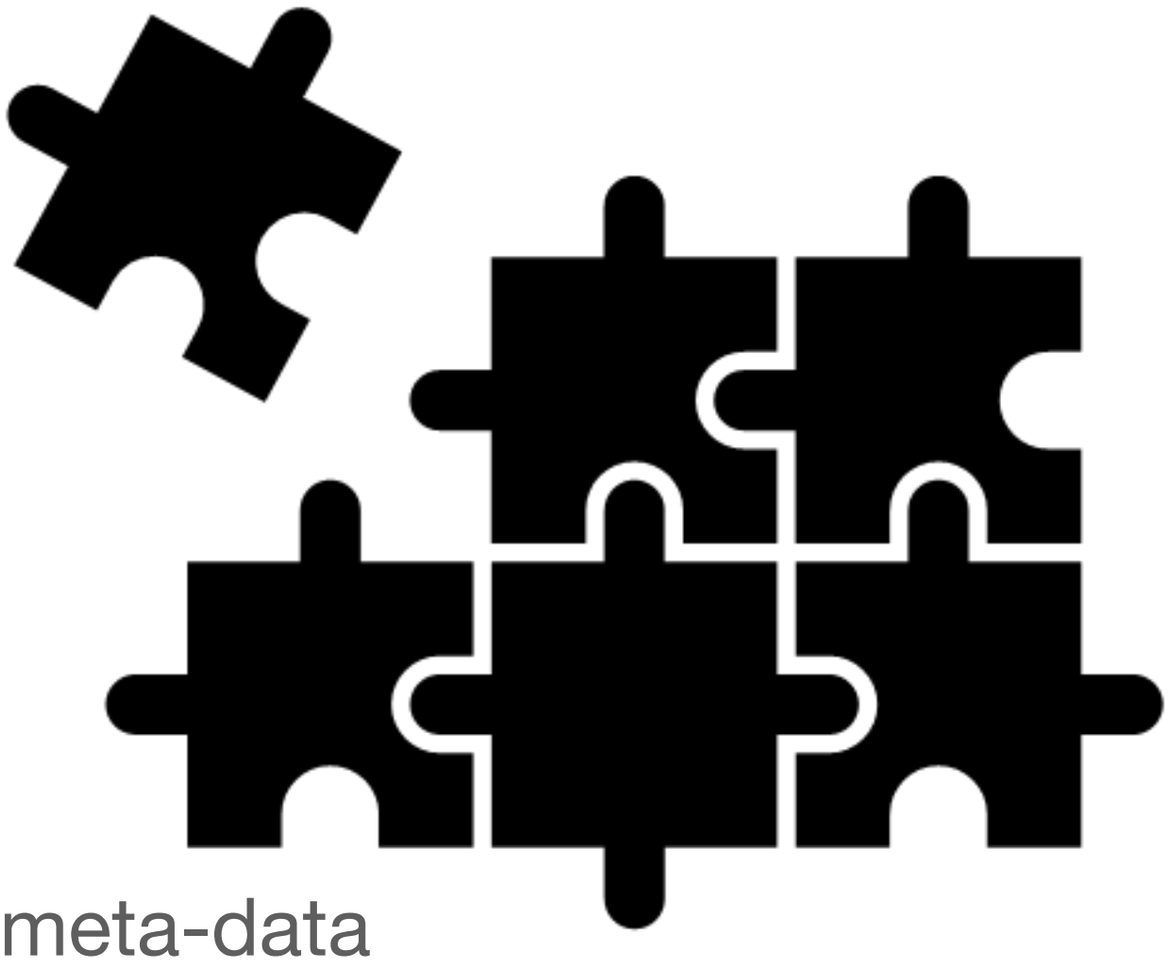
Quantitative Synthesis Reporting

@cjlortie

Evidence implementation and reuse is a non-trivial challenge in most disciplines



Transparency
Detail of reporting
Extractable data
Missing data and meta-data
Key covariates sparsely reported

OPEN ACCESS | Perspective

Ten simple rules to facilitate evidence implementation in the environmental sciences

Authors: Christopher J. Lortie and Malory Owen | **AUTHORS INFO & AFFILIATIONS**

Publication: FACETS • 20 August 2020 • https://doi.org/10.1139/facets-2020-0021

Big picture for all syntheses because always about reuse, context, and purpose

1. Reframe problem as challenge.
2. Describe the scope and extent of the challenge.
3. Explicitly link the basic science to management implications and policy.
4. Propose implications of ignoring this challenge.
5. State the direct human needs associated with this challenge.

6. List at least one limitation of the study and explain.
7. Explore the benefits of minimal intervention for stakeholders.
8. Be transparent in reporting methods.
9. Be explicit in linking to proposed management outcomes.
10. Apply the tool to another challenge.

Know better, do better.

Research
Synthesis Methods

Tutorial

How to critically read ecological meta-analyses

Christopher J. Lortie ✉, Gavin Stewart, Hannah Rothstein, Joseph Lau,

First published: 19 December 2013 | https://doi.org/10.1002/jrsm.1109 |
Citations: 19

A brief note on reading ecological meta-analyses.

