Research Synthesis

An Introduction to Reviews, Meta-Analyses, and PRISMA Criteria

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1. Introduction

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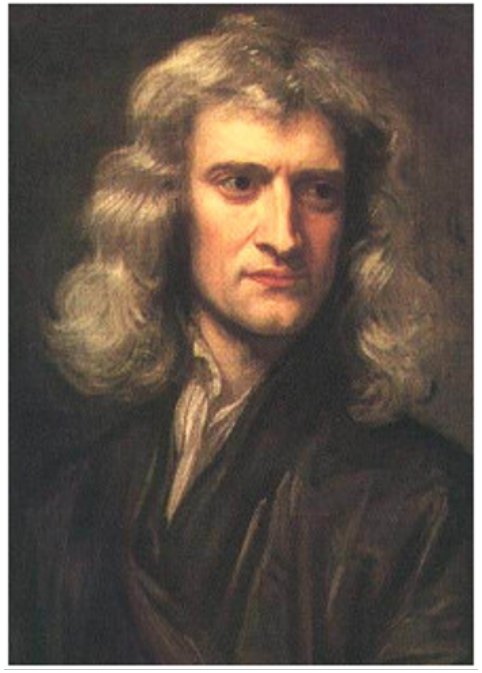
"If I have seen further it is by standing upon the shoulders of giants"



Isaac Newton
(1643 - 1727)

A central principle in science

The advancement of scientific knowledge is based on systematic building of one study on top of a foundation of prior studies

1.1 Types of Analyses: Basic Terminology

- **Primary analysis**
  is the original analysis of data in a research study. It is what one typically imagines as the application of statistical methods.
- **Secondary analysis**
  is the re-analysis of data for the purpose of answering the original research question with better statistical techniques, or answering new questions with old data.
- **Research Synthesis**
  set of qualitative/quantitative methods to combine data or findings of previous research

(Card, 2012; Glass, 1976)

1.2 Research Synthesis

- Narrative Review
- Systematic Review
- Meta-analysis

(Uman, 2011, *J Can Acad Child Adolesc Psychiatry*)

1.3 Narrative Reviews

- Tend to be mainly descriptive
- Do not involve a systematic search strategy; hence, they could be prone to selection bias...
- ... however, narrative reviews are often published by important authors, and they are easy to read. Furthermore, they provide a broader range of subtopics: Thus, it may be very useful for an initial search stage!!!

Suggested Journals

- *Annual Review of Psychology*
- *Personality and Social Psychology Review*
- *Psychological Review*
- *Annual Review of Organizational Psychology and Organizational Behavior*

Some examples of Narrative Reviews

- **Developmental Psychology**
  Cicchetti, D. (2016). Socioemotional, personality, and biological development: Illustrations from a multilevel developmental psychopathology perspective on child maltreatment. *Annual Review of Psychology, 67*, 187-211. https://doi.org/10.1146/annurev-psych-122414-033259
- **Organizational Psychology**
  Fraccaroli, F., Zaniboni, S., & Truxillo, D. M. (2024). Challenges in the new economy: A new era for work design. *Annual Review of Organizational Psychology and Organizational Behavior, 11*, 307-335. https://doi.org/10.1146/annurev-orgpsych-081722-053704
- **Personality Psychology**
  Falk, C. F., & Heine, S. J. (2015). What is implicit self-esteem, and does it vary across cultures? *Personality and Social Psychology Review, 19*(2), 177-198. https://doi.org/10.1177/1088868314544693
- **Psychometrics**
  Preacher, K. J. (2015). Advances in mediation analysis: A survey and synthesis of new developments. *Annual Review of Psychology, 66*, 825-852. https://doi.org/10.1146/annurev-psych-010814-015258

1.4 Systematic Reviews

- Tend to be mainly descriptive (as narrative reviews), or they show **simple descriptive analyses**
- However, the search strategy involves **a detailed and replicable plan**
- The topic is **narrower** than narrative reviews

Suggested Journals

- *Clinical Psychology Review*
- *Health Psychology Review*
- *Review of Educational Research*
- *The Leadership Quarterly*

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Guidance on conducting and reviewing systematic reviews (and meta-analyses) in work and organizational psychology

Kevin Daniels

European Journal of Work and Organizational Psychology

ABSTRACT

Systematic reviews and meta-analyses are means of summarizing and synthesizing research evidence in a given topic area. They can be used to define the current state of knowledge and how confident we can be in that knowledge, to identify evidence gaps, and to provide recommendations for policy and practice based on the best available evidence. At *European Journal of Work and Organizational Psychology*, our editorial stance is explicitly to encourage the conduct of systematic reviews and meta-analyses. The purpose of this editorial is to provide some guidance to authors and journal referees on the (technical) features of good systematic reviews.

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KEYWORDS
Systematic review methods; work and organizational psychology; evidence-based decision-making

1) Before the review
2) Searching the literature
3) Selecting studies
4) Data extraction
5) Evidence synthesis

Table 1. List of features of high quality reviews explicitly stated in *EJWOP* articles since 2015.

Feature		Proportion of studies meeting criteria
Dummy searches and/or scoping reviews	1	Red
Explicit & registered review protocol		Red
Specifying PICOS/PECOS or other structured approach to bounding the review questions		Red
Consultation with experts/other stakeholders on review questions, keywords, databases		Red
Specific keywords	2	Green
Specified electronic sources		Green
Plans for additional searches		Amber
Explicit discussion of any restrictions on searches		Amber
Criteria for including/excluding grey literature		Amber
Searches into relevant bibliographic software		Red
Procedures to ensure and demonstrate inter-rater reliability/consistency at all stages of sifting (title/abstract/full study)	3	Red
Presentation of PRISMA diagram		Amber
Explicit and piloted data extraction sheets	4	Red
Procedures to ensure and demonstrate inter-rater reliability/consistency of data extraction from full study		Amber
Use of meta-analysis or graphical or other structured methods for evidence synthesis	5	Green
Explicit evidence statements or other forms of summarizing into review findings		Amber
Explicit assessments of quality of evidence underpinning each review finding		Amber
Assessment of sources of bias		Red
Stated evidence gaps		Amber

Red – stated in <1/3 of studies, Amber – stated in 1/3 to 2/3 of studies, Green – stated over 2/3 of studies.

Some examples of Systematic Reviews

- **Developmental Psychology**
  Aldrup, K., Carstensen, B., & Klusmann, U. (2024). The role of teachers' emotion regulation in teaching effectiveness: A systematic review integrating four lines of research. *Educational Psychologist, 59*(2), 89-110. https://doi.org/10.1080/00461520.2023.2282446
- **Organizational Psychology**
  Robertson, I. T., Cooper, C. L., Sarkar, M., & Curran, T. (2015). Resilience training in the workplace from 2003 to 2014: A systematic review. *Journal of Occupational and Organizational Psychology, 88*(3), 533-562. https://doi.org/10.1111/joop.12120
- **Personality Psychology/Clinical Psychology**
  Perinelli, E., & Gremigni, P. (2016). Use of social desirability scales in clinical psychology: A systematic review. *Journal of Clinical Psychology, 72*, 534-551. https://doi.org/10.1002/jclp.22284
- **Psychometrics**
  van de Schoot, R., Winter, S. D., Ryan, O., Zondervan-Zwijnenburg, M., & Depaoli, S. (2017). A systematic review of Bayesian articles in psychology: The last 25 years. *Psychological Methods, 22*(2), 217-239. https://doi.org/10.1037/met0000100

1.5 Meta-Analyses

Group of statistical methods used for

- summarize the results of primary studies;
- analyze the degree of heterogeneity of these studies;
- explain the differences found between studies.

- Analyses are **more advanced** than those used for systematic reviews (Correlation Coefficient, Cohen's d, GLM, multitrait-multimethod matrices, SEM)
- Here too, search strategy involves **a detailed and replicable plan**. Hence, the starting point of a meta-analysis is a systematic review
- The topic is narrower than systematic reviews: Usually the focus is obtaining an **effect size** ("the amount of something that might be of interest"; Cumming, 2012, p. 34), called **meta-analytic effect size**

ESCI chapters 5-6 Jul 4 2011.xlsm [sheet: CIs and replication]

Suggested Journals

- *Psychological Bulletin*
- *Journal of Personality and Social Psychology*
- *Journal of Applied Psychology*

1.6 History of Meta-Analyses

In 1976, **Gene V. Glass** coined the term Meta-Analysis.

In 1977, **Smith & Glass** published a meta-analysis of the effectiveness of psychotherapy from 375 studies, showing that psychotherapy was effective and that there is little difference in effectiveness across different types of therapies.

In late 1975, **Schmidt & Hunter** wrote a meta-analysis on personnel selection, but did not immediately submit it for publication, because of an APA award participation. They won that award, but as a result, their first meta-analysis article was not published until 1977 (Schmidt & Hunter, 1977).

