

Meta-Analysis with Effect Sizes

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What is Meta-Analysis?

The summary of results across studies...
or more specifically:

“The systematic, quantitative review of published research in a particular field”

(Marsh et al. 2008)

- e.g. review of the effects of cognitive behavioural therapy on adolescent depression
- e.g. review of the extent of psychological changes at school transfer

Examples of Meta-Analysis

Kling, Kristen C., Shibley Hyde, Janet, Showers, Carolin J. & Buswell, Brenda (1999) Gender Differences in Self-Esteem: A Meta-Analysis, *Psychological Bulletin*, Vol.125(4), 470-500

Aim To examine gender differences in global self-esteem.

Method Systematic literature review finds 184 articles for analysis. Within these are 216 effect sizes, representing the testing of 97,121 respondents.

Findings The overall effect size was 0.21, a small difference favoring males. A significant quadratic effect of age indicated that the largest effect emerged in late adolescence ($d = 0.33$).

Kling, Kristen C., Shibley Hyde, Janet, Showers, Carolin J. & Buswell, Brenda (1999)
 Gender Differences in Self-Esteem: A Meta-Analysis, *Psychological Bulletin*,
 Vol.125(4), p.485

Table 4
Magnitude of Gender Differences as a Function of Country

Country	<i>k</i>	<i>d</i>	95% confidence interval for <i>d</i>	<i>H</i>
United States	143	0.17	0.16 to 0.19	397*
Australia	22	0.24	0.21 to 0.27	75*
Canada	18	0.24	0.20 to 0.29	31*
Norway	6	0.24	0.16 to 0.32	14*
Miscellaneous	27	0.31	0.27 to 0.35	65*

Note. *k* represents the number of effect sizes; *H* is the within-groups homogeneity statistic (Hedges & Becker, 1986).

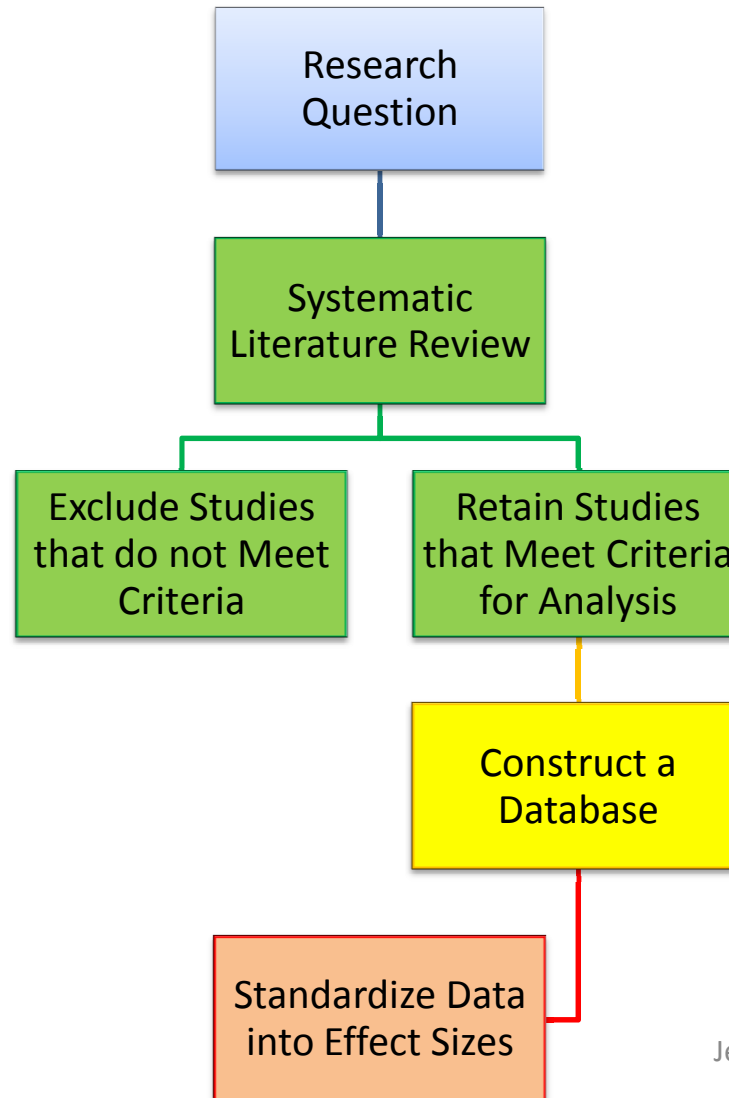
* Significant nonhomogeneity at $p < .05$, according to chi-square test.

