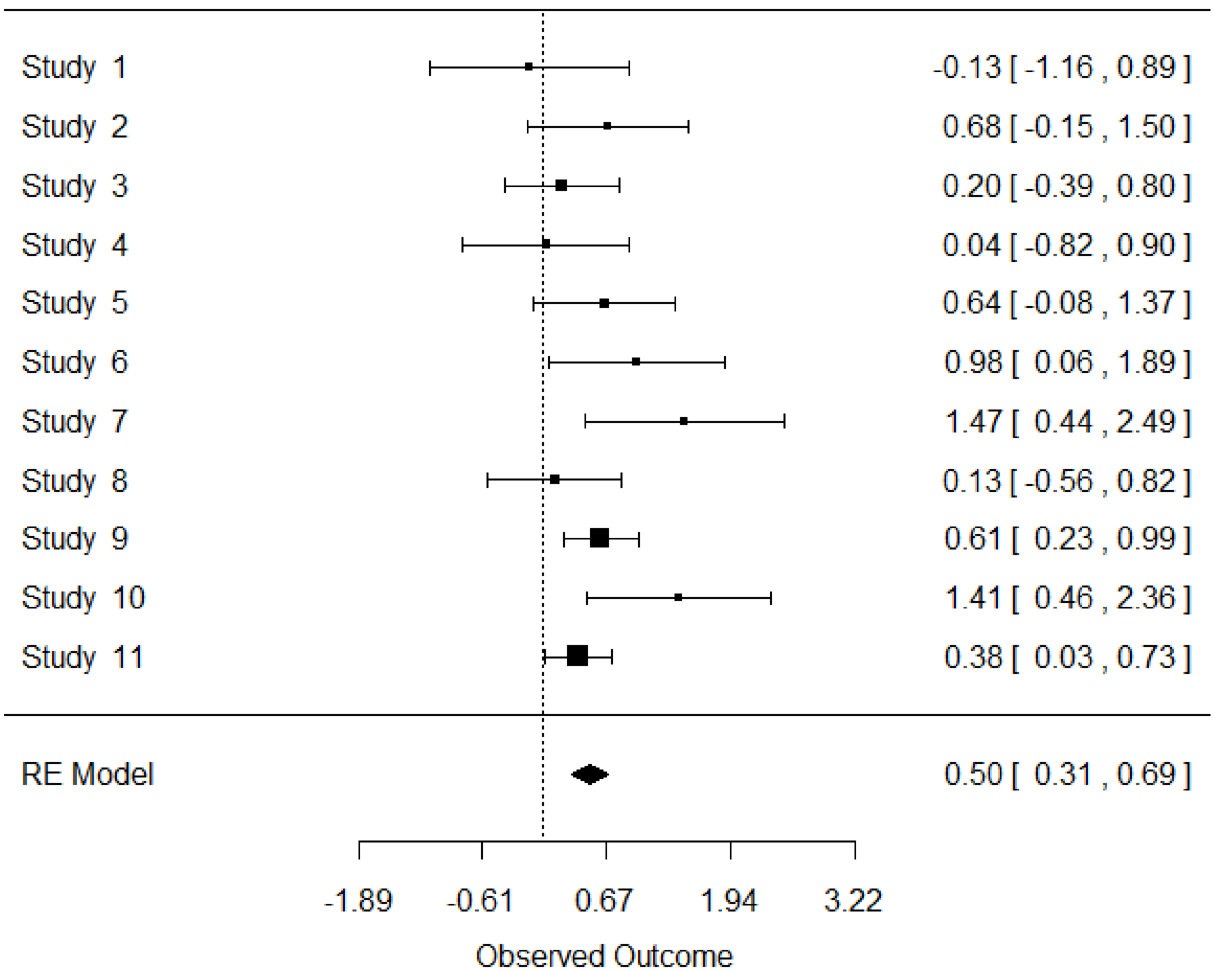
Chapter 17 – Meta-Analysis and Single-Case Designs

[Note: The exercises in this chapter come as groups of exercises on a common research study. It is sometimes difficult to separate the answers neatly by individual question. For that reason I will make an exception in this chapter and provide general answers without trying to restrict them to the odd-numbered items.]