Suggested Literature:
- Glass, G. V. (2015). Meta-analysis at middle age: A personal history. *Research Synthesis Methods, 6*(3), 221-231. https://doi.org/10.1002/jrsm.1133
- Schmidt, F. L. (2015). History and development of the Schmidt–Hunter meta-analysis methods. *Research Synthesis Methods, 6*(3), 232-239. https://doi.org/10.1002/jrsm.1134

Some examples of Meta-Analyses

- **Developmental Psychology**
  Gini, G., Pozzoli, T., & Hymel, S. (2014). Moral disengagement among children and youth: A meta-analytic review of links to aggressive behavior. *Aggressive Behavior, 40*(1), 56-68. https://doi.org/10.1002/ab.21502
- **Organizational Psychology**
  Mazzetti, G., Robledo, E., Vignoli, M., Topa, G., Guglielmi, D., & Schaufeli, W. B. (2023). Work engagement: A meta-analysis using the job demands-resources model. *Psychological Reports, 126*(3), 1069-1107. https://doi.org/10.1177/00332941211051988
- **Personality Psychology**
  Bühler, J. L., Orth, U., Bleidorn, W., Weber, E., Kretzschmar, A., Scheling, L., & Hopwood, C. J. (2024). Life events and personality change: A systematic review and meta-analysis. *European Journal of Personality, 38*(3), 544-568. https://doi.org/10.1177/08902070231190219
- **Health Psychology**
  Ottaviani, C., Thayer, J. F., Verkuil, B., Lonigro, A., Medea, B., Couyoumdjian, A., & Brosschot, J. F. (2016). Physiological concomitants of perseverative cognition: A systematic review and meta-analysis. *Psychological Bulletin, 142*(3), 231-259. https://psycnet.apa.org/doi/10.1037/bul0000036

2. Steps

2. Steps

Step	Aim
1	Articulating one or more Research Questions for your systematic review or meta-analysis
2	Define Inclusion and Exclusion criteria
3	Identifying Relevant Literature
4	Coding study characteristics in a table
5	Extracting *effect sizes* (e.g., correlations, standardized mean differences) and standard errors from individual studies, and presenting them visually
6	Artifact correction
7	Computing the meta-analytic effect size (*fixed-effects* vs. *random-effects* model)
8	Assessing statistical Heterogeneity among effect sizes (e.g., Q statistic and I^2 index)
9	Explaining Heterogeneity among effect sizes (*Moderator Analyses* and *Meta-Regression*)
10	Assessing the Risk of Publication Bias (*moderation analysis* between published vs. unpublished studies; *Funnel Plot*; Egger's linear regression method; Begg and Mazumdar's rank correlation method; Failsafe Number; *Trim and Fill method*)
11	Publishing the Systematic Review or Meta-analysis following PRISMA guidelines

Table 1: Steps and Aims in a Systematic Review or Meta-analysis

1) Articulating one or more **research questions** for your systematic review or meta-analysis

2) Define **Inclusion and Exclusion Criteria**, by taking into account:

- definition of constructs of interest
- sample characteristics
- study design
- time frame[1]
- publication type
- effect sizes information

[1] Options (Crocetti, 2016, p. 6):

- Do not specify any criteria related to the year of publication.
- Select literature published starting from a certain year because:
  - there is a clear starting point (e.g., year of a seminal contribution);
  - the aim is to update a previous review.

Inclusion Criteria

The most basic requirement for inclusion in the present meta-analysis was consideration of measures of Bandura's MD mechanisms and any form of aggressive behavior, or bullying, or cyberaggression/cyberbullying, including self-report questionnaires, as well as peer-, parent-, or teacher-reports. Studies were excluded if the aggression items were part of a wider measure (e.g., a scale measuring externalizing problems) and a separate effect size was not available. In one case (Hyde, Shaw, & Moilanen, 2010), the original author was able to

excluded. Third, study participants were school-age children or adolescents from the community, with studies involving clinical samples or incarcerated offenders, and studies of adults excluded. Finally, both published reports (i.e., journal articles) and unpublished studies (e.g., conference papers, doctoral theses) were considered. In the latter case, data were obtained from the principal investigator or his/her supervisor. When multiple reports (e.g., a conference paper or dissertation and a published article) presented results from the same sample, only one effect size was used in the meta-analysis. Using these inclusion criteria, the final sample of the current meta-analysis included 27 studies; 12 examined the relation between MD and general aggression, 11 considered MD and bullying and four considered MD and cyberbullying (see Table I).

(Gini et al., 2014)

- **Contructs:** Moral Disengagement and aggression
- **Characteritics of the Sample**: Adolescents
- **Research design**: Cross-sectional
- **Time frame**: No restriction (but review conducted on March 2012)
- **Type of publications**: Published and not published articles
- **Information on Effect Size**: Correlations (Pearson r) between moral disengagement and aggressive behaviors

3) Identifying **Relevant Literature**

Strategy Example in Electronic Database (from Perinelli & Gremigni, 2016)

social desirability	name of the construct
socially desirable responding	alternative name of the construct
impression management	subdimension (facet)
self deception	subdimension (facet)
balanced inventory of desirable responding	scale***
marlowe crowne	scale***
faking	related construct

***If you do not know the exact name of the scales, write the name of the construct and "measure".

3) Identifying **Relevant Literature**

Take advantage from "advanced search"

Boolean Algebra: $\wedge$ = AND; $\vee$ = OR; $\neg$ = NOT Find in:

Field	**PsycINFO**	**Scopus**
Abstract	AB	ABS
Title	TI	TITLE
Author	AU	AUTH

Example of Search Query in PsycINFO (Alessandri, Zuffianò, & Perinelli, 2017):

- *AB intervention AND AB pretest AND AB posttest AND AB follow-up* $\rightarrow$ **260 documents**
- *AB intervention AND AB pretest AND AB posttest NOT AB follow-up* $\rightarrow$ **1544 documents**

3) Identifying **Relevant Literature**

Unpublished Works (Grey Literature)

- Conference Programs
- Funding Agency Lists
- Research Registries

Rothstein, H. R., & Hopewell, S. (2009). The Grey literature. In H. Cooper, L. V. Hedges, &. J. Valentine (Eds.), *The handbook of research synthesis* (2nd ed., pp. 103-126). New York, NY: Russell Sage Foundation.

Adams, R. J., Smart, P., & Huff, A. S. (2017). Shades of grey: Guidelines for working with the grey literature in systematic reviews for management and organizational studies. *International Journal of Management Reviews, 19*(4), 432-454.

3) Identifying **Relevant Literature**

Backward and Forward Searches

Backward Searches After accumulating a set of studies for potential inclusion in your meta-analysis, you should read these articles completely searching for *cited studies* (i.e., in *References*) that might be relevant for your review that you did not identify through your other strategies.

Forward Searches To find *studies that cite* the studies you have (*"cited by"* option in Google Scholar).

3) Identifying **Relevant Literature**

Communication with Researchers in the Field

Ask some experts (or listserv/forum)

- to examine your inclusion/exclusion criteria
- to examine the list of studies you have identified
- if there are additional studies that should have been included

3) Identifying **Relevant Literature**

Example from Gini et al (2014)

METHODS

Literature Search

Multiple methods were used to identify potentially eligible studies. First, computer literature searches from the year each database started until March 2012 were conducted using PsychInfo, Educational Research Information Center, Scopus and Google Scholar with "moral disengagement," "aggressive behavior," "aggression," "bullying," "school violence," "antisocial behavior" used as keywords. Second, recent review articles and book chapters on aggressive behavior, bullying, or morality in children were reviewed for relevant citations. Third, reference sections of the collected articles were searched for relevant earlier references (i.e., "backward search" procedure). Finally, authors were contacted directly to obtain other relevant studies. With unpublished studies (conference papers, dissertations), principal investigators were contacted to ask for ad hoc analysis (if no response was received, a second e-mail was sent 2–3 months after the first). A total of 70 potentially relevant journal articles, chapters, conference and dissertation abstracts were reviewed.

- **Databases used**: PsychInfo, ERIC, Scopus, Google Scholar
- **String:** "moral disengagement", "aggressive behavior", "aggression", "bullying", "school violence", "antisocial behavior"
- **Backward search:** Yes

3) Identifying **Relevant Literature**

Raters' agreement

Compute indices like:

- Agreement Rate, $AR = \dfrac{\text{No. of agreements}}{\text{No. of studies}}$
- Cohen's Kappa, $k = \dfrac{p_o - p_e}{1 - p_e}$ (see HERE for more info)

AGREEMENT MEASURES FOR CATEGORICAL DATA 165

Kappa Statistic	*Strength of Agreement*
<0.00	Poor
0.00–0.20	Slight
0.21–0.40	Fair
0.41–0.60	Moderate
0.61–0.80	Substantial
0.81–1.00	Almost Perfect

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, *33*(1), 159–174. https://www.jstor.org/stable/2529310

4) Coding study characteristics

- Authors and years of publication (citation)
- Sample size
- Country of the sample
- Other characteristics (e.g., % gender)
- Effect size (e.g., Pearson's r or Cohen's d)
- Notes/Other relevant information

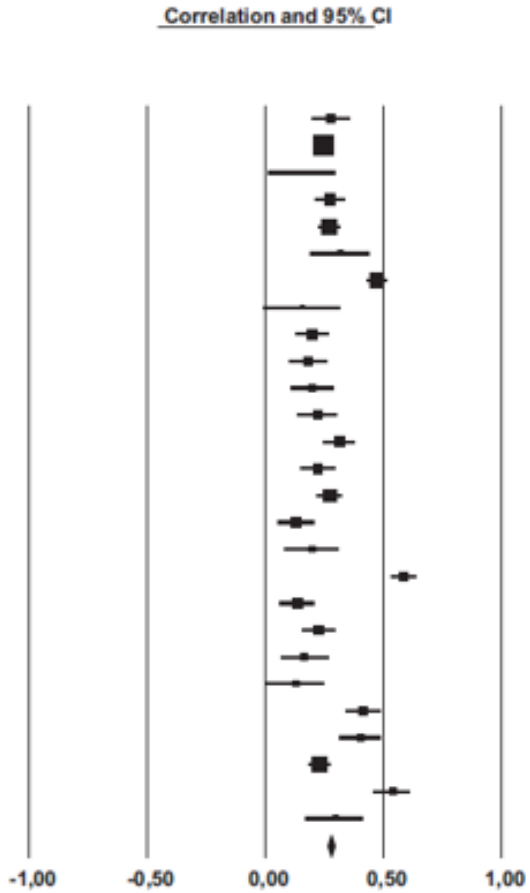
TABLE I. Summary of Studies Included in the Meta-Analysis