What types of findings can Meta-Analysis produce?

- **Generalisability** of a phenomenon given certain conditions
 - e.g. decline in self-esteem *when transferring schools* is found internationally and across time *for girls*
- **Patterns and trends** in phenomena
 - e.g. self-esteem *declines* at school transfer whilst academic motivation *increases*
- **Variance** in a phenomenon
 - *No trends* are found in academic self-concept at transfer
- **Extent of influence** of certain conditions on the phenomenon
 - e.g. induction days (the 'intervention') have *a weak but positive effect* on reducing anxiety at transfer

How is it done?

The Meta-Analytic Process (with effect sizes)



Research Question

Generalisability

Do gender differences in self-esteem persist across countries?

Patterns and trends

Does self-esteem decline at school transfer at different ages?

Variance

How similar are the effects of CBT interventions on self-esteem under different conditions?

Extent of influence

What is the overall effectiveness of CBT interventions on self-esteem?

Systematic Literature Review

- Develops **inclusion criteria** for studies to be included in the review
 - i.e. must focus on the use of a *controlled CBT intervention* to reduce *aggression* in *boys aged 9-14*
- Uses select **key words** to search for abstracts
 - i.e. *CBT, aggression, adolescence*
- Several steps in **inclusion process**:
 - Scan abstracts (105 studies included, 25 excluded)
 - Closer review of studies (75 included, 30 excluded)
 - Identification of usable data (15 included, 50 excluded)

Systematic Literature Review

- Reports systematically on studies retained for analysis

Final Studies Used in Meta-Analysis				Data Gathering Time Points					
				Elementary School			Middle School or Junior High School		
Reference	Date	Sample	Age	Term 1	Term 2	Term 3	Term 1	Term 2	Term 3
Hirsch & Rapkin	1987	159	12.5			✓	✓	✓	
Feldlaufer & Midgley	1988	2,210	12.5	✓		✓	✓		✓
Midgley et al.	1989	1,329	12.5	✓		✓	✓		✓
Crockett et al.	1989	181	11.5	✓	✓		✓	✓	
Seidman et al.	1994	863	9-13			✓			✓
Chung et al.	1998	99	11.5			✓	✓		
Fenzel	2000	116	11.5			✓	✓	✓	
Rudolph et al.	2001	329	11.5			✓	✓		
Cantin & Boivin	2004	142	12.5			✓	✓		✓
Wargo-Aikins et al.	2005	111	12.5		✓			✓	
Symonds with Vida & Eccles	2008	2,263	12.5	✓		✓	✓		✓
			Total n.						
			7949						
			Av.						
			12.5						

Construct a Database

- Log data on studies into Excel or SPSS (or EndNote)

Study	Age Group	Length of Intervention	Control Sample	Experimental Sample
Gibbons 2002	9.5-10.5	6 weeks	n. 142	n.100
Frank 2001	11.0-12.5	12 weeks	n.35	n.37

Self-Esteem Mean Time 1	Standard Deviation	Self-Esteem Mean Time 2	Standard Deviation
23.49	4.56	24.58	4.37
10.24	2.23	10.52	2.23

