

# Basic Steps and Procedures for a Campbell Systematic Review

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Center on  
**KNOWLEDGE TRANSLATION FOR  
DISABILITY & REHABILITATION RESEARCH**  
at American Institutes for Research ■



# Goals for the Presentation

- Provide an overview of the stages of a systematic review and meta-analysis.
- Provide overview of standards for producing a Campbell systematic review using MECCIR.

# Campbell Collaboration MECCIR

- The Methodological Expectations of Campbell Collaboration Intervention Reviews (MECCIR) provide authors and users of Campbell reviews of intervention effects with clear and transparent expectations of review conduct and reporting.
- They are based on the original work of the Cochrane MECIR project team (Higgins et al., 2016)
- This presentation provides highlights from these standards for the conduct of a systematic review.
- Campbell's MECCIR standards can be accessed [here](#).

# Problem Formulation

- What kinds of questions can be addressed in a systematic review?
- What is the scope of a systematic review?
- How does the review question shape the inclusion and exclusion criteria for studies included in the review?

# Systematic reviews are a form of research

- Systematic reviews follow the same basic steps as any research study (Cooper, 2016) but with primary studies as the unit of analysis
- Stages of a systematic review:
  1. Problem formulation
  2. Data collection
  3. Data evaluation
  4. Data analysis and interpretation

# Stages of a Systematic Review

## 1. Problem Formulation

# Systematic Review (SR) Questions: Effectiveness of interventions

- **Example:** Dietrickson, J., Bog M., Gilges, T. & Klint Jorgensen, A.-M. (2017). Academic interventions for elementary and middle school students with low socioeconomic status: A systematic review and meta-analysis. *Review of Educational Research, 87*, 243–282.
- This study is a systematic review of the effectiveness of academic interventions for elementary and middle school students with low-socioeconomic status.

# SR Questions: Effectiveness of interventions (cont'd)

- Research questions for Dietrichson et al. (2017):
  - What are the effects of  $x$  intervention on  $y$  outcome for  $z$  population?
  - Variations on this theme (e.g., differences in effects of interventions  $x_1$  vs.  $x_2$ )
  - **Our example:** Effects of academic interventions for low-SES students

# SR Questions: How do two groups compare?

- How does group  $X$  differ from group  $Y$  on some characteristic?
- **Example 1:** Gender differences in leadership, math performance, hours worked in the home, etc.
  - Voyer, D., & Voyer, S. D. (2014). Gender differences in scholastic achievement: A meta-analysis. *Psychological Bulletin*, 140, 1174–1204.
- **Example 2:** Differences between first- and second-generation immigrant students on academic achievement
  - Duong, M. T., Badaly, D., Liu, F. F., Schwartz, D., & McCarty, C. A. (2016). Generational differences in academic achievement among immigrant youths: A meta-analytic review. *Review of Educational Research*, 86, 3–41.

# SR Questions: Associations among constructs

- **Example:** Gardella, J. H. , Fisher, B. W., Teurbe-Tolon, A. R. (2017). A systematic review and meta-analysis of cyber-victimization and educational outcomes for adolescents. *Review of Educational Research, 87*, 83–308.
- This systematic review and meta-analysis estimates the association between cyber-victimization and academic outcomes in students aged 12–17.

# SR Questions: Associations among constructs (cont'd)

- Research questions in Gardella et al. (2017):
  - How does  $x_1$  relate to  $x_2$  for population  $z$ ? (direction and strength of correlation)
  - Variations on this theme (e.g., differences in relation of  $x_1$  and  $x_2$  between populations  $z_1$  and  $z_2$  )
  - Our example: Estimating the associations between peer cyber victimization (PCV) and educational outcomes among U.S. adolescents

# Summary: Types of SR Questions

- **Intervention effects:** Does program *A* have larger effects than treatment as usual?
- **Comparison of groups:** Does group *A* differ from group *B* on some outcome?
- **Associations between two constructs:** What is the strength and direction of the association between two constructs?
- **Diagnostic and prognostic tests:** Which test is more accurate at diagnosis? Which test is better at prediction?
- **Prevalence:** What is the prevalence of some phenomenon?