Authors (Year)	Sample Size (% of Girls)	Age Range	National Setting	Behavior Measure	Shared Method Variance	Effect Size: *r*
Almeida, Correia, Marinho, and Garcia (in press)	499 (47.1%)	11–18	Spain	Cyberbullying, SR	Yes	.28
Ando et al., (2005)	2,301 (49.8%)	12–15	Japan	Bullying, SR	Yes	.25
Bacchini et al. (1998)	169 (46.9%)	9–14	Italy	Bullying, SR	Yes	.16
Bandura et al. (1996)	799 (45.2%)	10–15	Italy	Aggression, SR, PN, TR, PR	Mixed	.27
Barchia and Bussey (2011)	1,285 (53.8%)	12–15	Australia	Aggression, SR	Yes	.27
Bauman (2010)	190 (54.2%)	10–14	United States	Cyberbullying, SR	Yes	.32
Bussey and Quinn (2012)	1,152 (37.2%)	12–17	Australia	Aggression	Yes	.47
Bussman (2008, study 2)	136 (52.9%)	9–12	United States	Aggression, PN	No	.16
Caprara et al. (1995)	706 (43.6%)	8–14	Italy	Aggression, SR, PN, TR	Mixed	.20
Caravita and Gini (2010)	538 (46.6%)	9–15	Italy	Bullying, PN	No	.18
Caravita, Gini, and Pozzoli, (2011)	879 (47.4%)	8–15	Italy	Bullying, PN	No	.20
Del Bove et al. (2008)	475 (45.1%)	11–18	Italy	Aggression, SR	Yes	.22
Fitzpatrick and Bussey (2012)	708 (57.1%)	12–16	Australia	Bullying, SR	Yes	.31
Gini (2006)	581 (49.2%)	8–11	Italy	Bullying, PN	No	.22
Gini et al. (2007b)	1,084 (50.9%)	15–17	Italy	Bullying, PN	No	.27
Gini, Pozzoli, and Hauser (2011)	719 (48.5%)	9–13	Italy	Bullying, PN	No	.13
Hyde et al. (2010)	257 (0%)	15	United States	Aggression, PR	No	.20
Hymel et al. (2005)	468 (43%)	13–16	Canada	Bullying, SR	Yes	.59
Menesini, Fonzi, and Vannucci (1999)	652 (48.2%)	8–14	Italy	Bullying, PN	No	.14
Obermann (2011)	677 (47.6%)	11–14	Denmark	Bullying, SR, PN	Mixed	.22
Paciello et al. (2008)	349 (53.3%)	12–14	Italy	Aggression, PN	No	.17
Pelton et al. (2004)	245 (49.4%)	9–14	United States	Aggression, SR, TR, PR	Mixed	.13
Perren and Sticca (2011)	480 (48.9%)	12–18	Switzerland	Cyber/Bullying, SR	Yes	.42
Pornari and Wood (2010)	359 (53%)	12–14	UK	Cyber/Aggression, SR	Yes	.40
Qingquan, Zongkui, Fan, and Lei (2009)	1,578 (48%)	9–11	China	Aggression	No	.23
Stevens and Hardy (in press)	290 (60.3%)	13–18	Samoa	Aggression	Yes	.54
Yadava et al. (2001)	200 (50%)	15–17	India	Aggression	Yes	.30

Note. Measures of moral disengagement were all self-reports. SR, self-report; PN, peer nominations, TR, teacher-report; PR, parent-report.

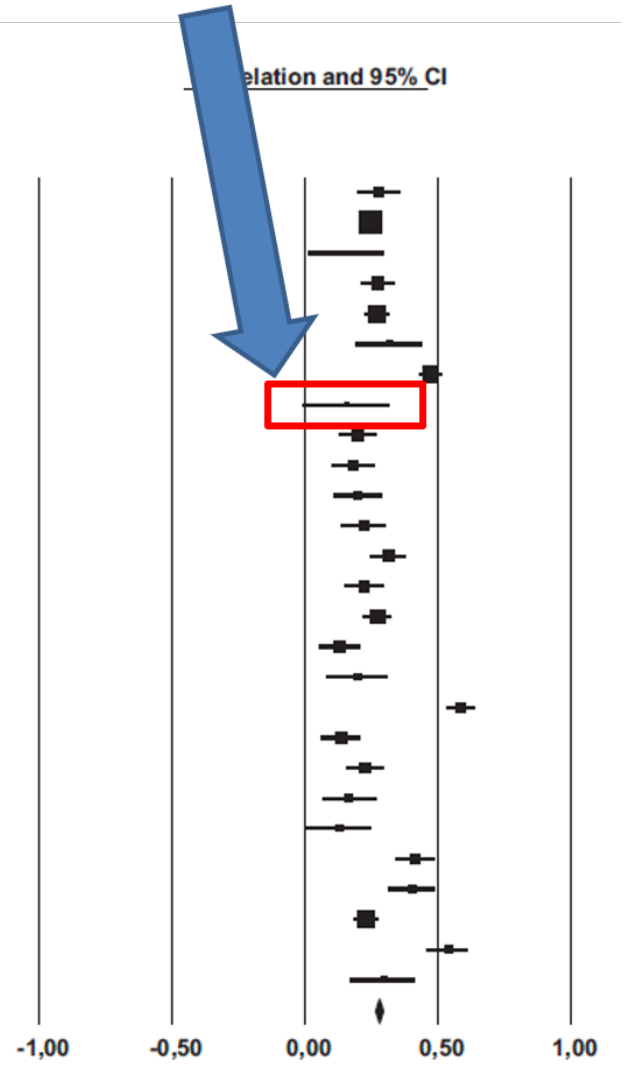
5) Extracting effect sizes (e.g., correlations, standardized mean differences) and standard errors from individual studies, and presenting them visually (e.g., through a *forest plot*)

Study	Correlation	Lower limit	Upper limit	Z-Value	p-Value
Almeida et al. (in press)	0,28	0,20	0,36	6,41	0,00
Ando et al. (2005)	0,25	0,21	0,28	12,09	0,00
Bacchini et al. (1998)	0,16	0,01	0,30	2,09	0,04
Bandura et al. (1996)	0,27	0,21	0,34	7,90	0,00
Barchia & Bussey (2011)	0,27	0,22	0,32	9,99	0,00
Bauman (2010)	0,32	0,19	0,44	4,54	0,00
Bussey & Quinn (2012)	0,48	0,43	0,52	17,51	0,00
Bussman (2007, study 2)	0,16	-0,01	0,32	1,84	0,07
Caprara et al. (1995)	0,20	0,13	0,27	5,30	0,00
Caravita & Gini (2010)	0,18	0,10	0,26	4,21	0,00
Caravita et al. (2011)	0,20	0,11	0,29	4,13	0,00
Del Bove et al. (2008)	0,22	0,14	0,30	4,97	0,00
Fitzpatrick & Bussey (2012)	0,31	0,25	0,38	8,64	0,00
Gini (2006)	0,22	0,15	0,30	5,48	0,00
Gini et al. (2007b)	0,27	0,22	0,33	9,17	0,00
Gini, Pozzoli, Hauser (2011)	0,13	0,05	0,21	3,32	0,00
Hyde et al. (2010)	0,20	0,08	0,31	3,23	0,00
Hymel et al. (2005)	0,59	0,53	0,64	16,06	0,00
Menesini et al. (1999)	0,14	0,06	0,21	3,49	0,00
Obermann (2011)	0,22	0,15	0,30	5,86	0,00
Paciello et al. (2008)	0,17	0,06	0,27	3,14	0,00
Pelton et al. (2004)	0,13	0,00	0,25	2,03	0,04
Perren & Sticca (2011)	0,42	0,34	0,49	9,70	0,00
Pornari & Wood (2010)	0,40	0,31	0,49	7,87	0,00
Qingquan et al. (2009)	0,23	0,18	0,28	9,29	0,00
Stevens & Hardy (in press)	0,54	0,46	0,62	10,64	0,00
Yadava et al. (2001)	0,30	0,16	0,42	4,28	0,00
	0,28	0,26	0,29	37,45	0,00



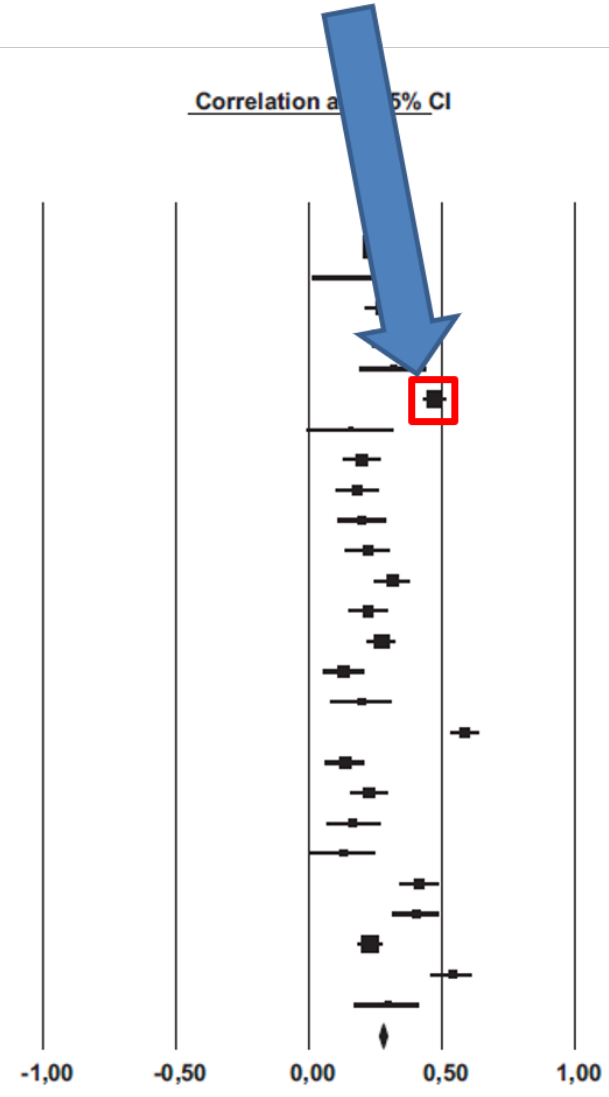
Large confidence intervals (bars) indicate more **uncertainty** of the estimate, due to **small sample size**

Study	Correlation	Lower limit	Upper limit	Z-Value	p-Value
Almeida et al. (in press)	0,28	0,20	0,36	6,41	0,00
Ando et al. (2005)	0,25	0,21	0,28	12,09	0,00
Bacchini et al. (1998)	0,16	0,01	0,30	2,09	0,04
Bandura et al. (1996)	0,27	0,21	0,34	7,90	0,00
Barchia & Bussey (2011)	0,27	0,22	0,32	9,99	0,00
Bauman (2010)	0,32	0,19	0,44	4,54	0,00
Bussey & Quinn (2012)	0,48	0,43	0,52	17,51	0,00
Bussman (2007, study 2)	0,16	-0,01	0,32	1,84	0,07
Caprara et al. (1995)	0,20	0,13	0,27	5,30	0,00
Caravita & Gini (2010)	0,18	0,10	0,26	4,21	0,00
Caravita et al. (2011)	0,20	0,11	0,29	4,13	0,00
Del Bove et al. (2008)	0,22	0,14	0,30	4,97	0,00
Fitzpatrick & Bussey (2012)	0,31	0,25	0,38	8,64	0,00
Gini (2006)	0,22	0,15	0,30	5,48	0,00
Gini et al. (2007b)	0,27	0,22	0,33	9,17	0,00
Gini, Pozzoli, Hauser (2011)	0,13	0,05	0,21	3,32	0,00
Hyde et al. (2010)	0,20	0,08	0,31	3,23	0,00
Hymel et al. (2005)	0,59	0,53	0,64	16,06	0,00
Menesini et al. (1999)	0,14	0,06	0,21	3,49	0,00
Obermann (2011)	0,22	0,15	0,30	5,86	0,00
Paciello et al. (2008)	0,17	0,06	0,27	3,14	0,00
Pelton et al. (2004)	0,13	0,00	0,25	2,03	0,04
Perren & Sticca (2011)	0,42	0,34	0,49	9,70	0,00
Pornari & Wood (2010)	0,40	0,31	0,49	7,87	0,00
Qingquan et al. (2009)	0,23	0,18	0,28	9,29	0,00
Stevens & Hardy (in press)	0,54	0,46	0,62	10,64	0,00
Yadava et al. (2001)	0,30	0,16	0,42	4,28	0,00
	0,28	0,26	0,29	37,45	0,00



