NIH TES Workshop

Establishing Reproducibility and Openness in tES Research

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Outline

- The “replicability crisis” in science
- How did we get here?
- The real issues in reproducibility that affect everyday science
- The role of reproducibility in tES research
- What we as scientists, journal editors, paper reviewers, funding agencies, and program officers can do to improve reproducibility in the field of tES

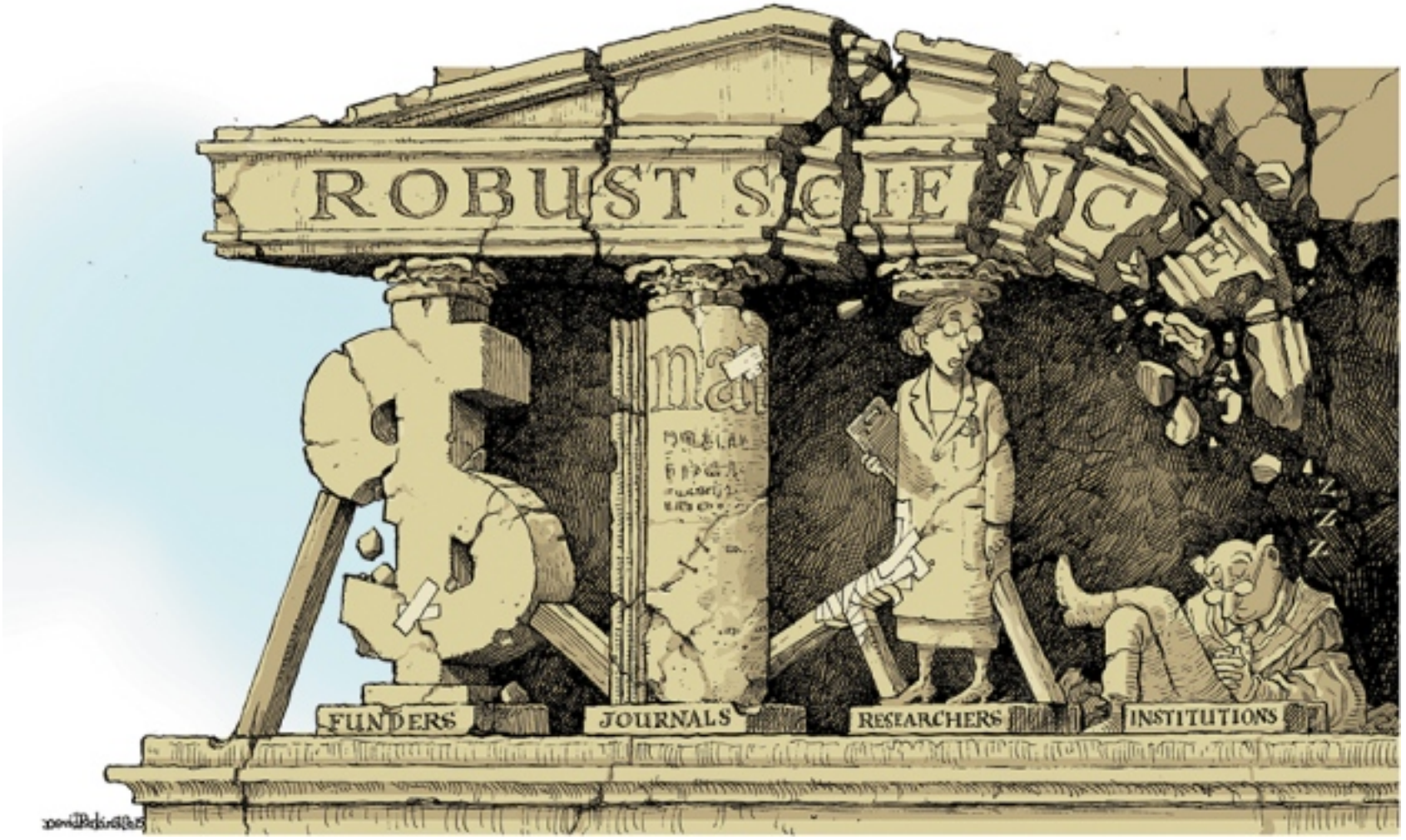
IS THERE A REPRODUCIBILITY CRISIS?

