Teen Pregnancy Prevention Evaluation Technical Assistance: BASIE (BAyeSian Interpretation of Estimates)

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OASH | Office of Population Affairs

Today's Speakers

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Outline

- Reminder
  - *When* to use BASIE
  - *Why* use BASIE
- Focus for today
  - BASIE in *theory* – components of the BASIE framework
  - BASIE in *practice* – spreadsheet tool demo

BASIE When and Why

When to Use BASIE

- You're conducting an impact evaluation

  Impact estimate = difference in mean outcomes between a treatment and control group

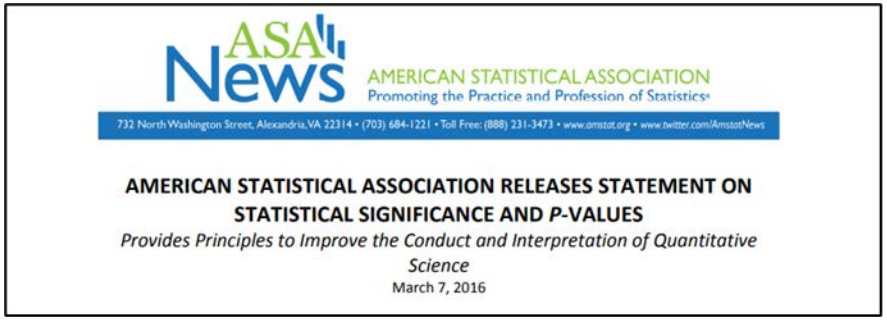
- You've designed the evaluation, collected the data, run the regression
- Now you have an impact estimate, and you're wondering what to make of it

OR

- You're reading an evaluation report or manuscript and wondering what to make of the findings

Why BASIE: Statistical Significance is Rejected

- In 2016, the American Statistical Association released a statement on the widespread misinterpretation of *p*-values and statistical significance
- In 2019, *The American Statistician* released a special issue: Statistical Inference in the 21st Century: A World Beyond $p < 0.05$
- In 2019, *Nature* published a commentary with more than 800 signatories: "Scientists Rise Up Against Statistical Significance"



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AMERICAN STATISTICAL ASSOCIATION RELEASES STATEMENT ON STATISTICAL SIGNIFICANCE AND *P*-VALUES

Provides Principles to Improve the Conduct and Interpretation of Quantitative Science

March 7, 2016

THE AMERICAN STATISTICIAN
2019, VOL. 73, NO. S1, 1–19: Editorial
https://doi.org/10.1080/00031305.2019.1583913

EDITORIAL

Moving to a World Beyond "$p < 0.05$"

Retire statistical significance

Valentin Amrhein, Sander Greenland, Blake McShane and more than 800 signatories call for an end to hyped claims and the dismissal of possibly crucial effects.

When was the last time you heard a seminar speaker claim there was 'no difference' between two groups because the difference was 'statistically non-significant'?

If your experience matches ours, there's a good chance that this happened at the last talk you attended. We hope that at least someone in the audience was perplexed if, as frequently happens, a plot or table showed that there actually was a difference.

How do statistics so often lead scientists to deny differences that those not educated in statistics can plainly see? For several generations, researchers have been warned that a statistically non-significant result does not 'prove' the null hypothesis (the hypothesis that there is no difference between groups or no effect of a treatment on some measured outcome)[1]. Nor do statistically significant results 'prove' some other hypothesis. Such misconceptions have famously warped the literature with overstated claims and, less famously, led to claims of conflicts between studies where none exists.

We have some proposals to keep scientists from falling prey to these misconceptions.

PERVASIVE PROBLEM

Let's be clear about what must stop: we should never conclude there is 'no difference' or 'no association' just because a *P* value is larger than a threshold such as 0.05 ▸

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BASIE in Theory

Resources

- Moving Beyond Statistical Significance: The BASIE (BAyeSian Interpretation of Estimates) Framework for Interpreting Findings from Impact Evaluations
- The BASIE (BAyeSian Interpretation of Estimates) Framework for Interpreting Findings from Impact Evaluations: A Practical Guide for Education Researchers
- Webinar on BASIE delivered as part of an IES-SREE webinar series
- An example of BASIE in a TPP context – evaluation of Making Proud Choices!
- Bayesian interpretation of cluster-robust subgroup impact estimates (more advanced BASIE)