Small confidence intervals (bars) indicate more **precision** of the estimate, due to **large sample size**

Study	Correlation	Lower limit	Upper limit	Z-Value	p-Value
Almeida et al. (in press)	0,28	0,20	0,36	6,41	0,00
Ando et al. (2005)	0,25	0,21	0,28	12,09	0,00
Bacchini et al. (1998)	0,16	0,01	0,30	2,09	0,04
Bandura et al. (1996)	0,27	0,21	0,34	7,90	0,00
Barchia & Bussey (2011)	0,27	0,22	0,32	9,99	0,00
Bauman (2010)	0,32	0,19	0,44	4,54	0,00
Bussey & Quinn (2012)	0,48	0,43	0,52	17,51	0,00
Bussman (2007, study 2)	0,16	-0,01	0,32	1,84	0,07
Caprara et al. (1995)	0,20	0,13	0,27	5,30	0,00
Caravita & Gini (2010)	0,18	0,10	0,26	4,21	0,00
Caravita et al. (2011)	0,20	0,11	0,29	4,13	0,00
Del Bove et al. (2008)	0,22	0,14	0,30	4,97	0,00
Fitzpatrick & Bussey (2012)	0,31	0,25	0,38	8,64	0,00
Gini (2006)	0,22	0,15	0,30	5,48	0,00
Gini et al. (2007b)	0,27	0,22	0,33	9,17	0,00
Gini, Pozzoli, Hauser (2011)	0,13	0,05	0,21	3,32	0,00
Hyde et al. (2010)	0,20	0,08	0,31	3,23	0,00
Hymel et al. (2005)	0,59	0,53	0,64	16,06	0,00
Menesini et al. (1999)	0,14	0,06	0,21	3,49	0,00
Obermann (2011)	0,22	0,15	0,30	5,86	0,00
Paciello et al. (2008)	0,17	0,06	0,27	3,14	0,00
Pelton et al. (2004)	0,13	0,00	0,25	2,03	0,04
Perren & Sticca (2011)	0,42	0,34	0,49	9,70	0,00
Pornari & Wood (2010)	0,40	0,31	0,49	7,87	0,00
Qingquan et al. (2009)	0,23	0,18	0,28	9,29	0,00
Stevens & Hardy (in press)	0,54	0,46	0,62	10,64	0,00
Yadava et al. (2001)	0,30	0,16	0,42	4,28	0,00
	0,28	0,26	0,29	37,45	0,00



6) Artifact corrections (e.g., unreliability)

- "individual primary studies [may] report effect sizes among imperfect measures of constructs, not the construct themselves" (Card, 2012, p. 127).
- Especially in Work and Organizational Psychology (due to the influential work of Hunter and Schmidt), it is important to correct for artifacts, such as unreliability. This requires the **collection of reliability indices (e.g., Cronbach's alpha)** for each measure used in meta-analytic purposes.
- See Schmidt & Hunter (2015), Card (2012, Chapter 6), Morris (2023, pp. 229–239), and two webpages from the `metafor` and `psychmeta` packages.

7) Computing **mean effect size** (fixed-effects model)

Equations from Card (2012, Eq. 8.1-8.4)

- Weight for study i, $w_i = \frac{1}{SE_i^2}$, where SE_i is the standard error of the effect size estimate for study i.
- Weighted mean effect size, $\overline{ES} = \frac{\sum(w_i ES_i)}{\sum w_i}$, where w_i is the weight for study i; ES_i is the effect size estimate from study i.
- Standard error of the mean effect size, $SE_{\overline{ES}} = \sqrt{\frac{1}{\sum w_i}}$
- Statistical significance test of the mean effect size, $z = \frac{\overline{ES}}{SE_{\overline{ES}}}$.

Problems with fixed-effects model

- The fixed-effects model is **often unrealistic** in the context of meta-analysis.
- It assumes that all studies included in the analysis estimate a common true effect size, **disregarding any between-study heterogeneity** that may arise due to differences in study populations, methodologies, or contextual factors.
- Therefore, it is often preferred to use the **random-effects model**, since it accounts for between-study heterogeneity by assuming that the true effect size varies across studies rather than being fixed.
- This model incorporates **an additional variance component** to capture differences in study characteristics, improving the generalizability of findings and providing more realistic estimates when study populations, methodologies, or contexts are diverse.

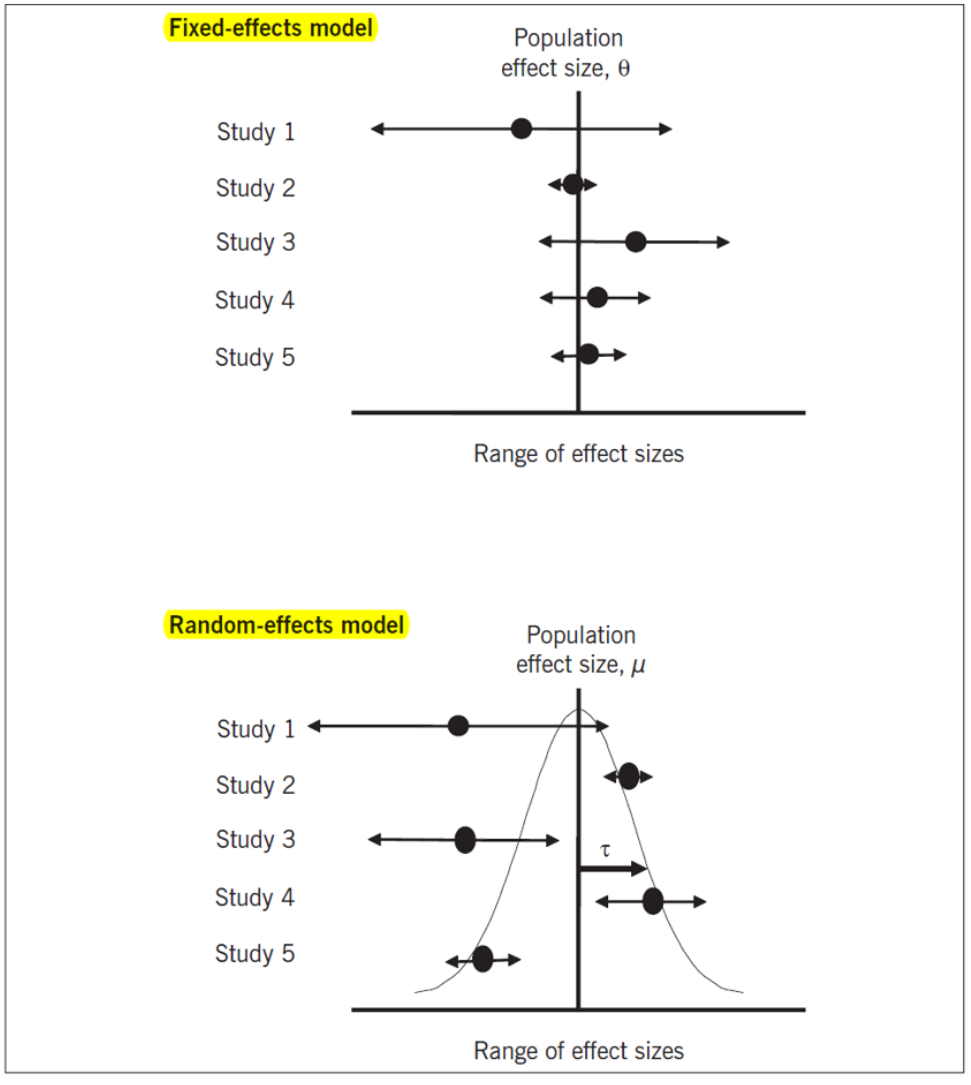


FIGURE 10.1. Conceptual representation of fixed- versus random-effects models.

Equation 10.1: Equation for effect sizes for studies in fixed-effects model

$ES_i = \theta + \varepsilon i$

- ES_i is the (observed) effect size for study i.
- θ is the (single) population effect size.
- ε_i is the deviation of study i from the population effect size.

Equation 10.2: Equation for effect sizes for studies in random-effects model

$ES_i = \mu + \xi + \varepsilon_i$

- ES_i is the (observed) effect size for study i.
- μ is the mean of the distribution of population effect sizes.
- ξ_i is the reliable (not due to sampling deviation) deviation of study i from the mean of the distribution of population effect sizes.
- ε_i is the conditional deviation (sampling deviation) of study i from the distribution of population effect sizes.