Reproducibility Crisis

- Failure to replicate published findings has been shown to be an issue in many fields
  - Most of my examples will come from psychology
- The public is taking notice
  - Headlines in every major news source
- Contentious issue within science

Failures to Replicate

How did we get here?



Nature, 2015

Everything Is Crumbling

An influential psychological theory, borne out in hundreds of experiments, may have just been debunked. How can so many scientists have been so wrong?

By Daniel Engber

Lisa Larson-Walker

Sad Face

Another classic finding in psychology—that you can smile your way to happiness—just blew up. Is it time to panic yet?

By Daniel Engber

Lisa Larson-Walker

My position on "Power Poses"

Regarding: Carney, Cuddy & Yap (2010).

Reasonable people, whom I respect, may disagree. However since early 2015 the evidence has been mounting suggesting there is unlikely any embodied effect of nonverbal expansiveness (vs. contractiveness)—i.e.., "power poses" -- on internal or psychological outcomes.

As evidence has come in over these past 2+ years, my views have updated to reflect the evidence. As such, **I do not believe that "power pose" effects are real.**

From Dana Carney's website: faculty.haas.berkeley.edu/dana_carney

Failure to Replicate

- These are not single studies that fail to replicate but “established” phenomena
- “How can so many scientists be wrong?”
- Conceptual “replications” are not always enough
- Publication bias on positive results
  - File drawer problem
- The literature does not “weed out” these effects on its own very effectively or quickly

Reproducibility in tES

- Collectively one of the broadest fields
  - Many tools, continually emerging/evolving
  - Huge parameter space
  - Applicable to a broad range of psychological, psychiatric, and neurological disorders
- Relatively new field with a large emphasis on “novel” findings
- Novice tES researchers joining the field every day

Reproducibility in tES

- Many unpublished murmurings of failures to replicate published tES findings
  - But I don't see this sufficiently represented in the literature yet
- Meta-analyses
  - Some show promising effects (working memory: Brunoni & Vanderhasselt, 2014; Hill et al., 2016)
  - Others question findings (Horvath et al., 2015ab)
  - But publication bias affects the legitimacy of the conclusions
- Thus far, not much time has been spent on systematically establishing reproducibility of tES

