

Supplemental Material S1. Summary of common publication bias tests.

Funnel Plots

Funnel plots use visual inspection to assess the presence or absence of publication bias within a sample of studies included in a meta-analysis. These are plots of individual study effect size and an index of sample size, most commonly the standard error (Sterne, Becker, & Egger, 2005; Sterne & Egger, 2001). The concept is that the more precise studies (i.e. large N studies with smaller error terms) will have effect sizes closer to the overall mean effect. Though funnel plots are relatively easy to interpret and display the visual relations between individual study effect size and standard error, drawing firm conclusions about publication bias from visual analysis can be challenging. For detailed information, see Sterne, Becker, and Egger, 2005.

Egger's Regression

Egger's regression is a regression-based analysis where the standard normal deviate of the individual study i is regressed on the precision of study i (Egger, Smith, Schneider, & Minder, 1997), such that

$$E[z_i] = \beta_0 + \beta_1 \text{prec}_i$$

In this test, the intercept (β_0) serves to represent publication bias, and the slope (β_1) corresponds to the size and direction of the meta-analytic summary effect. In the complete absence of bias, the regression line will pass through the origin. Testing the value of the intercept against the null hypothesis that $\beta_0 = 0$ produces a statistical test for publication bias in which statistically significant estimate indicates the presence of bias. While the analysis is statistical, this test uses a plot that corresponds to a funnel plot. Here, a non-significant effect corresponds to a symmetrical plot, and a significant effect corresponds to an asymmetrical plot. Although this test provides a more objective statistical test for publication bias, it may be underpowered unless there are a substantial number of studies or the individual effect sizes from individual studies in a given meta-analysis is severely biased (Sterne, Becker, & Egger, 2005).

The Trim and Fill Method

The trim and fill method (Duval & Tweedie 2000a, 2000b) is a statistical test that tests the relation between effect size and standard error and estimates a bias-adjusted overall mean effect. Here, the trim and fill method estimates the number of studies that contribute to asymmetry on the right side of the funnel plot (i.e. large effect sizes with large standard errors) and removes (or 'trims') these extreme values. Next, it estimates a new overall mean effect size using the remaining studies. Finally, the analysis replaces the removed studies, imputes the number of studies required to make the funnel plot symmetrical, and then estimates an adjusted summary effect (Duval & Tweedie, 2000a, 2000b). This analysis does not attempt to describe or adjust for all asymmetry in the funnel plot. Instead, it assumes that publication bias only suppresses studies in the leftmost area of the funnel plot (i.e. those with small effects and large standard errors). For more detail, see Duval (2005).

Tests Based on p Values

In addition to the aforementioned (and more common) tests that assess publication bias using the association between effect sizes and standard errors, another category of relatively

newer tests uses p -values to assess for publication bias. These methods include selection or weight-function models using p -values (e.g. Hedges & Vevea, 2005; Vevea & Woods, 2005), the p -curve analysis (Simonsohn, Nelson, & Simmons, 2014), and the p -uniform analysis (van Assen, van Aert, & Wicherts, 2015).

Selection models (e.g. Vevea & Woods, 2005) weight a study given its p -value, and estimate the probability that an effect size is observed based on a given parameter (the p -value in this case); they then adjust the summary effect estimate to represent what the "true" summary effect would be if selection effects were not present. The p -curve analysis (Simonsohn et al., 2014) uses individual study p -values to adjust the overall main effect of a meta-analysis for publication bias. This p -curve represents the distribution of statistically significant p -values within the meta-analytic sample. As long as individual study sample sizes are known, results can estimate the overall "true" effect size from the shape of the p -curve. Estimating a p -curve can be done using an online application found at: <http://www.p-curve.com/app4>. For more detail, see Simonsohn et al. (2014).

References

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