



VENTURING INTO SYSTEMATIC REVIEW AND META- ANALYSIS

2026 NSF Awardee Meeting
Terri Pigott, Georgia State University
Beth Tipton, Northwestern University



Problem Formulation

Questions for Systematic Reviews with a Meta-analysis

Comprehensive Search for Eligible Studies

Literature Search



Screening

Identifying Eligible Studies

Extracting Data from Eligible Studies

Coding



Analysis

Effect Sizes and Meta-Analysis Models

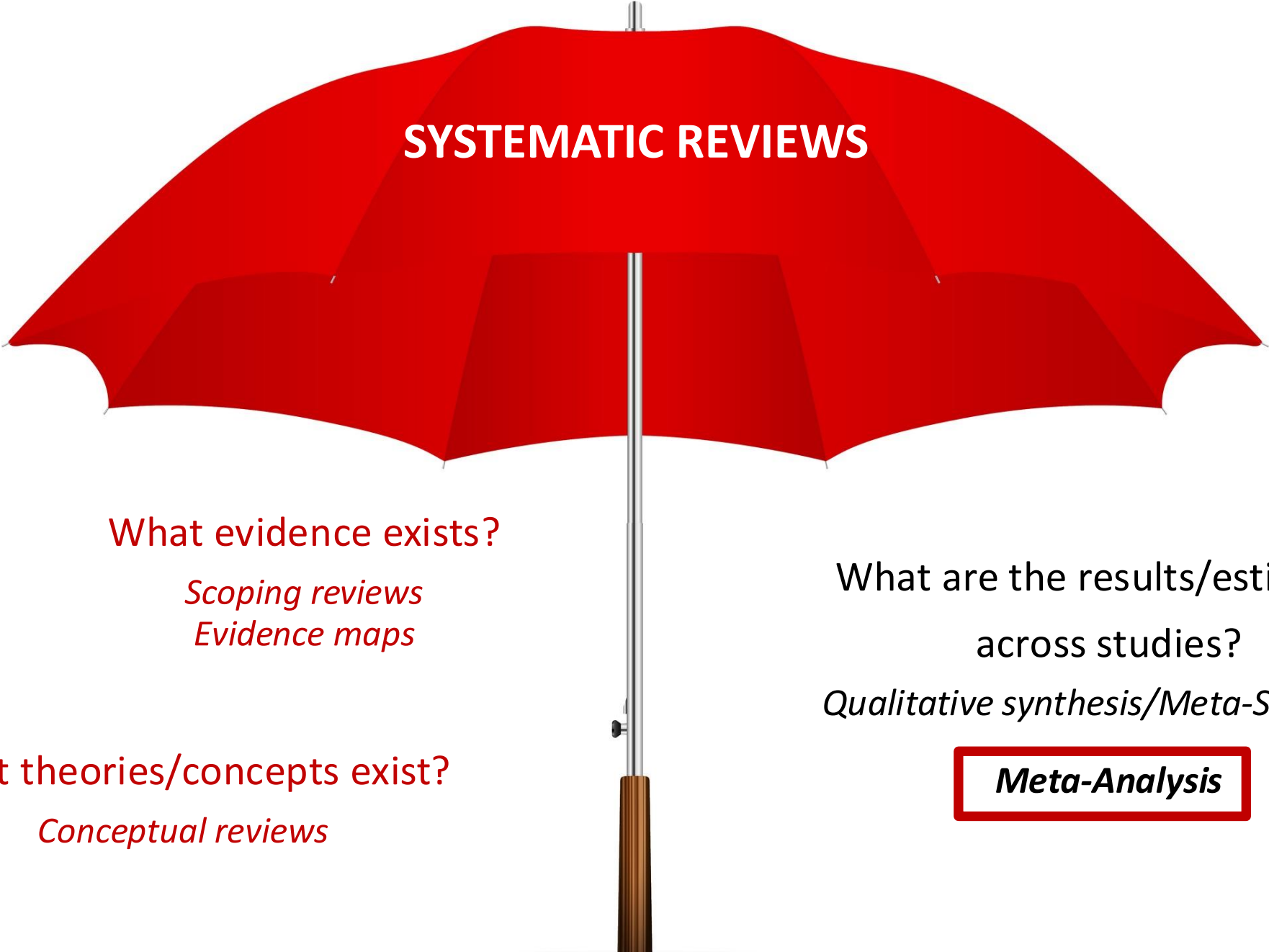
Definition of systematic review

- A systematic review
 - Uses explicit criteria and transparent, replicable processes
 - To identify, assess and synthesize results of multiple studies
 - To address a central research question
 - While minimizing bias and error at each step



Multiple definitions of systematic review

- Systematic Review
- Research Synthesis
- Meta-Analysis
- Meta-Synthesis
- And on and on



SYSTEMATIC REVIEWS

What evidence exists?

Scoping reviews
Evidence maps

What theories/concepts exist?

Conceptual reviews

What are the results/estimates
across studies?

Qualitative synthesis/Meta-Synthesis

Meta-Analysis

PROBLEM FORMULATION



Types of questions for meta-analysis

Effectiveness of an intervention: Does an intervention increase the performance of the intervention group?

Associations: What is the magnitude of the association between two constructs?

Comparison between two groups: How do two groups (e.g., boys and girls) differ on some outcome?

Rates and Trends: How prevalent is a phenomenon?

A Systematic Review and Meta-Analysis of Growth Mindset Interventions: For Whom, How, and Why Might Such Interventions Work?

Jeni L. Burnette¹, Joseph Billingsley², George C. Banks³, Laura E. Knouse⁴, Crystal L. Hoyt⁵,
Jeffrey M. Pollack⁶, and Stefanie Simon⁷

¹ Department of Psychology, College of Humanities and Social Sciences, North Carolina State University

² School of Science and Engineering, Tulane University

³ Belk College of Business, University of North Carolina Charlotte

