Are registered reports an effective method to counter p-hacking?

•••

Andreas Holst
Supervisor: Bram Duyx, PhD

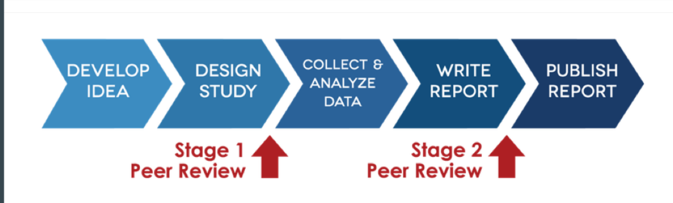
Replication Crisis in Psychology

Open Science Collaborations (2015) article estimated that only 39% of psychological research can be replicated

- Statistics would predict 5% with significance level at $\alpha = 0.05$
- Researchers degrees of freedom (Simonsohn et al., 2011)
  - Increases the chances of finding false-positive results and overinflated effect sizes
    - 34 items of potential degrees of freedom (Wicherts et al., 2016)
    - p-hacking - data analysis and eligibility decisions
- Selective publishing of significant results by journals
  - Survival of the fittest
  - Publication bias - most published results are significant.
    - file-drawer problem
  - Researchers Degrees of Freedom + perverse incentives

Registered reports

- Pre-registered reports sent to journals to be peer-reviewed (Center for Open Science)
  - Before collecting and analyzing data
  - Just 190 reports since 2013
  - Pre-registration requires researchers to disclose their methods in advance