Overarching Principles
Transparency
Replicability
Statement of purpose

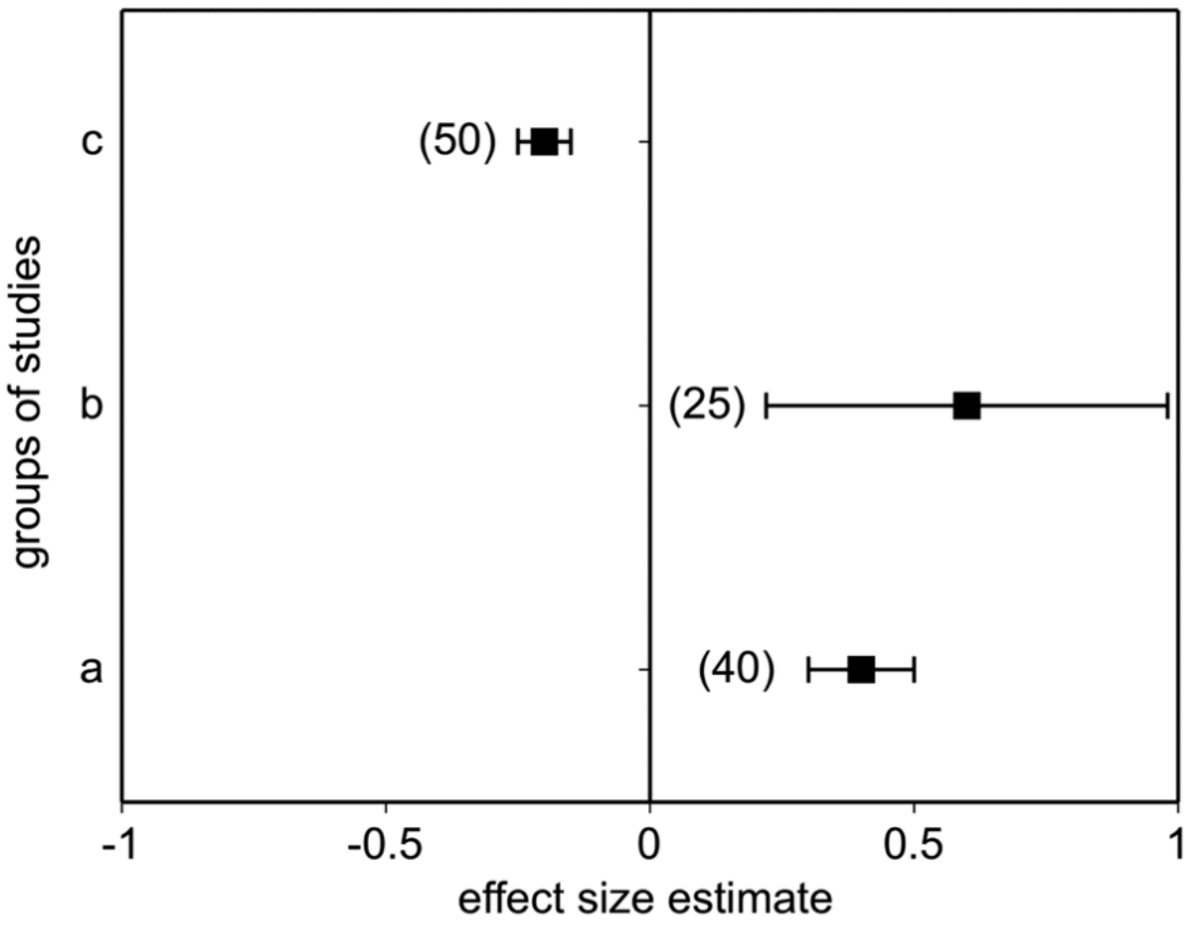
A. Literature & Scope
General Heuristic
Scope of search
Choice of relevant studies
Representativeness

Specifics
Defined inclusion/exclusion criteria for identification of relevant (evidence) studies
Reasons for inclusion/exclusion documented for each study
Inclusion/exclusion controlled & listed excluded studies in appendix
Assessment of study quality/validity: design, context, scale, and taxa
Data extraction methodology documented and repeatable
Reporting of aggregation methods across studies
Estimation of publication bias

B. Results & Interpretation
Heuristic
Larger context of evidence framed & interpreted
Variation effectively explored
Ecology of system included, i.e. generalizable results

Specifics
Reported number of studies (N) relative to number of effect size estimates (n)
Investigation of sources of variation including heterogeneity
Conducted sub-group analyses or meta-regression
Partial reporting of covariates in studies listed
Alternative response variables explored
Identification evidence gaps & proposed future designs and/or sample sizes
Common ecological drivers tested (latitude, climate, etc.)
Appropriate effect sizes calculated & statistical methods applied

Sources: Pullin, A. S., and G. B. Stewart. 2006. Guidelines for Systematic Review in Conservation and Environmental Management. Conservation biology 10.1111/j.1523-1739.2006.00485.x. Russo, M. W. 2007. How to review a meta-analysis. Gastroenterology & Hepatology 3: 637-642.


c
b
a
(50)
(25)
(40)
groups of studies
-1
-0.5
0
0.5
1
effect size estimate

A. Heterogeneity

Heuristic

Statistical model

Low-quality studies

Sensitivity

Specifics

Degree of fit of statistical model

Heterogeneity reported & statistically tested

Heterogeneity within & between groups interpreted & explanations proposed

Alternative models explored

Sign consistency & changes addressed

Observational versus mensurative methods contrasted

Studies coded whether directly tested question or reported associated data

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B. Phylogenetics

Heuristic

Inclusion of many different species

Phylogenetic signal & size treated as factors

Size of dataset relates to nonindependence

Specifics

Fixed versus random effects models tested or justified

Number of species included in the meta-analyses provided

Tree balance, distribution of nodes, & reporting of phylogenetic correlations

Phylogenetic signal examined as a form of nonindependence bias

Alternative statistical approaches explored

Functional classifications considered

Sources: (1) *Stewart, G. 2010. Meta-analysis in applied ecology. Biology Letters 6: 78-81. (2) Lajeunesse, M. et al. 2013. Phylogenetic nonindependence and meta-analysis. Handbook of meta-analysis in ecology and evolution: 284-299. (3) Chamberlain, S.A. et al. 2012. Does phylogeny matter? Assessing the impact of phylogenetic information in ecological meta-analysis. Ecology Letters 15: 627-636.*