⁴ School of Arts and Sciences, University of Richmond

⁵ Jepson School of Leadership Studies, University of Richmond

⁶ Poole College of Management, North Carolina State University

⁷ School of Liberal Arts, Siena College

INTERVENTION EFFECTIVENESS



Examining the relations between spatial skills and mathematical performance: A meta-analysis

Kinnari Atit¹ • Jason Richard Power² • Terri Pigott³ • Jihyun Lee⁴ • Elyssa A. Geer^{5,6} • David H. Uttal⁷ • Colleen M. Ganley⁵ • Sheryl A. Sorby⁸

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Associations - Correlations

- What is the correlation between spatial skills and mathematics performance?
- Does this correlation vary across studies?

Generational Differences in Academic Achievement Among Immigrant Youths: A Meta-Analytic Review

Mylien T. Duong^{1,2}, Daryaneh Badaly³, Freda F. Liu⁴, David Schwartz⁵, and Carolyn A. McCarty^{6,7}

Abstract

Research on generational differences in immigrant youths' academic achievement has yielded conflicting findings. This meta-analysis reconciles discrepant findings by testing meta-analytic moderators. Fifty-three studies provided 74 comparisons on academic outcomes. First- and second-generation youths did not significantly differ on academic achievement (Hedges's $g = .01$), and second-generation students performed slightly better than third-or-later-generation peers ($g = .12$). Moderation tests indicated that second-generation immigrants outperformed first-generation students on standardized tests ($g = .20$) and earned better grades than third-or-later-generation peers ($g = .20$). Immigrant advantage was stronger for Asian, low-socioeconomic, and community samples. Immigrant advantage may be overestimated in studies that use self-reported rather than school-reported achievement. Together, our results suggest a small, heterogeneous second-generation immigrant advantage that varies by immigrant population and study characteristics.

