

Graphical Methods for Meta-analysis: Looking at the forest and the trees

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Acknowledgements

I would like to thank Brian McNatt and Tim Judge for supplying the unpublished information necessary for me to conduct these analyses

Use of their data in this presentation is in no way meant to be critical of their meta-analyses.

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Key Points

- Graphical devices are important and underutilized tools for presenting meta-analytic results
- Properly used, they simplify, clarify, and amplify text-based and tabular presentations
- Forest plots
- Funnel plots

Key Points

- The data I am showing for today are uncorrected for artifacts
- Forest and funnel plots can and should be constructed for corrected coefficients, but only if corrections have been made to the **individual** effects
- They cannot be used with the artifact distribution method

Original Information (from Table 3, McNatt 2000)

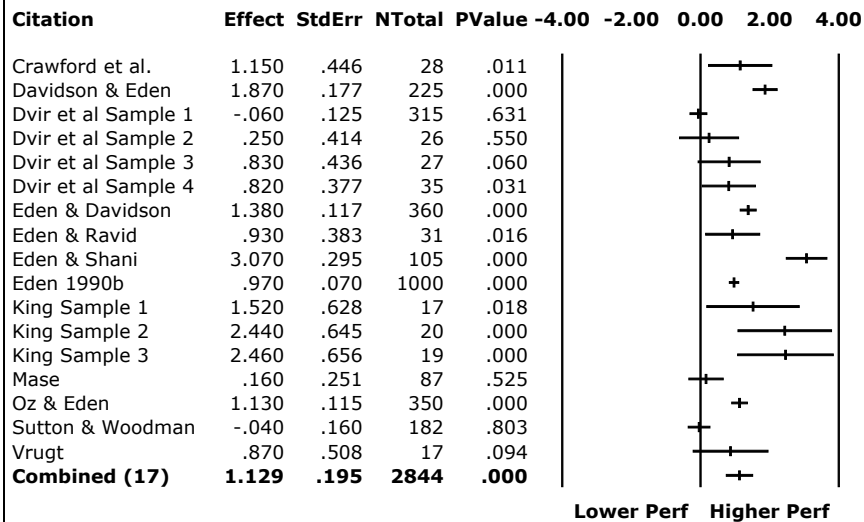
Overall Effect: Effects of Pygmalion interventions on Management Performance

N. Studies	N	K	D	D	Est.pop.SD	% var	80% cred
			uncor	corr		accted for	value
17	2874	58	.99	1.13	.77	6	.14-2.22

McNatt's Original Information -2

- What was the pattern of results?
- How much did the primary studies agree or disagree?
 - Were there any outliers?
 - How many effects were positive?
 - How many negative?
 - How much overlap was there in the confidence intervals?

Forest Plot of McNatt (2000) Pygmalion Effects, Sorted By Author

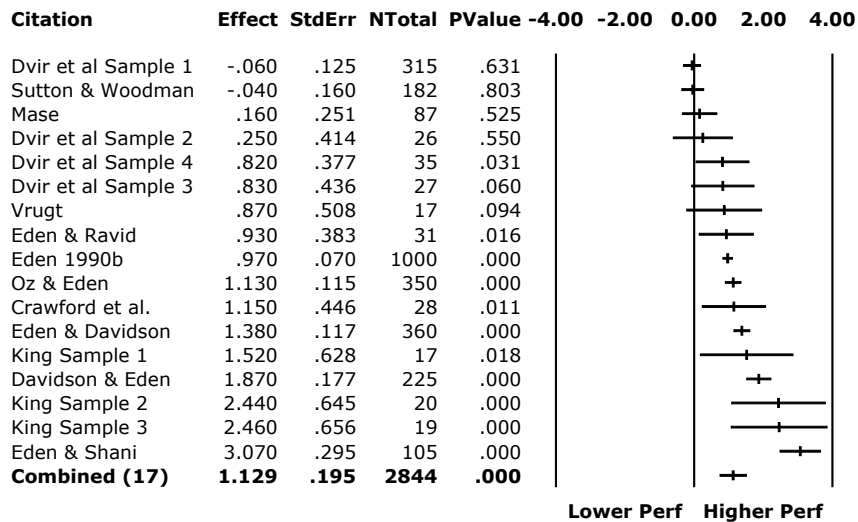


Data are standardized mean differences (ds) uncorrected for artifacts

Forest Plot of McNatt (sorted by author)