# Systematic reviews can vary in scope

- Specific, narrow questions
  - Useful for testing effects of specific treatments
- Broad, global questions
  - Useful for generating new knowledge
    - Identify common elements of effective programs.
    - Build better intervention theories to guide program development and evaluation design.

# Examples of Narrow and Broad Questions

- In the case of an intervention, we might be interested in understanding the use of a particular intervention such as Second Step, an intervention for developing socio-emotional skills in elementary school children—a narrow question.
- **A broader question:** What are the impacts of interventions that are focused on developing socio-emotional skills in elementary school children?
- The scope of the question will guide many aspects of the review.

# The SR question guides decisions in the review

- The critical characteristics of studies included in the review are guided by the systematic review question
  - Participants
  - Types of interventions, if applicable
  - Study design
  - Outcomes

# Problem formulation guides the study inclusion criteria: PICOS framework

- The **PICOS** framework:
  - Population/Participants (problems/conditions)
  - Interventions (if applicable)
  - Comparison group (e.g., absolute vs. relative effects, counterfactual conditions), if applicable
  - Outcomes (primary and secondary outcomes, acceptable outcome measures)
  - Study Design (should be fit for purpose) or Settings

# Example: Dietrichson et al. (2017)

- **P**: Low-income students in elementary and middle school
- **I**: Interventions explicitly aimed to improve educational achievement that could be implemented by schools
- **C**: Non-treatment, control condition
- **O**: Standardized academic tests
- **S**: Randomized controlled trial or controlled quasi-experimental study

# Summary: Problem Formulation

- As is true in any research study, the research question guides all other decisions made about methods in the study.
- Systematic review questions can involve questions about differences among groups, associations among constructs, prevalence.
- Systematic review questions vary in their scope:
  - Narrow questions about a particular intervention
  - Broad questions designed to understand a literature on a topic (IES Goal 1 questions)
- Systematic review is most productive when there is a large body of literature.
- The research question leads to PICOS—the inclusion criteria for studies eligible for the systematic review.

# Stages of a Systematic Review

1. Problem Formulation
2. Data Collection

# Data Collection: Searching the Literature

- **Goal:** Collect all primary studies examining the research question for the systematic review and that meet the inclusion criteria
- Unit for the SR: primary studies
- Generalizing to a hypothetical population of studies on a given research question
- **Realistic goal:** Use a search strategy that can support the argument that the SR has a representative sample of studies

Source: [Kugley et al. \(2017\)](#)

# Data Collection: Locating Studies

- Need both sensitive (broad) and specific (focused) searches
  - Google Scholar sensitive but not specific
  - Databases like ERIC more specific
- Use of keyword searches of multiple electronic databases—and knowledge of the keywords used in that database
- Search of multiple sources of grey literature (websites, dissertations, special registers, reference lists of included studies and reviews, listservs, personal contacts)
- Hand-searching of selected journals

# Databases to Search

- Important issues in disability research are multidisciplinary—researchers in education, health, medicine, psychology, sociology, and many other disciplines are interested in these questions.
- Systematic reviews in disability research need to search multiple databases to find all relevant studies.
- Appendix A in Campbell's information retrieval guide (Kugley et al.) provides a list of potential databases to consider.

# Search Strategies

- Generally, a search strategy to identify intervention studies will typically have three sets of terms: (1) the **condition of interest**, i.e., the population; (2) the **intervention(s)** evaluated; and (3) the **outcomes**.
- Each database may use different terms for the same phenomenon, so it is important to understand the concepts in each discipline.
- The formulation of search terms will include controlled vocabulary, keywords, Boolean operators and limiters.
- Consult Campbell's information retrieval guide (Kugley et al., 2017) for more details <https://www.campbellcollaboration.org/library/searching-for-studies-information-retrieval-guide-campbell-reviews.html>