17.1 Mazzucchelli et al. (2010) study



17.2 – 17.4

Author	SubGrp	n1	n2	g	sg^2	weight	Wg	W*g^2	W^2	W(gi-gbar)^2	
Barlow86a	E	12.00	12.00	-0.134	0.2740	3.6496	-0.4891	0.0655	13.3198359	1.4609	
Besyner79	E	14.00	16.00	0.675	0.1790	5.5866	3.7709	2.5454	31.21001217	0.1737	
Lovett88	E	33.00	27.00	0.204	0.0930	10.7527	2.1935	0.4475	115.6203029	0.9338	
Stark	E	10.00	9.00	0.043	0.1930	5.1813	0.2228	0.0096	26.84635829	1.0759	
VanDenHaut	E	15.00	14.00	0.644	0.1380	7.2464	4.6667	3.0053	52.5099769	0.1530	
Weinberg	E	10.00	9.00	0.976	0.2180	4.5872	4.4771	4.3696	21.04199983	1.0451	
Wilson	E	9.00	11.00	1.466	0.2750	3.6364	5.3309	7.8151	13.2231405	3.4025	
SUM		103.00	98.00			40.6402	20.1729	18.2580	273.7716		
Barlow86a	M	12.00	13.00	0.133	0.1240	8.0645	1.0726	0.1427	65.0364204	1.0784	
Fordyce77	M	50.00	60.00	0.609	0.0380	26.3158	16.0263	9.7600	692.5207756	0.3202	
Fordyce83	M	40.00	13.00	1.41	0.2330	4.2918	6.0515	8.5326	18.41993774	3.5644	
Reich81	M	49.00	49.00	0.378	0.0320	31.2500	11.8125	4.4651	976.5625	0.4552	
SUM		151.00	135.00			69.9222	34.9629	22.9004	1752.5396		
GrandSum		254.00	233.00			110.5623	55.1358		2026.3113	13.6631	
						Mean g =	0.4987		Q =	13.6631	which is chi.sq on 10 df
						se(Mean g) =	0.0951				p = .189
						CI-lower =	0.3123		C =	92.2350	
						CI-upper	0.6851				
									Tau =	0.1993	

17.5 Fixed model

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Fixed-Effects Model (k = 11)

Test for Heterogeneity:
Q(df = 10) = 13.6678, p-val = 0.1887

Model Results:

estimate     se      zval     pval     ci.lb    ci.ub
  0.4987   0.0951   5.2428   <.0001   0.3122   0.6851     ***

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Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

17.6 - 17.8 The following results are from R using library(metaphor)

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Fixed-Effects Model (k = 4)

Test for Heterogeneity:
Q(df = 3) = 7.2655, p-val = 0.0639

Model Results:

estimate     se     zval     pval    ci.lb    ci.ub
  0.2274   0.0881   2.5813   0.0098   0.0547   0.4001      **

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Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
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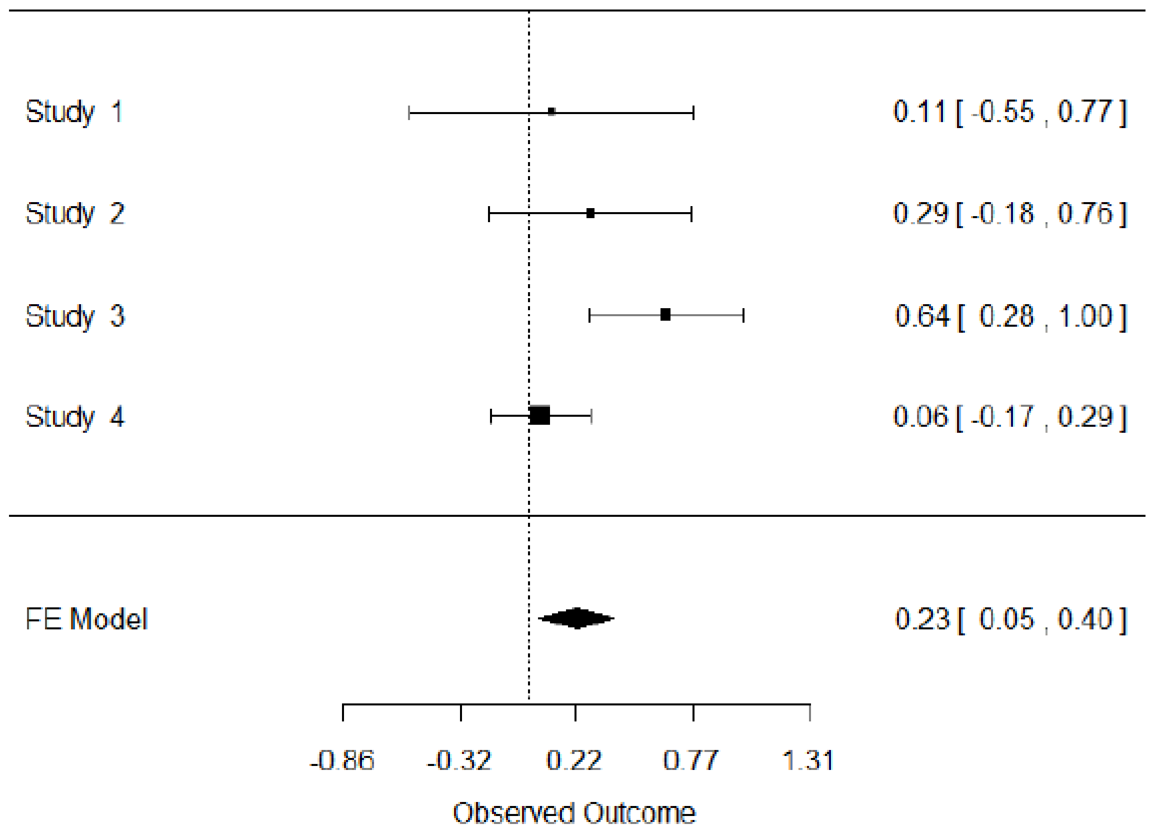


