Meta-Analysis

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Meta-analysis is…

A. A rigorous method for objectively combining the results of many different studies to arrive at a better estimate of "truth"

B. The greatest boon to humanity since the invention of the double bed

C. A way of combining the results of many inadequate studies to arrive at an inadequate answer

D. A new growth industry, allowing people to build up their CVs

E. All of the above

Objectives

- To learn more about meta-analyses
  - The rationale
  - A soupçon of history
  - Embarking on a 12-step program

Rationale

- Two main sources:
  - Dissatisfaction with conventional review articles and chapters
    - Possibility of bias
    - Incompleteness
  - Articles with conflicting findings

A Bit of History

- Before meta-analysis:
  - Subjective interpretations
  - "Vote counting"
- First meta-analysis
  - Smith ML and Glass GV. 1977. "Meta-analysis of psychotherapy outcome studies." *American Psychologist;* 32: 752-760.

Growth in Meta-Analyses
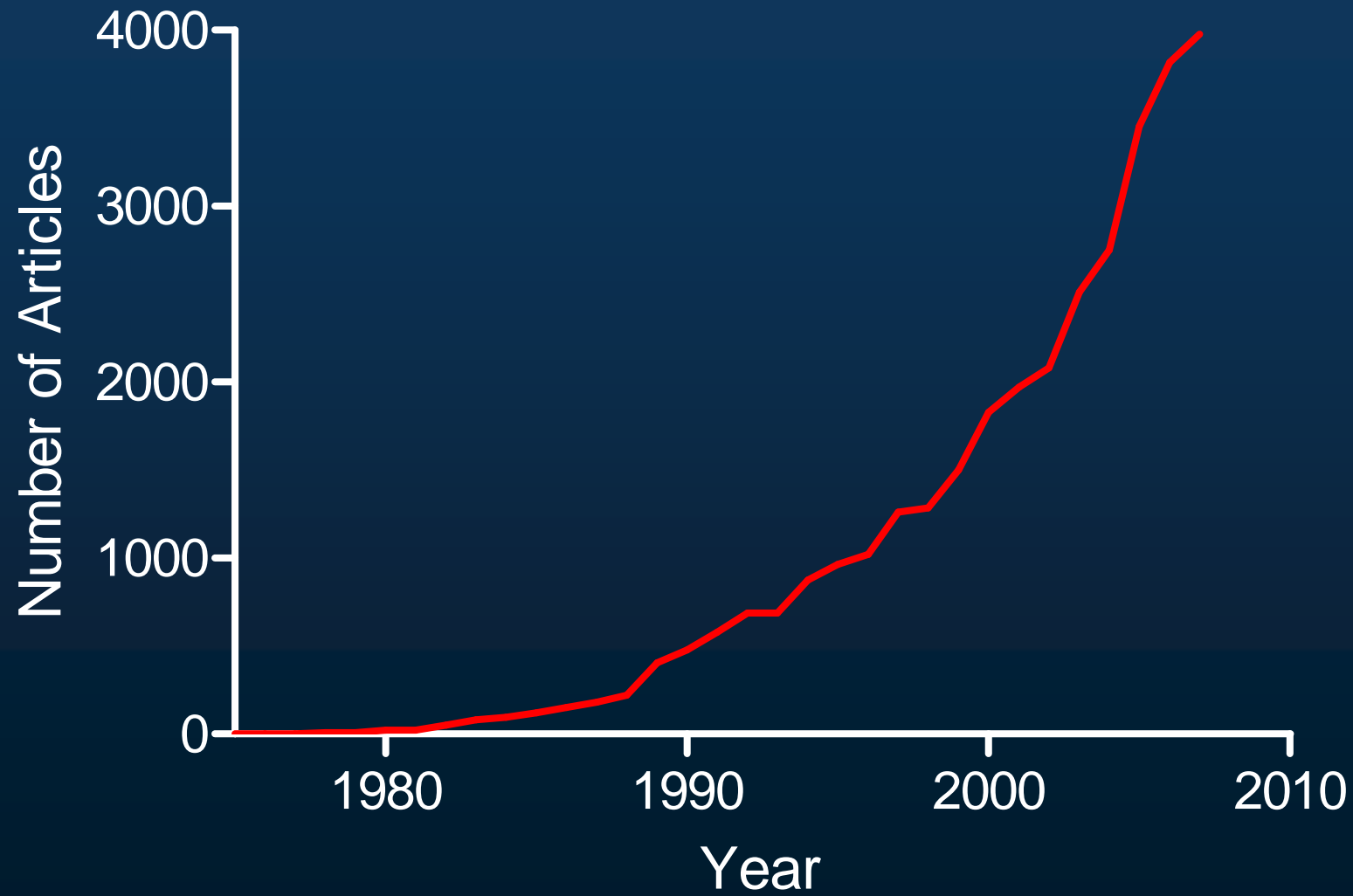
Meta-Analysis:
A 12-Step Program