## Appendix A. ERIC Search Example

(Prevention AND "Sexual violence" AND Experiment\*) OR  
(Prevention AND "Sexual violence" AND Quasi-Experiment\*) OR  
(Prevention AND "Sexual coercion" AND Experiment\*) OR  
(Prevention AND "Sexual coercion" AND Quasi-Experiment\*) OR  
(Prevention AND "Peer support" AND Quasi-Experiment\*) OR  
(Prevention AND "Intimate Partner violence" AND Experiment\*) OR  
(Prevention AND "Intimate Partner violence" AND Quasi-Experiment\*) OR  
(Prevention AND "Bystander" AND Experiment\*) OR  
(Prevention AND "Bystander" AND Quasi-Experiment\*) OR  
(Prevention AND "Dating Violence" AND Experiment\*) OR  
(Prevention AND "Dating Violence" AND Quasi-Experiment\*) OR  
(Prevention AND "Physical Violence" AND Experiment\*) OR  
(Prevention AND "Physical Violence" AND Quasi-Experiment\*) OR  
(Prevention AND "Dating Aggression" AND Experiment\*) OR  
(Prevention AND "Dating Aggression" AND Quasi-Experiment\*) OR

(Intervention AND "Sexual violence" AND Experiment\*) OR  
(Intervention AND "Sexual violence" AND Quasi-Experiment\*) OR  
(Intervention AND "Sexual coercion" AND Experiment\*) OR  
(Intervention AND "Sexual coercion" AND Quasi-Experiment\*) OR  
(Intervention AND "Peer support" AND Quasi-Experiment\*) OR  
(Intervention AND "Intimate Partner violence" AND Experiment\*) OR  
(Intervention AND "Intimate Partner violence" AND Quasi-Experiment\*) OR  
(Intervention AND "Bystander" AND Experiment\*) OR  
(Intervention AND "Bystander" AND Quasi-Experiment\*) OR  
(Intervention AND "Dating Violence" AND Experiment\*) OR  
(Intervention AND "Dating Violence" AND Quasi-Experiment\*) OR  
(Intervention AND "Physical Violence" AND Experiment\*) OR  
(Intervention AND "Physical Violence" AND Quasi-Experiment\*) OR

# Example of a search strategy: De La Rue et al. (2014)



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# Data Collection: Searching the Literature

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Best Advice: **Get a librarian**

# Data Collection: Issues to Consider

- Need methods to document the process from start to finish
  - All information sources searched; dates covered in search and date of search
  - Full electronic search strategy including limits and keywords for replication of search
- Searching may be an iterative process while defining key concepts and discovering appropriate search terms
- Use of software to manage the process ([Endnote](#), [RefWorks](#), [Zotero](#))

# Zotero example: <https://www.zotero.org/>

The screenshot shows a Primo search result page. At the top, the browser address bar displays the URL: [https://loyola-primo.hosted.exlibrisgroup.com/primo-explore/fulldisplay?docid=TN\\_sage\\_s10\\_3102\\_003465431668...](https://loyola-primo.hosted.exlibrisgroup.com/primo-explore/fulldisplay?docid=TN_sage_s10_3102_003465431668...). The page header includes navigation links for 'olarOne Manus...', 'Business Intelligenc...', 'ScholarOne Manus...', 'Log In | Wix', 'Loyola University C...', 'RRE email', and 'Office of Research...'. A yellow circle highlights a blue icon in the top right corner, likely representing a Zotero integration or a specific document type.

The main content area features a blue cover image for the journal 'REVIEW OF EDUCATIONAL RESEARCH'. To the right of the image, the article title is displayed in bold: 'Academic Interventions for Elementary and Middle School Students With Low Socioeconomic Status: A Systematic Review and Meta-Analysis'. Below the title, the authors are listed: 'Dietrichson, Jens ; Bøg, Martin ; Filges, Trine ; Klint Jørgensen, Anne-Marie'. The publication information is: 'Review of Educational Research, April 2017, Vol.87(2), pp.243-282'. A 'PEER REVIEWED' badge is visible below the authors.

On the left side of the article, there are navigation options: 'TOP', 'SAVE OR CITE', and 'VIEW IT'. In the center, there are two main action buttons: 'Download PDF' and 'View Issue Contents', both with external link icons. To the right of these buttons, a green link says 'Full text available >'. On the right side of the page, there is a 'Related' section with a 'Tertiary in rural A' article by David Cu, 'Educatio Vol. 21(2)', and 'ARTICLE S'.