It doesn't make sense to try to fit a random model because we have so few studies that we could not reasonably test for randomness.

17.9 The confidence interval does not include 0, and we can safely reject the null hypothesis and conclude that methylphenidate does increase the severity of tics in these children.

17.10 - 17.12

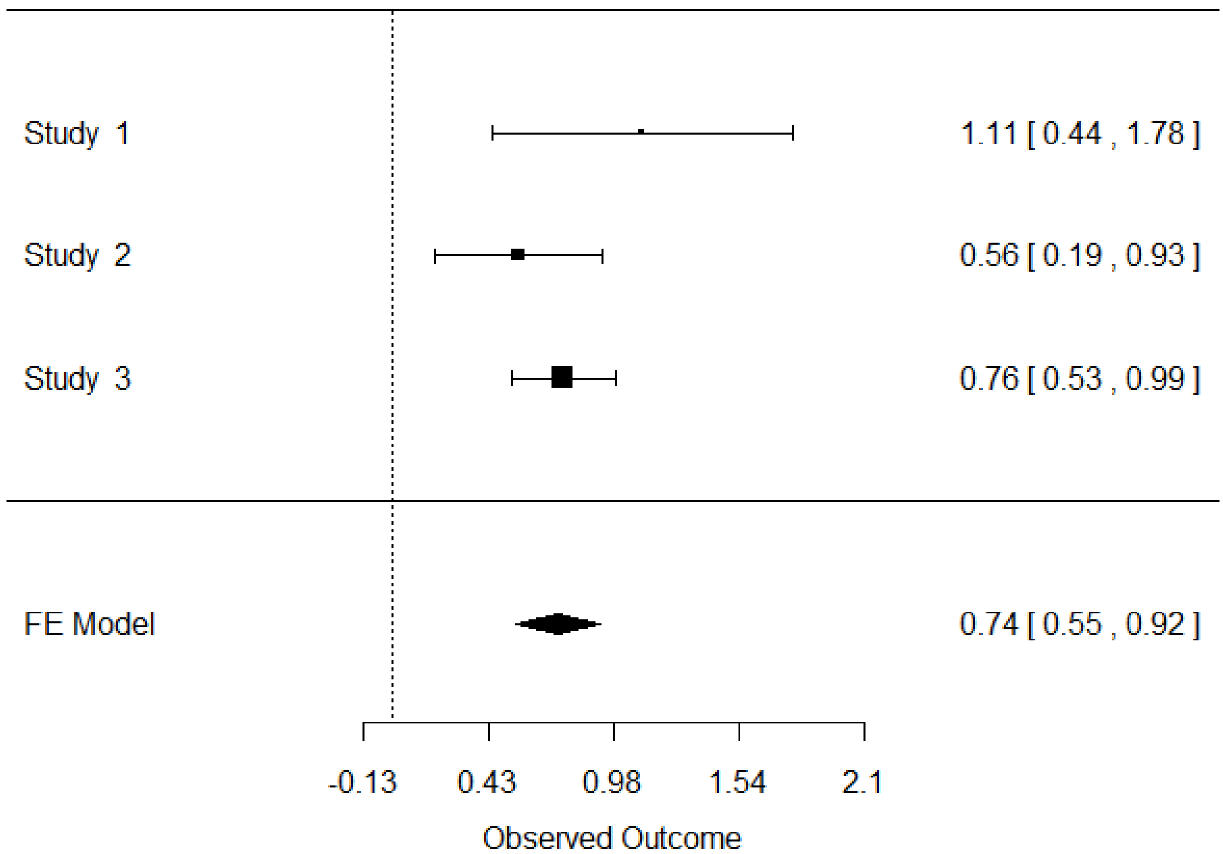
Fixed-Effects Model (k = 3)