1. How Was The Question Defined?

- Question should include:
  - Specific intervention
  - Target population
  - Definite outcome

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- Poor question:

  "How can I reduce the number of accidents in hospital?"

- Better question:

  "Does a balance training program provided by occupational therapists reduce the number of falls among mildly demented patients in a complex continuing care setting?"

1. How Was The Question Defined?

- **The trade-off:**
  - Too broad a search may produce many dissimilar studies
  - Too narrow a search may produce nothing

2. What Were The Selection Criteria?

- Criteria spelled out before search
- Should focus on:
  - Population
  - Methods
  - Interventions
- Should *not* use outcome as a criterion

3. How Was The Search Done?

- Much easier now, but…
  - Shouldn't be limited to any one database (such as Medline, PsycINFO, EMBase, CINAHL)
  - Many articles will still be missed
  - Publication bias
    - Submitting negative findings
    - Publishing negative findings

3. How Was The Search Done?

- Should be supplemented by:
  - Hand searching
  - Checking reference lists
  - Checking Cochrane and Campbell databases
  - Writing to authors

4. How Were The Articles Selected?

- *Must* have been selected using content and methodological criteria

- No suspicion of having been chosen because of results

- Ideally, two independent raters of each article

- Avoidance of duplicate publications

5. How Were The Articles Appraised?

- Internal consistency (how well was the study done?)
  - Drop-outs
  - Outcome measures
  - Matching of groups
  - Fidelity of intervention
  - Blinding of raters
  - Proper data analysis

5. How Were The Articles Appraised?

- **External validity (can the results be generalized?)**
  - Strictness of inclusion/exclusion criteria
 - Applicability of intervention in home setting

6. How Were They Abstracted?

- Should be done by independent raters
- Completeness of data
  - Only 13 percent of reviewed articles included final sample size, means, and SDs (Streiner *et al.*, 1998)