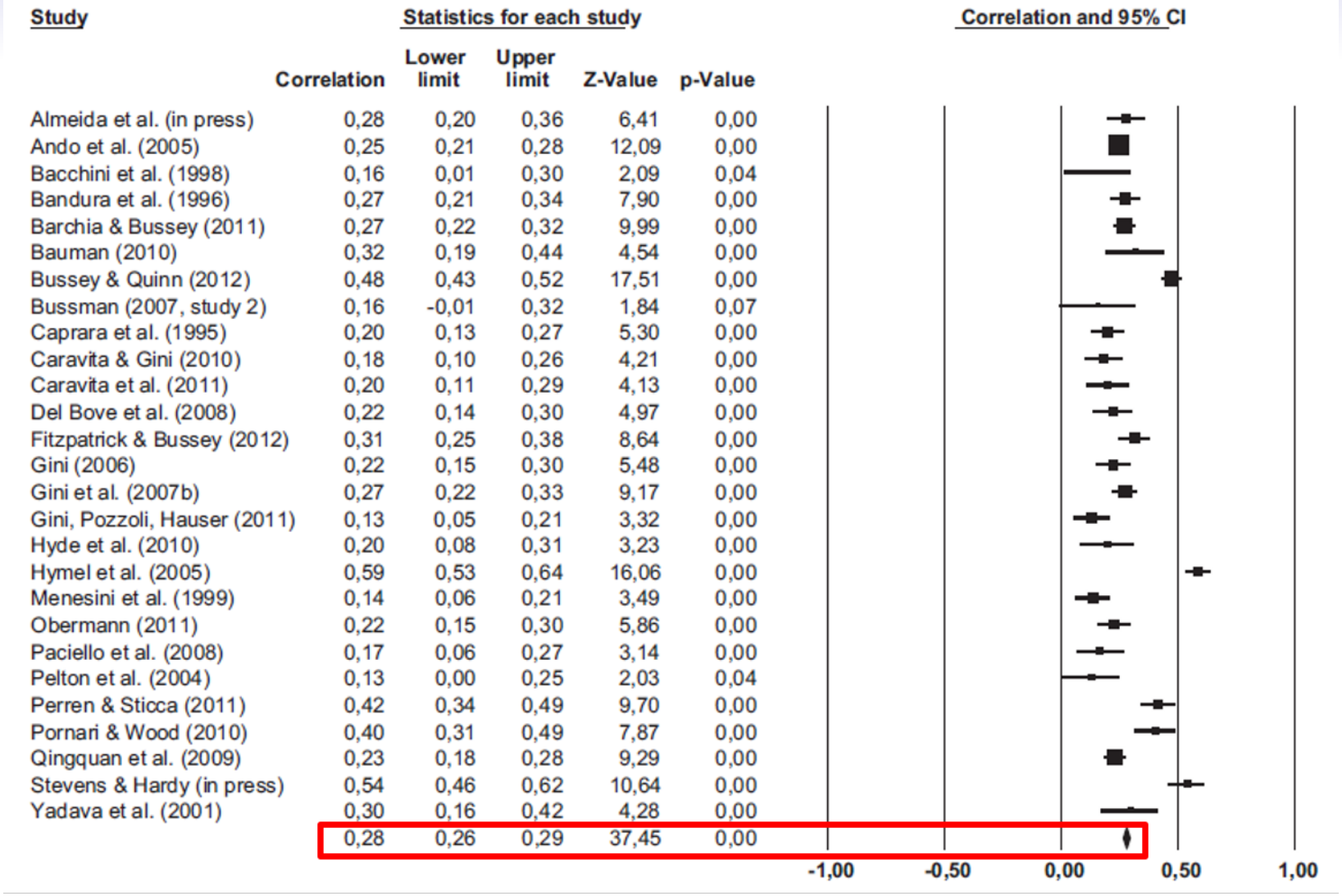
Card (2012, Ch.10)

7) Computing **mean effect size** (random-effects model)

A random-effects model in meta-analysis can be estimated in four general steps:

1. Estimating the heterogeneity among effect sizes Q (equation reported in Step 8),
2. Estimating population variability in effect sizes $\tau^2 = \frac{Q-(k-1)}{(\sum w_i)-\left(\frac{\sum w_i^2}{\sum w_i}\right)}$
3. Estimating the random-effects weights of study effect sizes $w_i^* = \frac{1}{\tau^2+SE_i^2}$
4. Using these random-effects weights to estimate a random-effects mean effect size $\overline{z_r} = \frac{\sum(w_i^* z_r)}{\sum w_i^*}$ and standard errors $SE_{\overline{z_r}} = \sqrt{\frac{1}{\sum w_i^*}}$ of this estimate.

Card (2012, Ch.10, p. 234-239)



(Gini et al., 2014)

Meta-analytic Effect size (Random-effects)

r = .28 (95% CI = .26, .29)

z = 37.45

$p < .001$

8) Assessing **Heterogeneity** among Effect Sizes

Heterogeneity is the extent to which effect sizes vary within a meta-analysis.

It is assessed by means of several indices and methods:

- Q
- I^2
- H^2
- Bajaut Plot

8) Assessing **Heterogeneity** among Effect Sizes

$$Q = \sum \left(w_i (ES_i - \overline{ES})^2 \right) = \sum (w_i ES_i^2) - \frac{\left(\sum (w_i ES_i) \right)^2}{\sum w_i}$$

- w_i is the weight of study i.
- ES_i is the effect size estimate from study i.
- $\overline{ES}$ is the mean effect size across studies.
- k is the number of studies.
  Degrees of freedom: $\chi^2_{df} = k - 1$

The *null hypothesis* is that of **homogeneity**. Hence, a significant p value (e.g., $< .05$) *should attest heterogeneity.*

Equation 8.6 from Card (2012, Ch. 8)

8) Assessing **Heterogeneity** among Effect Sizes

$$I^2 = \frac{\tau^2}{\tau^2+\sigma^2} = \begin{cases} \left(\frac{Q-(k-1)}{Q}\right) \times 100\% & \text{when } Q > (k-1) \\ 0 & \text{when } Q \leq (k-1) \end{cases}$$

- τ^2 is the estimated between-study variability.
- σ^2 is the within-study variability.
- Q is the statistic computed for significance tests of heterogeneity.
- k is the number of studies.

Suggestions of Huedo-Medina et al. (2006) regarding the amount of heterogeneity:

- $I^2 \approx 25\%$ small
- $I^2 \approx 50\%$ medium
- $I^2 \approx 75\%$ large

Equation 8.7 from Card (2012, Ch. 8)

8) Assessing **Heterogeneity** among Effect Sizes

H^2 statistic

H^2 statistic is defined as the relative excess in Q over its degree of freedom:

$$H^2 = \begin{cases} \frac{Q}{k-1} if Q \geq (k-1) \\ 1 if\ Q < (k-1) \end{cases} \qquad (4)$$

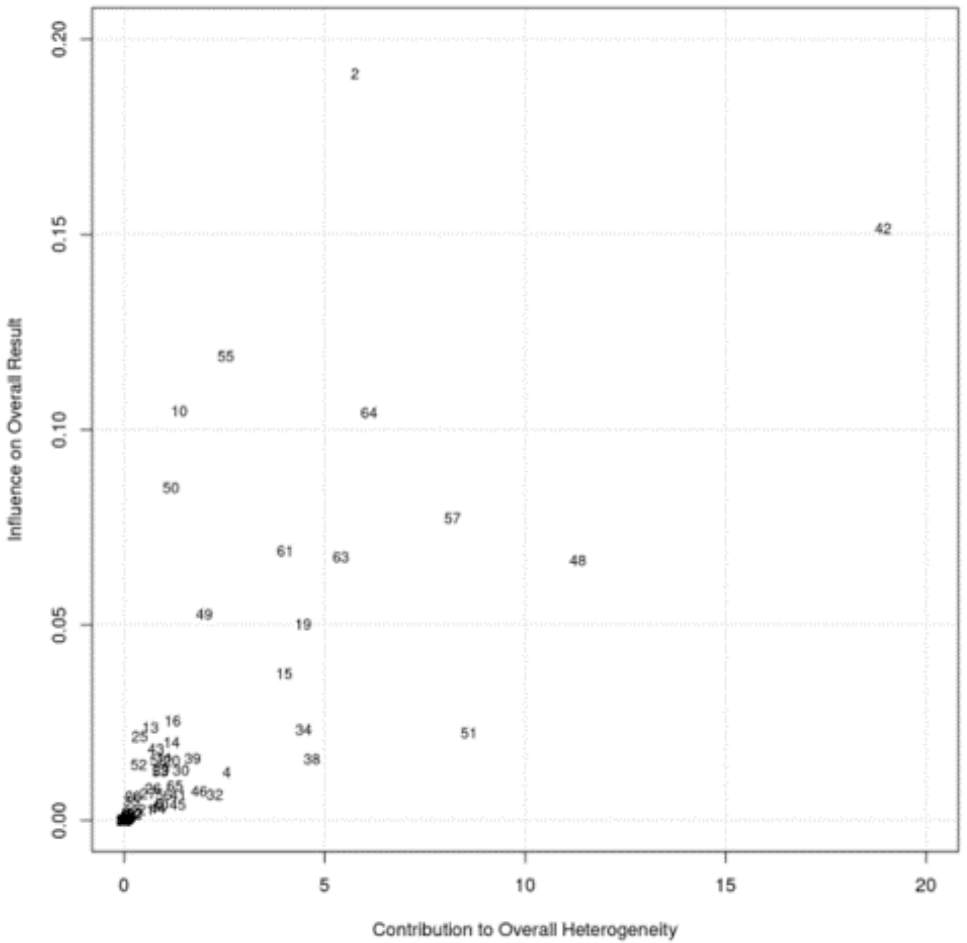
But, Higgnis & Thompson (2002) suggested to use H statistic, square root of H^2, because it is easy for clinicians to understand standard deviation and confidence interval than variance. They also defined H as the estimated residual standard deviation from the slope of the un-weighted least squares regression line through origin on Galbrith plot [7,14] i.e., plotting yi $\sqrt{}$wi against $\sqrt{}$wi:

$$H^2 = Q/(k-1) = \sum (y_i\sqrt{w_i} - \hat{\mu}_F \cdot \sqrt{w_i})^2 / (k-1) \qquad (5)$$

"The value of H = 1 represents complete homogeneity. So theoretically it ranges from one to infinite. Further, for assessing significance of heterogeneity, if the 95% CI of H statistic does not involve the null value (i.e., one), heterogeneity becomes significant at 5% level of significance. There is no universal rule to grade H2 in mild, moderate or severe"

Equations and text from Pathak, Dwivedi, Deo, Sreenivas, & Thakur (2017, p. 16, *Biostatistics and Biometrics Open Access Journal*)

8) Assessing **Heterogeneity** among Effect Sizes



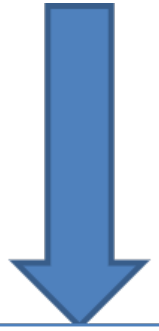
Bajaut Plot: "The X-axis represents the contribution of the trial to the overall Cochran Q-test for heterogeneity. The Y-axis represents the influence of the trial, defined as the standardized squared difference between the treatment effects estimated with and without the trial"

Baujat, Mahé, Pignon, & Hill (2002, p. 2641, *Statistics in Medicine*). Figure from https://www.metafor-project.org/doku.php/plots:baujat_plot

8) Assessing **Heterogeneity** among Effect Sizes

Effect Size: *r*
.28
.25
.16
.27
.27
.32
.47
.16
.20
.18
.20
.22
.31
.22
.27
.13
.20
.59
.14
.22
.17
.13
.42
.40
.23
.54
.30

- Is there heterogeneity in Gini et al.'s (2014) meta-analysis?
- It appears so, since the effect sizes range from .13 to .59, and we can observe different estimates within this range.
- However, we need to look for the appropriate information in the paper (e.g., Q and I^2) and interpret these indicators accordingly.