Test for Heterogeneity:
Q(df = 2) = 2.1121, p-val = 0.3478

Model Results:

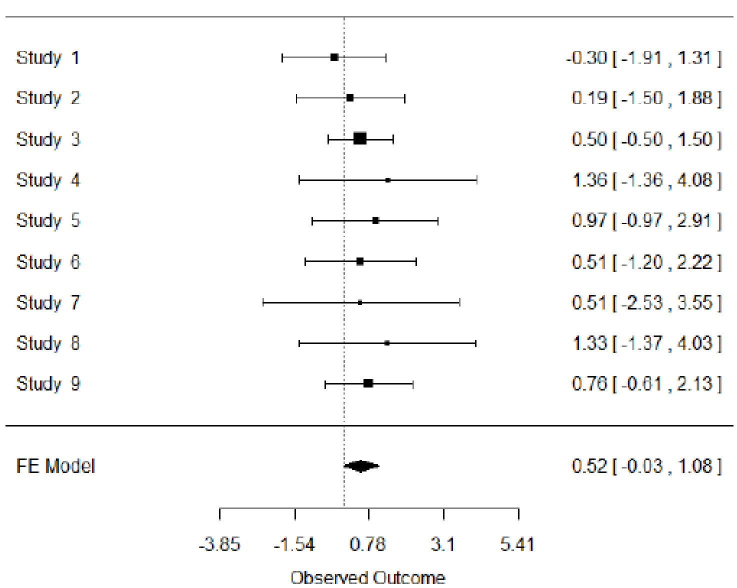
estimate	se	zval	pval	ci.lb	ci.ub	
0.7364	0.0955	7.7109	<.0001	0.5492	0.9236	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1



Again we have too few studies to seriously look at heterogeneity.

17.13 – 17.14



Fixed-Effects Model (k = 9)

Test for Heterogeneity:
Q(df = 8) = 2.1826, p-val = 0.9749

Model Results:

estimate	se	zval	pval	ci.lb	ci.ub	
0.5239	0.2826	1.8542	0.0637	-0.0299	1.0777	.

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

17.15 – 17.19 Rajkumar (2010)

The risk ratios and log risk ratios are
Risk Ratio
4.102326 6.336000 8.212389 1.963636
Log Risk Ratio
1.411554 1.846248 2.105644 0.674798

Mean Risk Ratio and confidence limits

Log Risk Ratio

Estimate	se	zval	pval	ci.lb	ci.ub
1.5747	0.3277	4.8055	<.0001	0.9324	2.2170

Risk Ratio	**CIlower**	**CIupper**
4.8293	2.5406	9.1798

Even at the low end of the confidence interval the addition of thalidomide increases the chances of success to 2.5 times the chance of success in the control group.

