Coupling Phase Main Analysis

Does sleep spindle-slow oscillation coupling contribute to memory consolidation during sleep? A meta-analysis and systematic review

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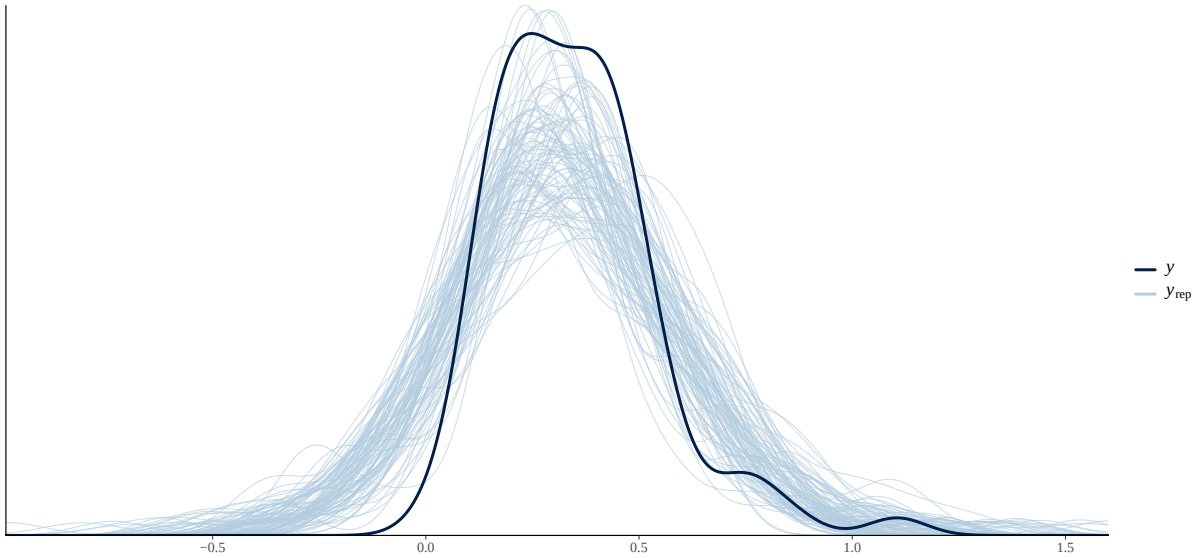
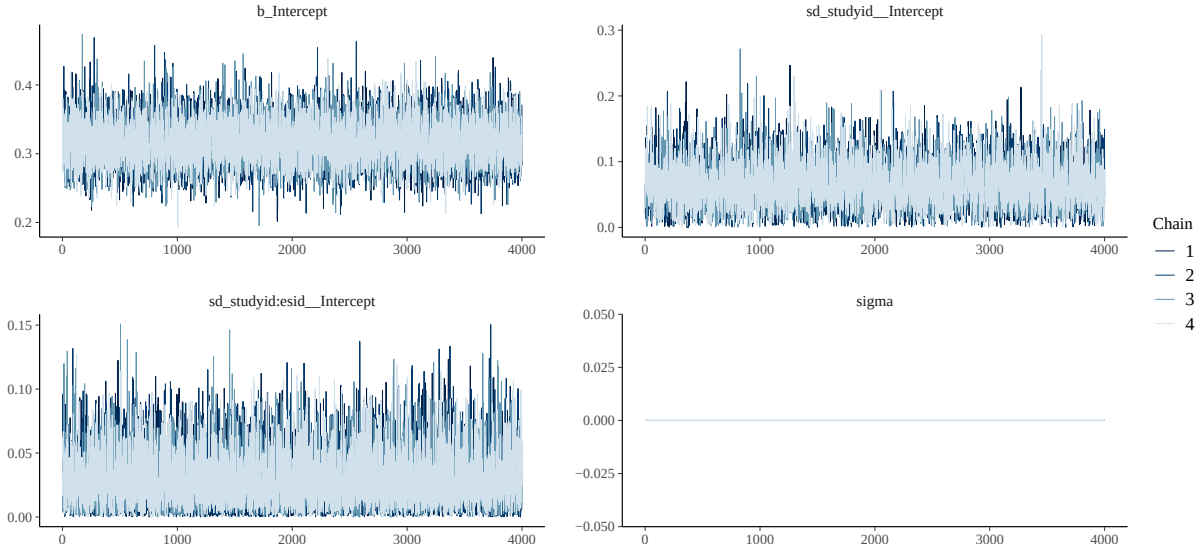
Preprocessing