Moderator Effects

The test of homogeneity of variance revealed significant heterogeneity across studies, $Q = 271.05$, $P < .001$, $I^2 = 90.41\%$. Therefore, mixed effects moderator analy-

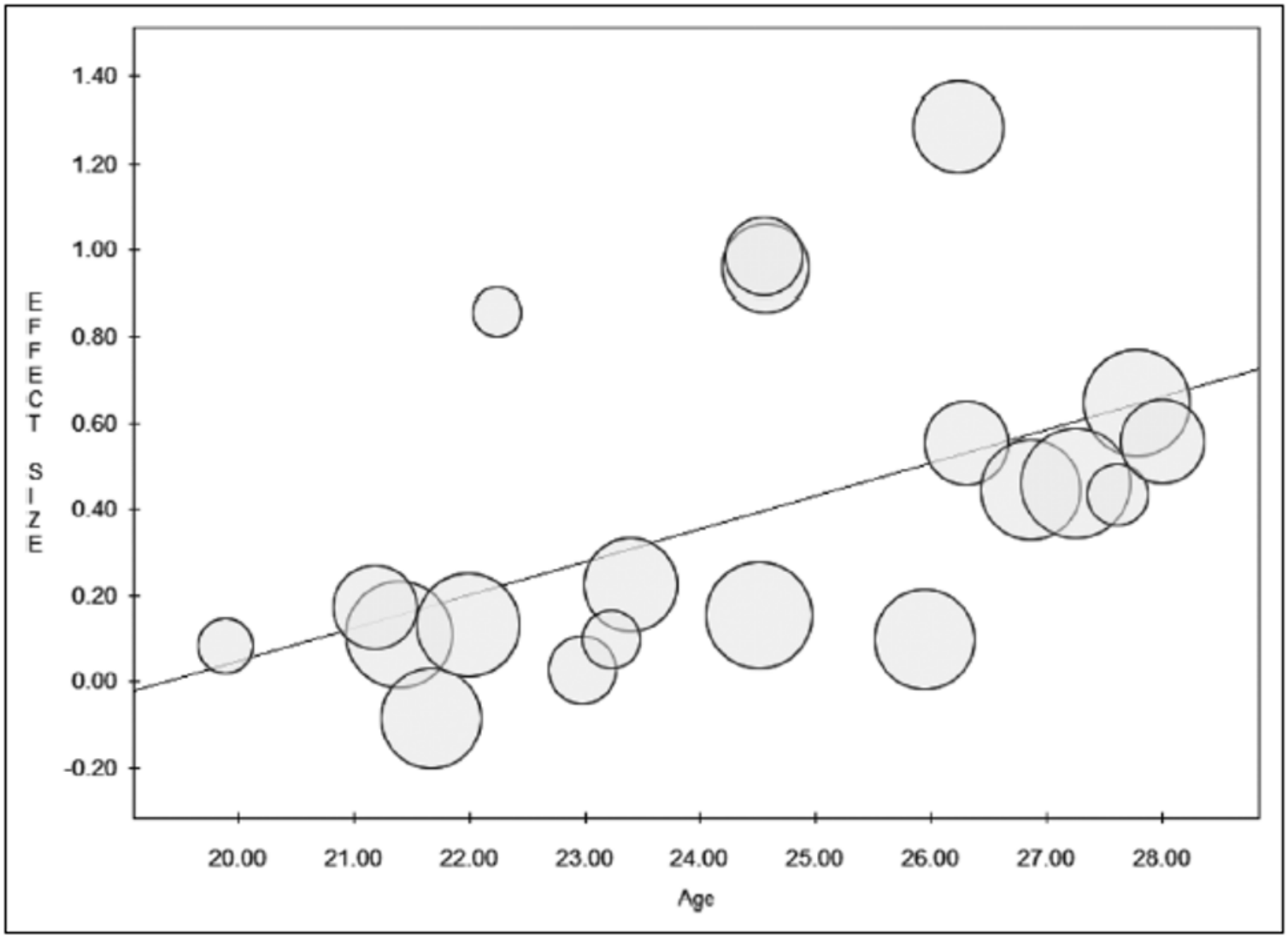
9) Explaining Heterogeneity among Effect Sizes: **Moderator Analyses** (e.g., meta-regression and subgroup analysis)

If a meta-analysis reveals significant heterogeneity among effect sizes, the next step is to explain this variability using additional variables collected during the coding of the primary studies.

There are two main strategies to account for heterogeneity among effect sizes:

- **Meta-regression:** used when continuous variables are employed to explain heterogeneity (e.g., using the variable "average age" to account for variability in effect sizes).
- **Analysis of categorical moderators:** used when categorical variables are employed to explain heterogeneity (e.g., using the variable "country of origin" to explain differences in effect sizes).

9) Explaining Heterogeneity among Effect Sizes: **Meta-Regression**



Example of a scatter plot reporting results of a meta-regression.

Crocetti (2016, p. 12)

9) Explaining Heterogeneity among Effect Sizes: **Analysis of categorical moderators**

TABLE II. Tests of Categorical Moderators

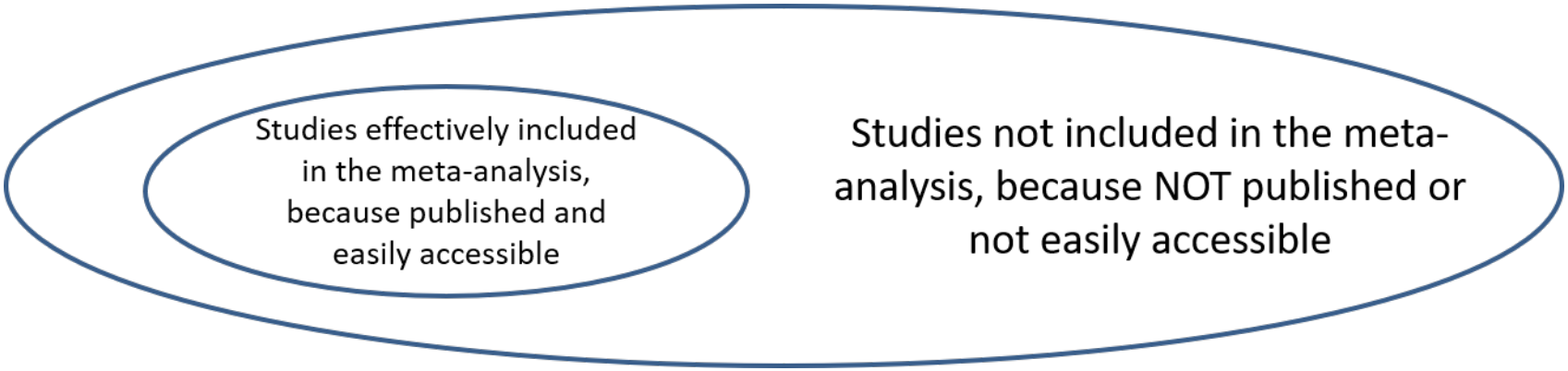
Study Characteristics	Between-Group Effect (Q_b)	Effect Size (r)	95% Confidence Interval		k	N
			Lower Limit	Upper Limit		
Type of behavior	2.63					
Aggression		.27***	.20	.34	12	7,472
Bullying		.25***	.17	.32	11	8,776
Cyberbullying		.31***	.27	.36	4	1,528
Gender	0.001					
Boys		.26***	.21	.31	23	5,704
Girls		.26***	.21	.31	22	5,267
Age group	13.47***					
Children (8–11 years)		.18***	.14	.22	10	4,201
Adolescents (12–18 years)		.31***	.26	.36	22	12,326
Type of MD scale	62.80***					
Bandura's original		.24***	.19	.28	16	8,734
Bandura-revised		.31***	.23	.38	8	7,939
Others		.36*	.07	.60	3	1,103
Shared method variance	14.89**					
Yes		.35***	.28	.42	13	8,576
No		.20***	.17	.23	10	6,773
Mixed		.24***	.15	.33	4	2,427
Publication status	0.14					
Published		.27***	.21	.33	19	11,516
Not published		.29***	.20	.37	8	6,260

Note. k indicates the number of independent subsamples; N indicates the number of participants.
*$P < .05$.
**$P < .01$.
***$P < .001$.

10) Assessing the Risk of **Publication Bias**

Publication Bias refers to the tendency for studies reporting significant or expected effects to be more likely to be published than those reporting null or unexpected results.

Studies that should be included in the meta-analysis



10) Assessing the Risk of **Publication Bias**

Strategies:

- **Moderator analysis** of published *Vs* unpublished studies
- **Funnel Plot** (Sterne & Egger, 2001): see the next slide
- **Egger's linear regression method** (Egger, Davey, Smith, Schneider, & Minder, 1997) and the **Begg and Mazumdar's (1994) rank correlation method** are two tests of the asymmetry of a funnel plot (significant results = potential publication bias)
- Failsafe numbers (**Failsafe *N***): the number of excluded studies, all averaging an effect size of zero, that would have to exist for their inclusion in the meta-analysis to lower the average effect size to a nonsignificant level. A **failsafe $N > 5k + 10$** supports findings' robustness
- **Trimm and Fill method**: imputes "missing" studies to create a more symmetrical funnel plot. If trivial differences between the observed and the new estimated effect sizes were observed, then publication bias (albeit present) should not be a serious threat to our results (Duval, 2005).

10) Assessing the Risk of **Publication Bias**

FUNNEL PLOT

the precision of the estimate. An unbiased sample would ideally show a cloud of data points that is symmetric around the population effect size and has the shape of a funnel.

