Effect Sizes, Power, and Biases in Intelligence Research

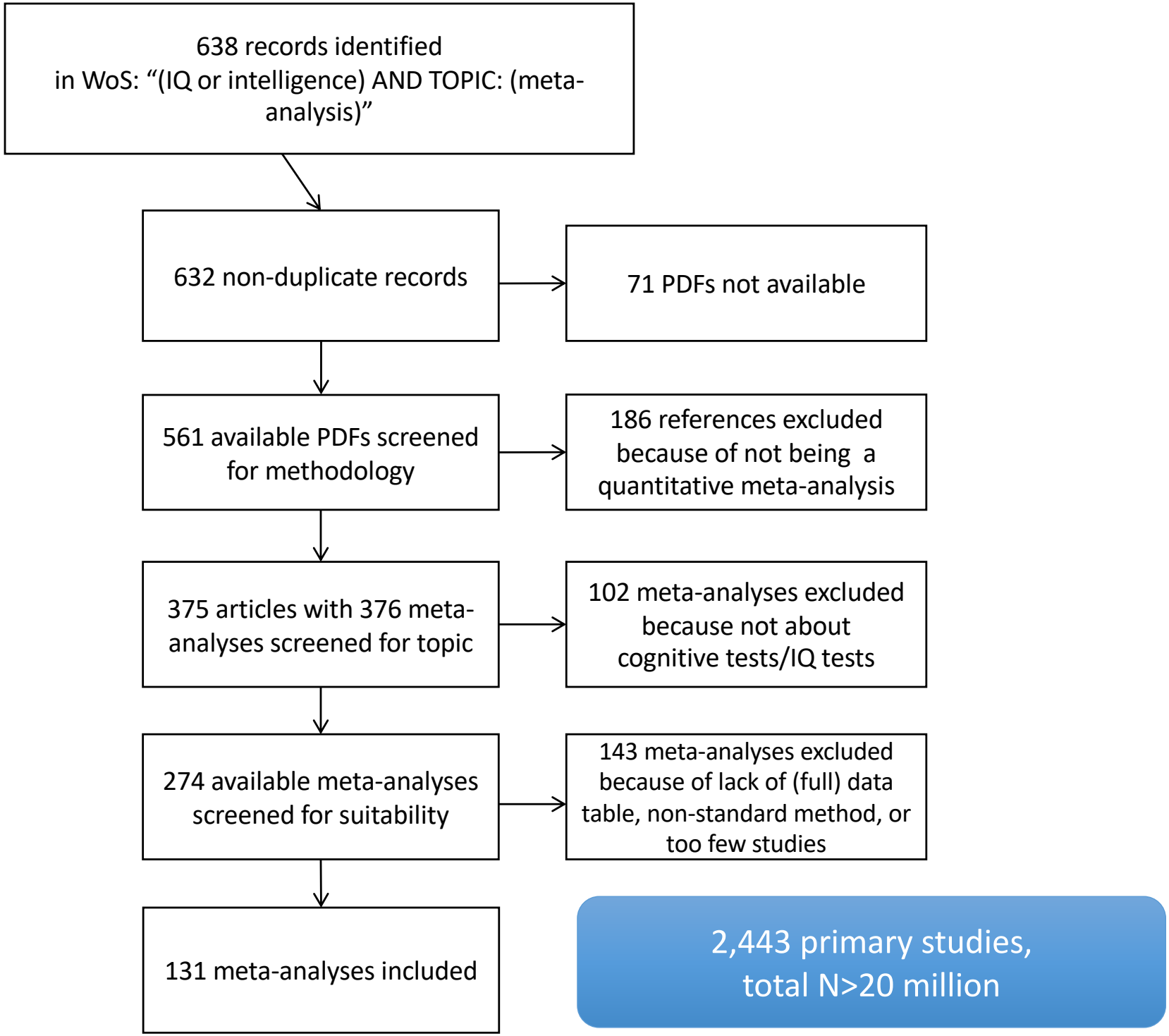
A Meta-Meta-Analysis

Michèle B. Nuijten, Marcel A. L. M. van Assen, Hilde E. M. Augusteijn, Elise A. V. Crompvoets, & **Jelte M. Wicherts**

TILBURG UNIVERSITY

Research questions

1) What is the typical power in studies of IQ and does power differ across different types of studies?
2) How severe is publication bias in intelligence research?
3) Is there evidence of a “decline effect” or citation bias?