Review | Open Access | Published: 03 March 2017

Meta-evaluation of meta-analysis: ten appraisal questions for biologists

Shinichi Nakagawa ✉, Daniel W. A. Noble, Alistair M. Senior & Malgorzata Lagisz

BMC Biology **15**, Article number: 18 (2017) | Cite this article

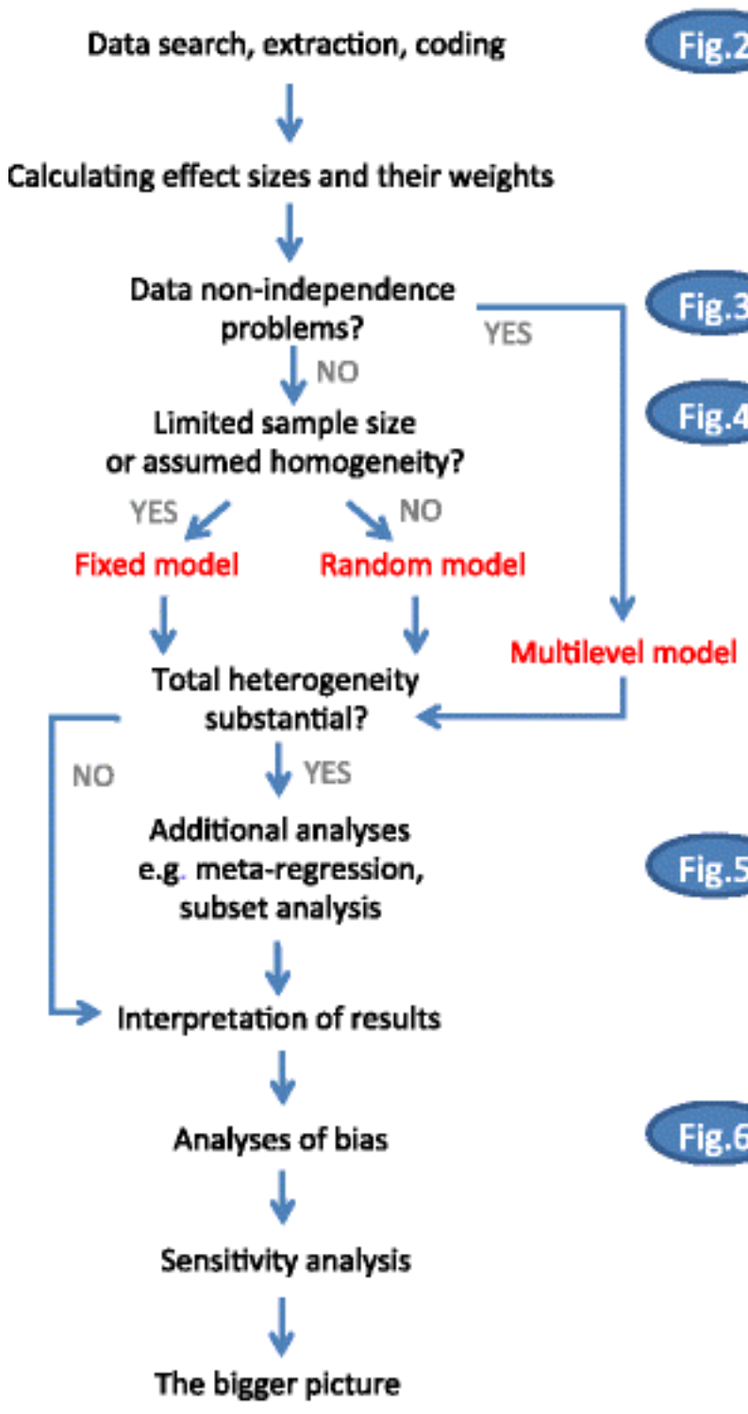


Fig.2

Is the search systematic and transparently documented? (Q1)

What question and what effect size? (Q2)

Fig.3

Is non-independence dealt with? (Q3)

Fig.4

Which meta-analytic model? (Q4)

Is consistency among studies reported? (Q5)

Fig.5

Are the causes of variation among studies investigated? (Q6)

Are effects interpreted in terms of biological importance? (Q7)