# Zotero example (continued)

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- Direct Export in RIS Format (e.g. CITAVI, EasyBib, EndNote, ProCite, Reference Manager, Zotero)
- Direct Export to EndNote Web
- Generic bibliographic management software

# Data Collection: Summary

- Importance of the information retrieval/search process
  - Not a “one-shot” deal—usually involves several iterations of searches
  - Requires expertise in the planning and implementation of searches
  - Should consult with a librarian/search specialist
- Use of bibliographic management software to store, manage, and organize results
- Documentation of all steps so that search can be replicated

# Stages of a Systematic Review

1. Problem Formulation
2. Data Collection
3. Data Evaluation

# Data Evaluation: Screening and Coding

- Once a search is “completed,” the next steps are
  - To identify the studies that meet inclusion criteria
  - To code information from included studies to use in the systematic review and meta-analysis

# Data Evaluation: Screening of Titles and Abstracts

- Screening for relevant studies usually takes place in two waves.
  - Screening based on reading titles and abstracts
  - Used to exclude obviously irrelevant articles, such as opinion pieces or nonempirical studies
  - Titles and abstracts are notoriously unreliable, so first screening tends to exclude nonempirical studies
  - Best practice to double-code using two trained raters working independently
  - Machine learning strategies for screening ([Abstrackr](#))

# Center for Evidence Synthesis in Health at Brown University

## Abstrackr



Software for (semi-automated?!) abstract screening for systematic reviews. At present, *abstrackr* is a free, open-source tool for facilitating the citation screening process. Upload your abstracts, invite reviewers, and get to screening!

We are currently integrating machine learning technologies to semi-automate the screening process. Already, *abstrackr* will prioritize the screening of those articles most likely relevant to the review at hand. In the near-future, it will screen out irrelevant citations for you, automagically.

[The tool.](#)

[The source code.](#)

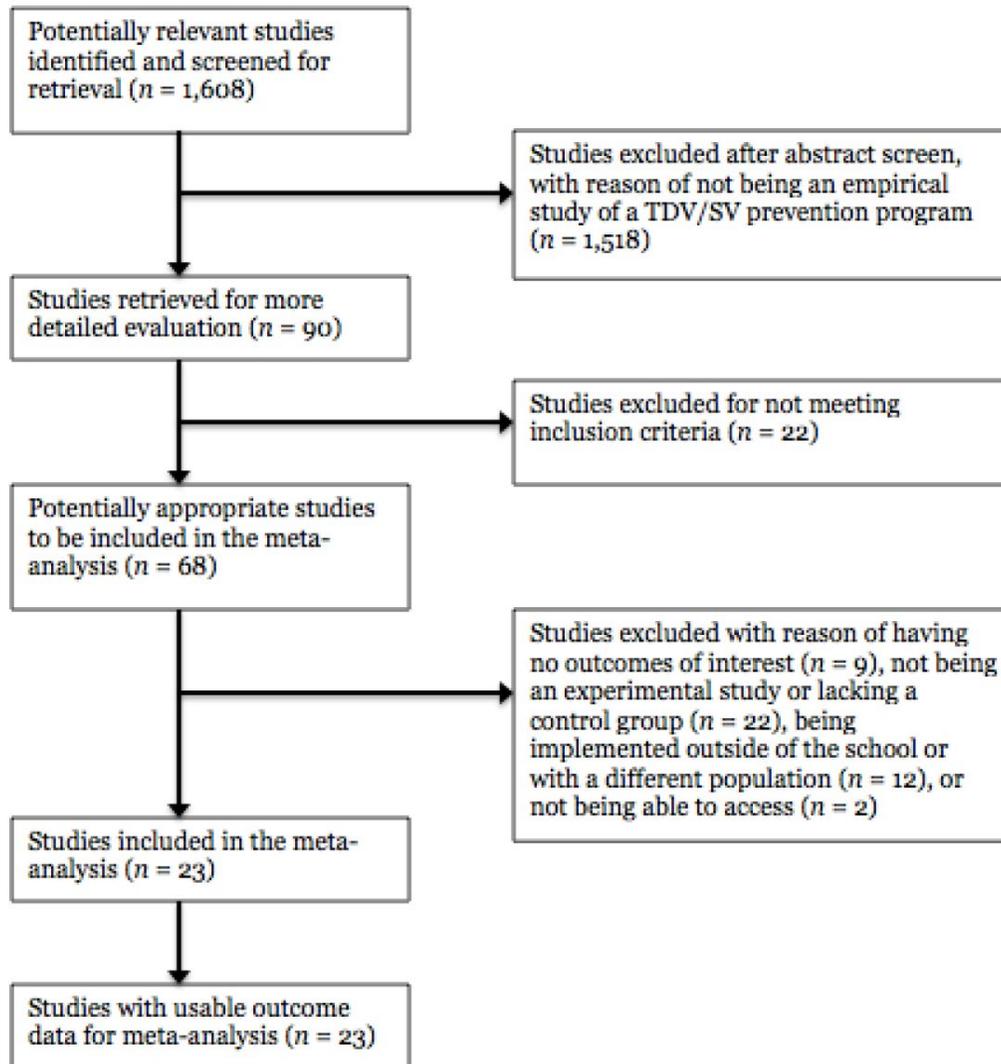
# Typical Numbers of Studies Located in Initial Searches