638 records identified in WoS: “(IQ or intelligence) AND TOPIC: (meta-analysis)”
632 non-duplicate records
71 PDFs not available
561 available PDFs screened for methodology
186 references excluded because of not being a quantitative meta-analysis
375 articles with 376 meta-analyses screened for topic
102 meta-analyses excluded because not about cognitive tests/IQ tests
274 available meta-analyses screened for suitability
143 meta-analyses excluded because of lack of (full) data table, non-standard method, or too few studies
131 meta-analyses included
2,443 primary studies, total N>20 million

Intelligence: 5 types of studies

1. **Predictive validity & correlational studies**
   - E.g., IQ - personality
2. **Group differences (clinical & non-clinical)**
   - E.g., IQ in healthy controls vs. schizophrenics
3. **Experiments & interventions**
   - E.g., intervention to improve IQ
4. **Toxicology**
   - E.g., the effect of lead exposure on IQ
5. **Behavior genetics**
   - E.g., heritability of intelligence

Intelligence: descriptives

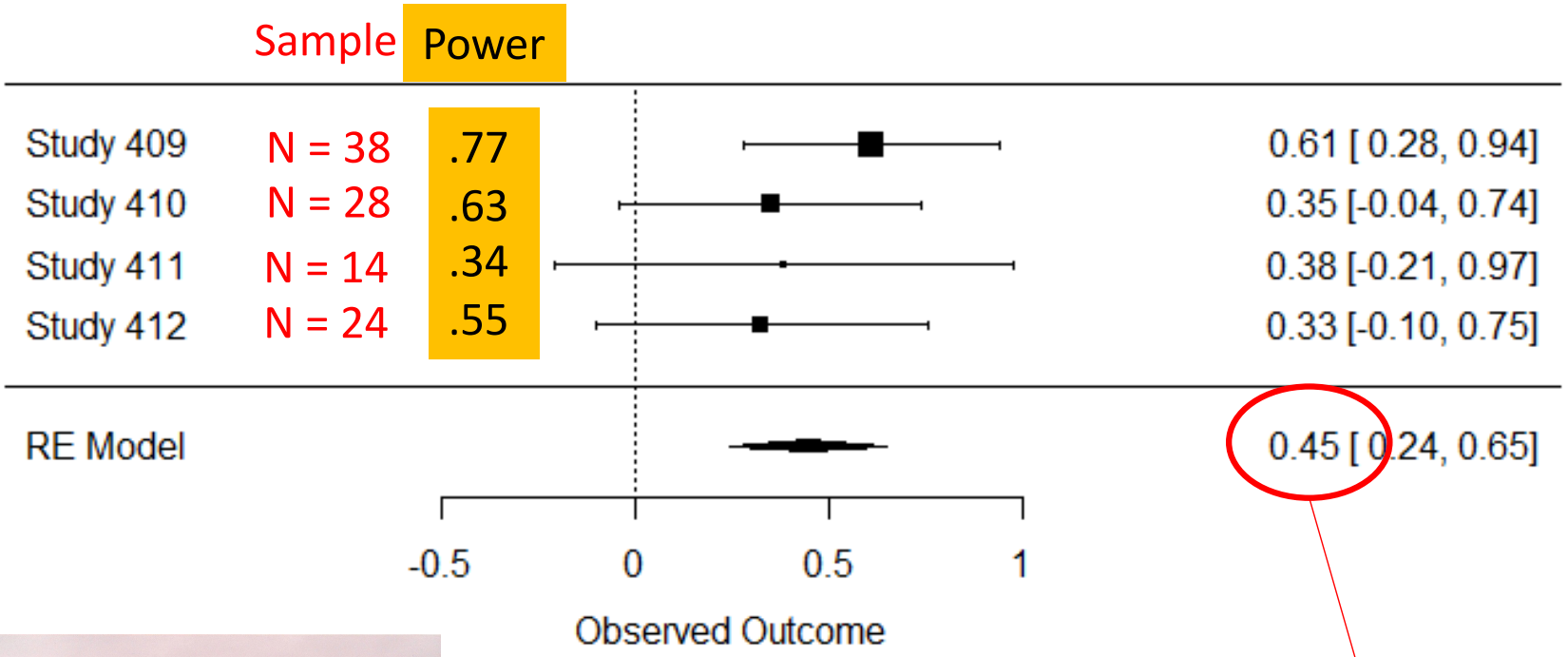
Type of research	# Meta-analyses	# Pri… studi…	…Median …otal N	…edian …nweighted …earson's r
1. Predictive validity & correlational studies	31	781	…55	…26
2. Group differences (clinical & non-clinical)	59	1,249		
3. Experiments & interventions	20	185	49	18
4. Toxicology	16	169	60	15
5. (Behavior) genetics	5	59	169	07
Total	**131**	**2,439**	**60**	**…5**

Straightforward methodologies most popular

N is typically quite low, except for behavior genetics.

