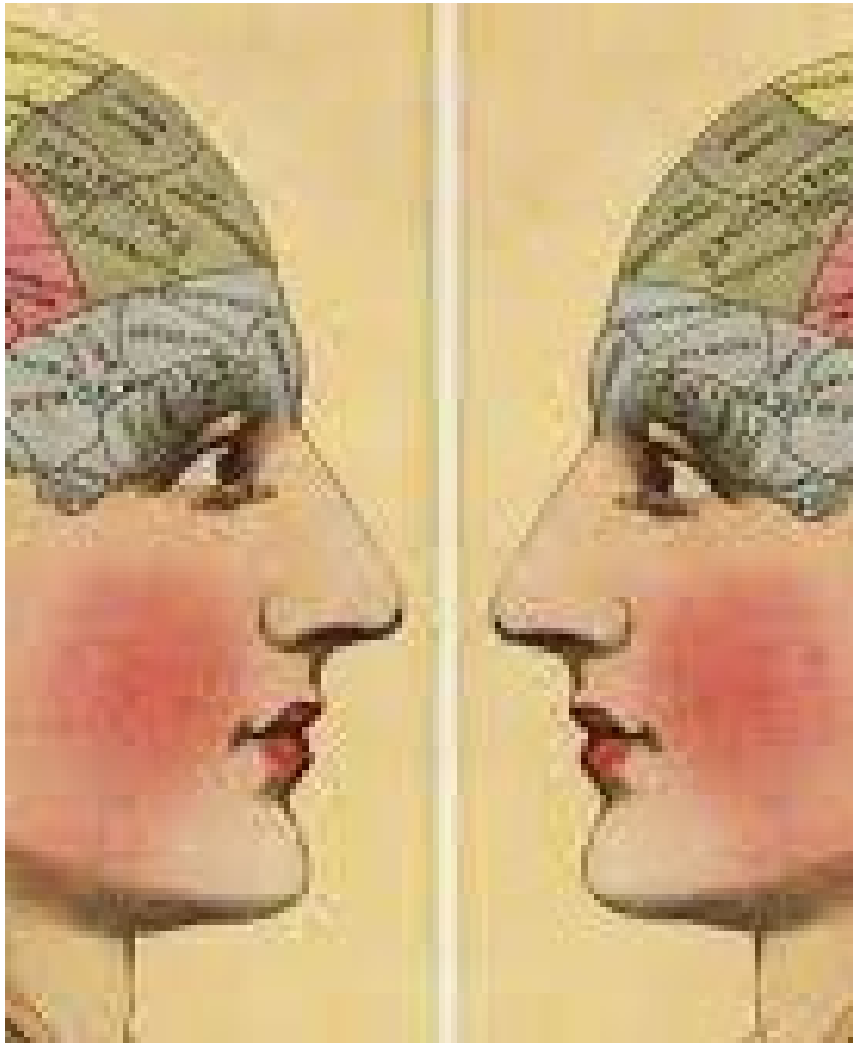
- Dr. Gillian Hue

Part 2 - Cognitive fallacies in research

- facilitated panel discussion

Part 3 - Debiasing techniques

- facilitated panel discussion



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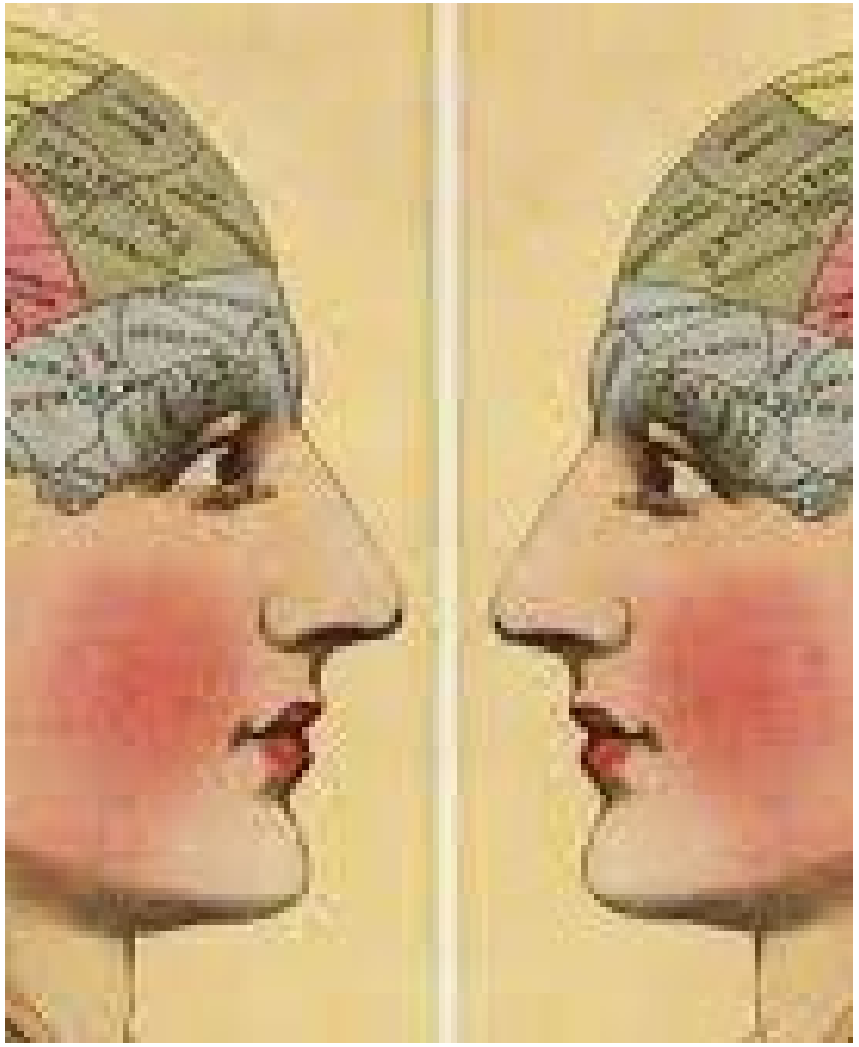