Review	Initial Number of Studies	Number After First Screening
Dietrichson et al. (2017)	11,807	1,137
Duong et al. (2016)	1,478	238
Gardella et al. (2017)	6,378	508
Littell et al. (2005)	5,290	266
Voyer et al. (2014)	17,307	Unclear

# Data Evaluation: Full-Text Eligibility Screening

- After initial screening of titles and abstracts, move on to screening full texts of potentially eligible studies
- Reviewers develop list of inclusion and/or exclusion criteria based on SR research question following PICOS
- Studies are screened with an accounting of ineligible studies and the reasons for their exclusion
- Best practice: blind, double-coding
- Recruitment and training of coders important

# Data Evaluation: PRISMA Flowchart



You can find the PRISMA guidelines here:  
<http://www.prisma-statement.org/>

# Data Evaluation: Coding

- With complete set of eligible studies, next step is coding study content and effect sizes
- Develop a coding manual that includes:
  - Setting, study context, authors, publication date, and type
  - Methods and method quality
  - Program/Intervention and comparisons
  - Participants/Clients/Sample
  - Outcomes
  - Findings, effect sizes

# Example: Coding Manual

## ***Section C – Sample & Program Characteristics***

### *Treatment Sample & Program Characteristics*

CO1. What was the SES of the students in the sample?

(Please indicate, with a 1, all that apply).

1. Low SES
2. Low-middle SES
3. Middle SES
4. Middle-upper SES
5. Upper SES
6. Only labeled as “mixed”
9. Can't tell

*Dependent measure (separate for each measure)*

E04. What does the outcome measure?

- 1- Teen dating violence knowledge
- 2- Teen dating violence attitude
- 3- Sexual violence knowledge
- 4- Sexual violence attitude
- 5- Rape construct (awareness, myths, etc.)
- 6- Bystander awareness
- 7- Other (specify)

E05. How was the outcome measure reported?

- 1- Self-report
- 2- Teacher report
- 3- Administrator report
- 4- Other (specify)

Source: De La Rue et al. (2014). C01, p. 38; E04 and E05, p. 42.

# Data Evaluation: Coding Rationale

- Provide descriptive detail of studies included in systematic review
  - To understand the “landscape” of the evidence base
  - To identify gaps or issues in the evidence base
- Record information about study effects and methods to explain differences in effect size

# Coding of Study Quality

- Variety of options for coding study methods
  - Cochrane risk of bias framework
  - GRADE system
  - Method quality checklists
  - Direct coding of methodological characteristics
- Used in meta-analysis to examine how results differ by study quality

