

# Meta-Analysis Workshop

*Psychometric Meta-Analysis*

*(Hunter/Schmidt Approach)*

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# Psychometric MA (Hunter & Schmidt, 2004)

- (Dis)Attenuation model as integral part of HS approach: Artifacts known from psychometrics (e.g., reliability, validity, range restriction, etc.) are taken into account
- Random effects assumption only
- 'Credibility intervals' are estimated: Emphasizes the distribution of true effects (rather than the overall mean effect; HO: prediction intervals in the RE model)
- Untransformed correlation coefficients are used (see Field, 2001; Schulze, 2007)
- (Inverse) Sample sizes are used (instead of inverse variance weight): no sign. difference if applied to  $r$  BUT major difference if used for  $OR$
- Heterogeneity is assessed using a 'rule of thumb'
- Applied/tested primarily in IO-Psychology contexts (esp. test validity research in personnel selection)

# Psychometric MA: Data Generation Model

## Attenuation model

$$\rho_o = A * \rho$$

$\rho_o = r_o + e$   
 $E(e) = 0$

$$A = \prod_{j=1}^m a_j$$

„True“  
 non-attenuated  
 correlation

Examples for  $a(j)$ :

$a(1,2)$ : Measurement errors (att. reliability),  
 $a(3,4)$ : Artificial dichotomization.

# Psychometric MA : Procedure

- Disattenuation model:

$$\rho = \frac{\rho_o}{A} = \frac{r_o}{A} + \frac{e}{A} = r_c + e_c$$

- Integration model:

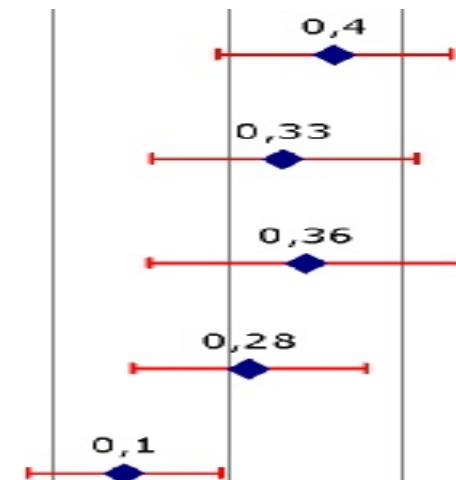
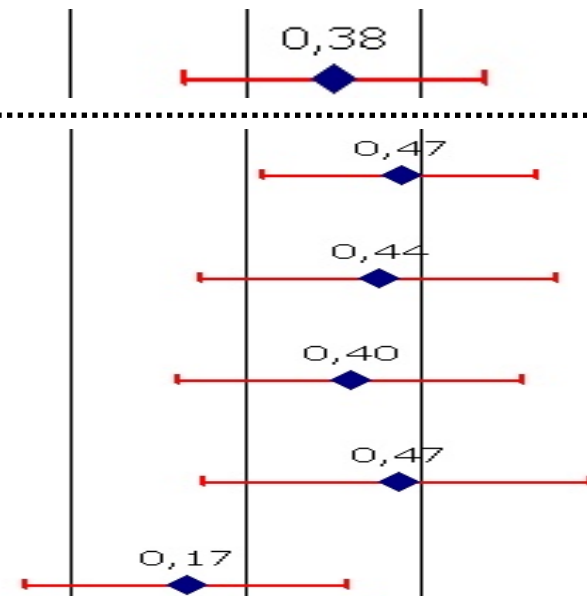
$$\overline{r_c} = \frac{\sum_{i=1}^k (w_i * r_{c(i)})}{\sum_{i=1}^k w_i} \quad \overline{SE_c^2} = \frac{\sum_{i=1}^k (w_i * SE_{c(i)}^2)}{\sum_{i=1}^k w_i} \quad w_i = N_i * A_i^2$$

- 75% rule for homogeneity 'testing' (rule of thumb)