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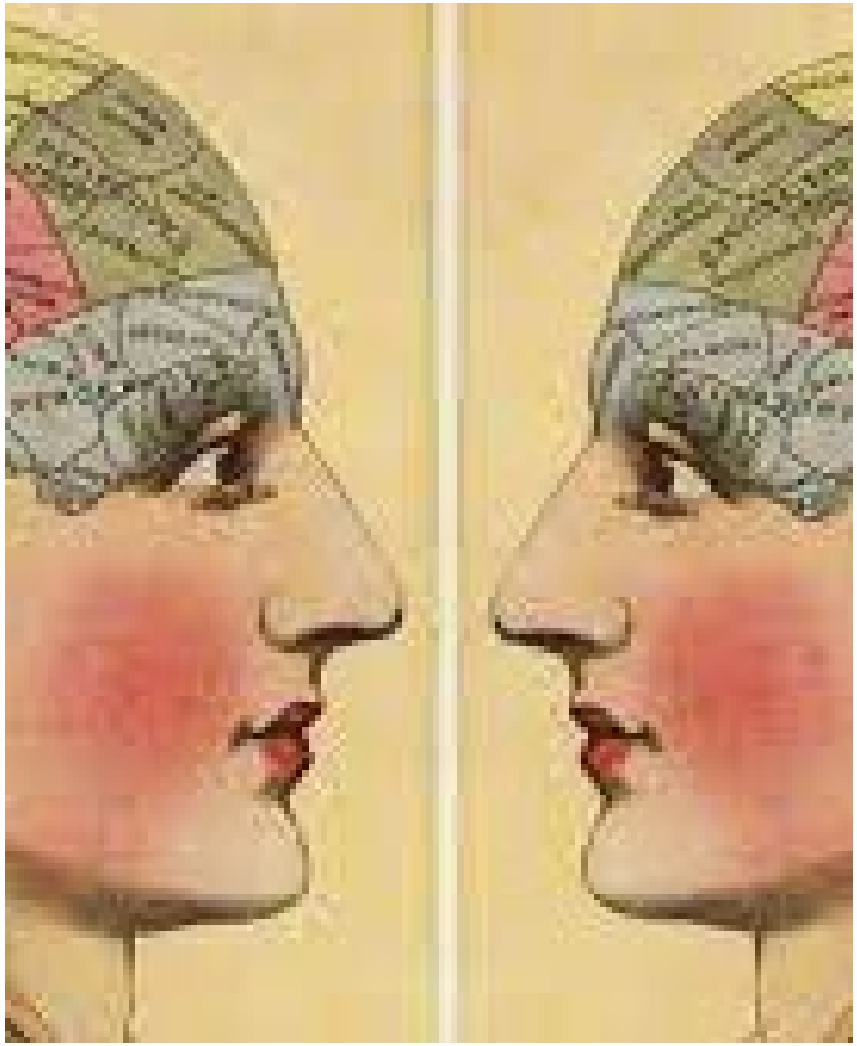

"Science is an ongoing race between our inventing ways to fool ourselves, and our inventing ways to avoid fooling ourselves."