17.20 Random effects model for Bisson and Martin (2009) study

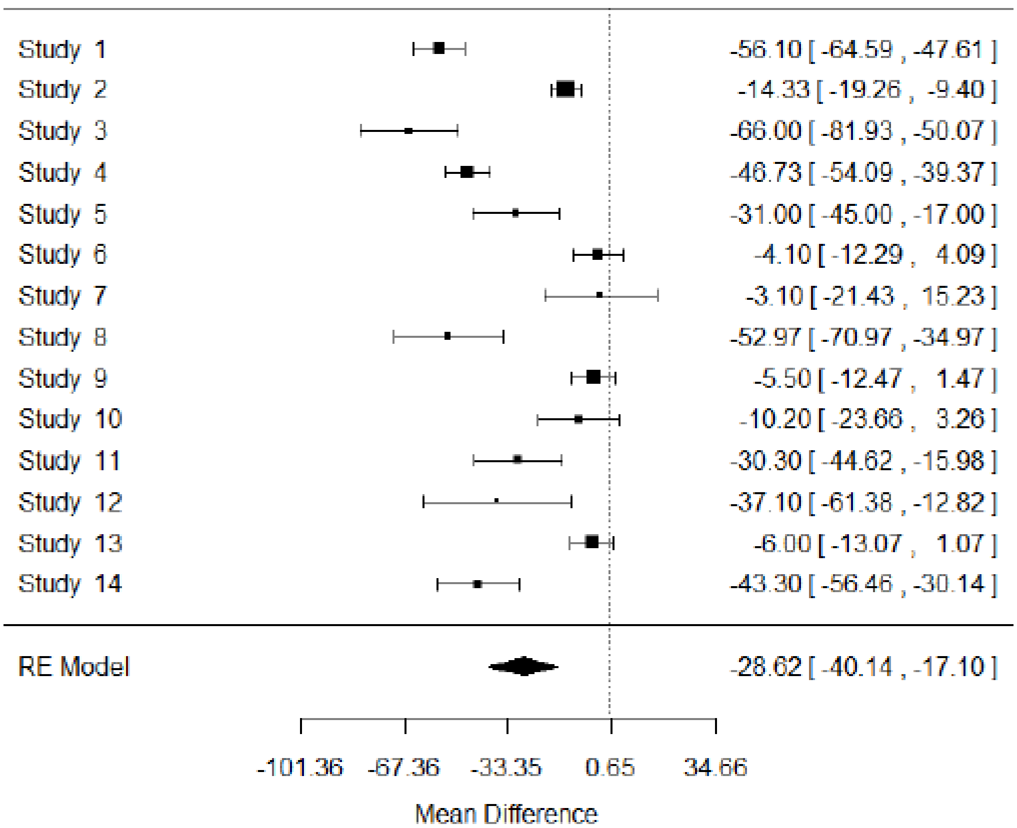
Random-Effects Model (k = 14; tau^2 estimator: REML)

tau^2 (estimate of total amount of heterogeneity): 438.6370 (SE = 189.2833)
tau (sqrt of the estimate of total heterogeneity): 20.9437
I^2 (% of total variability due to heterogeneity): 94.80%
H^2 (total variability / within-study variance): 19.24

Test for Heterogeneity:
Q(df = 13) = 236.1772, p-val < .0001

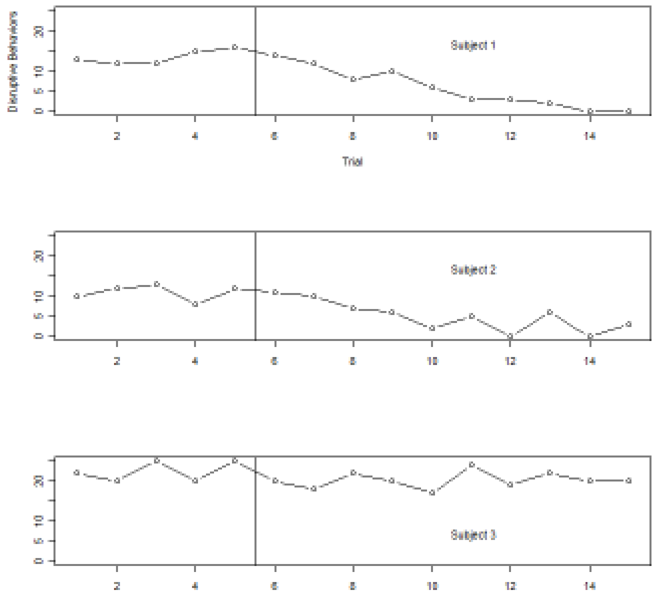
Model Results:

estimate	se	zval	pval	ci.lb	ci.ub	
-28.6212	5.8774	-4.8697	<.0001	-40.1407	-17.1017	***



Note that we can reject the null hypothesis in our test for heterogeneity, though we have no specific variable that might explain that variability. We can also conclude that VBT is a more effective treatment than the Control treatment.