# Psychometric MA : Synthesis

	<b>A</b>	<b>r[c]</b>	<b>SE(r[c])</b>
S 1	0,85	0,47	0,10
S 2	0,75	0,44	0,13
S 3	0,90	0,40	0,13
S 4	0,60	0,47	0,14
S 5	0,60	0,17	0,12

	<b>N</b>	<b>r[o]</b>	<b>SE(r[o])</b>
S 1	100	0,40	0,08
S 2	86	0,33	0,10
S 3	60	0,36	0,11
S 4	120	0,28	0,08
S 5	200	0,10	0,07



# Subgroup / Moderator Analysis

- Homogeneity, if 75% or more of the total (observed) variance is due to artifacts and sampling error
- If *a priori* hypotheses about covariates possibly explaining heterogeneity:
  - for categorical moderators:  
studies are divided into subgroups based on the values of the hypothesized covariate
  - for continuous moderators:  
meta-regression procedure using individually corrected ES and corrected sampling error variances
- If *no a priori* hypotheses about covariates possibly explaining heterogeneity: ? (*not applicable, need for theory-driven research emphasized!*)

# What if disattenuation of indiv. studies impossible?

1. A 'bare bones' meta-analysis (= MA only accounting for sampling error) is conducted, yielding estimated of the mean and standard deviation of the attenuated study population correlations.
2. The overall mean and standard deviation from bare bones meta-analysis are then corrected for the effects of artifacts other than sampling error using a mean compound multiplier, estimated from artifact distributions.

[http://wwwhomes.uni-bielefeld.de/metaanalyse/MA\\_Software.htm](http://wwwhomes.uni-bielefeld.de/metaanalyse/MA_Software.htm)

Roth, P.L. (2008). Software Review: Hunter-Schmidt Meta-Analysis Programs 1.1. *Organizational Research Methods*, 11, 192-196

# Combining HO & HS?

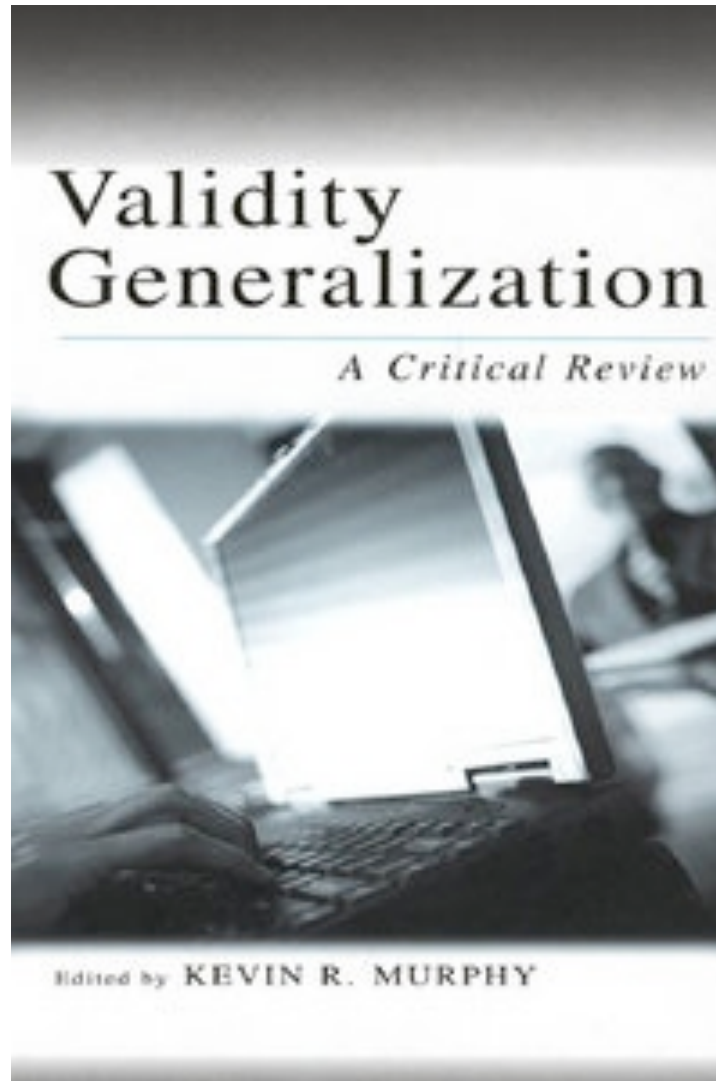
- Possible in principle (see Bornstein, 2009)
- 'Usual' HO-based integration of disattenuated effect sizes and variances
  - largely broadens the scope of software applications to use
  - 'robustness' of conclusions if HS integration is not followed
  - disattenuation procedure as one approach to estimating pooled correlation matrices
    - > multivariate MAs?
- HS-based integration ( $1/N$  instead of inverse variance weight, for instance)
- may make sense as a sensitivity analysis