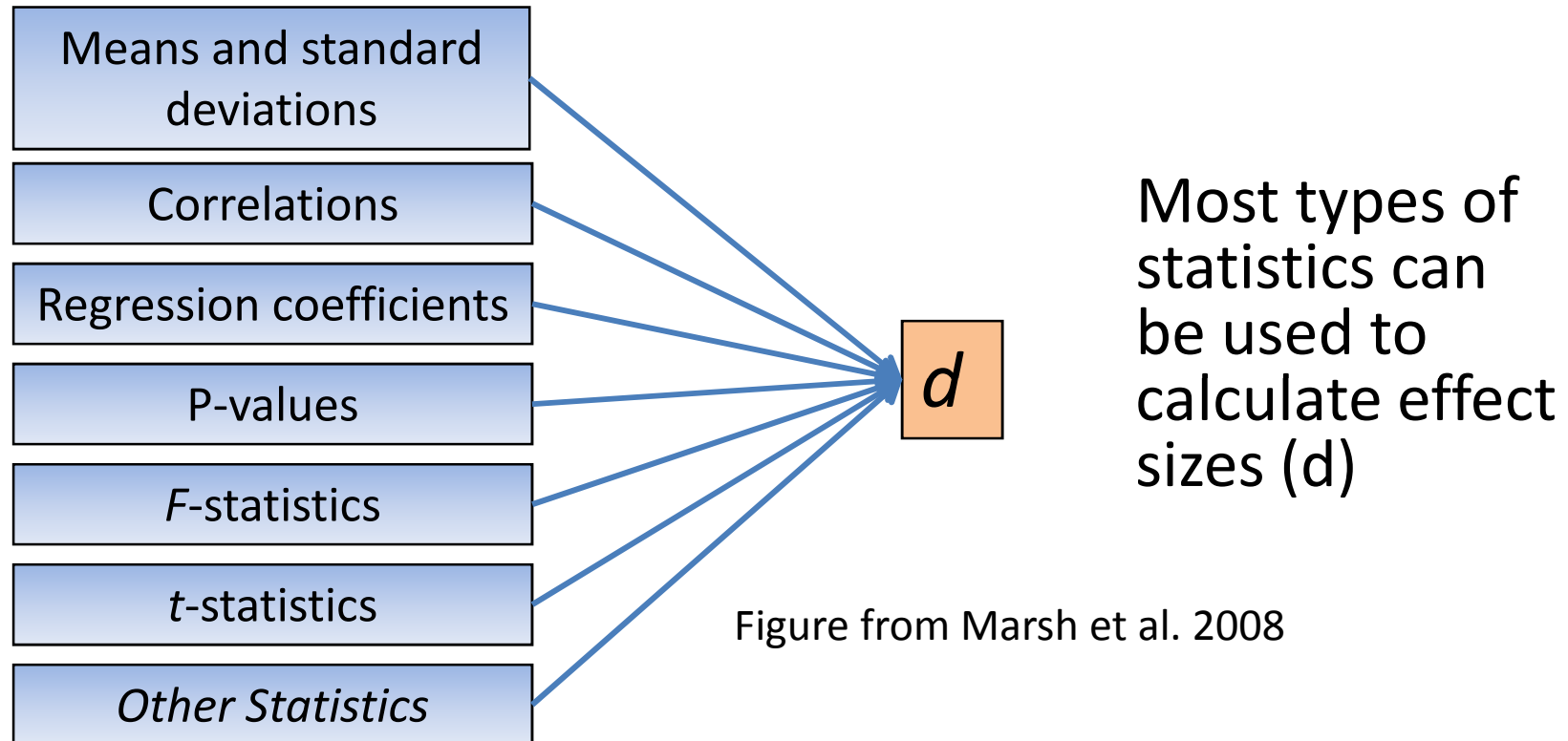
Standardize Data into Effect Sizes

An effect size is:

- A standardized unit of measurement between two conditions that:
 - focuses on a dependent variable (outcome)
 - is based on a continuous measure (i.e. self-esteem)
 - is independent of sample size
 - shows the magnitude and direction of effect between the conditions

e.g. measures the difference in a dependent continuous variable (i.e. self-esteem) between genders, schools, time points of study, treatment vs. non-treatment groups etc.

Calculating Effect Sizes



Statistics should measure 'the same aspect' of the phenomenon (i.e. change across time, gender differences etc)

Mean Values Effect Size Calculation

Study	Sample One	Mean One	SD One	Sample Two	Mean Two	SD Two	Effect Size
1	33	3.45	0.24	34	3.46	0.35	0.01 Negligible
2	150	13.57	4.56	270	14.04	4.60	0.24 Small
3	46	10.01	3.46	46	10.37	3.47	0.22 Small
4	79	0.45	0.02	37	0.92	0.02	0.43 Medium

