Article Level Metrics and Many Labs Replication Outcomes

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Introduction

- Psychologists have started using metrics based on test statistics or p-values to infer the evidential value of published research findings.
- At the same time, large-scale replication projects (e.g., Many Labs[1,2], Reproducibility Project: Psychology[3]) have tested the large-scale replicability of psychological research.
- Using data from Many Labs 1 and 3, this study examines whether paper-level metrics predict replication results.

- **Research Question:** Is it possible to predict from a paper's statistics whether or how well its effects will replicate?

Method

Sample: Original papers reporting effects included in Many Labs 1 and 3 were used because of the availability of meta-analytic estimates of replication success.

Only papers that reported sufficient information to calculate the appropriate metrics were included in each analysis.

Predictors: Using the p-checker app, six predictors were estimated for each original paper, based on tests of critical hypotheses, as recommended by Simonsohn, Nelson, & Simmons[4].

1. ***P*-Curve: Evidential Value:** Test statistic (*z*) for evidential value of a set of studies based on *p*-values[5]
2. ***P*-Curve: Lacks Evidential Value:** Test statistic (*z*) for evidential value of a set of studies based on *p*-values[5]
3. **R-Index:** Based on the difference between the expected and actual number of significant results[6]
4. **Test of Insufficient Variance (TIVA):** The variance in the converted *z*-scores of test statistics[7]
5. **Correlation Between Effect Size and *N*:** Pearson correlation between the observed effect sizes and sample sizes in a paper
6. **N-Pact Factor:** Median sample size for included tests[8]

Outcomes: Replication outcomes were operationalized in two ways:

1. **Difference in Effect Size (continuous):** The difference between the original and replication effects, scaled to Cohen's *d*
2. **Replication Success (dichotomous):** Whether the weighted estimate of the effect size was significant at $p < .05$.

PDF, Data, & Code

https://github.com/ecsalomon/TSR---Test-Stats-Replication

Fig 1. Predicting Differences Between Original and Replication Effect Sizes (d)

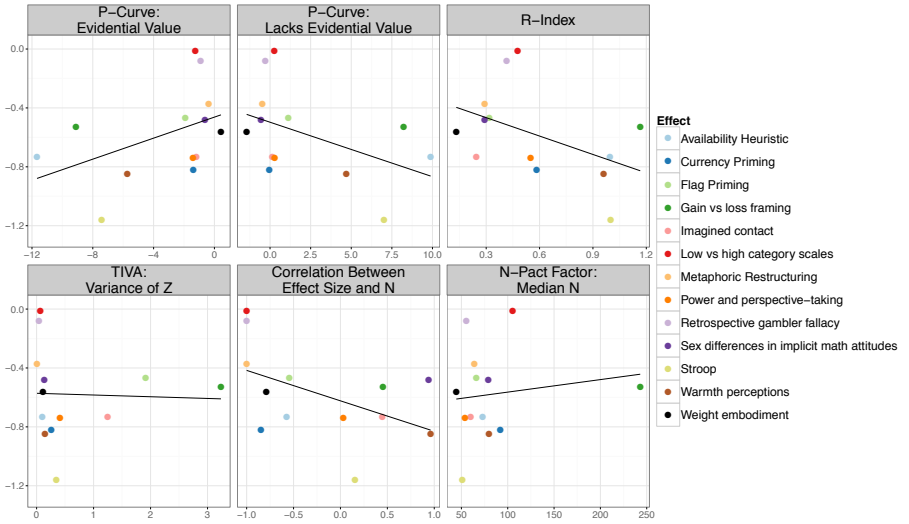
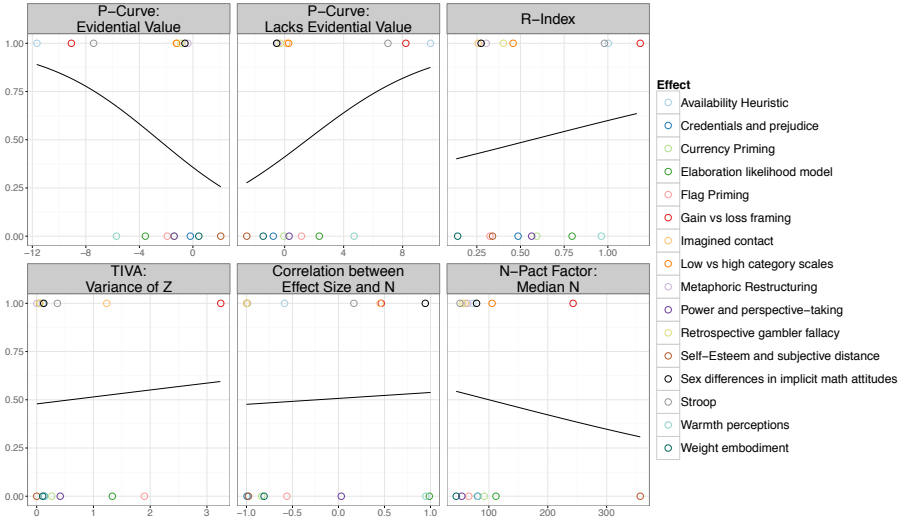


Fig 2. Predicted Probability of Replication Success



Results

Difference in Effect Size

Table 1 presents correlations between the predictor variables and the difference in effect size between original and replication results. **None of the relationships reached significance at $p < .05$.** However, **Figure 1** shows restricted range among many predictors.

Replication Success

Table 2 presents logistic regression coefficients from models predicting success from each of the predictors. **Figure 2** shows the predicted probability of successful replication from each model.

Table 1. Correlations Among Predictors and Continuous Outcome

	1	2	3	4	5	6
1. Difference in Effect Size						
2. P-Curve: Evidential Value	**.44**					
3. P-Curve: Lacks Evidential Value	**-.45**	-.99				
4. R-Index	**-.46**	-.89	.89			
5. TIVA: Variance in Z	**-.04**	-.37	.39	.35		
6. Correlation Between Effect Size and N	**-.49**	-.37	.37	.42	.40	
7. N-Pact Factor	**.14**	.06	-.03	.15	.27	-.06

Table 2. Six Different Logistic Regression Models Predicting Replication Success

	b	*SE*	*z*	*p*	*OR*
1. P-Curve: Evidential Value	-0.23	0.18	-1.31	.19	0.79
2. P-Curve: Lacks Evidential Value	0.23	0.18	1.33	.18	1.26
3. R-Index	0.93	1.64	0.56	.57	2.53
4. TIVA: Variance in Z	0.14	0.58	0.25	.80	1.16
5. Correlation Between Effect Size and N	0.12	0.66	0.19	.85	1.13
6. N-Pact Factor	-0.00	0.01	-0.48	.63	1.00

Conclusions

- **Reporting practices should be improved** so that papers consistently report information needed for meta-analytic and meta-scientific research (e.g., cell sizes, effect sizes, full model details).
- **Researchers should exercise caution in making inferences from metrics based on single papers or small sets of studies.**
- **P-curve may show promise** in predicting replication outcomes but is far from definitive when used on single papers.

References

[1]Ebersole et al., 2015 [2]Klein et al., 2014 [3]Open Science Collaboration, 2015 [4]Simonsohn, Simmons, & Nleson, 2015 [5]Simonsohn, Nelson, & Simmons, 2015, Quantifying Statistical Research Integrity: The Replicabilty-Index [6]Schimmack, 2014, The Test of Insufficient Variance (TIVA): A New Tool for the Detection of Questionable Research Practices [7]Fraley & Vazire, 2014