7. How Were ESs Calculated?

- Ideally based on continuous data (such as means, proportions)
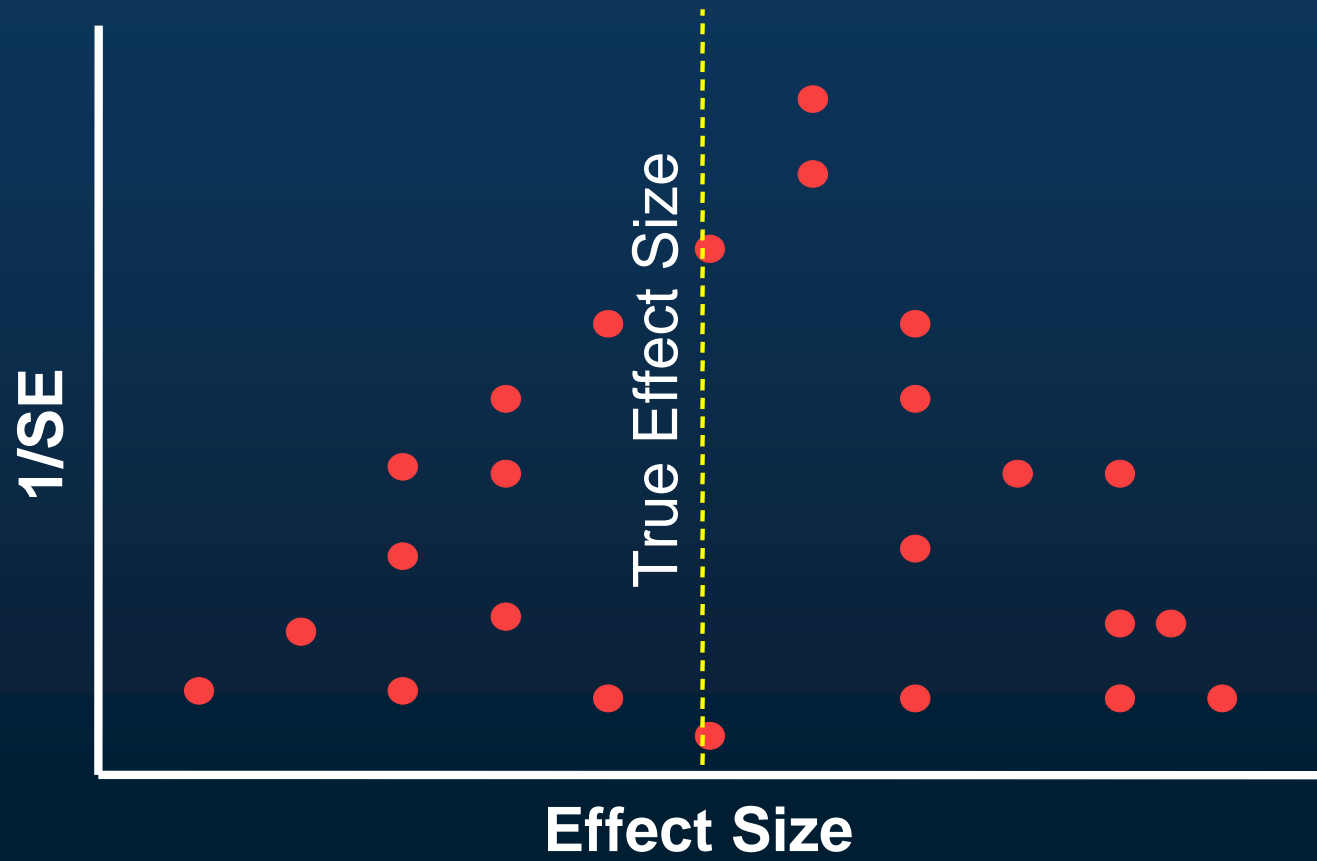- For dichotomous outcomes, usual to use log OR or log RR
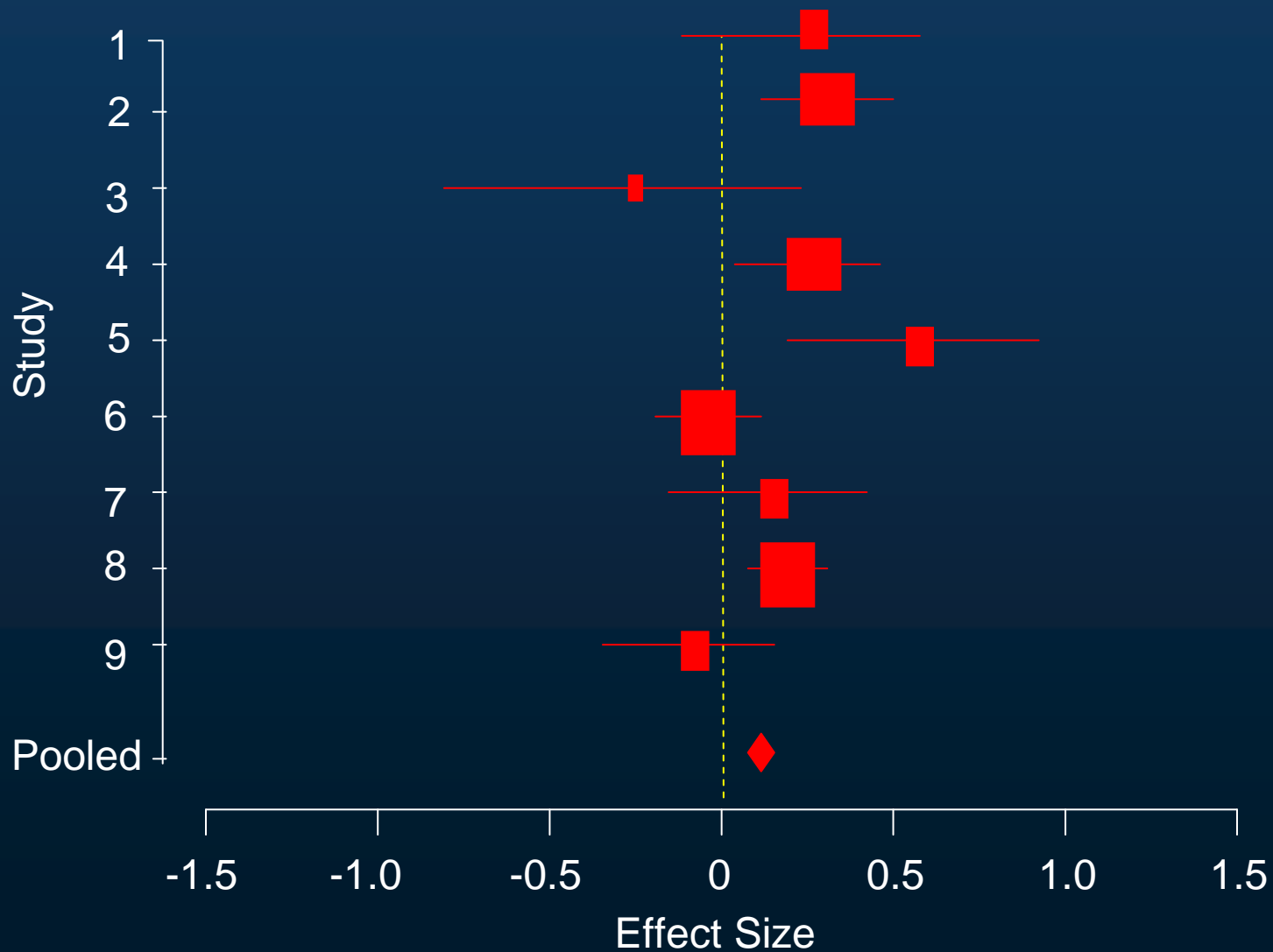
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- Should calculate "file drawer" number
- Should do funnel plot
  - Assume a "true" ES
  - As sample size increases, estimates of ES should be within narrower range