Total Sample	Average Effect	Lower Bound	Upper Bound
387	0.13	0.01	0.43

Examples of Meta-Analysis

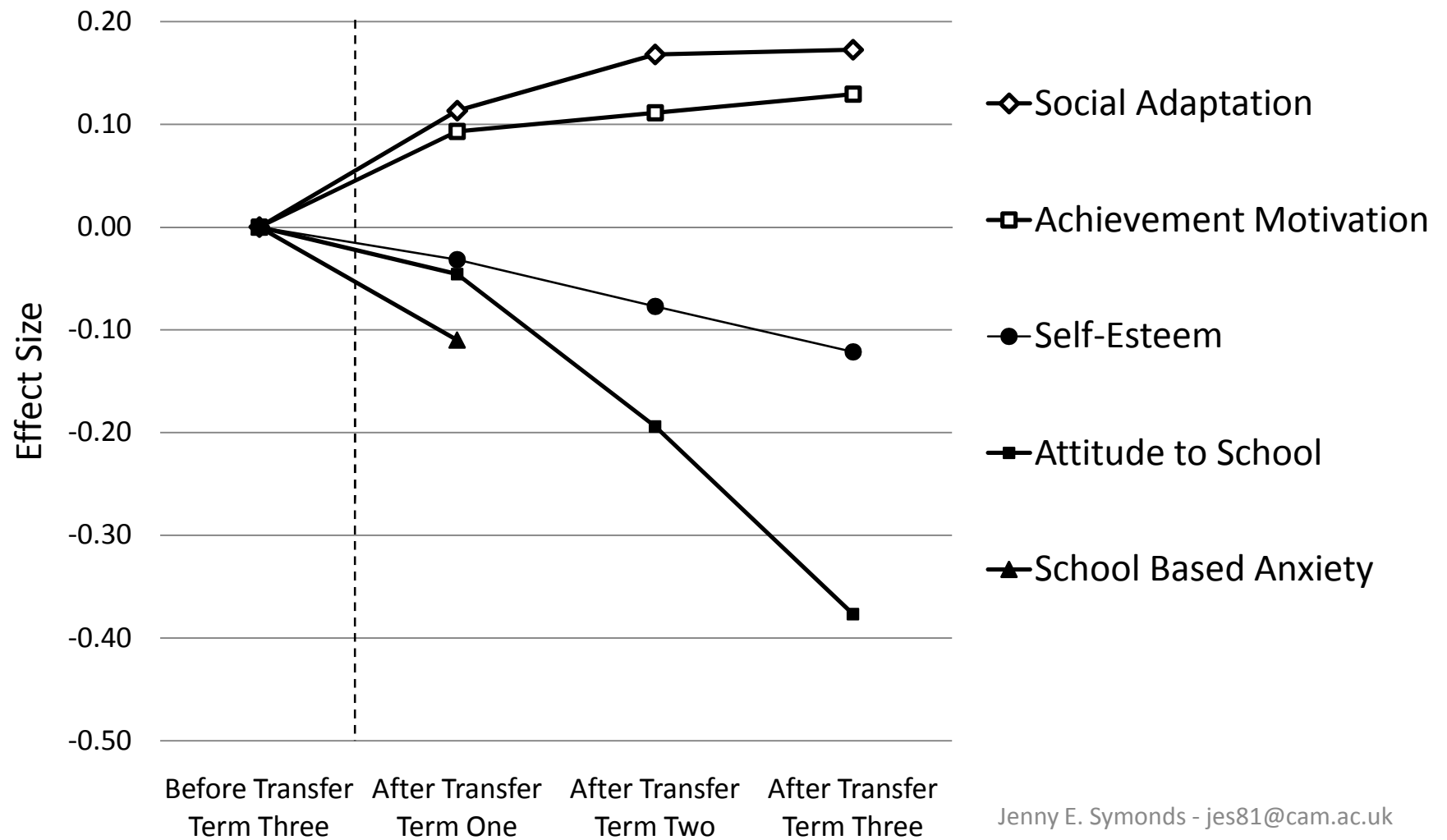
Symonds, Jenny E. & Galton, Maurice (to be submitted), Changing Schools: Five decades of research on school transition and transfer

Aim To examine psychological and behavioural changes in early adolescence when pupils change schools

Method Systematic literature review yields 170 studies of psychological changes. Seventeen of these measure change across a range of domains (e.g. self-esteem, achievement). Effect sizes are computed for each domain to show trends.