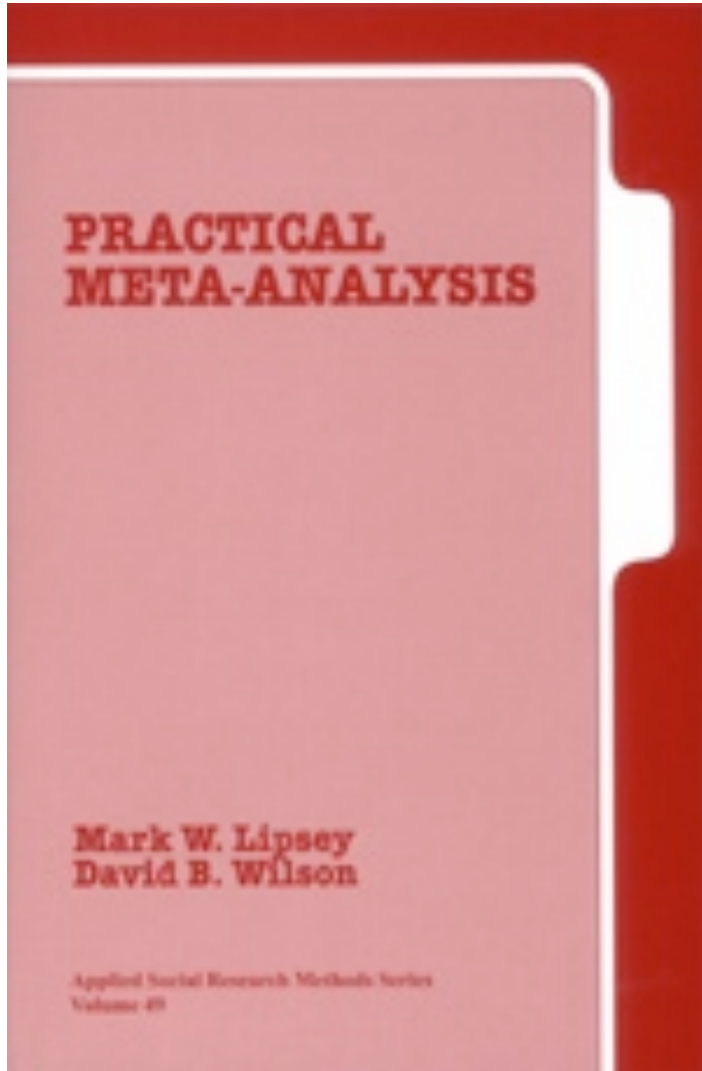
# Important Issues Related to HS approach

- Consequences of disattenuation:
  - Mean ES estimates get larger
  - Smaller between studies variance, i.e. less variability between ES (because artifacts are different across studies, increasing heterogeneity; disattenuation homogenizes ES between studies variability).
  - Larger within variability: **Standard errors get larger (!)**
    - for individually corrected ES
    - for the overall mean ES estimate
  - Supplement „**TechnischerAnnex\_HS\_MetaAnalyse.pdf**“
- 75% only rule-of-thumb, i.e. there might be remaining systematic variability in the 25% leftover
- What about the precision / sampling error of the artifact (multiplier) estimates?