GROUP COMPARISONS

Questions to ask yourself for an SRMA

- Is there another systematic review and meta-analysis in the literature?
 - How recent is it? Could the search and/or analysis be updated given new literature and new methods?
 - What could a new SRMA contribute?
- Is the literature mature enough for a systematic review and meta-analysis?
 - New constructs/interventions may not be mature enough for an SRMA
 - Newer constructs/intervention/theory may need a scoping review/evidence map

Answerable questions for a meta-analysis

Questions for a systematic review with a meta-analysis aim to summarize/synthesize a quantity across the studies

Meta-analysis cannot answer why or how questions

Meta-analysis examines the distribution of an effect size (difference between two groups, a correlation, an estimate of a treatment effect) across studies

Meta-analyses require sufficient studies - there must be a body of literature to synthesize

SRMA Scope

- A research question for an SRMA might be broad or narrow in approach
- Broad example: Effectiveness of *all* interventions for middle school students in low-income environments
- Narrow example: Effectiveness of *only* after-school programs
- Scope will impact all aspects of systematic review

The SRMA
question
guides the
eligibility
criteria

Participants

Types of interventions, if applicable

Outcomes

Study Designs

Settings

Frameworks for Eligibility Criteria

PICOS

- Participants
- Interventions
- Comparison Group
- Outcomes
- Study Design or Setting

MUTOS

- Methods (Study Designs)
- Units (Participants)
- Treatments
- Outcomes
- Settings



LITERATURE SEARCH

Components of a comprehensive search

Search

Search multiple databases (perhaps hosted within multiple platforms such as EBSCO or Proquest)

Search

Search the grey literature using multiple strategies

Use

Use citation-chaining strategies (forward and backward citation chasing)

Sensitivity over Specificity

STEM education topics are multi-disciplinary

Need to search multiple databases with terms specific to each database



Numbers of studies identified in RER reviews

Review	Initial number of studies
Dietrichson et al.	11,807
Duong et al.	1,478
Gardella et al.	6,378
Littell et al. (2005)	5,290
Voyer et al.	17,307

FIND A SEARCH LIBRARIAN



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Partial search example

ProQuest Dissertations & Theses Global

diskw(multisystemic OR multi-systemic) AND (therapy OR treatment)

MEDLINE

- 1 multisystemic therap\$.mp.
- 2 multi-systemic therap\$.mp.
- 3 multisystemic treatment\$.mp.
- 4 multi-systemic treatment\$.mp.
- 5 or/1-4 (97)
- 6 (research or evaluat\$ or intervention\$ or effectiv\$ or outcome\$).mp.
- 7 randomized controlled trial.pt.
- 8 controlled clinical trial.pt.
- 9 randomi#ed.ab.
- 10 placebo\$.ab.
- 11 drug therapy.fs.
- 12 randomly.ab.
- 13 trial.ab.
- 14 groups.ab.
- 15 or/7-14
- 16 exp animals/not humans.sh.
- 17 15 not 16
- 18 6 or 17
- 19 5 and 18
- 2020: added
- 20 (201* or 202*).dp,dt,ed,ep,yr.
- 21 19 and 20

ERIC

2010:

((multisystemic ADJ therap\$) OR (multi-systemic ADJ therap\$) OR (multi ADJ systemic ADJ therap\$) OR (multisystemic ADJ treatment\$) OR (multi-systemic ADJ treatment\$) OR (multi ADJ systemic ADJ treatment\$)) AND ((Intervention.DE.) OR (Outcomes-of-Treatment.DE.) OR (EXPERIMENTAL-GROUPS.DE. OR CONTROL-GROUPS.DE. OR PROGRAM-EFFECTIVENESS.DE. OR COMPARATIVE-ANALYSIS.DE. OR EVALUATION.W. DE. OR EVALUATION-METHODS.DE.) OR (random\$ OR compar\$ OR research\$ OR evaluat\$ OR outcome\$ OR intervent\$ OR effectiv\$))

2020:

1 ((multisystemic adj therap\$) or (multi-systemic adj therap\$) or (multi adj systemic adj therap\$) or (multisystemic adj treatment\$) or (multi-systemic adj treatment\$) or (multi adj systemic adj treatment\$)).mp. [mp=abstract, title, heading word, identifiers]

2 intervention.de.