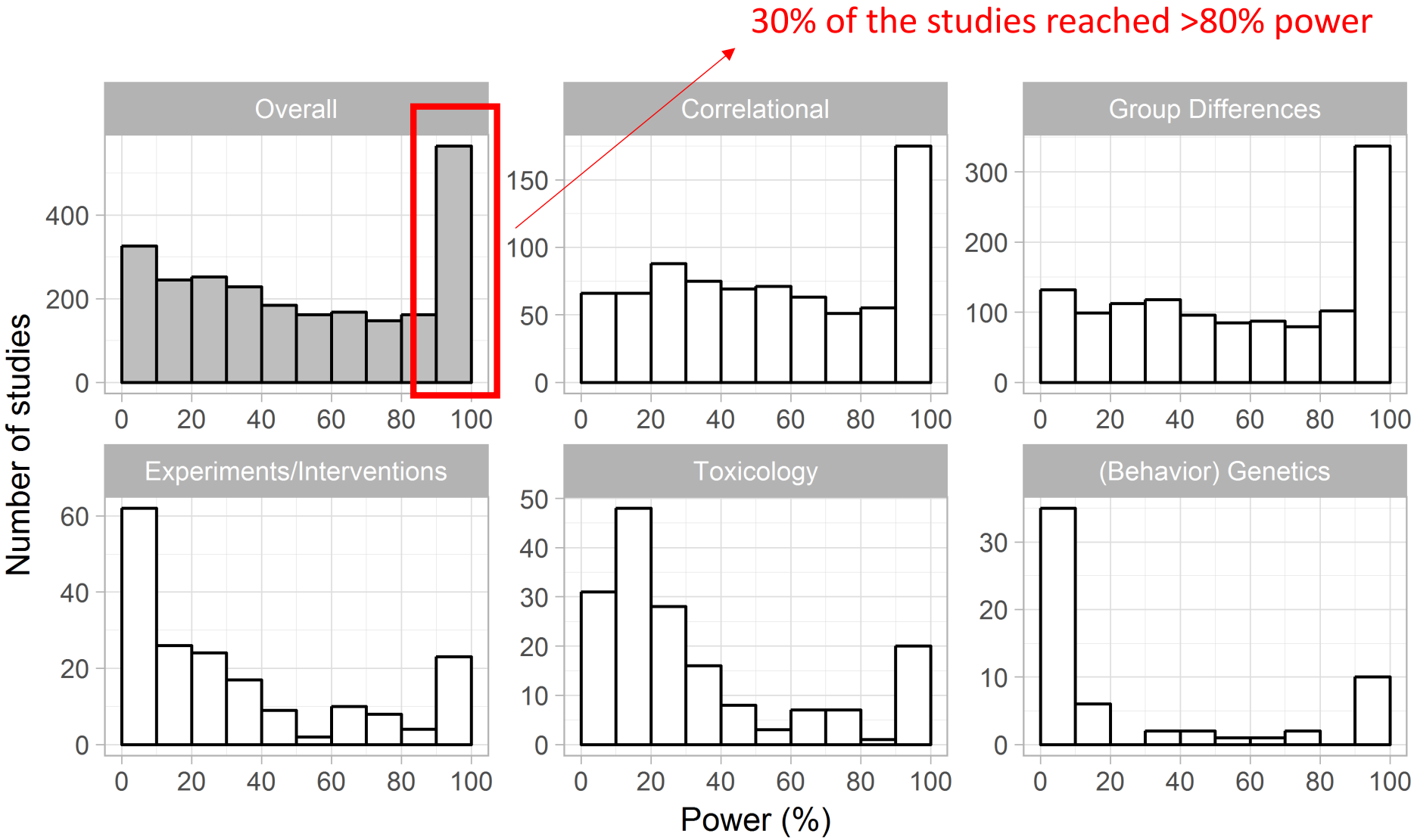
With total N = 65 & r = .26:
Power = 55.9%