# Cochrane Risk of Bias Framework 1.0 (for RCTs)

Table 8.4.a: A common classification scheme for bias

Type of bias	Description	Relevant domains in the Collaboration's 'Risk of bias' tool
Selection bias.	Systematic differences between baseline characteristics of the groups that are compared.	<ul style="list-style-type: none"> <li>• Sequence generation.</li> <li>• Allocation concealment.</li> </ul>
Performance bias.	Systematic differences between groups in the care that is provided, or in exposure to factors other than the interventions of interest.	<ul style="list-style-type: none"> <li>• Blinding of participants and personnel.</li> <li>• Other potential threats to validity.</li> </ul>
Detection bias.	Systematic differences between groups in how outcomes are determined.	<ul style="list-style-type: none"> <li>• Blinding of outcome assessment.</li> <li>• Other potential threats to validity.</li> </ul>
Attrition bias.	Systematic differences between groups in withdrawals from a study.	<ul style="list-style-type: none"> <li>• Incomplete outcome data</li> </ul>
Reporting bias.	Systematic differences between reported and unreported findings.	<ul style="list-style-type: none"> <li>• Selective outcome reporting (see also Chapter 10).</li> </ul>

## Table 8.4.a

Source: Higgins & Green, 2011

# Newcastle-Ottawa Scale (NOS) for Non-randomized Studies

- Focuses on quality assessment for case-control and cohort studies
- Assesses selection of the experimental groups and the comparability of the groups
- For case-control studies, assesses exposure to treatment
- For cohort studies, assesses outcomes

Source: Wells et al. (n.d.)

[http://www.ohri.ca/programs/clinical\\_epidemiology/oxford.asp](http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp)

# Coding: Issues to Consider

- Reviewers develop coding manuals for reviews
- The most time-intensive portion of a systematic review
- Best practice: Use of software to conduct and organize coding
  - Database software such as Access or FileMaker
  - Spreadsheets such as Excel or Google Sheets
- Attention to training of coders, double-coding, recording of reliability of coding decisions

# Common Challenges in Data Evaluation Stage

- Underestimating the time needed to prepare and code studies
- Assuming that developing a coding protocol is not an iterative process (it is!)
- Coding drift—important to check that all coders are interpreting the items the same way
- Organizing and supervising coding process
  - Personnel issues
  - Appropriate software

# Stages of a Systematic Review

1. Problem Formulation
2. Data Collection
3. Data Evaluation
4. Data Analysis and Interpretation

# Data Analysis

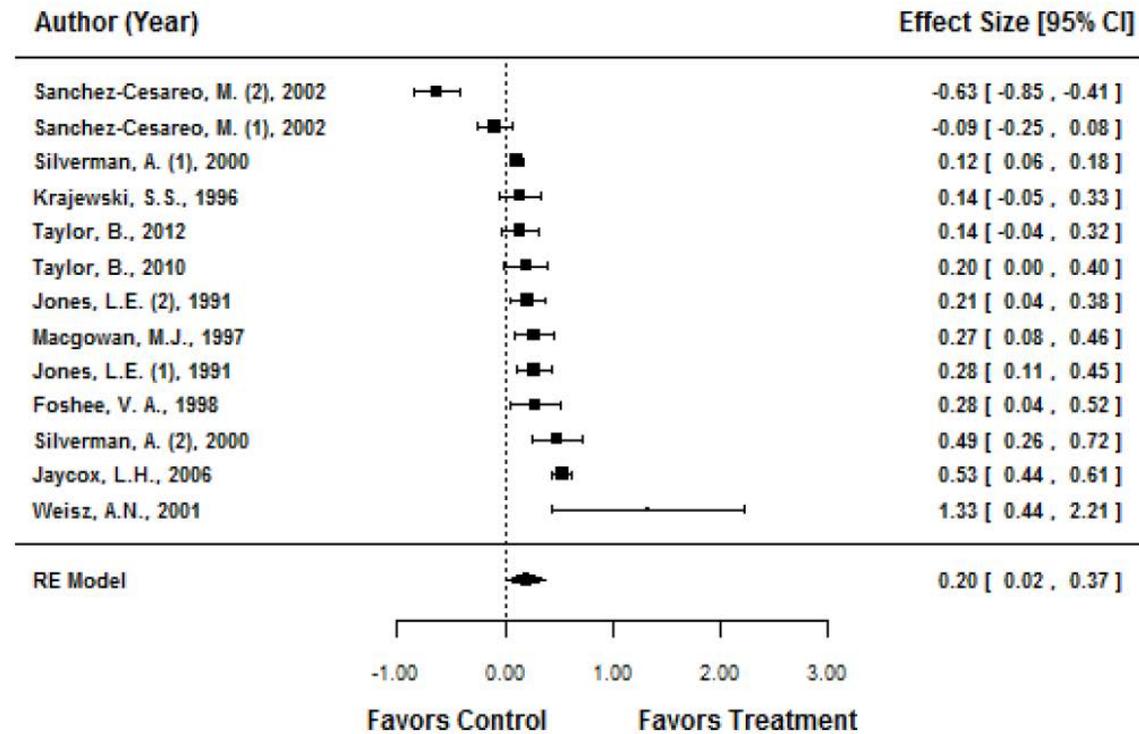
- Once eligible studies are coded, the analysis consists of two stages:
    1. Description of the studies included, usually in narrative and table form
    2. Meta-analysis of effect sizes, when possible
      - Examination of the average effect size and its confidence interval
      - Exploration of heterogeneity of study results
- (Narrative discussion of study results if meta-analysis is not possible.)