3 Outcomes-of-Treatment.de.

4 EXPERIMENTAL-GROUPS.de.

5 CONTROL-GROUPS.de.

6 PROGRAM-EFFECTIVENESS.de.

7 COMPARATIVE-ANALYSIS.de.

8 EVALUATION.de.

9 EVALUATION-METHODS.de.

10 (random\$ or compar\$ or research\$ or evaluat\$ or outcome\$ or intervent\$ or effectiv\$).mp. [mp=abstract, title, heading word, identifiers]

11 or/2-10

12 1 and 11



SCREENING FOR ELIGIBLE STUDIES

Steps in the Screening Process



Identify software to
support the process



Stage 1: Screen Titles and
Abstracts



Stage 2: Screen Full-Texts
of Studies Eligible in Title
and Abstract Stage

Screening Software

FREE

- Meta-Reviewer
- Rayyan
- Abstrakr

SUBSCRIPTIONS

- Covidence
- Rayyan
- EPPI-Reviewer

Links to programs in the resources at the end of the slides

Stage 1 Screening: Titles & Abstracts



Use Eligibility Criteria (PICOS/MUTOS) to develop a set of short questions



3 - 4 low inference questions



Questions should be information typically found in an abstract

Typical numbers after Stage 1

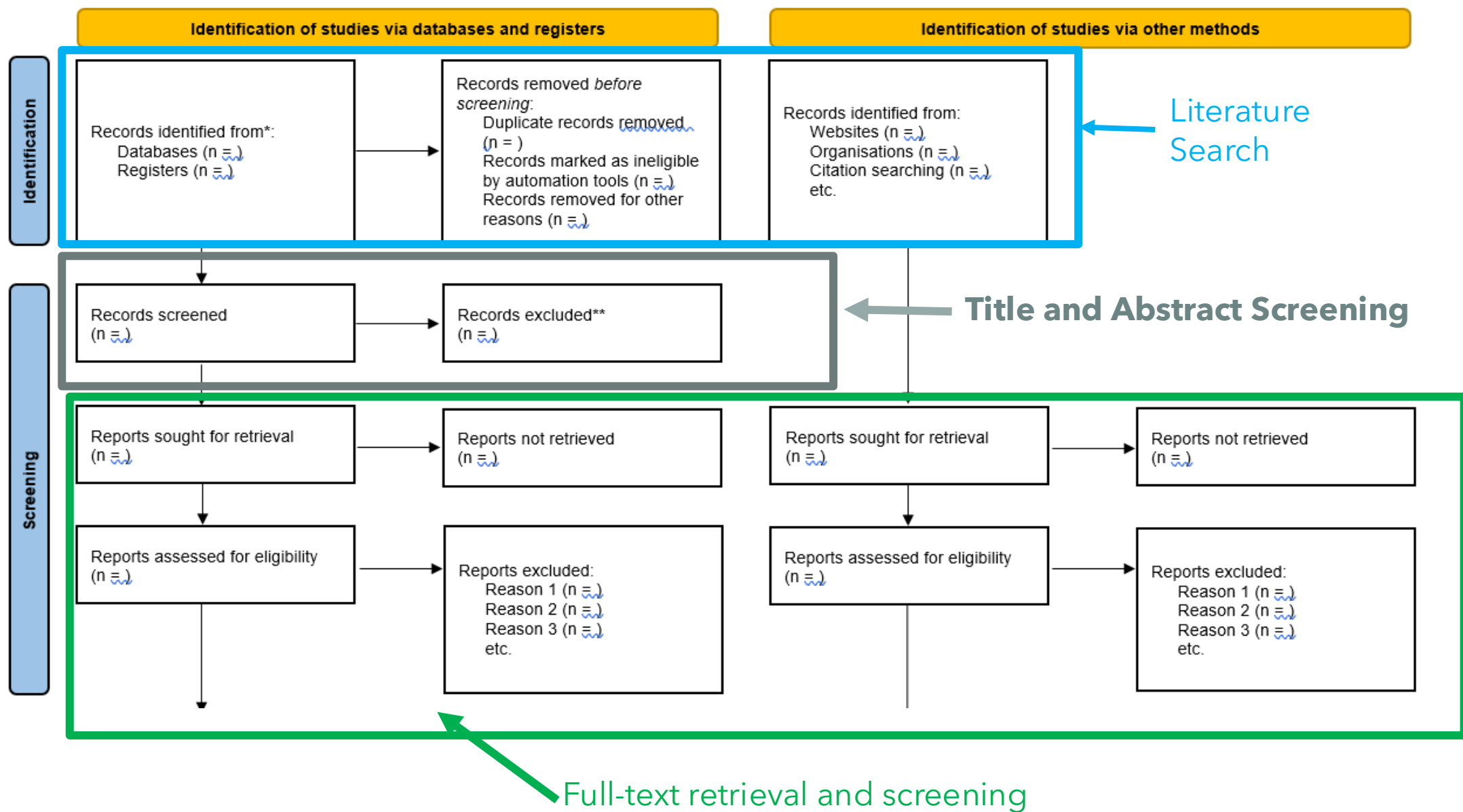
Review	Initial number of studies	Number after 1 st screening
Dietrichson et al.	11,807	1,137
Duong et al.	1,478	238
Gardella et al.	6,378	508
Littell et al.	5,290	266
Voyer et al.	17,307	Unclear