Saul Perlmutter, PhD

- Astrophysicist at the University of California, Berkeley
- 2011 Nobel Laureate, sharing the prize in Physics for the discovery of the accelerating expansion of the Universe

COGNITIVE FALLACIES IN RESEARCH

HYPOTHESIS MYOPIA

Collecting evidence to support a hypothesis, not looking for evidence against it, and ignoring other explanations.

TEXAS SHARPSHOOTER

Seizing on random patterns in the data and mistaking them for interesting findings.

ASYMMETRIC ATTENTION

Rigorously checking unexpected results, but giving expected ones a free pass.

JUST-SO STORYTELLING

Finding stories after the fact to rationalize whatever the results turn out to be.

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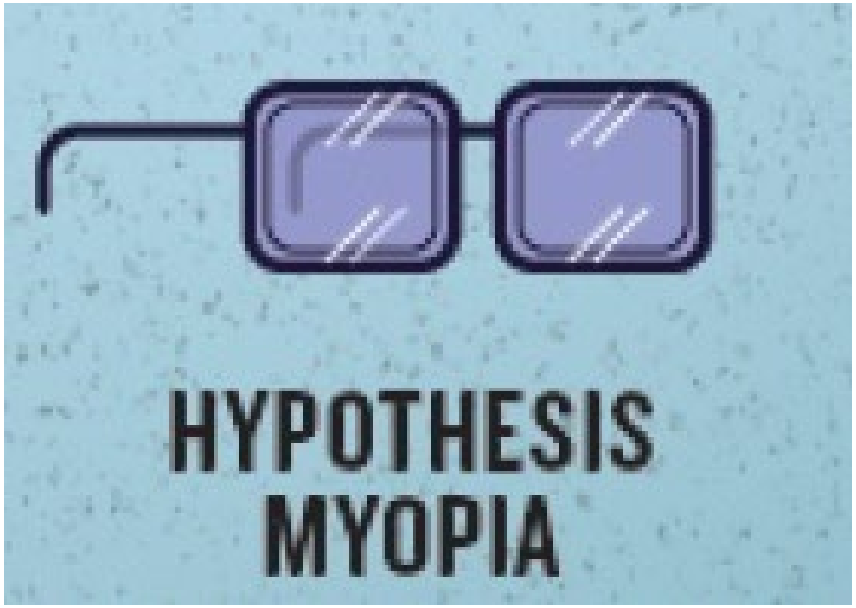
BY REGINA NUZZO

Hypothesis Myopia

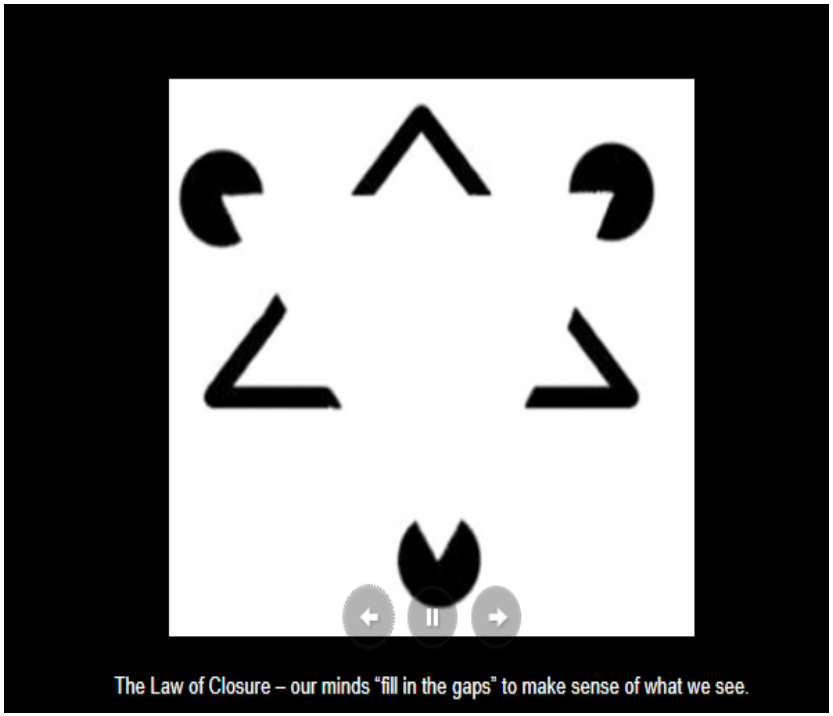
- Fixating on collecting evidence to support just one hypothesis
- Neglect to look for evidence against it
- Fail to consider other explanations