17.21 – 17.24



Phase	S1	S2	S3
A	13	10	22
A	12	12	20
A	12	13	25
A	15	8	20
A	16	12	25
B	14	11	20
B	12	10	18
B	8	7	22
B	10	6	20
B	6	2	17
B	3	5	24
B	3	0	19
B	2	6	22
B	0	0	20
B	0	3	20

Mean(A)	13.6	11	22.4
SD(A)	1.817	2	2.51
Mean(B)	5.8	5	20.2
SD(B)	5.007	3.8	2.044
s(pooled)	4.286260671	3.350774882	2.197933015
d	1.819767998	1.790630589	1.000940422
s(d)	0.640613133	0.637870361	0.577404587
CIlower	0.564166258	0.540404682	-0.130772569

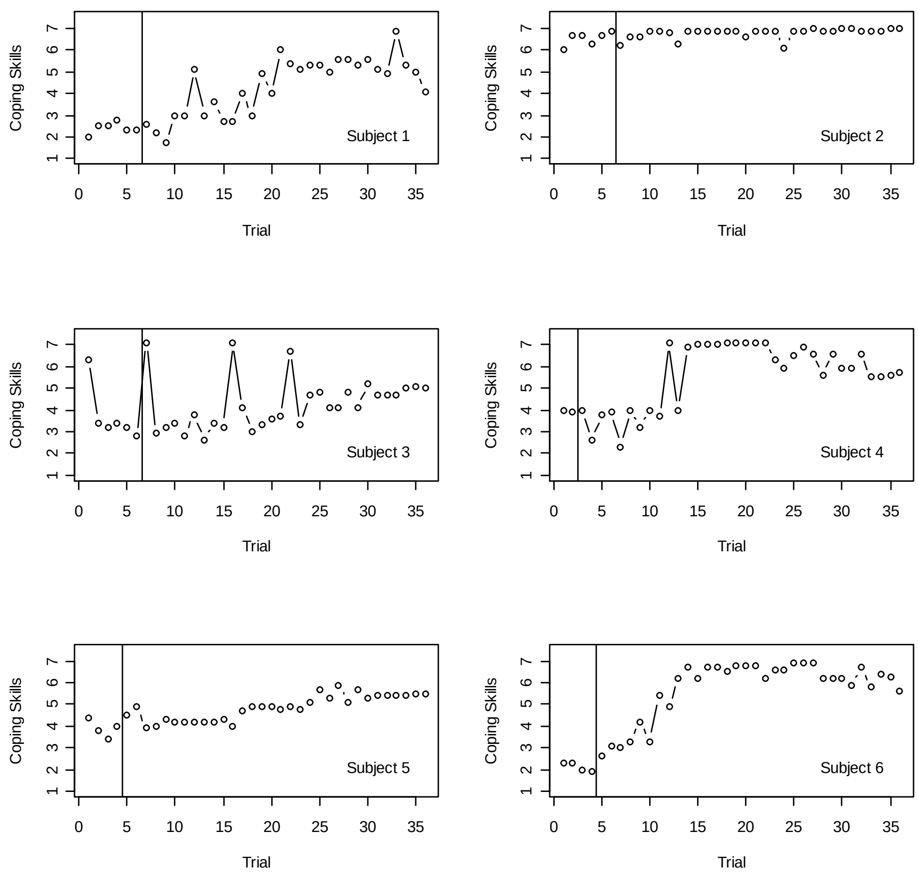
CIupper	**3.075369738**	**3.040856496**	**2.132653414**	
Weight	**2.436735134**	**2.457735569**	**2.999435588**	**7.893906291**
Widi	**4.434292616**	**4.40089649**	**3.002256323**	**11.83744543**

dbar	**1.499567514**
s(dbar)	**0.355921331**

CIlow(dbar)	**0.801961705**
CIup(dbar)	**2.197173322**

Two of the three subjects showed significant improvement (their confidence intervals did not include 0, and the overall confidence interval also did not include 0, indicating significant overall improvement.