# Murphy (2003)



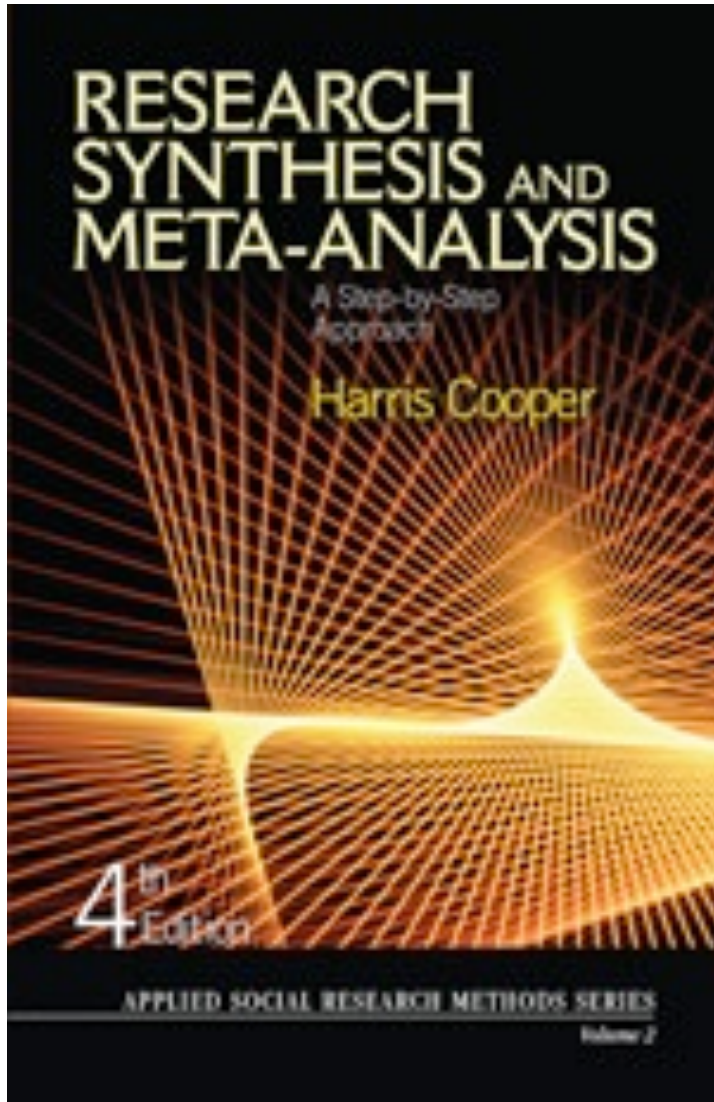
# Lipsey & Wilson (2001)



Lipsey, M.W., & Wilson, D.B.(2001). *Practical Meta-analysis*. Thousand Oaks: Sage.

- Chapter 6: Analysis issues and strategies:  
Four pages on HS artifacts adjustment  
within