Findings Apparent trends were declining self-esteem and attitude to school and to subjects, increasing motivation and social adaptation, a loss of anxiety post-transfer and a rise in maladaptive behaviours. These trends were consistent internationally and through time (1977-2008)

Symonds, Jenny E. & Galton, Maurice (to be submitted), Changing Schools:
Five decades of research on school transition and transfer

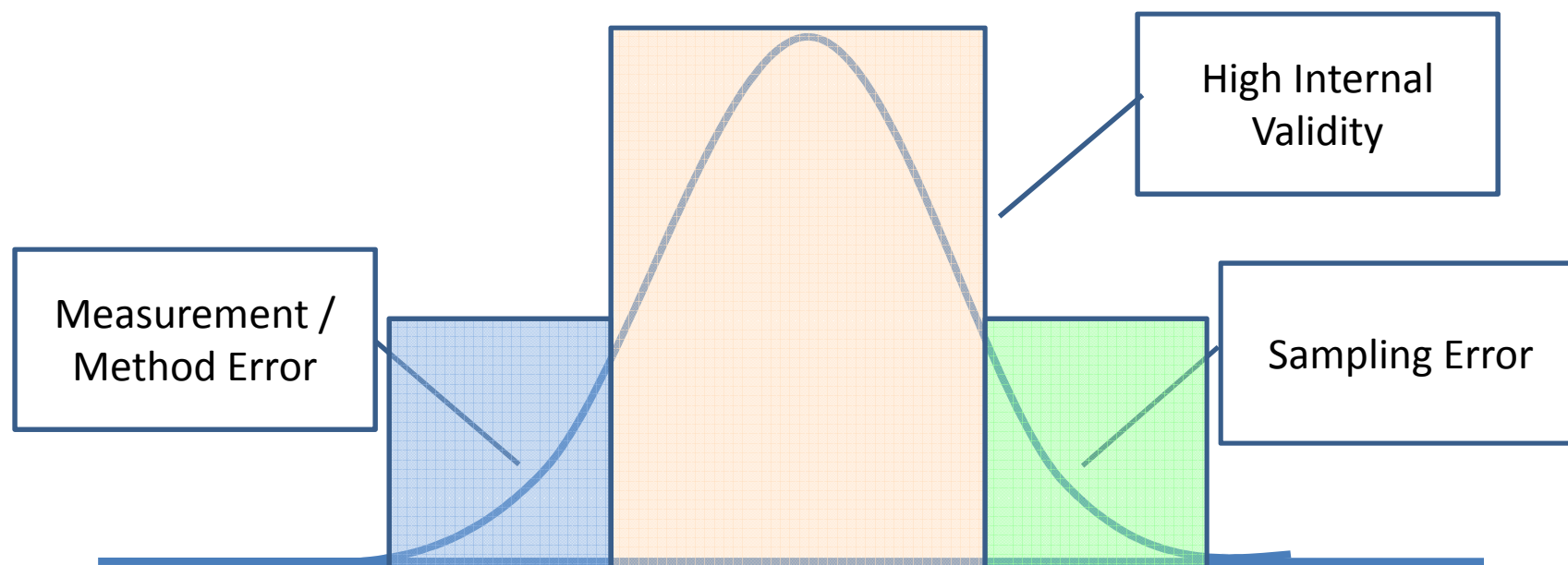


How can we validate the findings from Meta-Analysis?

- **Generalisability** of the phenomenon
 - How consistent are the findings across studies?
- **Patterns and trends** in phenomena
 - How reliable are the patterns and trends?
- **Variance** in a phenomenon
 - What factors contribute to the variance? Are they study characteristics (i.e. method/sample) or ethological differences?
- **Extent of influence** of certain conditions on the phenomenon
 - Is comparability robust enough for a generalised effect?
 - What are the potential effects of moderating/mediating variables?

How does Meta-Analysis provide a clearer picture of a phenomenon?

Range of Studies Used in Analysis



Meta-analysis can identify and counter for error

What can I do with Meta-Analyses?

- Read published meta-analyses to inform your literature review
- Perform meta-analyses if there is not one available in your field -> use it to inform your research design and publish it if you can
- Use established methods of meta-analysis or get creative! (e.g. you can meta-analyse interview data, factors within constructs, almost anything!)

Why is Meta-Analysis important?

- The rapid increase of social sciences information requires us to develop more sophisticated methods of summarising research findings in order to develop our fields of research
- Meta-analysis is a vital conceptual technology for synthesising research and is presently done ‘by hand’
- Future ‘automatic’ meta-analysis may become possible in social science informatics databases

Reference for Calculating Effect Sizes

Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis*. Thousand Oaks, CA: Sage Publications.