Power: example in 1 meta-analysis

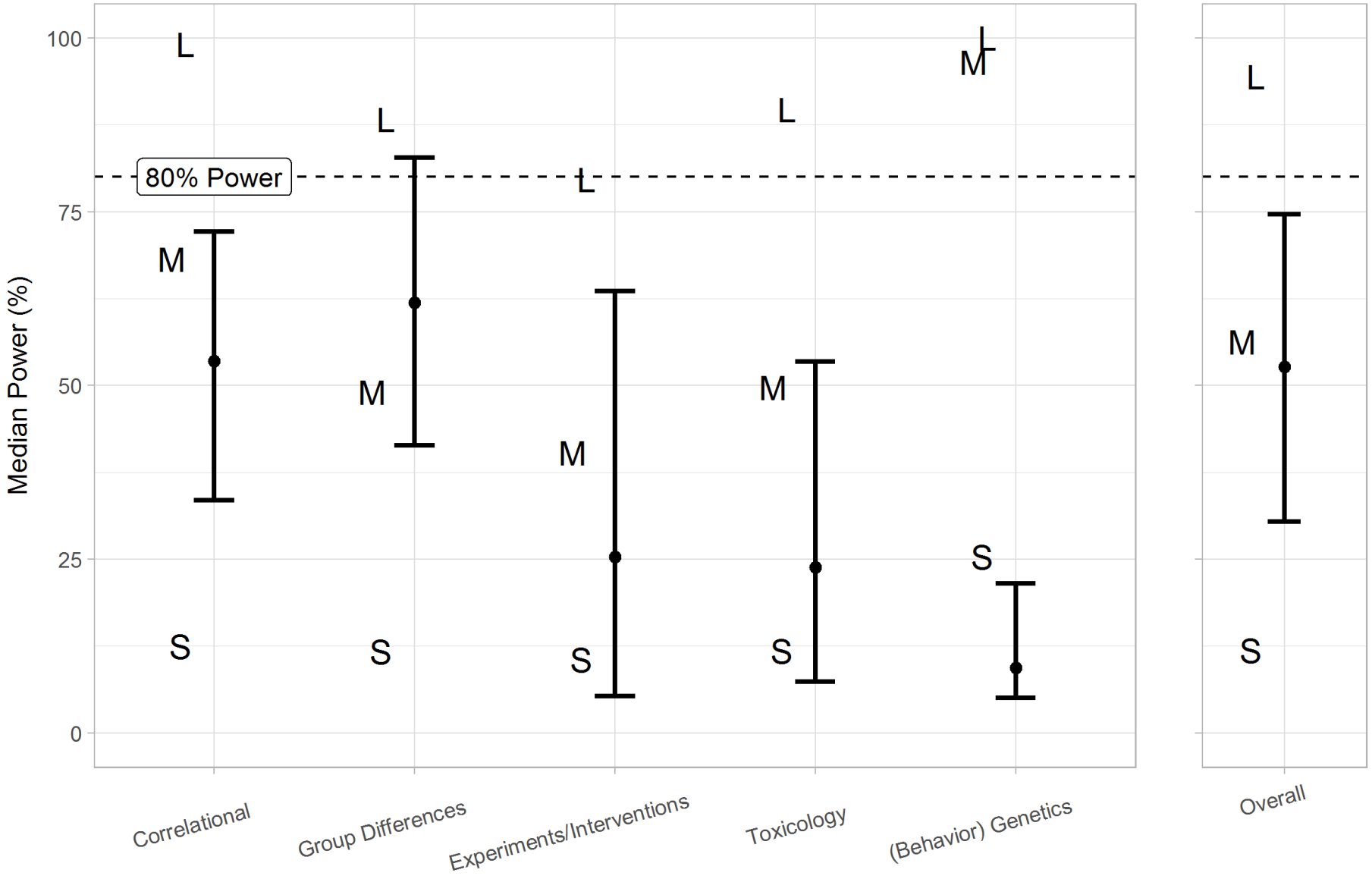


Approximation of true effect size

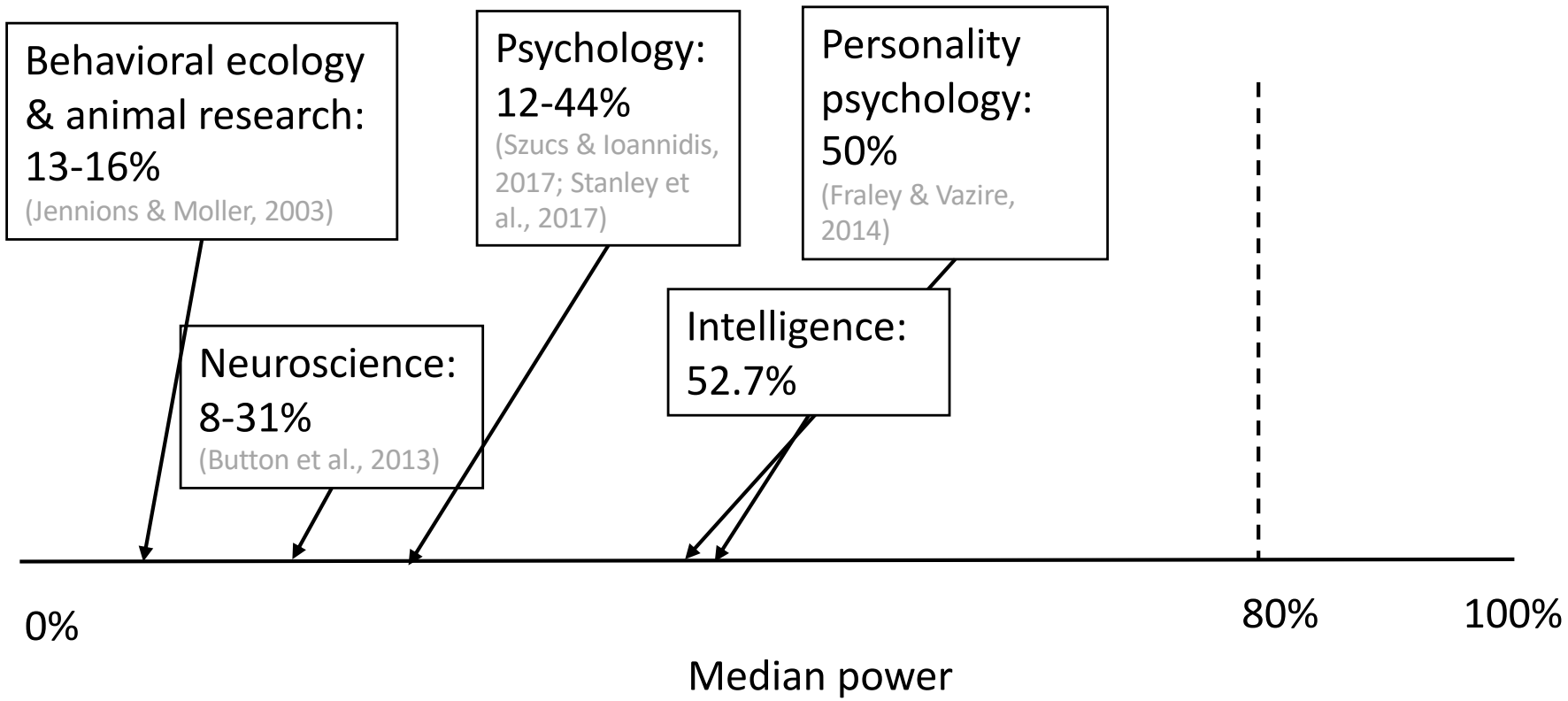
Power of primary studies in intelligence