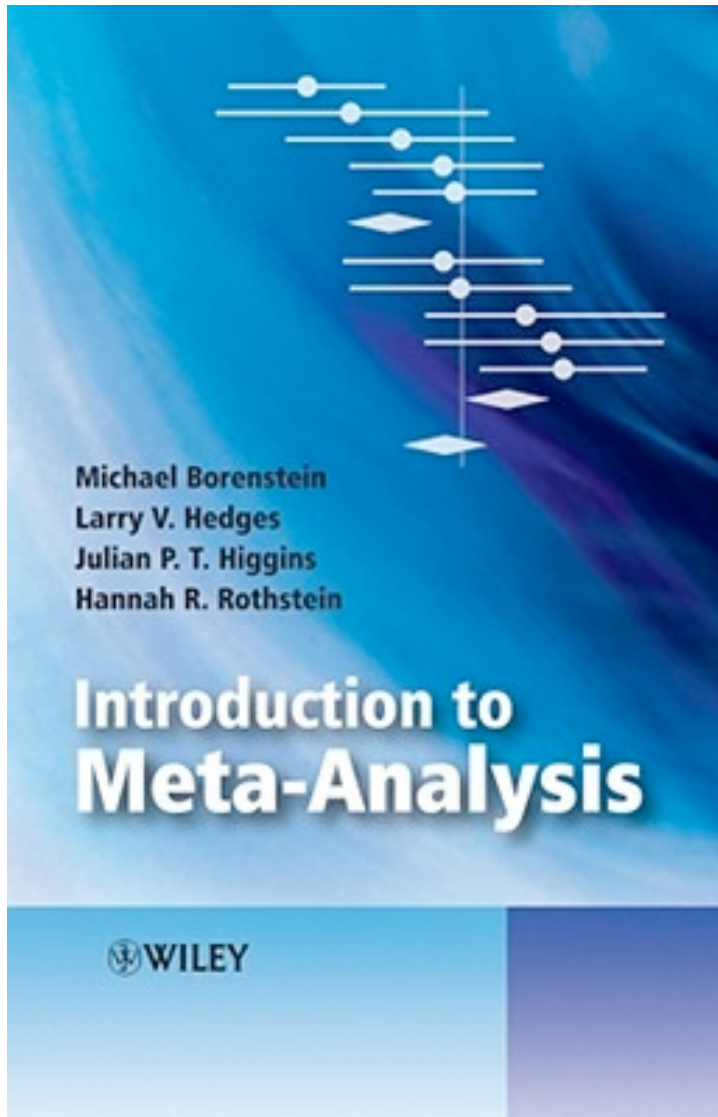
# Cooper (2010)



Cooper, H. (2010). *Research Synthesis and Meta-Analysis: A Step-by-Step Approach*. Thousand Oaks, CA: Sage.

Just a few 'pointers' to HS approach throughout the book.

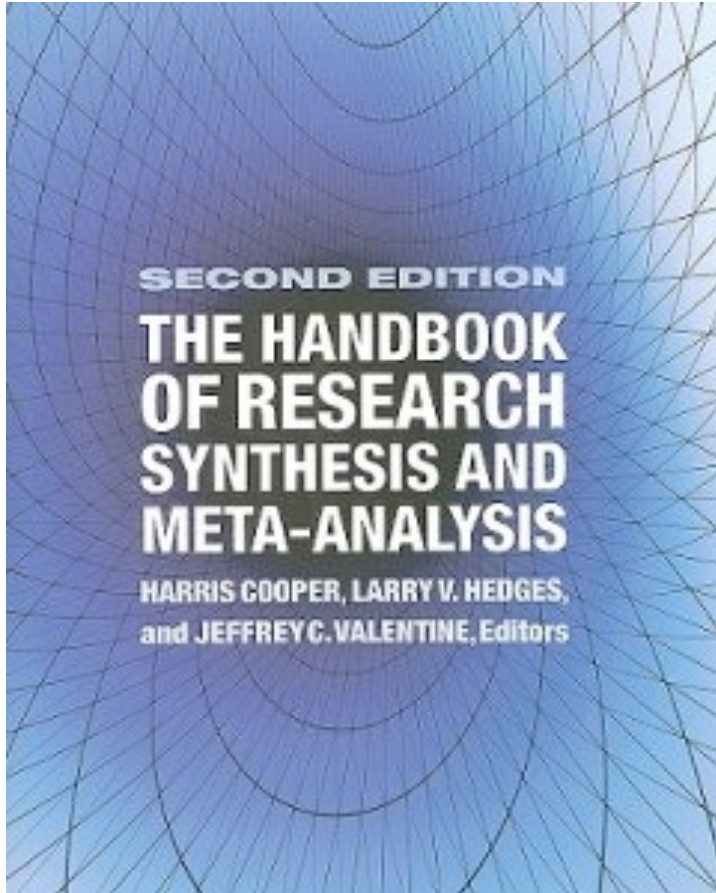
# Borenstein et al. (2009)