Full-text screening

- Title and abstract screening eliminates clearly ineligible studies
- Using the full text, need to make final decisions using ALL eligibility criteria
- Full-text screening is reserved for those parts of eligibility criteria that are not typically in the abstract or title
- We can do this full-text screening in most screening software programs

Screening Process

- Best practice: TWO INDEPENDENT SCREENERS
- Screeners are subject to drift - need to have two decisions per record
- Reconciliation process for each conflict
- Process needs to be reported in a PRISMA20 diagram (next slide)





CODING/DATA EXTRACTION

Data
extraction
follows the
review
objectives
and
underlying
theory

- Example questions in the literature:
 - Do randomized controlled trials produce results different from other research designs?
 - Do researchers independent from the original developers get different results?
 - Is the effectiveness of an intervention differ for studies conducted outside the US?
 - Is there a difference in effectiveness depending on whether the outcome is reported by a parent versus a health/social services professional?
 - Is there a difference in effectiveness across time, e.g., do effects fade so that longer follow-up times show lower effectiveness?

Rationale for data extracted from studies

To describe the evidence base: the number and nature of the studies eligible for the systematic review

To describe the distribution of effect sizes in our eligible studies

To assess the confidence we have in the study results or in other words, the credibility of results in the literature (risk of bias)

To explore the relationship between study results and characteristics of studies to test theories about the eligible studies

Identifying what data to extract

- Questions to ask yourself:
 - What aspects/characteristics of studies would researchers in the field want to understand/know about your sample?
 - What are the controversies and theories in the field that could be explored in this literature?
 - Why might effect sizes vary across studies?
 - How many resources do I have?

Best practice for data extraction

- Piloting the codebook - you may iterate a number of times before the codes are working well
- Using principles of survey question writing to produce a clear codebook (e.g., no double-barreled questions, as low inference as possible)
- Independent double-coding - ideally of all eligible studies, but at least of a sample

Organizing the coding

- Different levels of coding: study level, treatment group, outcome level, effect size level, etc.
 - Need a system so that you only code study level once, but have multiple linked effect sizes
- Use software for coding
 - Software: Meta-Reviewer, Covidence, EPPI-Reviewer
 - Spreadsheets?
 - Qualtrics?
 - NVivo?



META- ANALYSIS RESOURCES