- What new information is contained in this graph?
 - Almost all the effects are positive
 - There is a substantial amount of variability among the effects
 - Note: The amount of variability could change some if artifact corrections are made

Forest Plot of McNatt (2000) Pygmalion Effects, Sorted By Effect

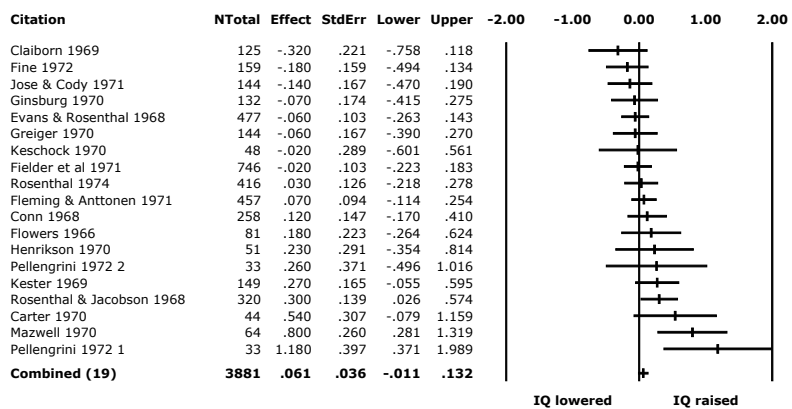


Data are standardized mean differences (ds) uncorrected for artifacts

Forest Plot of McNatt (by effect size)

- What new information is contained in this graph?
- How quickly can you grasp the information being relayed?

Forest Plot of Raudenbush (1984) Expectancy Effects, Sorted By Effect Size

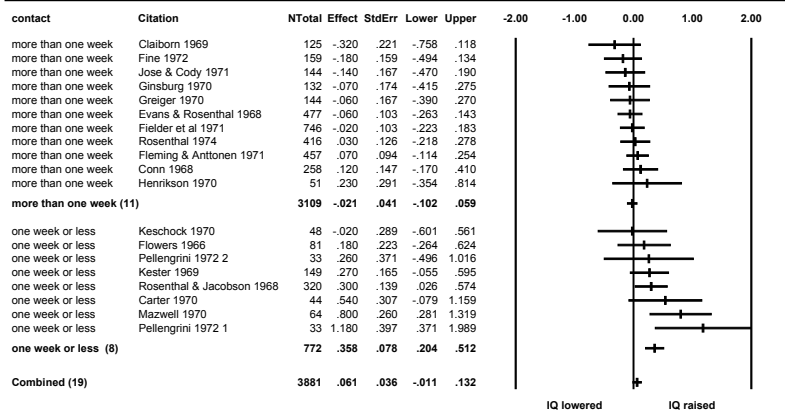


Data are standardized mean differences (ds) uncorrected for artifacts

Grouping Data

- Should we conclude there is no effect?
 - The overall effect is small
 - The standard error is not huge
 - But, there seems to be a pattern here