Borenstein, M., Hedges, L.V., Higgins, J.P.T., & Rothstein, H.R. (2009). *Introduction to Meta-Analysis*. Chichester, UK: Wiley.

- Chapter 38: Psychometric Meta-Analysis

# Cooper, Hedges & Valentine (2009)

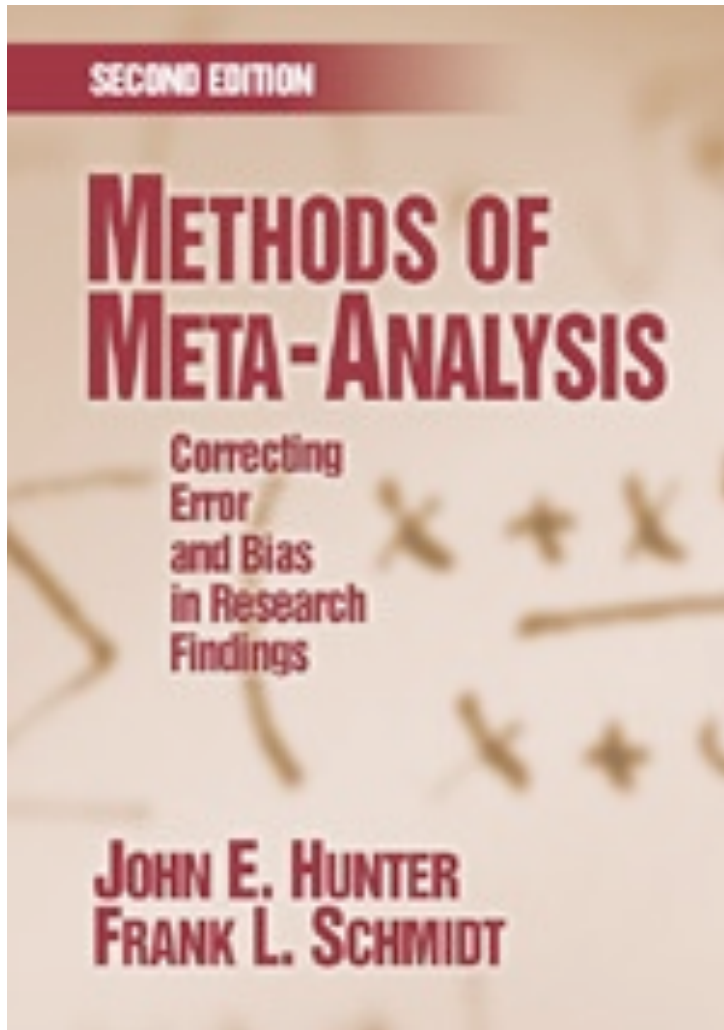


Cooper, H., Hedges, L.V., & Valentine, J.C. (Eds.) (2009). *Handbook of Research Synthesis (2nd ed.)*. New York: Russell Sage Foundation.

- Chapter 17: Correcting for the distortion effects of study artifacts in meta-analysis (by Frank Schmidt, Huy Le, and In-Sue Oh)



# Hunter & Schmidt (2004)



Hunter, J. E., & Schmidt, F. L. (2004). *Methods of meta-analysis: Correcting error and bias in research findings (2nd ed.)*. Thousand Oaks, CA: Sage.

- „The“ book about the HS approach