tDCS Reproducibility Project

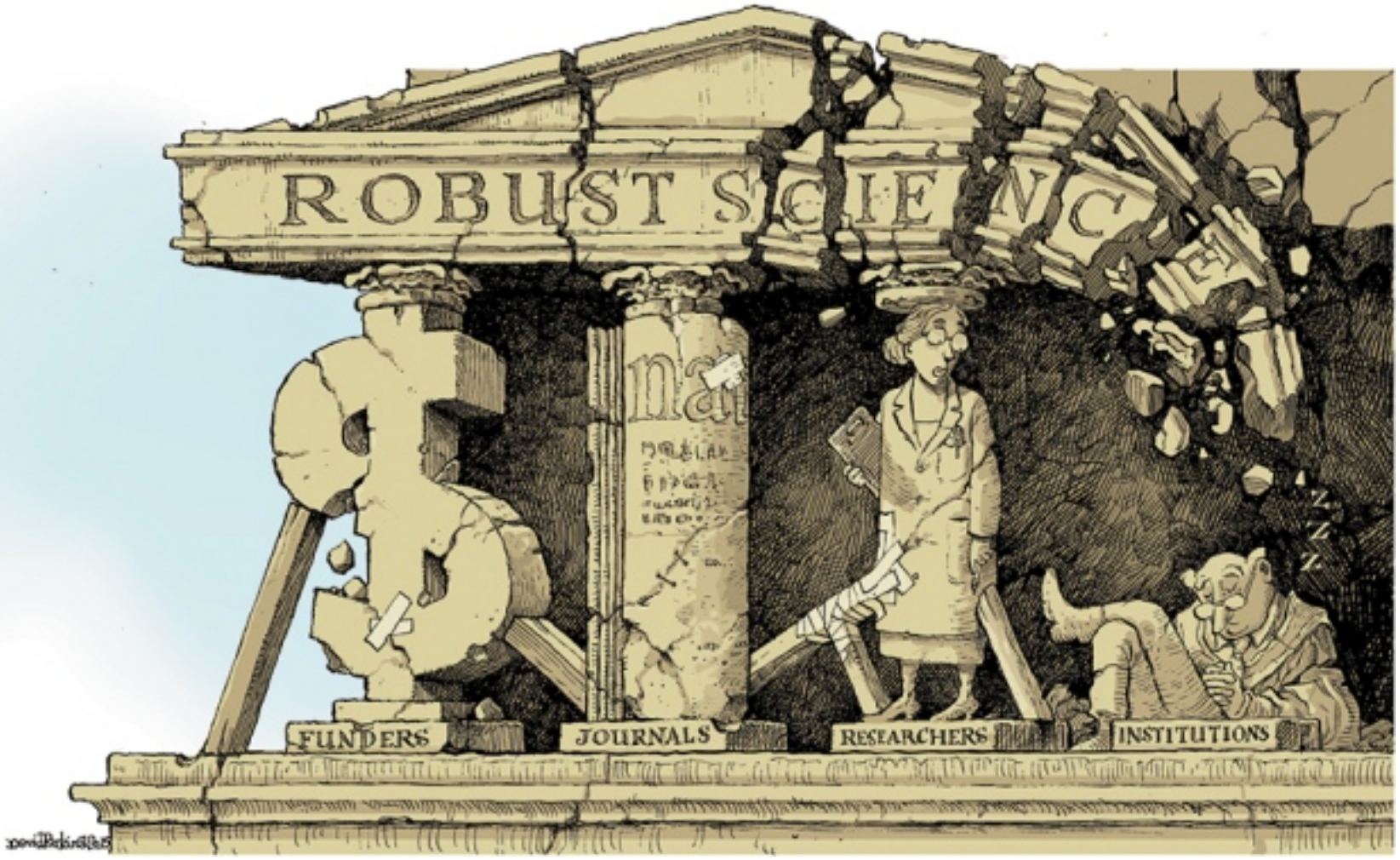
- Large-scale replication effort
- 4 major tDCS effects replicated across several prominent tDCS labs
- Funded by Center for Open Science and The Laura and John Arnold Foundation
- Pre-registration with *Brain Stimulation*
- All procedures, data, etc., will be posted on the Open Science Framework
- Goal: develop gold-standard protocols for other researchers to use as a starting point

What can/should we do?

- Be aware of the issue and potential unintended biases
- Increase sample sizes/power to detect effects
- Include metrics of reliability/validity in published papers
- Include multiple measures (neuroimaging)
- Don’t ignore procedural/statistical errors for flashy, exciting results
- Publish null and non-replication results
- Share data and materials with each other
- Large-scale reproducibility projects

Take Home

- Reproducibility is a serious issue that affects us all
- Replicability can be questionable even in “established” effects
- Every day practices in science can influence replicability
- Psychology studies illustrate the issues in reproducibility that may serve as a cautionary tale for tES


ROBUST SCIENCE
FUNDERS
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INSTITUTIONS

Nature, 2015

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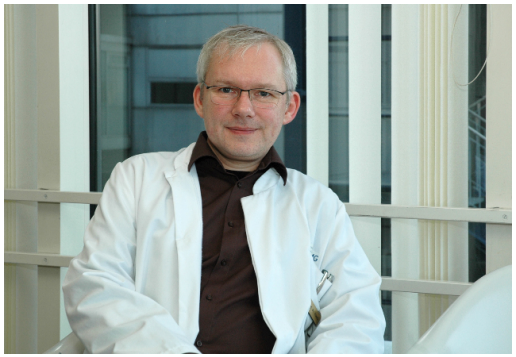

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CENTER FOR OPEN SCIENCE

laura and john arnold foundation