The statistical power of typical experimental studies in educational psychology is only .31, which falls well below the commonly acceptable threshold (.8).

Underpowered studies and overrepresented significant findings in Educational Psychology: An Empirical Study

Naike Wang[1] (wangnaike@tamu.edu)
[1]Texas A&M University

Introduction

- Systemically underpowered research persists in the behavioral sciences.
  - 0.35 is the average power in psychology[1].
- Excessive significant and positive findings in publication
  - 95.1% of published psychological studies are statistically significant[2].
- The problem
  - Meta-analyses synthesizing underpowered studies risk high false positive rates and inflated effect sizes.
- Research goal
  - This study examines the credibility of meta-analyses in educational psychology by evaluating their median retrospective power.

Median Retrospective Power (MRP)

$$MRP = 1 - N(1.96 - \frac{|UWLS|}{SE_m})$$

UWLS = unrestricted weighed least squares
$N()$ = cumulative normal probability
SE_m = median of the standard errors of study effects

- MRP tells us whether the typical study in a meta-analysis is adequate to investigate the research question.
- With a MRP of .5 to .6, conventional meta-analyses findings are far more likely to be trustworthy[1].

Method

Inclusion Criteria

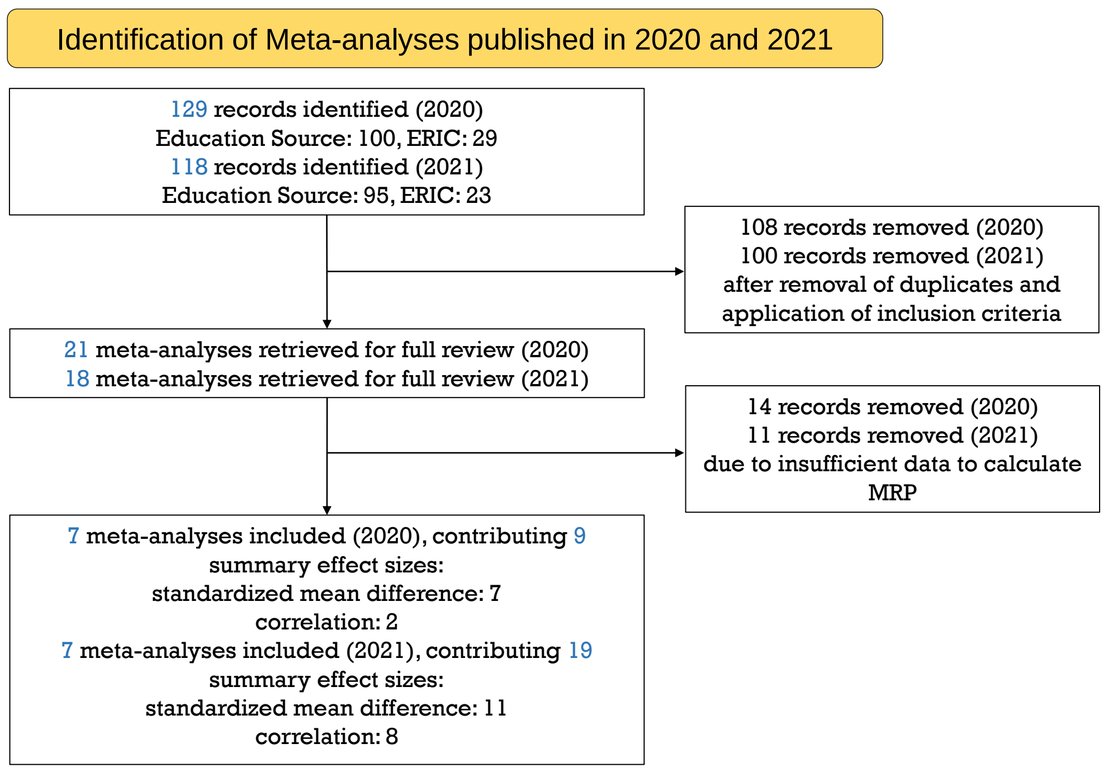
- Educational psychology studies
- Meta-analysis
- Top peer-reviewed journals
- Publication year: 2012 - 2022
- English language

Data Collection

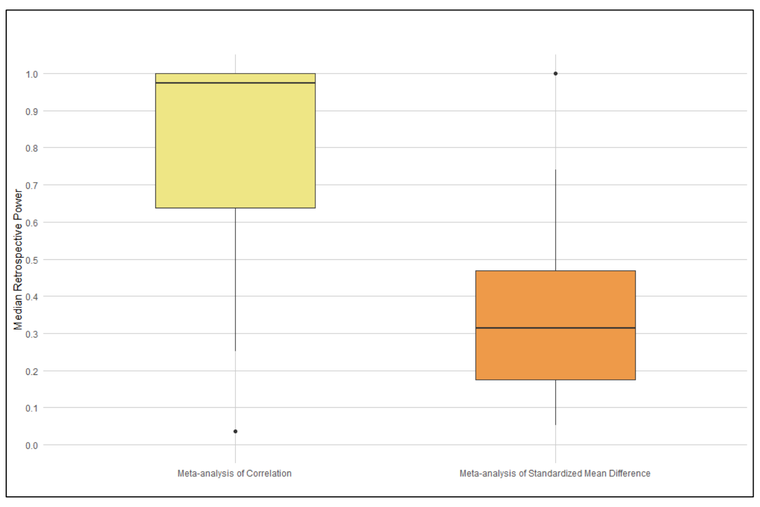
- For meta-analysis of standardized mean difference (Cohen's *d* or Hedges' *g*)
  - Sample size, group mean, standard deviation for control and treatment groups
  - Effect size estimate and its standard error (SE)
- For meta-analysis of correlation
  - *r* and sample size
  - *r* and SE

References
Stanley, T. D., Doucouliagos, H., & Ioannidis, J. P. (2022). Retrospective median power, false positive meta-analysis and large-scale replication. *Research Synthesis Methods*, *13*(1), 88-108.
Fanelli, D. (2010). "Positive" results increase down the hierarchy of the sciences. *PloS one*, *5*(4), e10068.

Identification of Meta-analyses published in 2020 and 2021



Results



- Median MRP of SMD-based meta-analyses: .31 (small).
- Median MRP of correlation-based meta-analyses: .95 (large).

Figure 1. Boxplot of median retrospective power of SMD-based and correlation-based meta-analyses. A commonly used interpretation for SMD: small (.2), medium (.5), large(.8). For correlation: small (.1), medium (.3), large (.5).

Educational Psychology effect	MRP
Effects of Gamification on Cognitive, Motivational, and Behavioral Learning Outcomes	.70
Peer Interaction in Facilitating Learning	.51
Social and Emotional Learning Interventions on Teachers' Burnout Symptoms	.42
Reading Interventions for Students with Reading and Behavioral Difficulties	.36
Impact of Motivational Reading Instruction On Reading Achievement and Motivation of Students	.23

Table 1. Median retrospective power of a few selected meta-analyses included in the study. The investigated effects with a MRP larger than .5 are more likely to be true.

Discussion

- The low MRP found in the study suggests that existing findings previously deemed "significant" are likely spurious or biased in favor of inflated effects.
- Based on MRP, we can build a database to provide researchers with potential replication topics in psychology and their probabilities of being successfully replicated.
- Many meta-analysis authors fail to report essential statistics, such as SE.