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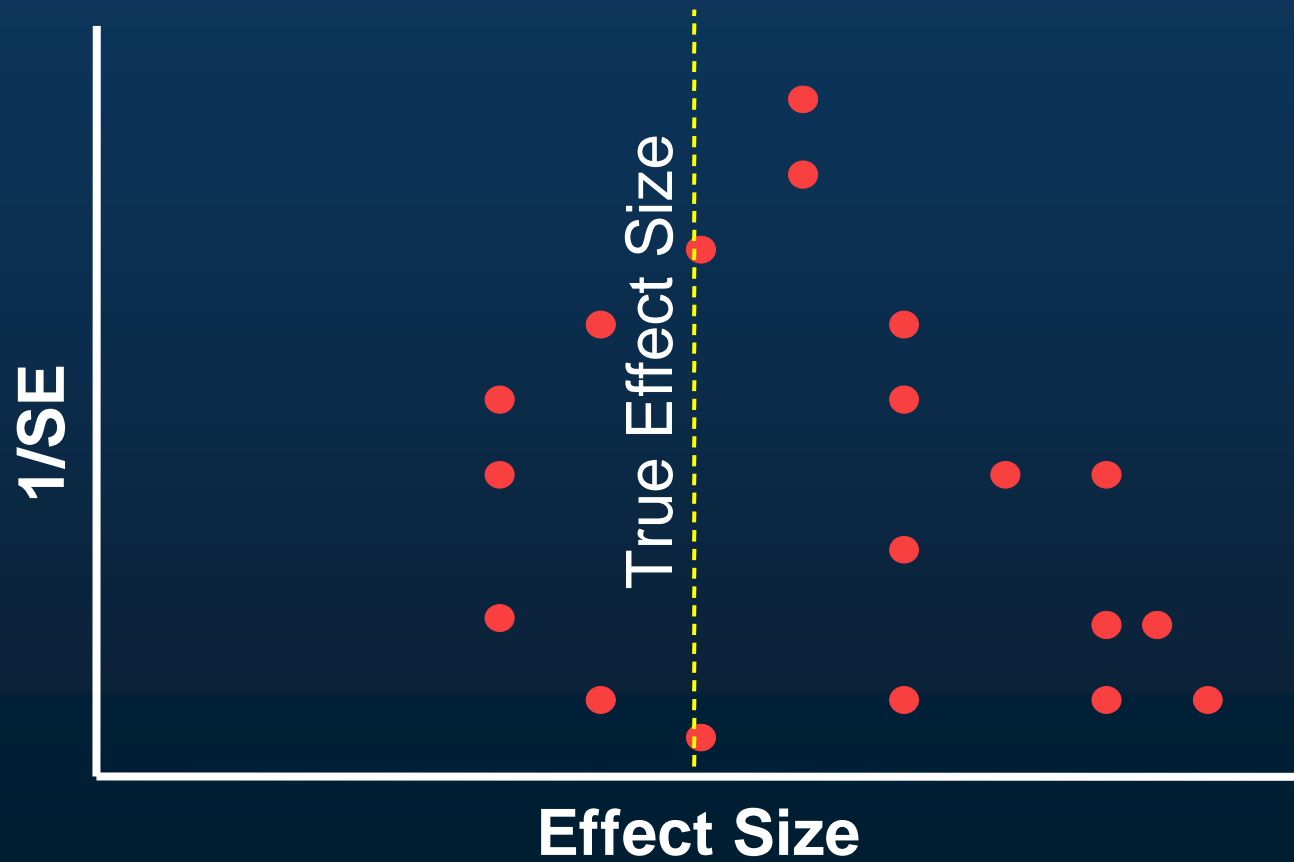 - If publication bias, funnel truncated where small ESs should be