Texas Sharpshooter/Clustering Fallacy

- Ignoring the difference while focusing on the similarities
- Inserting meaning into randomness
- Seizing on random patterns in the data and mistaking them for interesting findings
- Taking a large amount of data and only focus on a small subset
- This fallacy is the philosophical or rhetorical application of the multiple comparisons problem in statistics

The Holy Toast



The Law of Closure

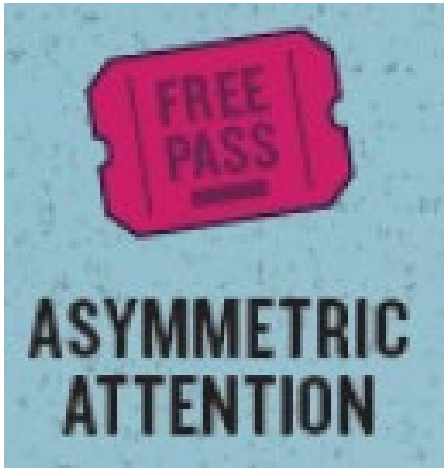
HARKing - don't do it!

- Characterized often by a lack of a specific hypothesis prior to gathering the data

"Hypothesis after results known"

Asymmetric Attention/Disconfirmation Bias

- Believe and accept evidence that supports your prior beliefs while dismissing evidence that refutes your beliefs.
  - Give expected results a free pass
  - Rigorously check non-intuitive results



Just-So Storytelling

- Finding stories after the fact to rationalize whatever the results turn out to be
- Matthew Hankins, a statistician at King's College London, collected more than 500 creative phrases that researchers use to convince readers that their non-significant results are worthy of attention; examples are
  - "flirting with conventional levels of significance ($p > 0.1$)"
  - "on the very fringes of significance ($p = 0.099$)"
  - "not absolutely significant but very probably so ($p > 0.05$)".
- JARKing – justifying after results known (don't do it!)

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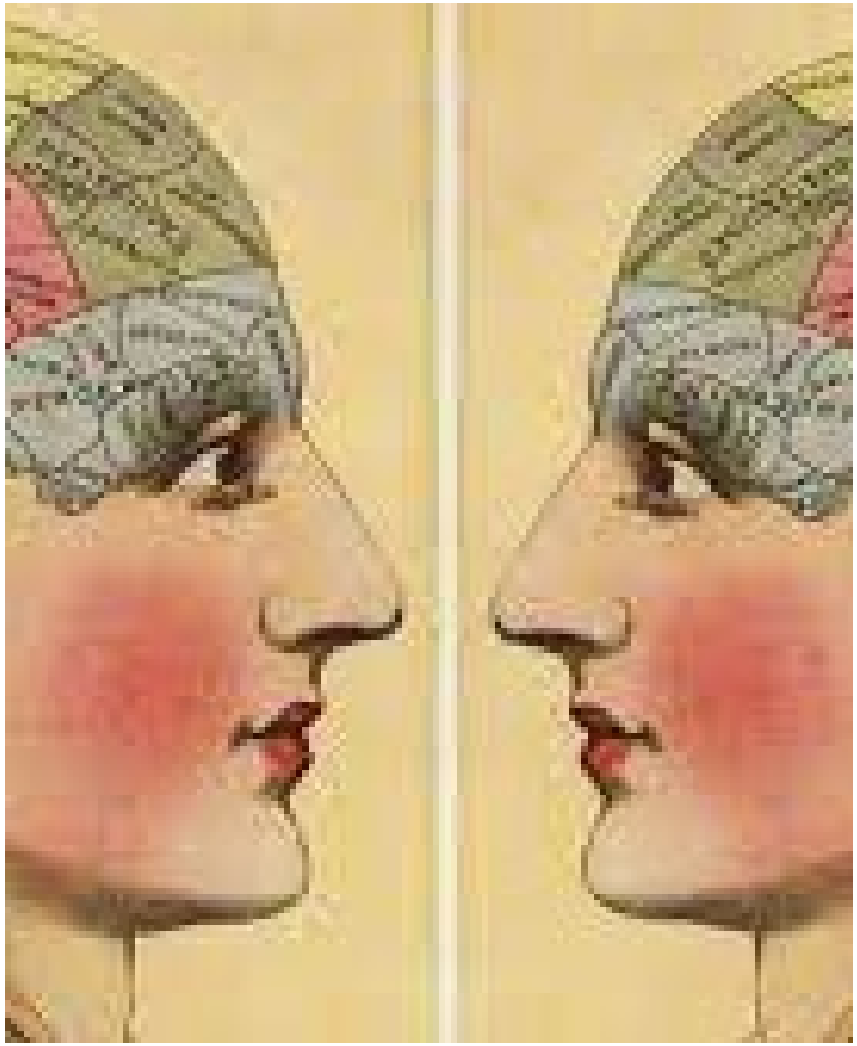