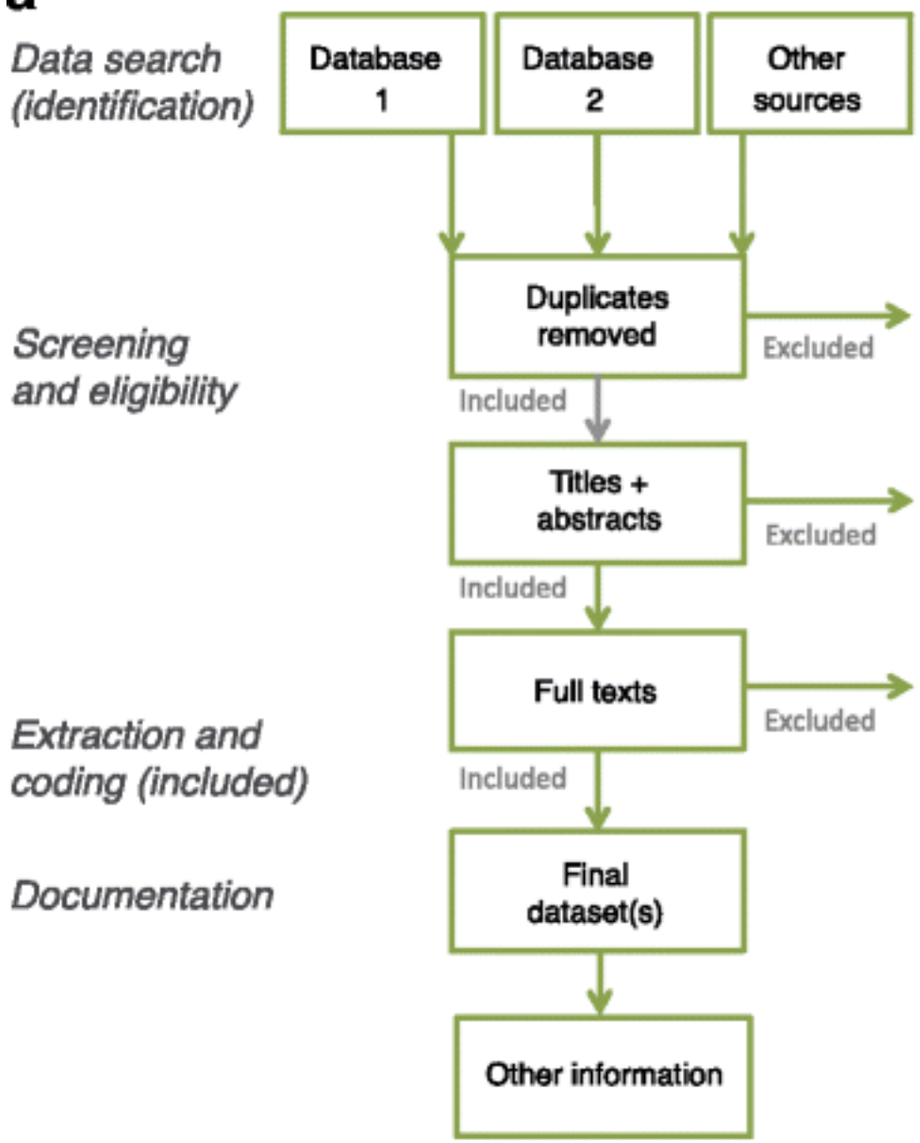
Fig.6

Has publication bias been considered? (Q8)

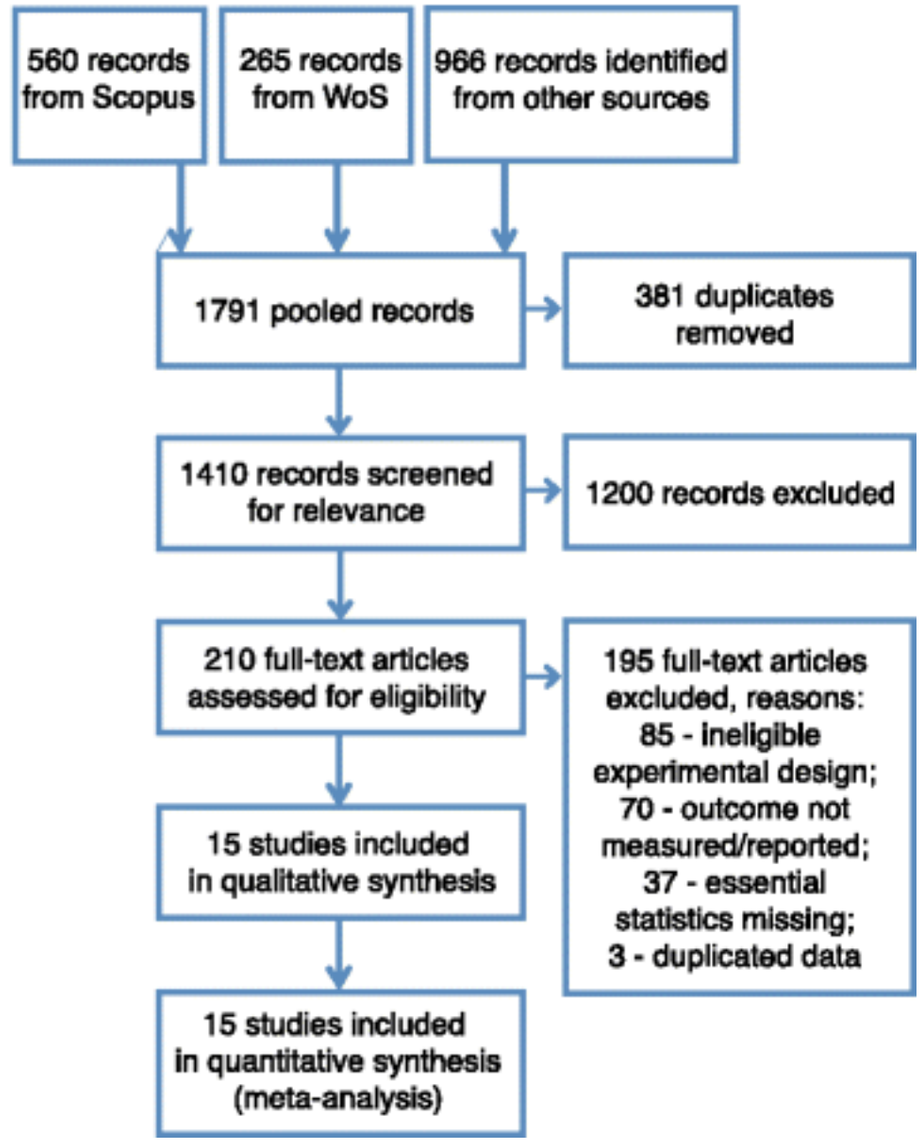
Are results really robust and unbiased? (Q9)