Four steps to implement BASIE

- BASIE Step 1: Select Prior Evidence
- BASIE Step 2: Report impact estimate
- BASIE Step 3: Interpret impact estimate
- BASIE Step 4: Sensitivity analyses

BASIE Step 1: Select Prior Evidence

- Use meta-regression to synthesize prior evidence to form prior distributions
  - See IES guide for detailed recommendations
- Two prior distributions used in the evaluation of Making Proud Choices! and provided in Excel tool we will demo:
  - **Sexual behavior domain:** meta-analysis of evaluations of teen pregnancy prevention interventions; mean = 0.03; sd = 0.15 (Juras et al. (2019))
  - **Risk and protective factor domain:** meta-analysis of findings from the What Works Clearinghouse; mean = 0.16; sd = 0.29 (Hermann et al. (2019))

BASIE Step 2: Report impact estimate

- We recommend reporting two estimates, but one can receive greater emphasis
  - Prespecify which estimate you will emphasize
- Traditional estimate, based only on study data
  - Important to report to be transparent about what is observed in the study data and to facilitate future meta-analysis
- Bayesian estimate, a precision-weighted average of the traditional estimate and the prior evidence
  - Important to report because it is less susceptible to statistical noise, especially in small studies

BASIE Step 3: Interpret impact estimate

- Use posterior probabilities to interpret impact estimates

  "We estimate a 75 percent probability that our intervention increased knowledge of contraception methods, given our estimates and prior evidence on the impacts of educational interventions."

  Color key:

  Posterior

  Likelihood

  Prior

BASIE Step 4: Sensitivity analyses

- Calculate posterior probabilities for at least one **pre-specified prior** distribution
- A zero-centered prior is often a good candidate for sensitivity analysis
- Sensitivity to the prior distribution can also be taken into account at the design stage

BASIE in Practice

Example designs, calculations, and interpretations

- Two hypothetical studies
- Choosing prior distributions
- Calculating posterior probabilities (spreadsheet example)
- Sensitivity analyses
- Discussion

Two hypothetical studies

- Study A – 400 randomized students

Outcome	Domain	Impact estimate (effect size)	Standard error	*p*-value (2-tailed)
STI knowledge	Risk and protective factors	0.25	0.10	0.01
Sexual initiation	Sexual behavior	- 0.10	0.10	0.32

- Study B – 100 randomized students

Outcome	Domain	Impact estimate (effect size)	Standard error	*p*-value (2-tailed)
STI knowledge	Risk and protective factors	0.25	0.20	0.21
Sexual initiation	Sexual behavior	- 0.10	0.20	0.62

Choose prior distributions

- To interpret estimated impacts on STI knowledge outcome, we use a prior distribution with mean = 0.16 and sd = 0.29
  - Choosing WWC-based prior from Hermann et al. (2019) because it includes proximal outcomes
- To interpret estimated impacts on initiation outcome, we use a prior distribution with mean = 0.03 and sd = 0.15
  - Choosing prior from Juras et al. (2019) because it is based on TPP literature and focused on sexual behavioral outcomes
- Will look at sensitivity to these choices
  - Zero-centered versions of both priors
  - Also, for risk and protective factor outcomes, try priors based on Juras et al. (2019)

Calculate posterior probabilities

- Study A – 400 randomized students

Outcome	Impact estimate (effect size)	Standard error	*p*-value (2-tailed)	Probability Impact > 0
STI knowledge	0.25	0.10	0.01	99%
Sexual initiation	- 0.10	0.10	0.32	83%

- Study B – 100 randomized students

Outcome	Impact estimate (effect size)	Standard error	*p*-value (2-tailed)	Probability Impact > 0
STI knowledge	0.25	0.20	0.21	91%
Sexual initiation	- 0.10	0.20	0.62	68%

Sensitivity Analysis

- Probability of a favorable impact on STI knowledge

Prior Distribution	Study A (N=400)	Study B (N=100)
Mean = 0.16; sd = 0.29	99%	91%
Mean = 0; sd = 0.29	99%	85%
Mean = 0.03; sd = 0.15	99%	82%
Mean = 0; sd = 0.15	98%	77%

- Probability of a favorable impact on Sexual initiation

Prior Distribution	Study A (N=400)	Study B (N=100)
Mean = 0.03; sd = 0.15	83%	68%
Mean = 0; sd = 0.15	80%	62%

Discussion

- How does your perception of study findings change when we use BASIE instead of statistical significance?
- What do the sensitivity analyses tell us?

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Q & A