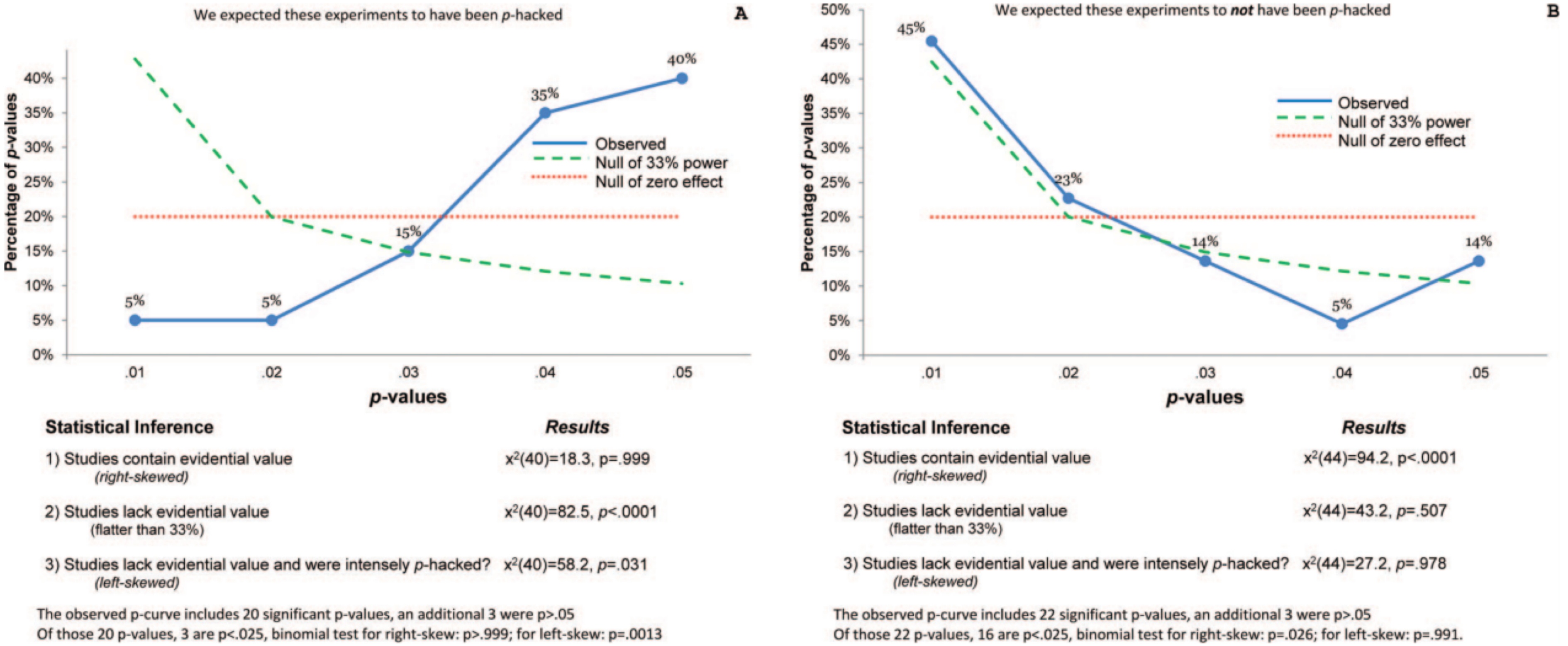


- Journals base their decision of publication on the relevance of research question and quality of the research design, not results.
  - Motivator to follow improved guidelines and disincentivizes p-hacking.

The p-curve (Simonsohn, Nelson, Simmons)

- Estimating the evidential value of a meaningful set of findings
  - Distribution of statistically significant p-values
    - Avoids the effects of publication bias on the sample

- There is evidential value if selective reporting can be ruled out as the sole reason for the results.
  - Estimated by the skewness of the graph
    - Inferenced with 3 statistical tests
      - Test for right skew
      - Test for flat right skew with 33% power
      - Power analysis



We expected these experiments to have been *p*-hacked

Statistical Inference	***Results***
1) Studies contain evidential value *(right-skewed)*	$x^2(40)=18.3$, p=.999
2) Studies lack evidential value (flatter than 33%)	$x^2(40)=82.5$, *p*<.0001
3) Studies lack evidential value and were intensely *p*-hacked? *(left-skewed)*	$x^2(40)=58.2$, *p*=.031

The observed p-curve includes 20 significant p-values, an additional 3 were p>.05
Of those 20 p-values, 3 are p<.025, binomial test for right-skew: p>.999; for left-skew: p=.0013

We expected these experiments to ***not*** have been *p*-hacked

Statistical Inference	***Results***
1) Studies contain evidential value *(right-skewed)*	$x^2(44)=94.2$, p<.0001
2) Studies lack evidential value (flatter than 33%)	$x^2(44)=43.2$, *p*=.507
3) Studies lack evidential value and were intensely *p*-hacked? *(left-skewed)*	$x^2(44)=27.2$, *p*=.978

The observed p-curve includes 22 significant p-values, an additional 3 were p>.05
Of those 22 p-values, 16 are p<.025, binomial test for right-skew: p=.026; for left-skew: p=.991.

Study aim & Hypothesis

This study investigates if registered reports are an effective way to counter p-hacking using the p-curve.

- Allows to avoid the effect of publication bias for more accurate estimations

Hypothesis:

1. The p-curve associated with registered reports has a significant result for right skew.
2. The p-curve associated with C-group has a significant result for flat right skew expected at 33% power.

Methods

Quasi-experimental Design

Confirmatory research

Independent variable - publication type

- categorical, nominal
  - registered reports
  - normal publication

Dependent variable - Evidential value

- categorical, ordinal
  - Set of studies contain evidential value
  - Set of studies needs further investigation
  - Lack of any evidential value
    - Set of studies were probably p-hacked

Inclusion criteria:

- Only psychological research
  - Confirmatory
  - Experimental
  - Continuous dependent variable
- Inclusion criteria of p-values
  - uniform distribution under the null hypothesis
  - test relevant hypothesis
  - statistically independent of other p-values

Exclusion criteria:

- journals publishing only one publication type. (matching)
- simultaneous recording devices.

Methods

Selecting p-values:

1. Identify hypothesis and study design
2. Identify the appropriate statistical test
3. Report the result of interest
4. Recompute the precise p-value(s)
5. Report robustness results.