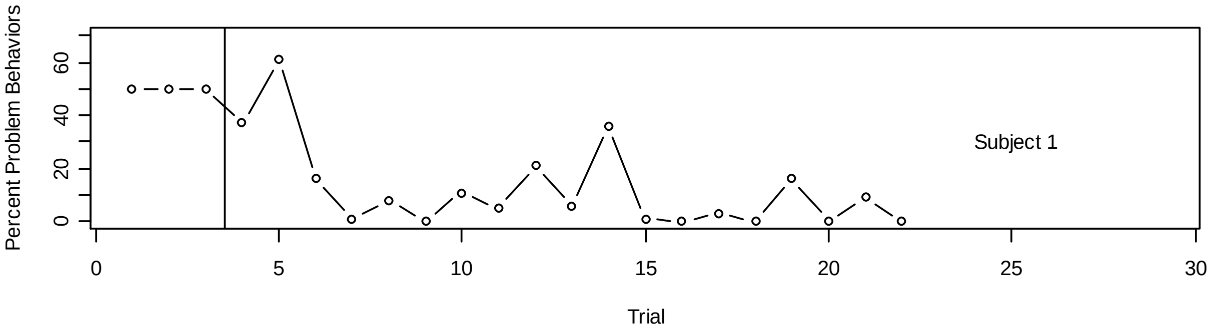
17.25 – 17.28

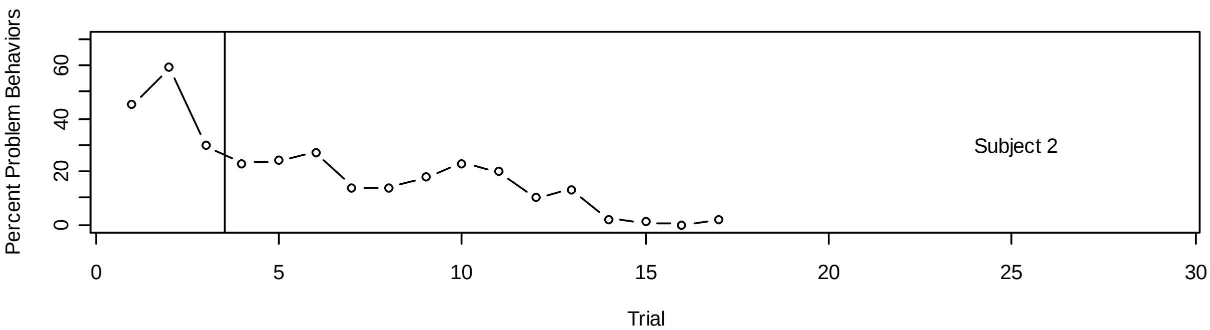


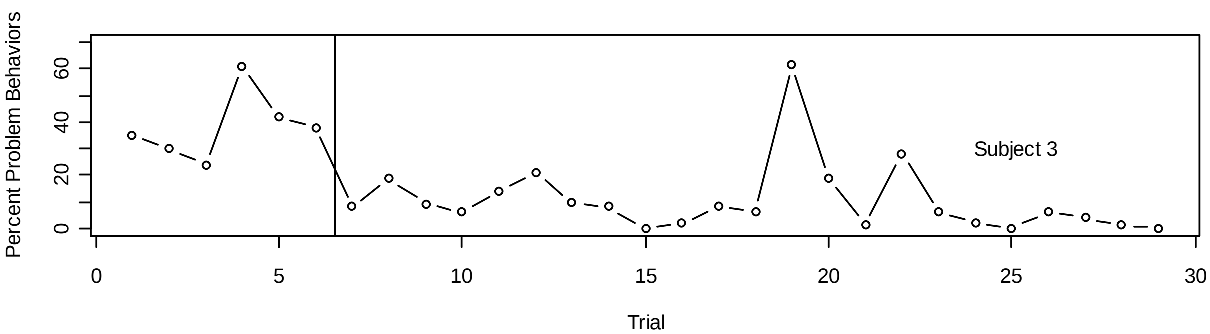
Subj1	Subj2	Subj3	Subj4	Subj5	Subj6
2.0	6	6.3	4.0	4.4	2.3
2.5	6.7	3.4	3.9	3.8	2.3
2.5	6.7	3.2	4.0	3.4	2.0
2.8	6.3	3.4	2.6	4.0	1.9