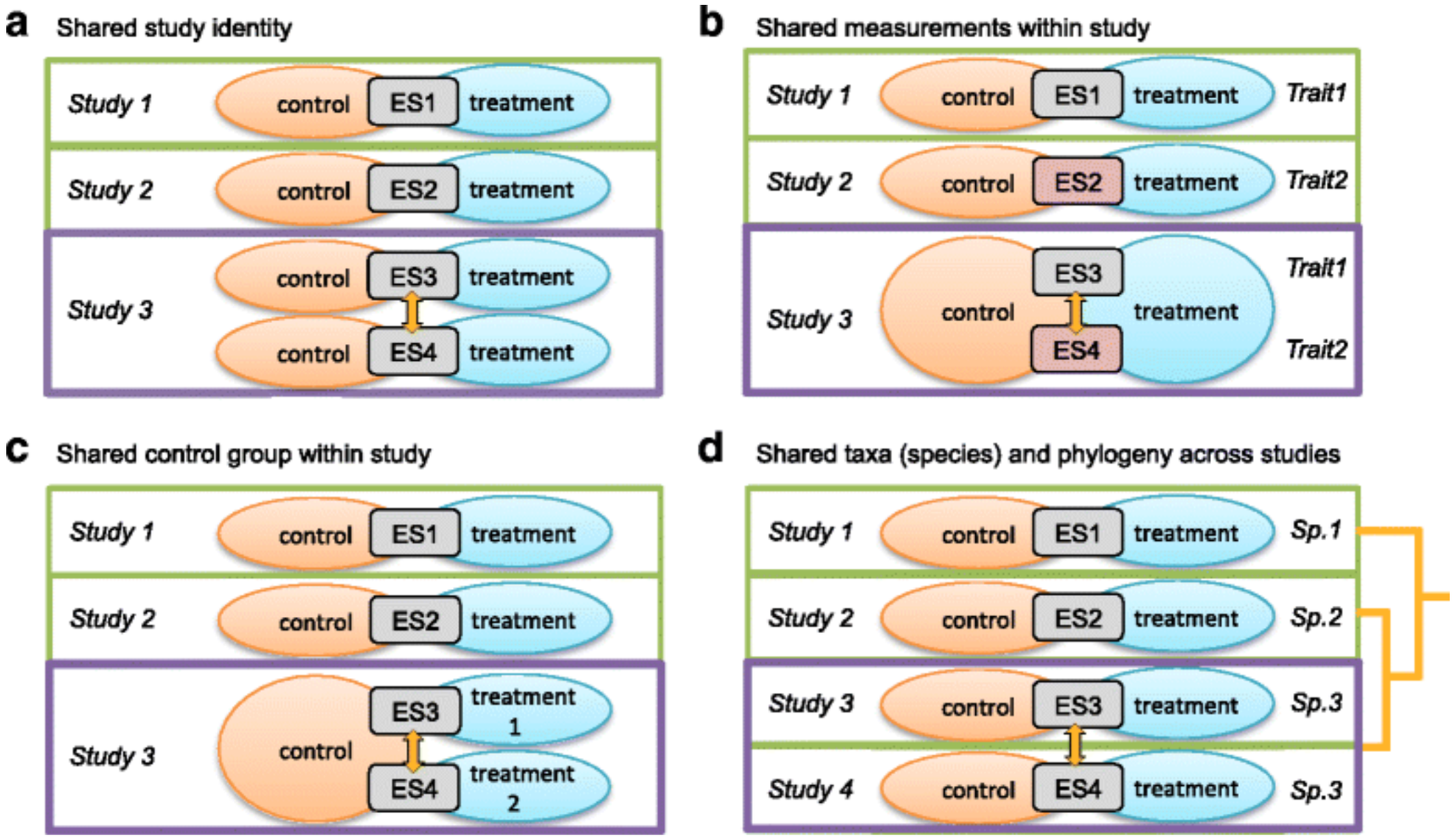
Is the current state (and lack) of knowledge summarized? (Q10)