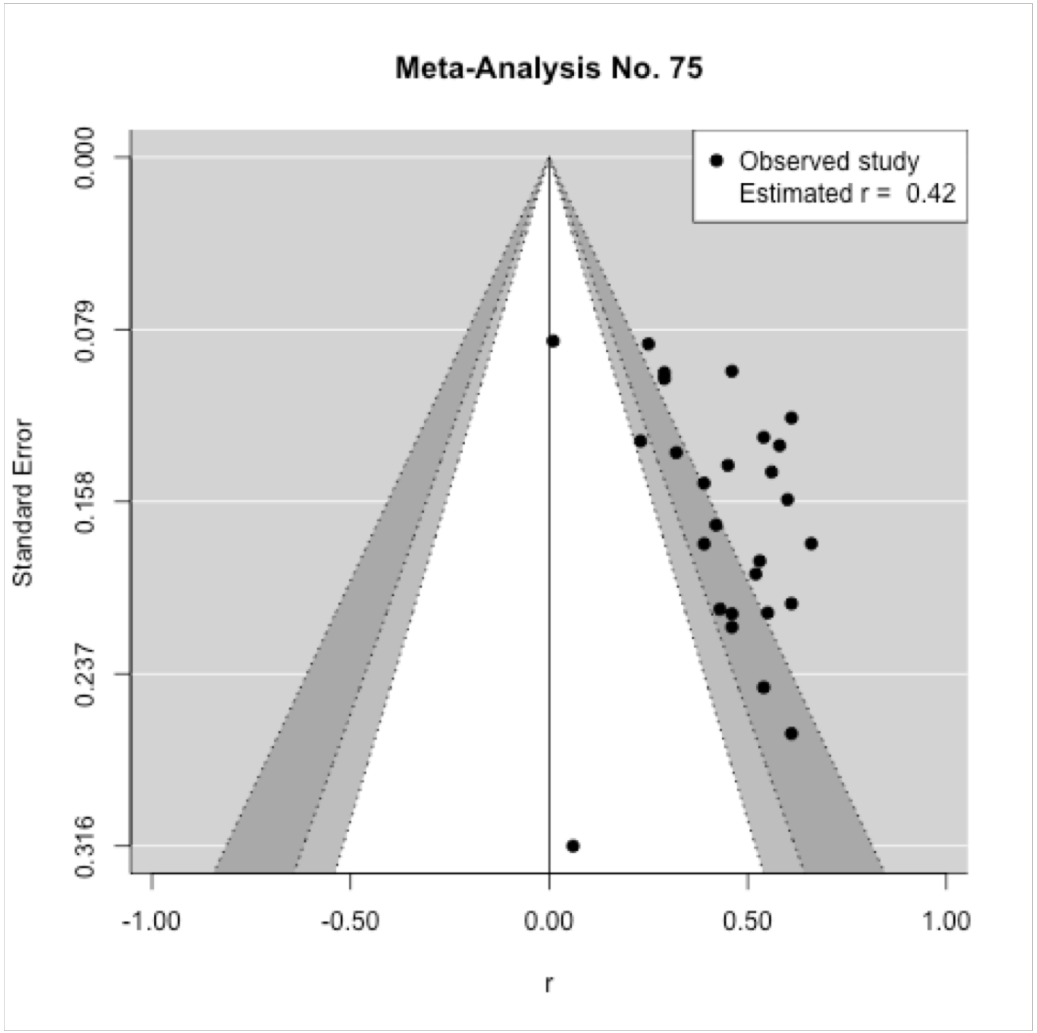
The median power in intelligence research