	2.3	6.7	3.2	3.8	4.5	2.6	
	2.3	6.9	2.8	3.9	4.9	3.1	
	2.6	6.2	7.1	2.3	3.9	3.0	
	2.2	6.6	2.9	4.0	4.0	3.3	
	The Rest Of The Data Go Here						
	6.9	6.9	4.7	5.5	5.4	5.8	
	5.3	6.9	5.0	5.5	5.4	6.4	
	5.0	7.0	5.1	5.6	5.5	6.3	
	4.1	7.0	5.0	5.7	5.5	5.6	
Mean(A)	2.4	6.55	3.71666	3.95	3.9	2.125	
SD(A)	0.26832	0.33316	1.28439	0.07071	0.41633	0.20615	
Mean(B)	4.35	6.76666	4.96666	4.29	4.8875	4.5125	
SD(B)	1.76493	0.31411	1.33516	1.24762	0.67493	1.64788	
s(pooled)	1.63324	0.31698	1.32782	1.23218	0.65622	1.5747	
	-	-		-	-	-	
d	1.19394	0.68352	-0.94139	0.27593	1.50481	1.51616	
s(d)	0.46882	0.45441	0.46077	0.72894	0.55919	0.55962	
CIlower	2.11284	1.57416	-1.8445	1.70466	2.60084	2.61302	
Ciupper	0.27504	0.20712	-0.03828	1.15279	0.40879	-0.4193	
Weight	4.54962	4.84287	4.71012	1.88196	3.19794	3.19308	22.3756
Widi	-5.4319	-3.3102	-4.43407	-0.5193	4.81231	4.84123	23.3491
dbar			-1.04351				
s(dbar)			0.211404				
CIlow(dbar)			-1.45786				
CIup(dbar)			-0.62915				

17.29 – 17.31







Individual Regressions

Subject 1

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	d	Wt
(Intercept)	5.000e+01	2.182e+01	2.291	0.0342 *		
Phase	-2.482e+01	2.272e+01	-1.092	0.2891	0.515	0.002
trial	-7.106e-15	1.010e+01	0.000	1.0000	0.000	0.010
int1	-1.447e+00	1.012e+01	-0.143	0.8879	0.943	0.010

Residual standard error: 14.29 on 18 degrees of freedom
Multiple R-squared: 0.5717, Adjusted R-squared: 0.5003
F-statistic: 8.008 on 3 and 18 DF, p-value: 0.000

Subject 2

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	d	Wt
(Intercept)	59.667	10.332	5.775	6.44e-05 *		
Phase	-3.352	10.887	-0.308	0.763	0.171	0.008
trial	-7.500	4.783	-1.568	0.141	0.870	0.044
int2	5.551	4.804	1.155	0.269	0.641	0.043

Residual standard error: 6.764 on 13 degrees of freedom

Multiple R-squared: 0.8494, Adjusted R-squared: 0.8147

F-statistic: 24.44 on 3 and 13 DF, p-value: 1.283e-05

Subject 3

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	d	Wt
(Intercept)	29.533	12.614	2.341	0.0275 *		
Phase	-32.633	13.750	-2.373	0.0256 *	0.949	0.005
trial	2.514	3.239	0.776	0.4449	0.310	0.095
int3	-2.884	3.267	-0.883	0.3858	0.353	0.094

Residual standard error: 13.55 on 25 degrees of freedom

Multiple R-squared: 0.4627, Adjusted R-squared: 0.3982

F-statistic: 7.176 on 3 and 25 DF, p-value: 0.001235

From the columns for *t* and *d* we see that taken individually, the only significant difference was for the change of slope for Subject 3, although many of the *d* values were reasonably large.

We can compute the mean of *d* and its standard error from the above.

Phase

$$\bar{d}_{Phase} = \frac{\Sigma W_i d_1}{\Sigma W_i} = \frac{(0.002*0.515+0.008*0.171+0.005*0.949)}{(0.002+0.008+0.005)} = \frac{0.007}{0.015} = 0.467$$

$$s_{\bar{d}} = \sqrt{\frac{1}{\Sigma W_i}} = \sqrt{\frac{1}{0.015}} = 8.165$$

Trial

$$\bar{d}_{Trial} = \frac{0.068}{.149} = 0.046$$

$$s_{\bar{d}} = \sqrt{\frac{1}{0.149}} = 2.59$$

Interaction

$$\bar{d}_{\text{int}} = \frac{0.070}{0.147} = 0.476$$

$$s_{\bar{d}} = \sqrt{\frac{1}{0.147}} = 2.608$$

It is apparent from the above results that the mean of *d* is not significant for any effect. Contrary to the example in the text, the standard errors were very large.