a

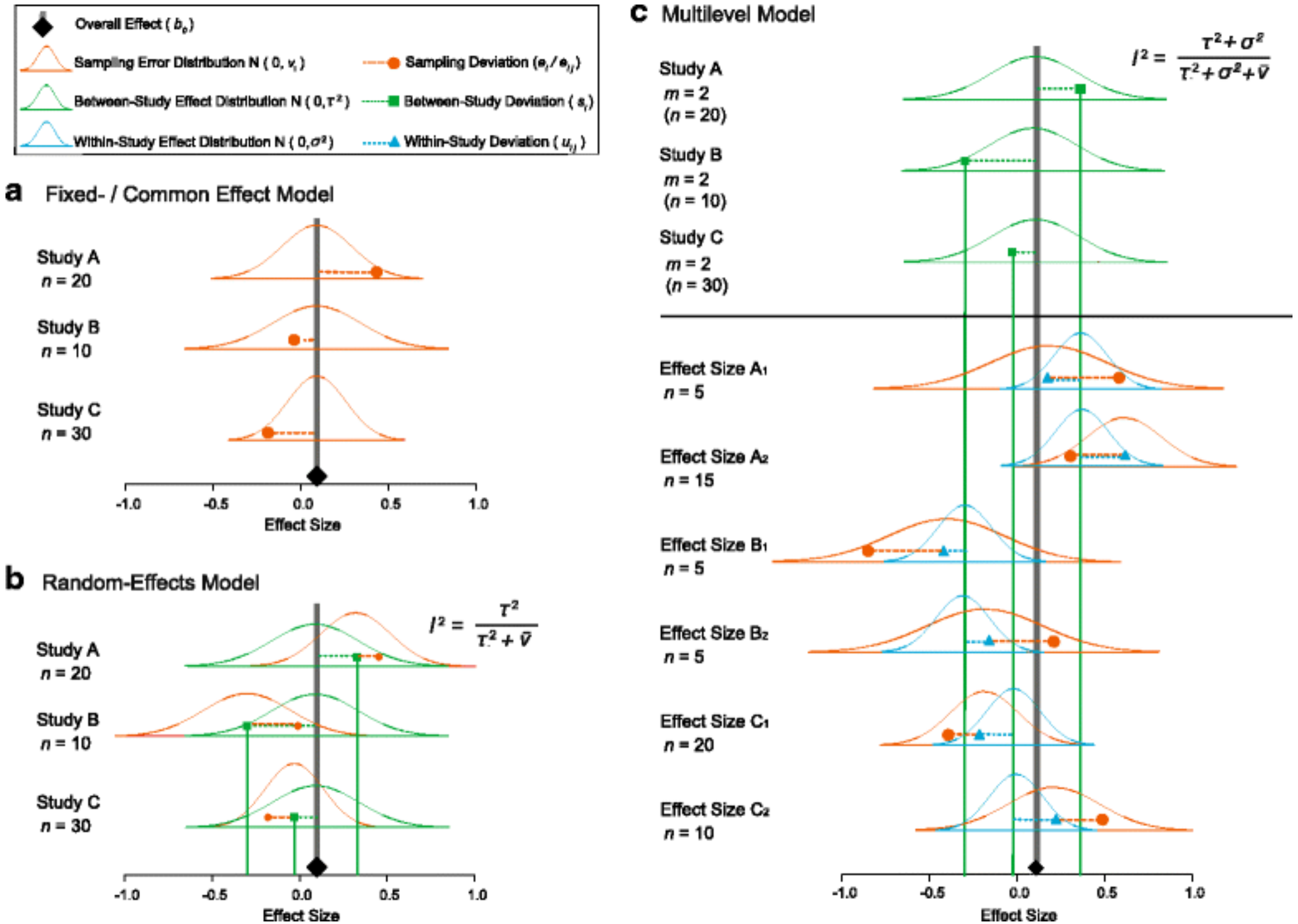

Data search (identification)
Database 1
Database 2
Other sources
Duplicates removed
Excluded
Included
Screening and eligibility
Titles + abstracts
Excluded
Included
Full texts
Excluded
Included
Extraction and coding (included)
Final dataset(s)
Documentation
Other information

b

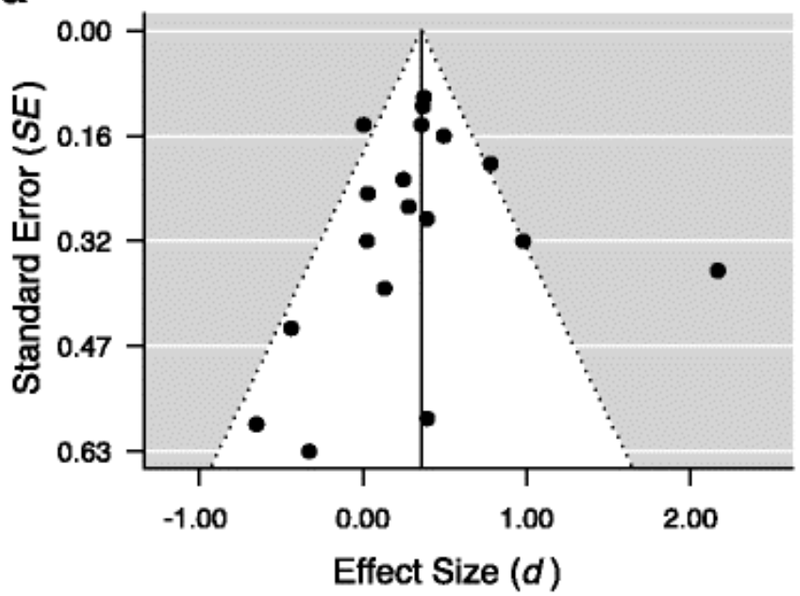

560 records from Scopus
265 records from WoS
966 records identified from other sources
1791 pooled records
381 duplicates removed
1410 records screened for relevance
1200 records excluded
210 full-text articles assessed for eligibility
195 full-text articles excluded, reasons:
85 - ineligible experimental design;
70 - outcome not measured/reported;
37 - essential statistics missing;
3 - duplicated data
15 studies included in qualitative synthesis
15 studies included in quantitative synthesis (meta-analysis)


a
Shared study identity
Study 1
control
ES1
treatment
Study 2
control
ES2
treatment
Study 3
control
ES3
treatment
control
ES4
treatment
b
Shared measurements within study
Study 1
control
ES1
treatment
Trait1
Study 2
control
ES2
treatment
Trait2
Study 3
control
ES3
ES4
treatment
Trait1
Trait2
c
Shared control group within study
Study 1
control
ES1
treatment
Study 2
control
ES2
treatment
Study 3
control
ES3
ES4
treatment 1
treatment 2
d
Shared taxa (species) and phylogeny across studies
Study 1
control
ES1
treatment
Sp.1
Study 2
control
ES2
treatment
Sp.2
Study 3
control
ES3
treatment
Sp.3
Study 4
control
ES4
treatment
Sp.3