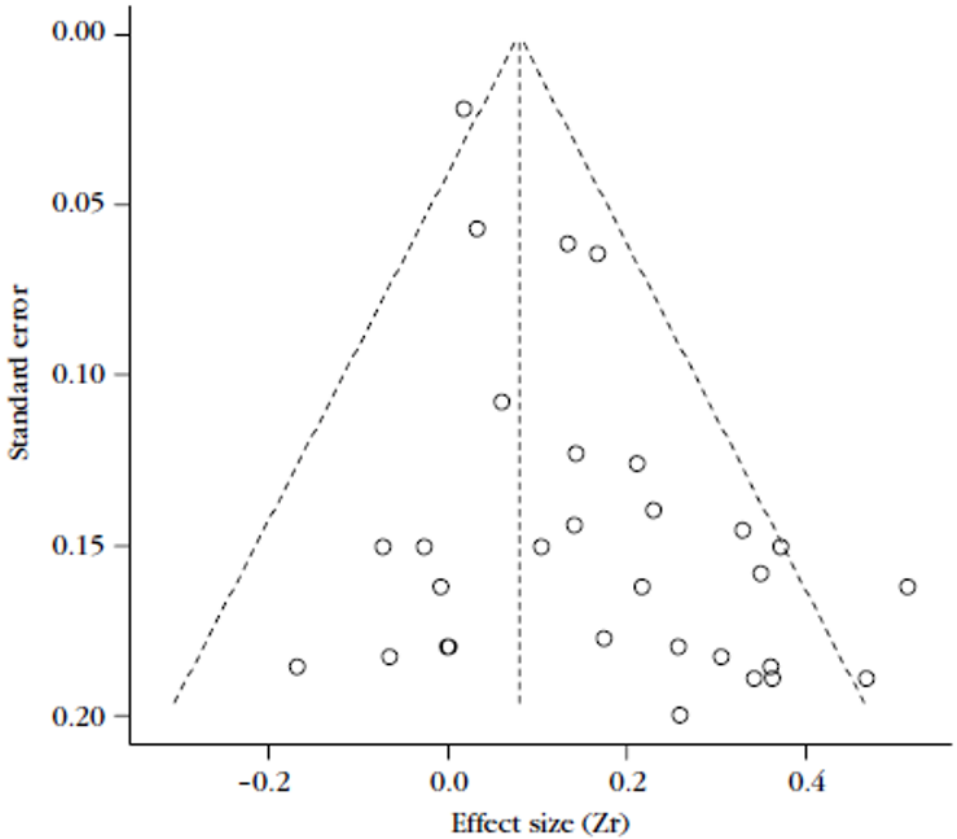
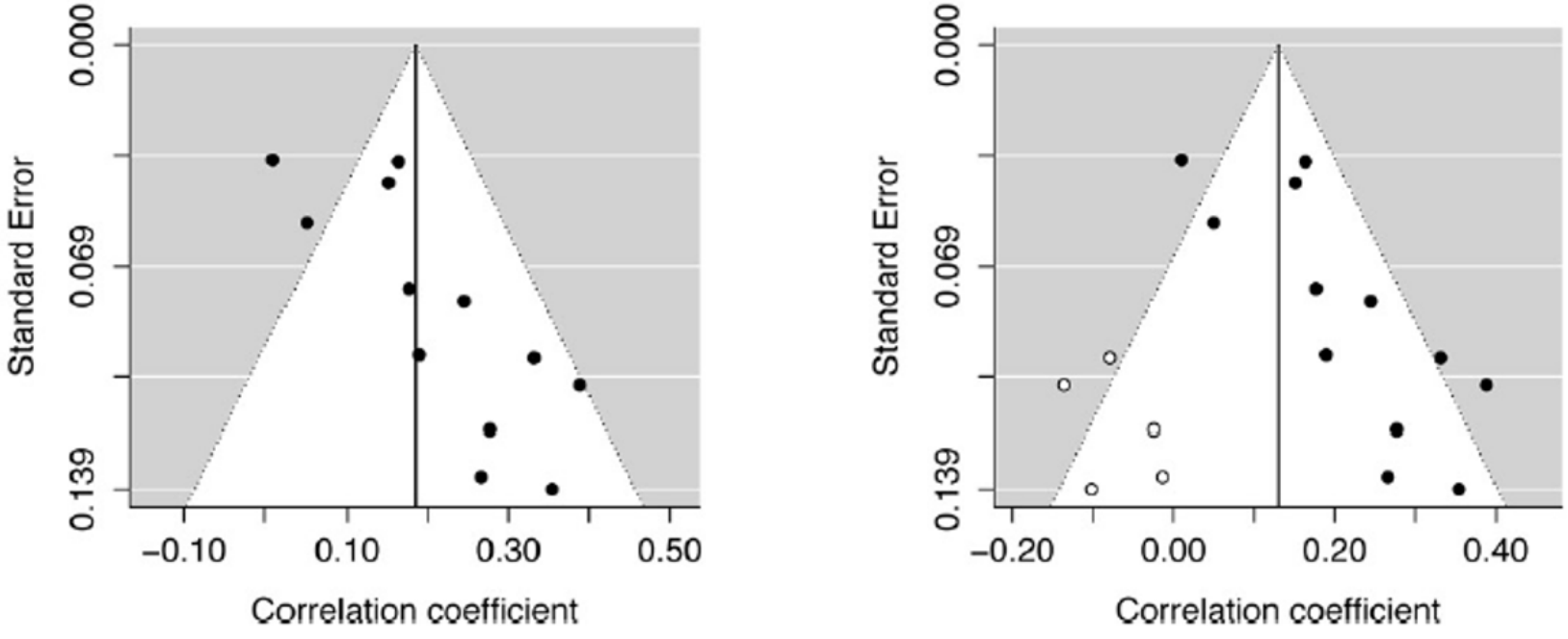


Figure 3. Example of a funnel plot showing little publication bias. The vertical line is the population effect size estimate and the diagonal lines the 95% confidence interval.

Field & Gillett (2010, p. 686)

10) Assessing the Risk of **Publication Bias**

TRIMM AND FILL PROCEDURE



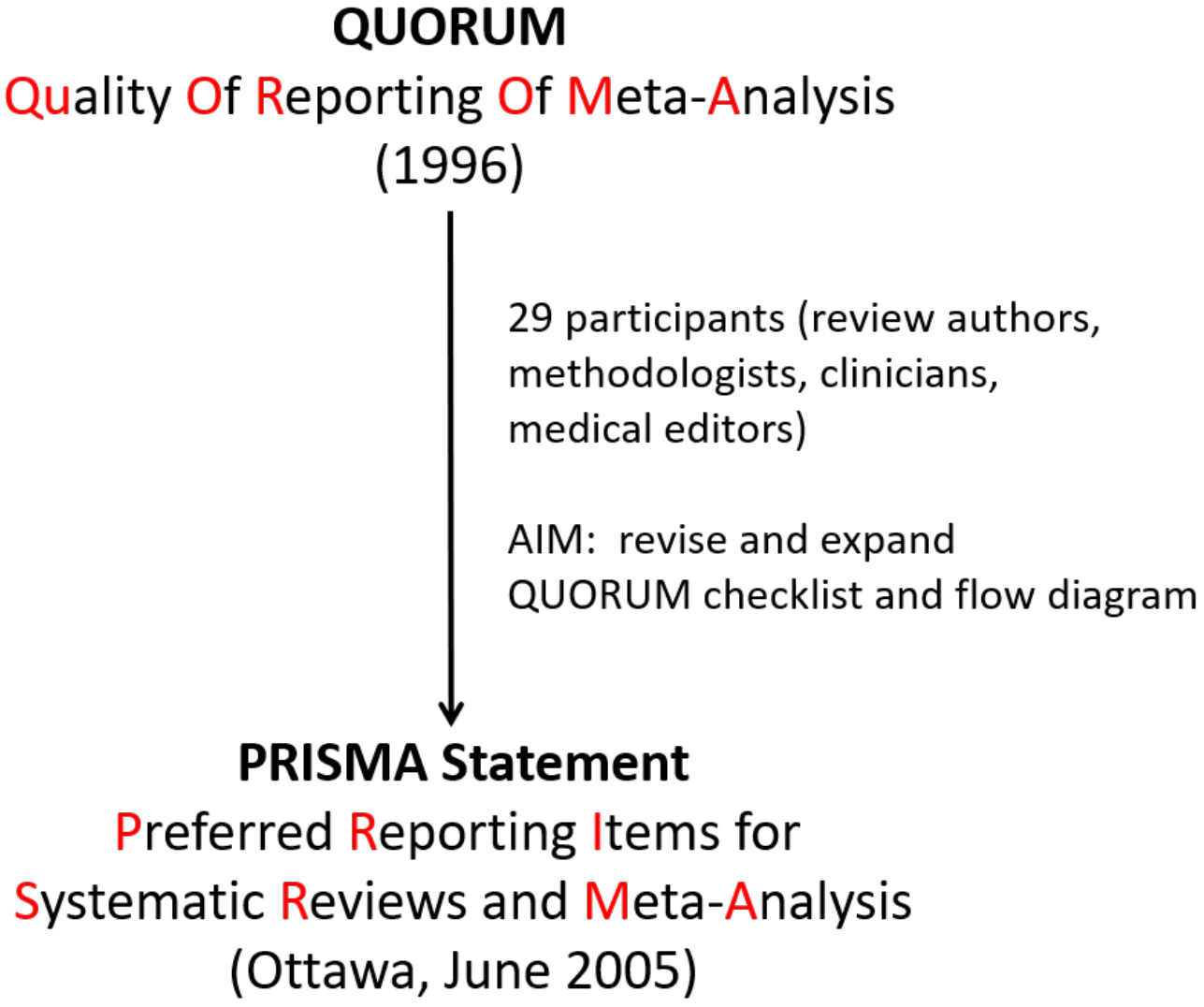
Quintana (2015, p. 6, *Frontiers in Psychology*)

11) Publishing the systematic review or meta-analysis following PRISMA guidelines

Guidelines for high-quality reports:

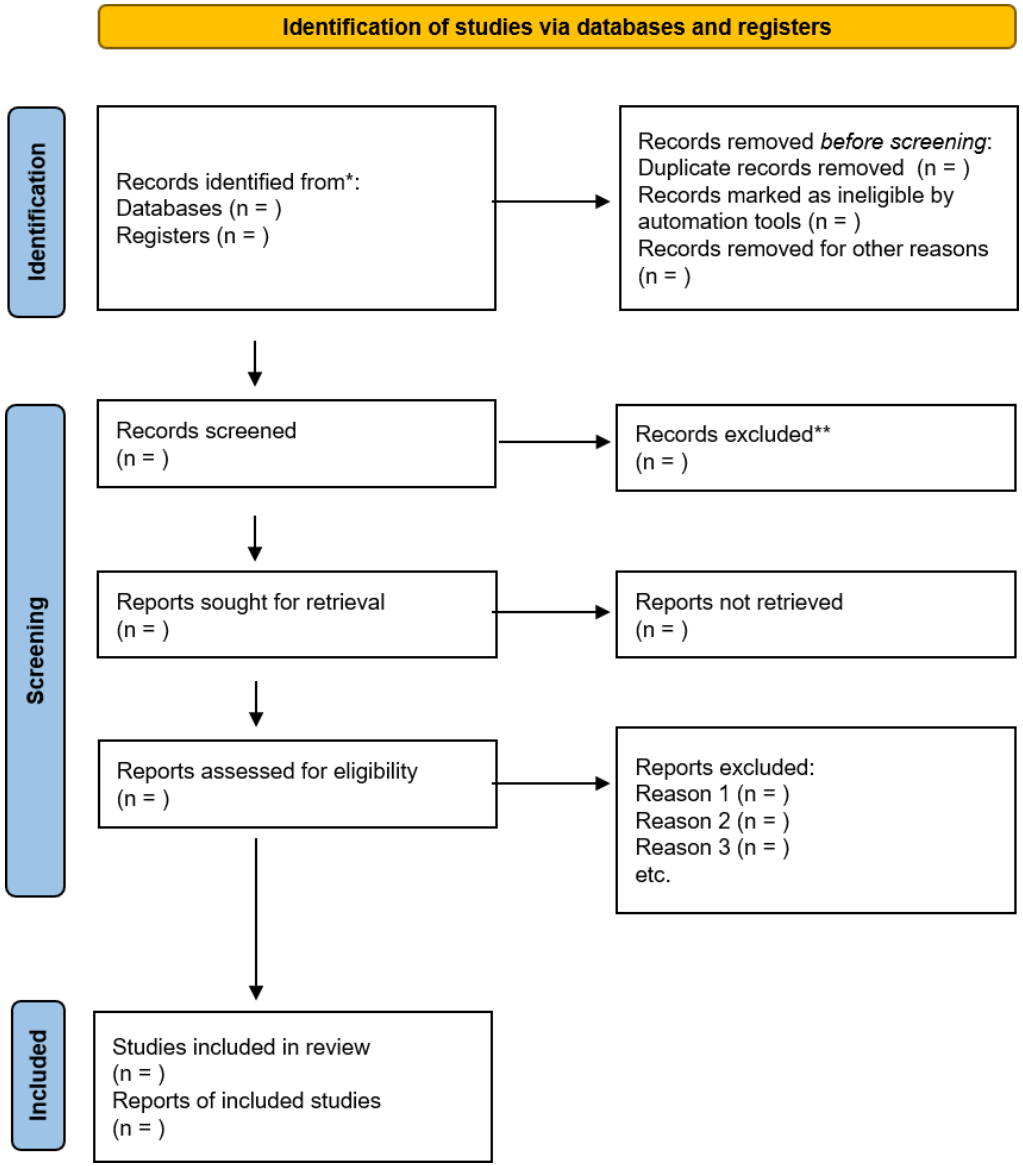
- **QUORUM** (Quality Of Reporting Of Meta-Analysis, 1996)
- **MARS** (Meta-Analysis Reporting Standards; APA, 2010, p. 251-252, NOT in APA 2020)
- **PRISMA** (Preferred Reporting Items for Systematic Reviews and Meta-Analysis; see next slides)

11) Publishing the systematic review or meta-analysis following PRISMA guidelines



PRISMA

- Standard guidelines for conducting and reporting systematic reviews and meta-analyses.
- Composed of **27 items**, organized by the standard sections of a scientific article (title, abstract, introduction, method, results, discussion, funding).
- A key contribution is the **PRISMA flow diagram** (see right), which illustrates the study selection process from the initial search to the final included studies.



PRISMA

- On the right, an example of a PRISMA flow diagram from Crocetti (2016, p. 7).
- Note how the number of articles decreases substantially across phases: the process starts with 2698 articles identified through the initial keyword search and ends with only 20 studies included in the final meta-analysis.

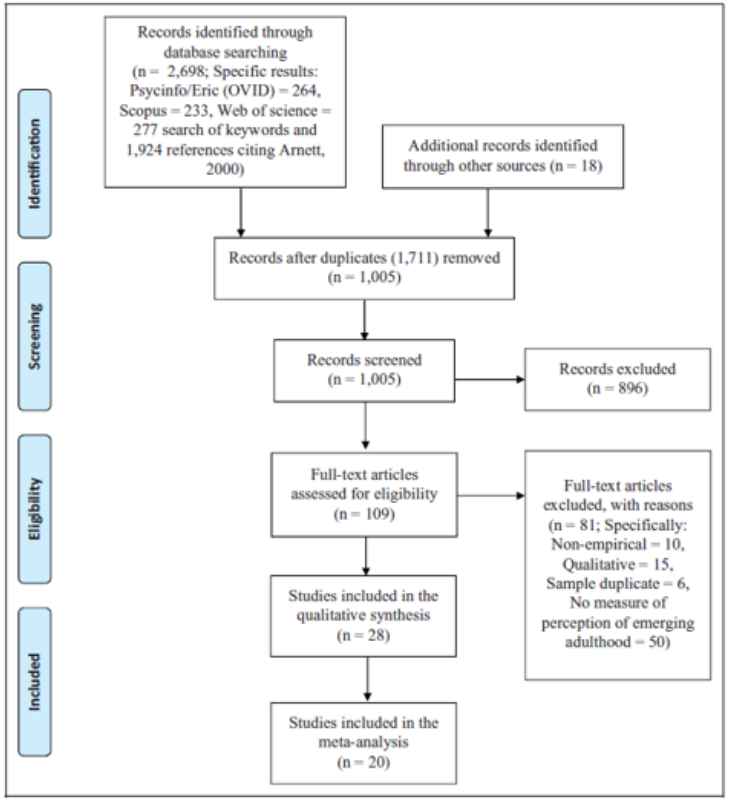


Figure 1. Example of a Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram.

PRISMA

- On the right, the list of the 27 items from Page et al. (2021)

Table 1 | PRISMA 2020 item checklist

Section and topic	Item #	Checklist item	Location where item is reported
Title			
Title	1	Identify the report as a systematic review.	
Abstract			
Abstract	2	See the PRISMA 2020 for Abstracts checklist (table 2).	
Introduction			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	
Methods			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	
	13d	Describe any methods used to synthesise results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesised results.	
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	
Results			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram (see fig 1).	
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	
Study characteristics	17	Cite each included study and present its characteristics.	
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesised results.	
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	
Discussion			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	
	23b	Discuss any limitations of the evidence included in the review.	
	23c	Discuss any limitations of the review processes used.	
	23d	Discuss implications of the results for practice, policy, and future research.	
Other information			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	
Competing interests	26	Declare any competing interests of review authors.	
Availability of data, code, and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	

PRISMA Statement

[see the folder **PRISMA-Explanation**]

Basic explanation:

Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med, 6*(7), Article e1000097. https://doi.org/10.1371/journal.pmed.1000097

For a deeper explanation item per item:

Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, et al. (2009) The PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies That Evaluate Health Care Interventions: Explanation and Elaboration. *PLoS Med, 6*(7), Article e1000100. https://doi.org/10.1371/journal.pmed.1000100

Update to PRISMA statement occurred in 2021:

Page M J, McKenzie J E, Bossuyt P M, Boutron I, Hoffmann T C, Mulrow C D et al. (2021) The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ, 372*, Article 71. https://doi.org/10.1136/bmj.n71

3. Other Topics

3. Other Topics

The **Individual Participant Data (IPD) Approach**: Rather than extracting summary data from study publications, original research data are sought directly from the researchers responsible for each study (Debray et al., 2015).

- PROS = more reliable results, given the possibility to run further analyses
- CONS = very time consuming!!

3. Other Topics

Software: Several R packages

- `meta` https://cran.r-project.org/web/packages/meta/index.html
- `metafor` https://www.metafor-project.org/doku.php/features
- `metaSEM` https://cran.r-project.org/web/packages/metaSEM/index.html
- `psychmeta` https://cran.r-project.org/web/packages/psychmeta/index.html

CMA (Comprehensive Meta-Analysis; https://meta-analysis.com/), ProMeta 3, ESCI (Exploratory Software for Confidence Intervals; https://thenewstatistics.com/itns/)

3. Other Topics

Overview of Reviews

- "Synthesizes findings from existing systematic reviews to provide a higher-level synthesis of evidence."

Scoping Reviews

- "Maps the breadth and scope of literature on a topic without necessarily appraising or synthesizing findings."

Evidence and Gap Map (EGM)

- "Identifies where research exists and where gaps remain, providing a visual representation of research coverage rather than synthesizing findings."

(Maynard, in press, Table 1)

4. References

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4.3 Specific Topics

IPD

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4.4 Journal

About this journal

Research Synthesis Methods

ISSN: 1759-2879 (Print), 1759-2887 (Online)
Frequency: 6 issues per year

Research Synthesis Methods, the official journal of the Society for Research Synthesis Methodology, is a multidisciplinary peer-reviewed journal devoted to the development and dissemination of methods for designing, conducting, analyzing, interpreting, reporting, and applying systematic research synthesis. It aims to facilitate the creation and exchange of knowledge about research synthesis methods that is of general interest or utility for the many fields and disciplines in which research synthesis is undertaken or used. Research synthesis is common in the health and social sciences and many of the methods explored in this journal will apply directly to these disciplines and to their practitioners. The journal's aim is to cross-fertilize these fields as well as others so as to enrich the methods of research synthesis in all scientific disciplines.

`https://www.cambridge.org/core/journals/research-synthesis-methods`

Thanks for your attention

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Presentation and material available at
`https://github.com/EnricoPerinelli/Intro-ResearchSynthesis`