Raudenbush (1984) Expectancy Data Grouped By Contact, Sorted by ES



Data are standardized mean differences , uncorrected for artifacts

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Raudenbush Moderators

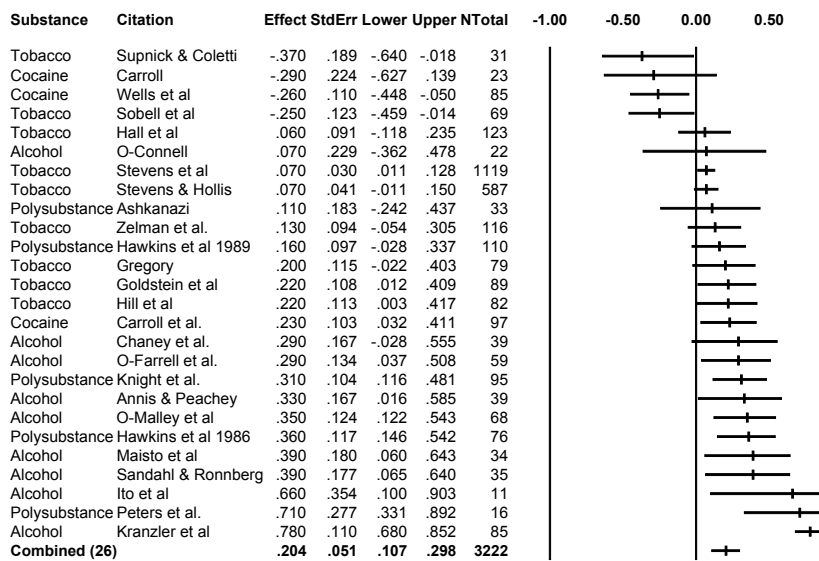
- When sorted by length of contact with students, a clear moderator effect appears
 - The high prior contact group shows no effects
 - The low prior contact group shows an effect of about .36

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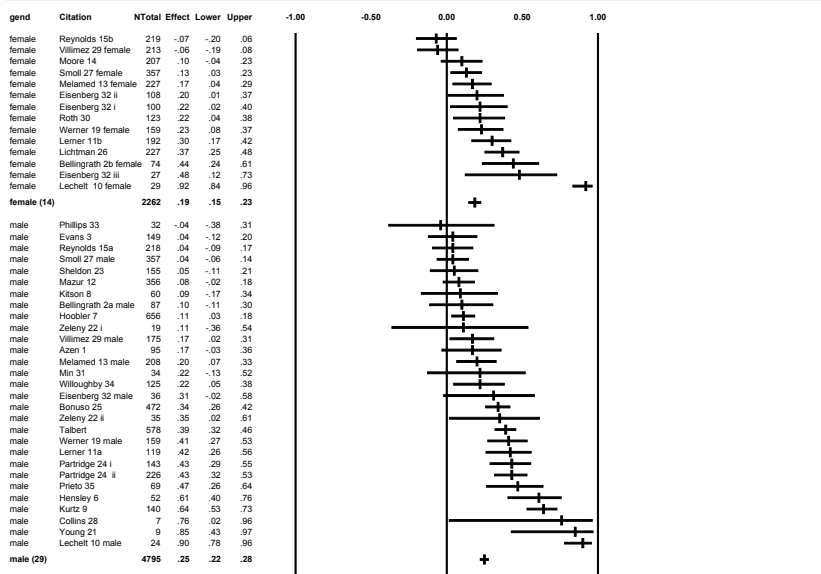
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Irvin t al. (1999, JCCP) Relapse Prevention Meta-Analysis



Grouping and Sorting

T. Judge Height-Perf. Grouped by Gender Sorted by ES



Multiple Page Graphs

Constructing a Forest Plot-1

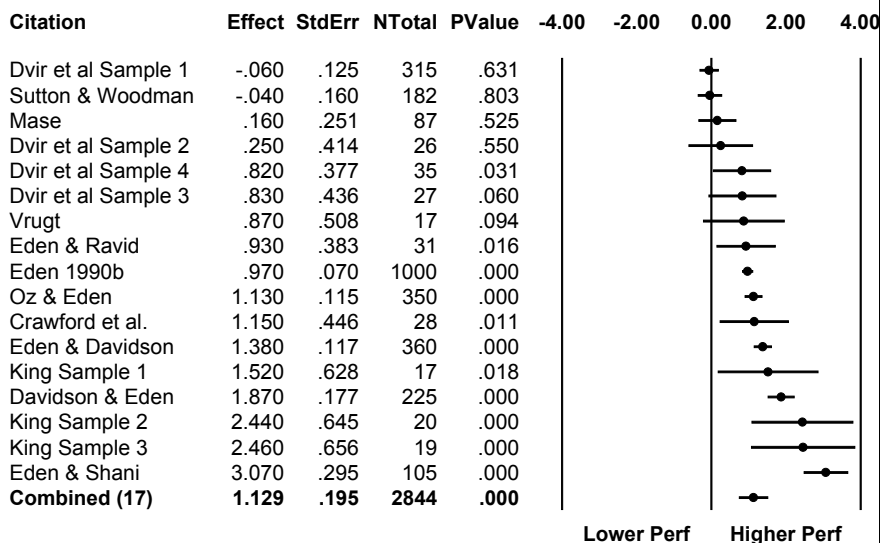
- It is a graphical display
- It depicts the individual study effects + Cis
- Study symbols
 - Constant size symbols for each study
 - Proportional symbols for each study.
 - The size of the symbol shows the % weight each study has in the pooled analysis