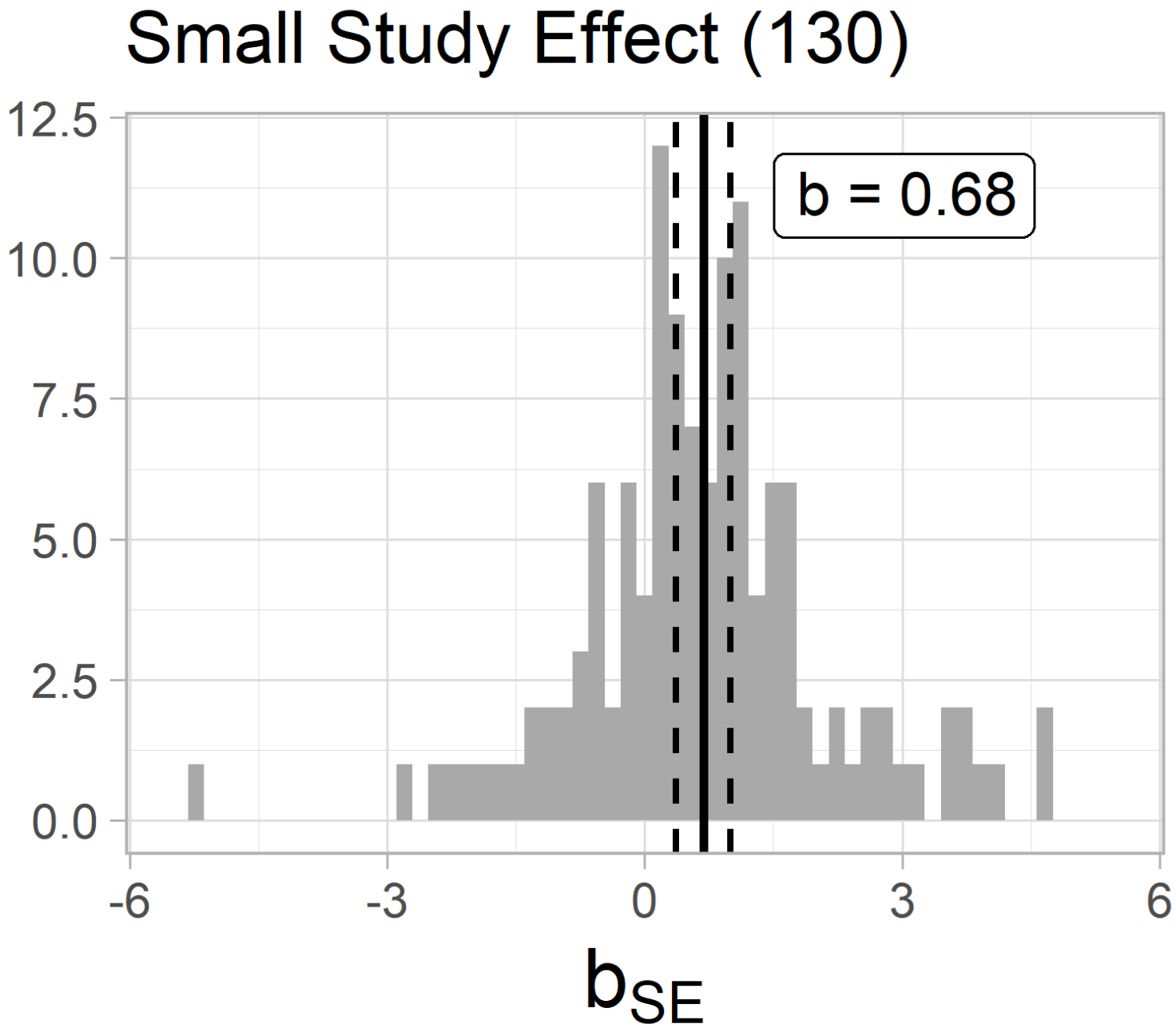
Pretty bad, right?