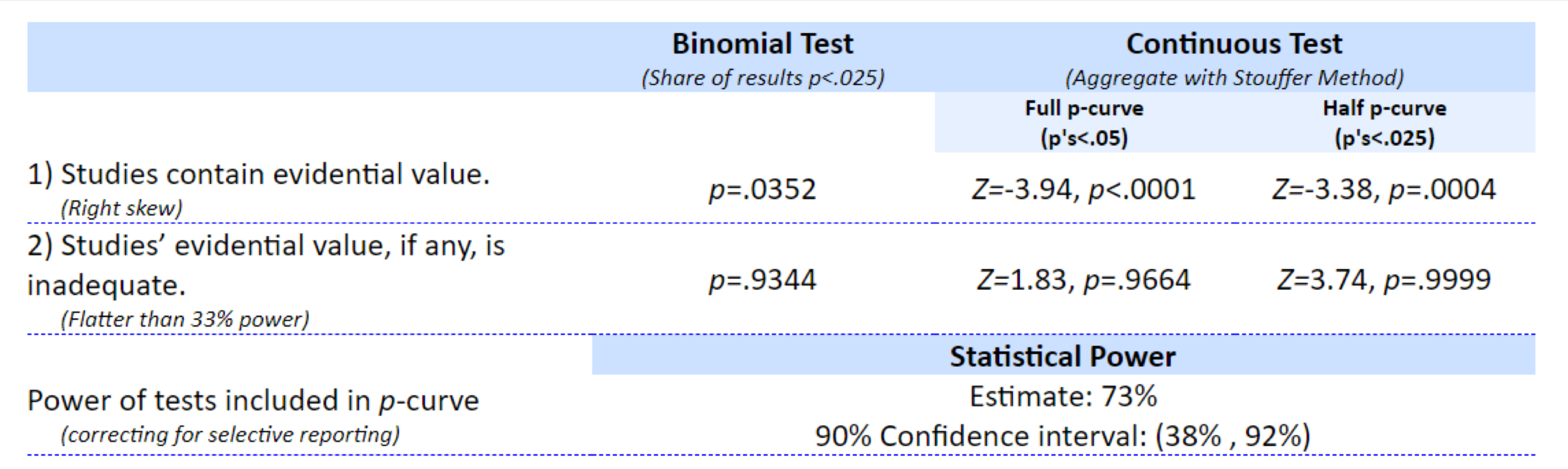
Following this process with every study in the sample

will result in a standardized “p-curve disclosure table”

Matching algorithm:

1. Identify suitable independent p-values for the p-curve associated with registered reports in a public Center for Open Science Database.
   a. Total of 190 studies
2. Find the articles in their original journal
3. Find a p-value for C-group keeping all publishing related variables constant besides publishing type
   a. RR - center
   b. First above article, then under
   c. Does it match inclusion-exclusion criteria?

Statistical analysis



	Binomial Test *(Share of results p<.025)*	**Continuous Test** *(Aggregate with Stouffer Method)*	
		Full p-curve **(p's<.05)**	**Half p-curve** **(p's<.025)**
1) Studies contain evidential value. *(Right skew)*	*p*=.0352	*Z*=-3.94, *p*<.0001	*Z*=-3.38, *p*=.0004
2) Studies' evidential value, if any, is inadequate. *(Flatter than 33% power)*	*p*=.9344	*Z*=1.83, *p*=.9664	*Z*=3.74, *p*=.9999
	Statistical Power		
Power of tests included in *p*-curve *(correcting for selective reporting)*	Estimate: 73% 90% Confidence interval: (38% , 92%)		

Limitations and Questions

Only continuous dependent variable underlying the p-value

Only experimental designs

Confirmatory research

Is the p-curve a valid measure?

Is it an accurate measure?

- Can the p-curve distinguish well enough between the levels of the dependent variable?

Is there a difference in power analysis and a test for left skew?

Thank you for listening!