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McNatt, Constant Size Symbols



Data are standardized mean effects , uncorrected for artifacts

Perceptually Misleading?

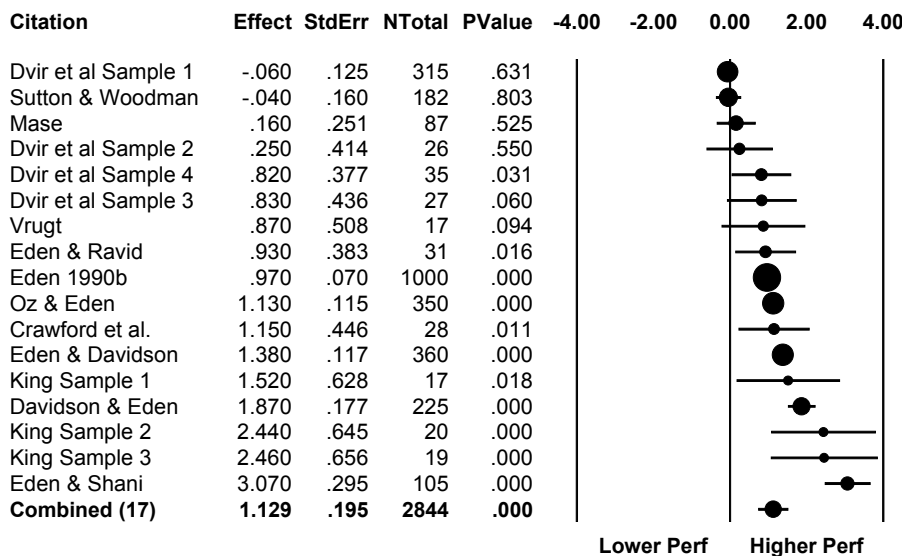
- The eye is drawn to the longer error bars (CI bars)
- Less informative studies have a relatively greater visual effect
- The use of proportional symbols for point estimates reduces this distortion

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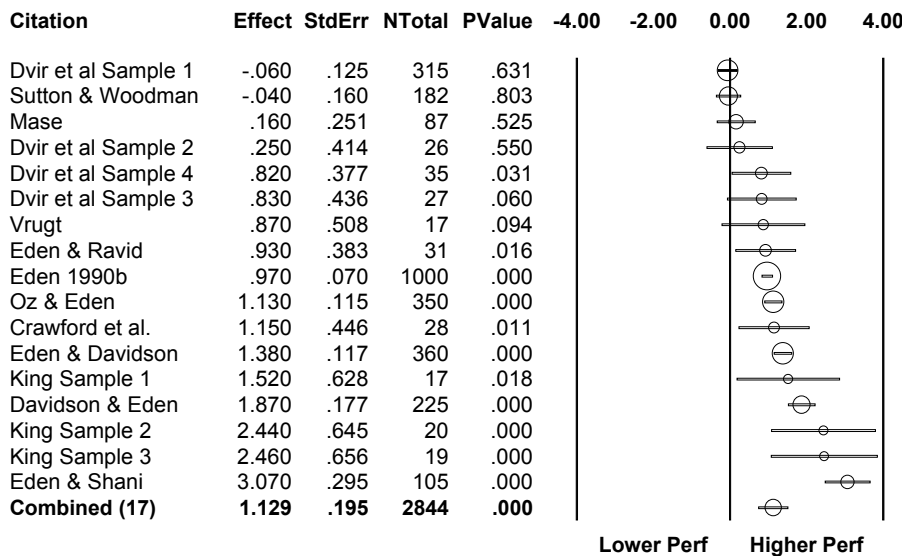
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McNatt, Proportional Symbols (Telescoped)