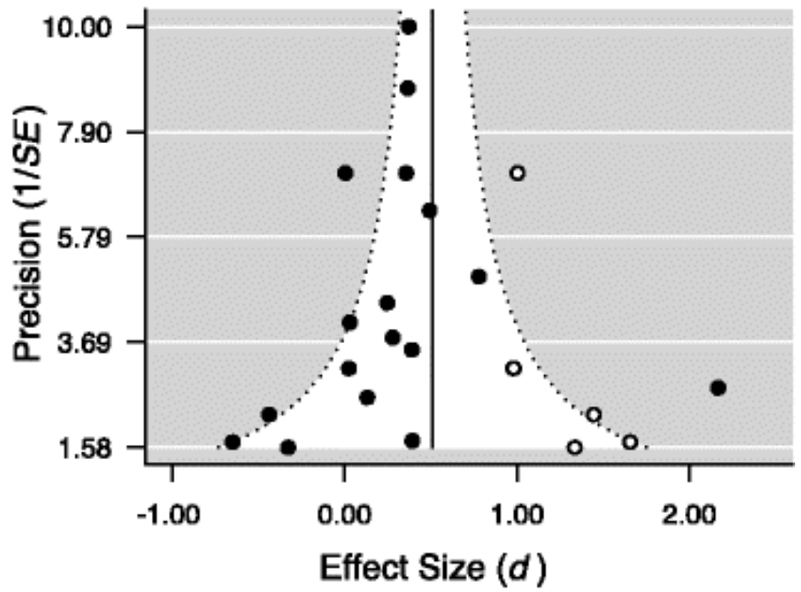
Distributional meta-thinking versus point



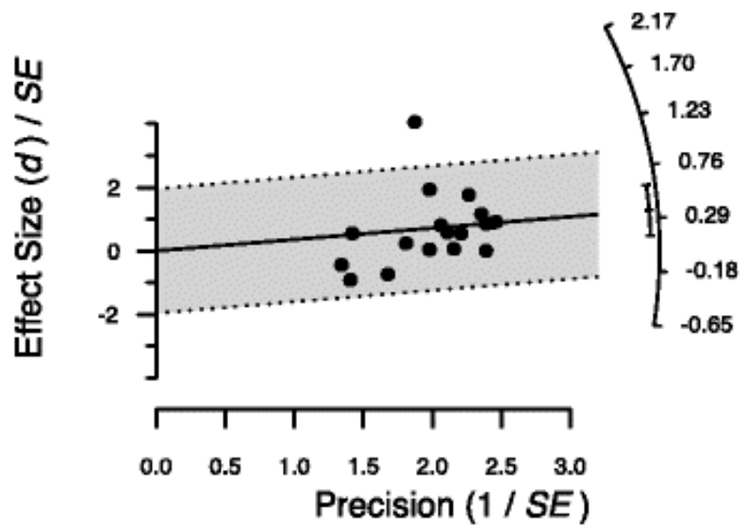
a


Standard Error (SE)
0.00
0.16
0.32
0.47
0.63
-1.00
0.00
1.00
2.00
Effect Size (d)

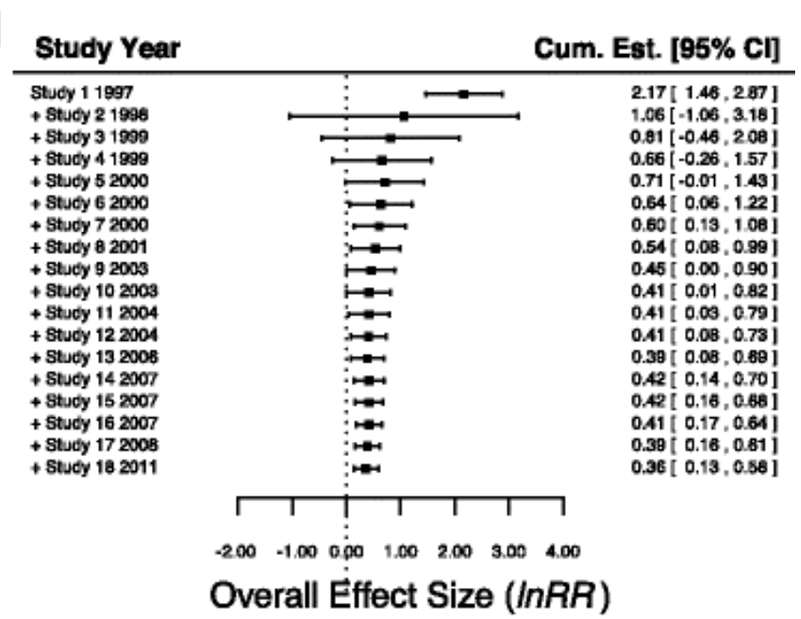
b


Precision (1/SE)
10.00
7.90
5.79
3.69
1.58
-1.00
0.00
1.00
2.00
Effect Size (d)