DEBIASING TECHNIQUES

DEVIL'S ADVOCACY

Explicitly consider alternative hypotheses — then test them out head-to-head.

PRE-COMMITMENT

Publicly declare a data collection and analysis plan before starting the study.

TEAM OF RIVALS

Invite your academic adversaries to collaborate with you on a study.

BLIND DATA ANALYSIS

Analyse data that look real but are not exactly what you collected — and then lift the blind.

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BY REGINA NUZZO

Devil's Advocacy

- Consider alternative hypothesis and test head-to-head
- 1964 publication on "Strong inference" (John R. Platt) and the climbing a tree analogy
- List alternative explanations for observations
  - Attacks hypothesis myopia head on
  - Reduces tendency to tell just-so stories

Pre-Commitment

- Publicly declare a data collection and analysis plan before starting the study
- Can even choose to make various parts of the project subject to outside scrutiny and peer review via registered reports
  - Publications in which scientists present their research plans for peer review before they even do the experiment
  - If the plan is approved, the researchers get an ‘in-principle’ guarantee of publication, no matter how strong or weak the results turn out to be
  - Reduce the unconscious temptation to adjust the data analysis according to the data collected

Center for Open Science’s Open Science Framework

Pre-Commitment: *Preregistration Process*

- Preregistration, in its simplest form, is a one-page document answering basic questions such as:
  - What question will be studied?
  - What is the hypothesis?
  - What data will be collected, and how will they be analyzed?
- Preregistration had already become the norm in clinical trials as a way to prevent publication bias, the tendency for many negative results to remain unpublished.
- By committing researchers to a fixed plan, it takes away some of the degrees of freedom that can skew their work.

Pre-Commitment: *Benefits of Preregistration*

- **Faster publication**
- **Demonstrated credibility** - publicly posted study design and staged review process transparently showcases the underlying validity of the research
- **Stake a claim** - establish priority earlier in the research process and showcase your most current work for review
- **Quality** - research is evaluated based on the validity of the research question and the thoroughness of the study design protocol (as opposed to the arbitrary perceived impact of the outcome)
- **Constructive review** - When peer review takes place before you conduct your investigation, the focus of review shifts from gatekeeping to productive feedback aimed at ensuring the best study design possible
- **Increase likelihood of acceptance of publication**
- **Fairness**

Pre-Commitment: *Preregistration benefits*

Fairness

Evaluating the study design rather than the final article precludes some types of subconscious bias. For example:

- **Publication bias**
  Authors' inclination to selectively publish results that seem to support a hypothesis, leaving out negative, null or inconclusive outcomes
- **Confirmation bias**
  The tendency of editors and reviewers to give more credence to results that support their own views or previously published work
- **Impact bias**
  The inclination among editors to give novel results more consideration, even though they are not necessarily more valid than expected or confirmatory outcomes

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Ummul-Kiram Kathawalla,Priya Silverstein,Moin Syed, Easing Into Open Science: A Guide for Graduate Students and Their Advisors, Collabra: Psychology, 2021,

Team of Rivals

- Invite your academic adversaries to collaborate with you on a study
- With competing hypotheses and theories in play, the rivals will quickly spot flaws such as hypothesis myopia, asymmetric attention or just-so storytelling, and cancel them out with similar slants favoring the other side. – Daniel Kahneman

Blind Data Analysis

- Analyze data that look real but are not exactly when you collected – then lift the blind
  - write a program that creates alternative data sets by adding random noise or a hidden offset, moving participants to different experimental groups or hiding demographic categories.
  - handle the fake data set as usual (i.e. clean the data, handle outliers, run analyses) while the computer faithfully applies all actions to the real data
  - At the end lift the blind to see the true results
- "Intellectual hygiene"

Questions and Discussion