Meta-Analysis versus Systematic Reviews

- If we stop here, we've done a *systematic review*
  - Set criteria *a priori* for inclusion/exclusion
  - Thorough search for articles
  - Abstraction of articles
  - Calculation of ESs

Meta-Analysis versus Systematic Reviews

- In the next steps, we go on to do a *meta-analysis:*
  - Combine the ESs mathematically
  - Come up with an overall measure of effect

9. How Similar Were The ESs?

- If dissimilar ("heterogeneous"), may be trying to compare apples with oranges
- No consensus regarding what to do about it:
  – Eliminate heterogeneous studies
  – Analyse to determine reasons for heterogeneity

10. How Were ESs Combined?

- Easiest is to use average of all ESs
  - Gives equal weight to large and small studies, good and bad studies
- Better to weight each study
  - Usually weighted by sample size or reciprocal of squared standard error
  - Sometimes weighted by methodology score

11. Influential Factors?

- Did the authors look to see what may have affected the magnitude of the ESs?
  - Characteristics of the sample
  - Elements of the intervention
  - Methodology of the study

12. How Were Data Analysed?

- **Fixed effects model**
  - Used to draw conclusions about this particular set of articles
  - Yields more significant results
  - Usually inappropriate
- **Random effects model**
  - Can generalize results
  - Smaller effects
  - Usually right approach

Summary

- Can be very powerful tool for synthesizing literature
- Do not eliminate need for judgment and decision-making
- As with all tools, use judiciously