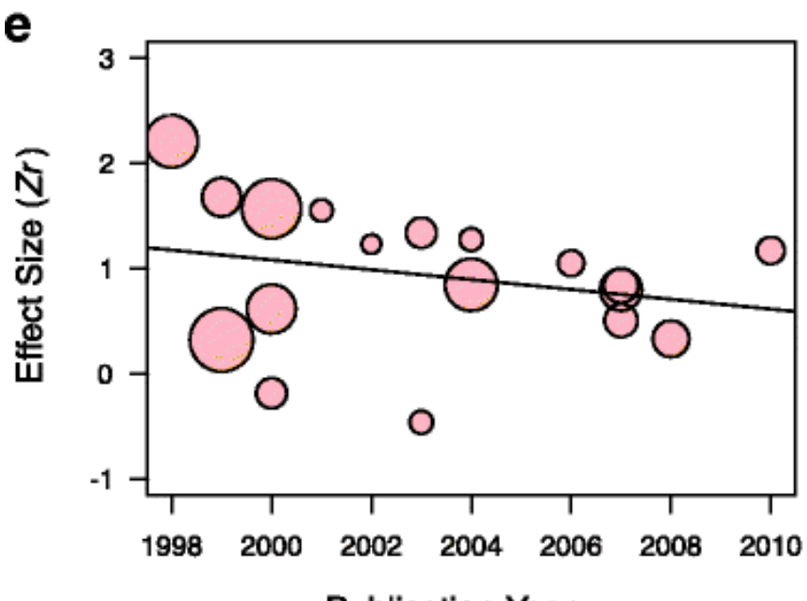
c


Effect Size (d) / SE
2
0
-2
2.17
1.70
1.23
0.76
0.29
-0.18
-0.65
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Precision (1 / SE)

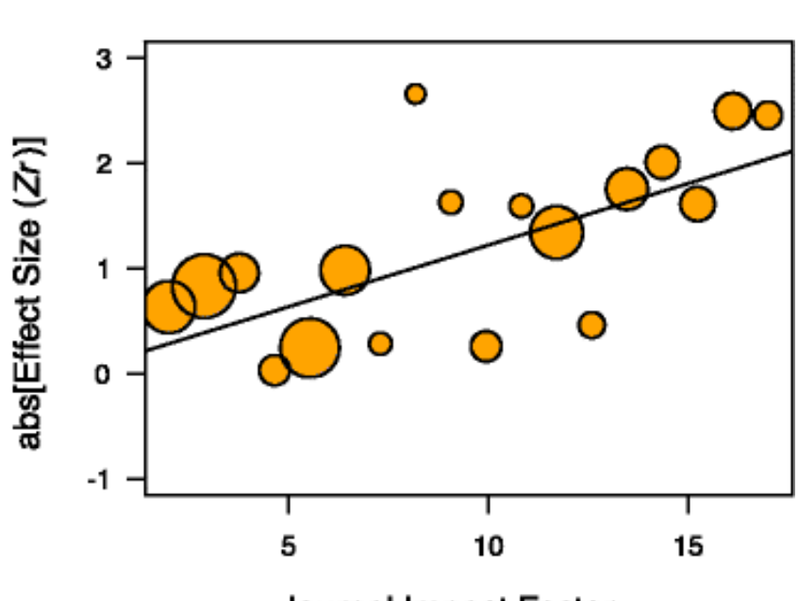
d


Study Year
Cum. Est. [95% CI]
Study 1 1997 2.17 [1.46 , 2.87]
+ Study 2 1998 1.06 [-1.06 , 3.18]
+ Study 3 1999 0.81 [-0.46 , 2.08]
+ Study 4 1999 0.66 [-0.26 , 1.57]
+ Study 5 2000 0.71 [-0.01 , 1.43]
+ Study 6 2000 0.64 [0.06 , 1.22]
+ Study 7 2000 0.60 [0.13 , 1.08]
+ Study 8 2001 0.54 [0.08 , 0.99]
+ Study 9 2003 0.45 [0.00 , 0.90]
+ Study 10 2003 0.41 [0.01 , 0.82]
+ Study 11 2004 0.41 [0.03 , 0.79]
+ Study 12 2004 0.41 [0.08 , 0.73]
+ Study 13 2006 0.39 [0.08 , 0.69]
+ Study 14 2007 0.42 [0.14 , 0.70]
+ Study 15 2007 0.42 [0.16 , 0.68]
+ Study 16 2007 0.41 [0.17 , 0.64]
+ Study 17 2008 0.39 [0.16 , 0.61]
+ Study 18 2011 0.36 [0.13 , 0.58]
-2.00
-1.00
0.00
1.00
2.00
3.00
4.00
Overall Effect Size (lnRR)

e


Effect Size (Zr)
3
2
1
0
-1
1998
2000
2002
2004
2006
2008
2010
Publication Year

f


abs[Effect Size (Zr)]
3
2
1
0
-1
5
10
15
Journal Impact Factor

Collectively, it would be ideal if synthesis reporting exceeded the norms and standards associated with primary research reporting to better enable next-level synthesis and reproducibility

Easy to get lost in the weeds
or not see the forest for the trees

IJSPT INTERNATIONAL JOURNAL OF SPORTS PHYSICAL THERAPY

Int J Sports Phys Ther. 2012 Oct; 7(5): 493–503. PMCID: PMC3474302

PMID: 23091781

SYSTEMATIC REVIEW AND META-ANALYSIS: A PRIMER

Franco M. Impellizzeri, PhD[1] and Mario Bizzini, PT, PhD[1]

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Keep your eye on the prize.

Table 1. *Characteristics of narrative and systematic reviews, modified from Physiotherapy Evidence Database.*[37]

	Systematic review	**Narrative review**
Research question	Strictly formulated	Broadly formulated
Methodology	Clearly defined	Not or insufficiently described
Search strategy	Clearly defined	Not described
Selection of the studies	Clearly defined	Not described
Ranking of the studies	By levels of evidence	Not performed
Analysis of the studies	Clearly described	Not described
Interpretation of results	Objective	Subjective

Good thinking, **purpose**, audience and reuse to inform others.