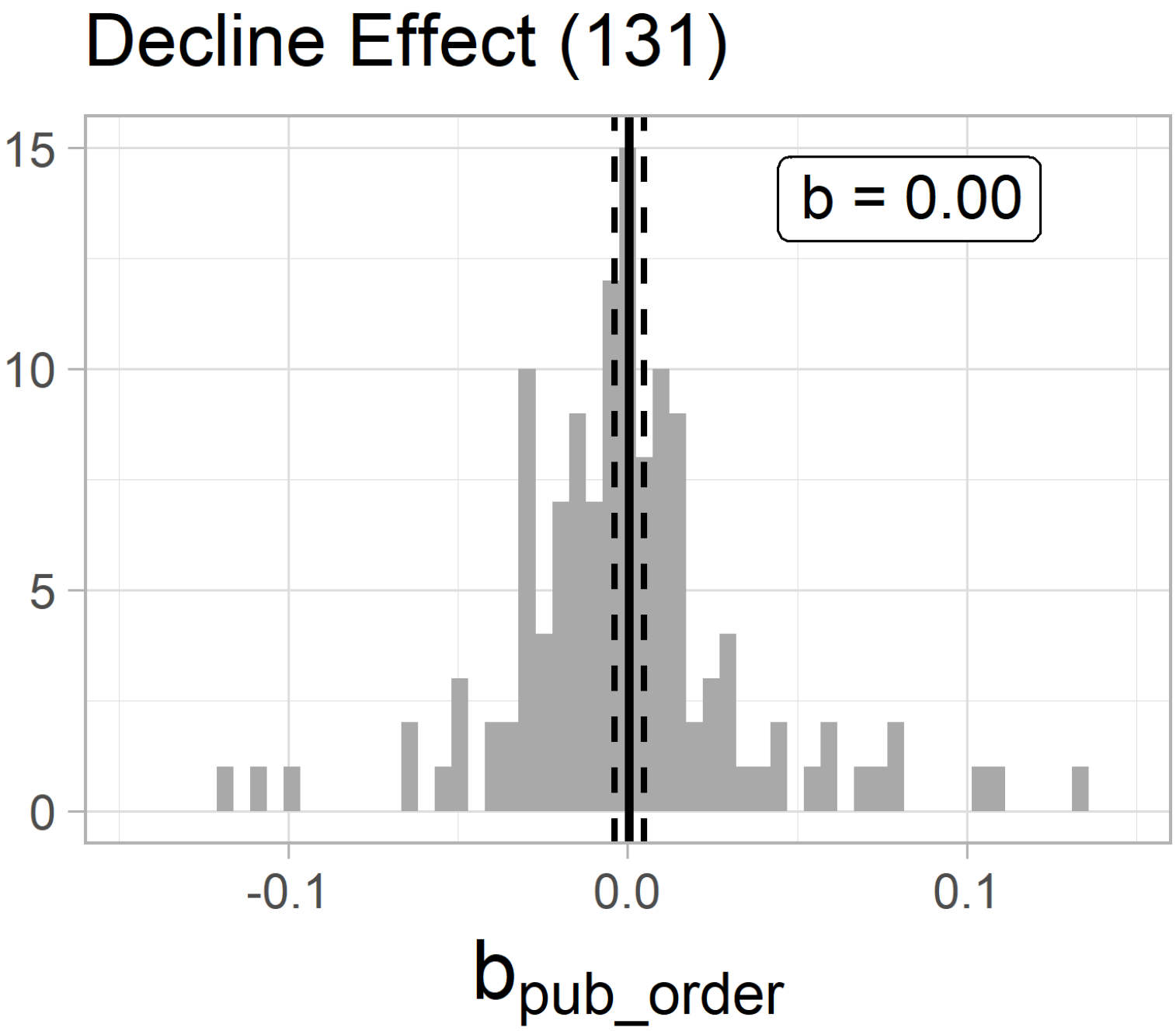


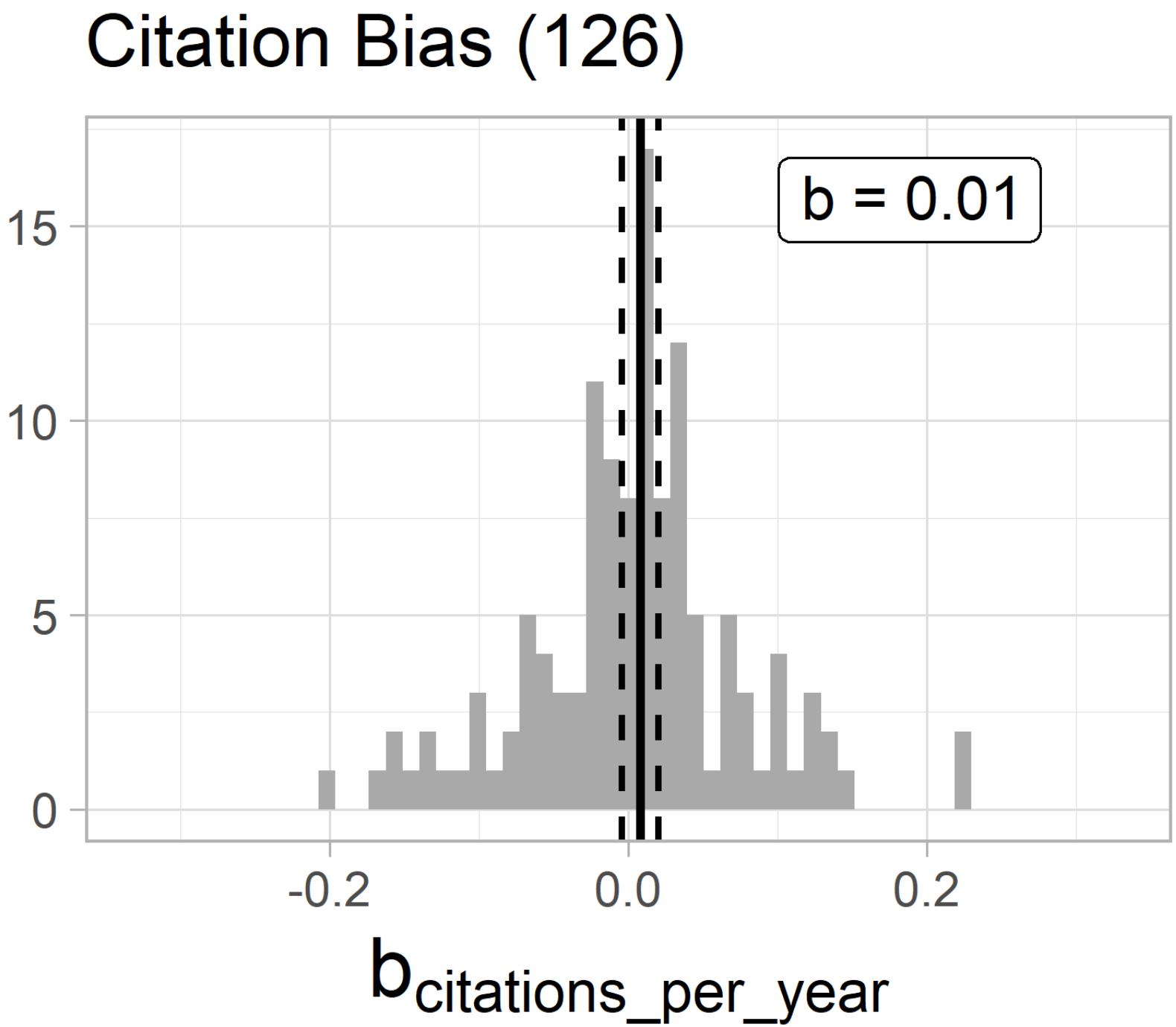
Small study effects in meta-analysis



Infant habituation and recognition memory performance as predictors of later IQ (McCall, 1993)


Small Study Effect (130)
b = 0.68
12.5
10.0
7.5
5.0
2.5
0.0
-6
-3
0
3
6
bSE


Decline Effect (131)
b = 0.00
15
10
5
0
-0.1
0.0
0.1
b pub_order


Citation Bias (126)
b = 0.01
15
10
5
0
-0.2
0.0
0.2
b citations_per_year

Conclusions

- Power in intelligence research is low
- Evidence for publication bias
- Bad, but less bad than in other fields

Preprint: https://psyarxiv.com/ytsvw/

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Analyses

Table 3

Overview of the meta-meta-regressions we estimated in this paper to investigate different predictors for effect size that could potentially indicate bias. We estimated these bias-related patterns in five separate analyses.

Type of bias	**"Predictor" in** $\boldsymbol{Fisher's\ Z_{ij} = a^j + b^j Predictor_{ij} + \varepsilon_{ij}}$	**Estimate of the mean parameter across meta-analyses [95% CI]**	**Heterogeneity of the estimate (SE)**
1. Small study effect	Standard error of primary study's effect size (SE)	0.68 [0.44; 0.92]	τ^2 = 0.71 (0.24)
2. US effect	US*SE	0.47 [0.01; 0.93]	τ^2 = 0.21 (0.75)
3. Decline effect	Order of publication	0.001 [-0.003; 0.004]	τ^2 = 0.00 (0.00)
4. Early-extremes effect*	$deviation = \lvert Fisher's\ Z_{ij} - Fisher's\ Z_j \rvert$, $deviation = a^j + \boldsymbol{b^j PublicationOrder_{ij}} + \varepsilon_{ij}$	-0.001 [-0.005; 0.002]	τ^2 = 0.00 (0.00)
5. Citation bias	Citations per year	0.001 [-0.001; 0.003]	τ^2 = 0.00 (0.00)

* We estimated the presence of early-extremes using a different dependent variable; instead of predicting the primary study' effect size itself, we predicted the deviation of the primary study effect size from the meta-analytic effect.