# Data Analysis: Effect Sizes

- In a meta-analysis, we express the results of each study using a quantitative index of effect size (ES).
- ES is a measure of the strength or magnitude of a relationship of interest.
- ESs have the advantage of being comparable (i.e., they estimate the same thing) across all of the studies and therefore can be summarized across studies in the meta-analysis.
- *NOTE: Session 5 on “Effect Size and Meta-Analysis” is scheduled for June 19, 2019.*

# Forest Plot: Teen Dating Violence Knowledge

## 9.2.1 Teen Dating Violence Knowledge



Source: De La Rue et al. (2014), p. 89.

Notes: Study-level effect sizes and 95% confidence intervals; Positive effect sizes indicate knowledge improvement for the treatment group.

# Data Analysis: Examining Heterogeneity

- As in any statistical analysis, the mean and its associated standard error may not be the best descriptive statistic for a distribution of data.
- In education, we expect that study results will vary.
- An important part of any meta-analysis is examining the amount of heterogeneity among effects.

# Data Analysis: Exploring Heterogeneity

- With a sufficient number of studies, we can explore potential correlates of heterogeneity among effect sizes.
- With one categorical predictor, can use simple, one-way ANOVA models.
- With multiple predictors, can use meta-regression.
- Common predictor of heterogeneity: study quality.

# Example: Sensitivity of Results to Study Quality

**TABLE 4.6: MODERATOR ANALYSIS USING METHOD OF ASSIGNMENT TO CONDITION FOR ALL OUTCOMES FOR EACH TYPE OF EFFECT**

	Immediate Post-test		Follow-Up	
	Random Assignment	Non-random Assignment	Random Assignment	Non-random Assignment
Teen Dating Violence Knowledge	.36** (.13, .59)	.09 (-.12, .30)	.24 (-.45, .93)	-.13 (-.72, .45)
Teen Dating Violence Attitudes	.12** (.06, .18)	.19** (.11, .29)	.13 (-.02, .27)	-.09 (-.19, .38)
Rape Myth Awareness	-.46** (-.78, -.15)	-.52 (-1.09, .05)	NA	NA

Source: De La Rue et al. (2014), p. 45.

# Common Challenges in Effect Size Computation and Synthesis

- Missing data in primary studies for computing effect sizes, particularly in older studies
- Appropriate effect sizes for complex designs in primary studies, i.e., clustered RCTs, regression models
- Combining effect sizes from different metrics
- Multiple effect sizes within studies: dependent effect sizes
- Often need to consult with a meta-analysis specialist

# Summary: Data Analysis and Interpretation

- **Not** the most time-intensive part of the systematic review
- Exploration of heterogeneity of greatest importance
  - Expect variation in effects across studies
  - Careful planning for moderator analysis, both in coding stage and in analysis
- Care needed in interpretation of these exploratory results
- Rapid development of statistical methods may require consultation with a statistician

# Narrative Synthesis

- Narrative synthesis methods may be needed when
  - There are few or no studies identified for the review.
  - The review question is focused on configuration rather than aggregation.
- Narrative and qualitative synthesis methods exist and also use transparent and replicable methods.
- Campbell is beginning to develop standards for these types of reviews.

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# Thank you!

*Please take a few minutes to respond to the brief Evaluation Survey:*

<https://www.surveymzmo.com/s3/4866082/Evaluation-Steps-Campbell-SR>

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