Data are standardized mean effects , uncorrected for artifacts

McNatt, Proportional Symbols (Telescoped)



Data are standardized mean effects , uncorrected for artifacts

Constructing a Forest Plot-3

- A vertical line drawn down the middle of the graph represents no effect
 - For standardized mean effects and correlations, this is represented by a zero
 - For odds ratios, this is represented by a one
- The horizontal line at the bottom is the scale measuring the magnitude of the effect

Funnel Plots

- A means for detecting publication bias
Graphs effect size by effect precision
 - Magnitude of the effect
 - Sample size or $1/\text{standard error}$

Funnel Plots 2

- If the meta analysis had captured all the relevant studies we would expect the funnel plot to be symmetric.
- If the funnel plot is actually asymmetric,
 - Relatively high number of small studies falling toward the right (representing a large treatment effect)
 - Relatively few falling toward the left,
 - We are concerned that these left-hand studies exist, but are missing from the analysis.

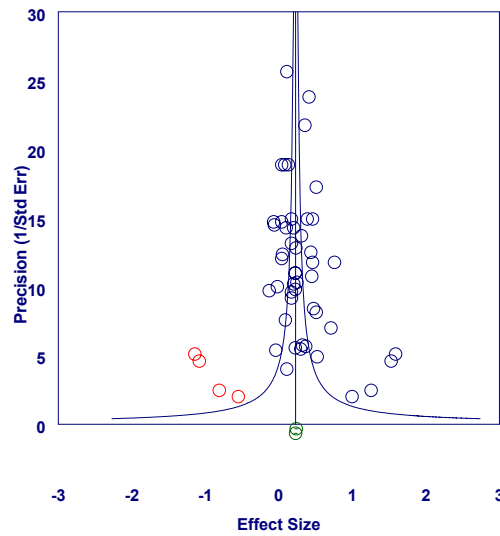
T. Judge
Height-Perf
Data

Effects
shown are
Fisher's zs.

Red circles
denote
imputed
studies

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Funnel Plot of Precision by Effect Size



Funnel Plots 4

- Trim and Fill Method
- Suggests that there are 4 “missing” studies
- However, the change in the mean correlation is only about .01
- We can thus feel confident in our results
- Caveat: These are uncorrected effects, the shape of the funnel can change when you make corrections for artifacts.

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Funnel Plots 5

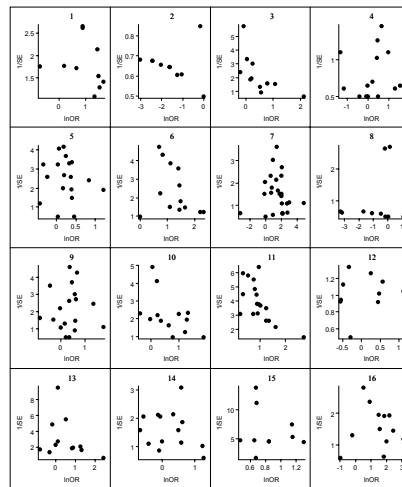
- The Judge Height-Performance funnel plot is nicely behaved
- This is partly because it is based on 48 ES
- In Funnel Plots based on fewer data points (more common in Medicine, and in moderator analyses), symmetry and asymmetry are harder to detect, as shown in the next slide

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Data courtesy
of Alex
Sutton, from
Sutton et al.
(2000) BMJ



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Funnel Plots 7

- Funnel plot analysis should probably not be used when there are only a few studies in the meta-analysis
- This is for the same reason moderator analyses should not be done when there is a small K
- Second order sampling error

Funnel Plots 8

- While small studies may show relatively large effects because of publication bias, they may also show relatively large effects for other reasons
- Perhaps researchers are better able to control the conditions of small studies than large studies

Funnel Plots 9

- However, whatever the basis for the bias, the essential goal of this analysis, to determine whether or not we can have confidence in the results, remains valid.

In Conclusion

- Demonstration of the added value of graphic methods
- Encouragement of their wider use in I/O meta-analyses