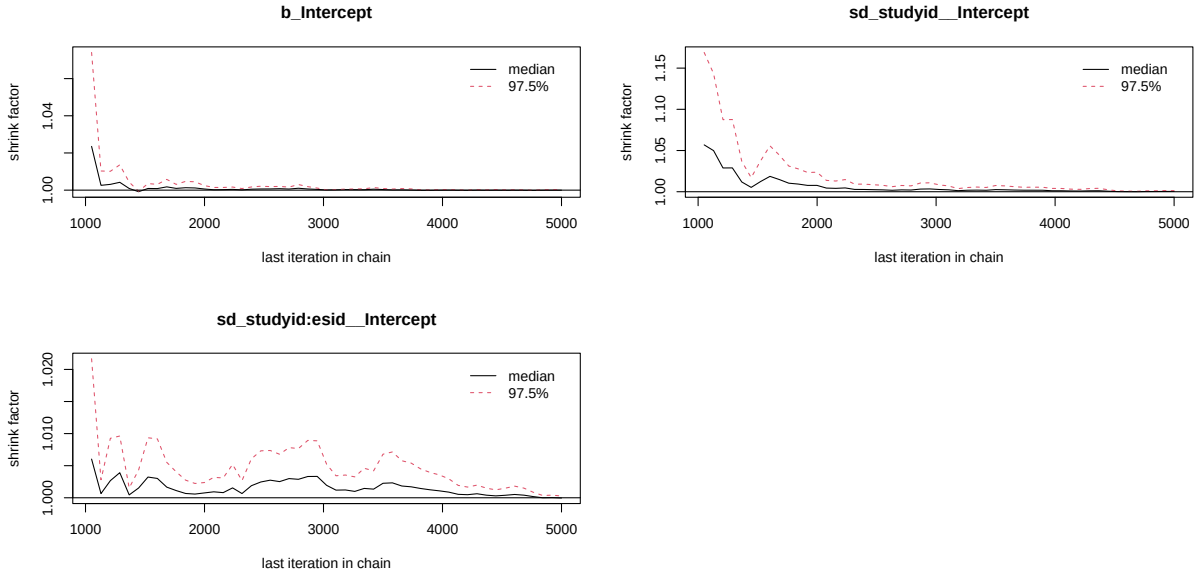
Main Model

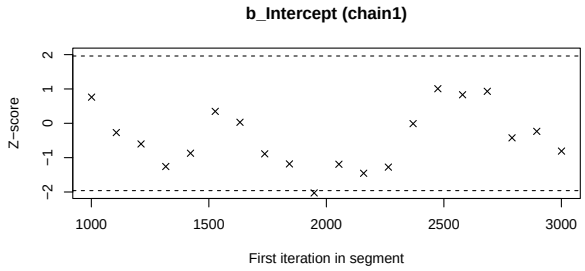


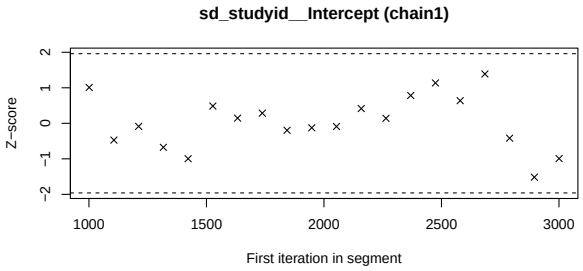
```
 Family: gaussian
  Links: mu = identity; sigma = identity
Formula: esz | se(se) ~ 1 + (1 | studyid/esid)
   Data: phase_final (Number of observations: 81)
  Draws: 4 chains, each with iter = 5000; warmup = 1000; thin = 1;
         total post-warmup draws = 16000

Group-Level Effects:
~studyid (Number of levels: 20)
              Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sd(Intercept)     0.06      0.03     0.01     0.14 1.00     5059     4903

~studyid:esid (Number of levels: 81)
              Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sd(Intercept)     0.03      0.02     0.00     0.08 1.00     7936     7434

Population-Level Effects:
          Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
Intercept     0.32      0.03     0.26     0.38 1.00    10871    10805

Family Specific Parameters:
      Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
sigma     0.00      0.00     0.00     0.00   NA       NA       NA

Draws were sampled using sampling(NUTS). For each parameter, Bulk_ESS
and Tail_ESS are effective sample size measures, and Rhat is the potential
scale reduction factor on split chains (at convergence, Rhat = 1).
```

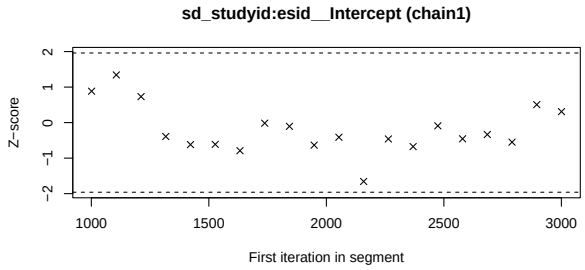


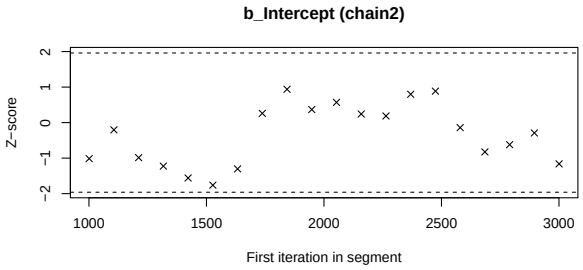

```
Potential scale reduction factors:

                           Point est. Upper C.I.
b_Intercept                         1          1
sd_studyid__Intercept               1          1
sd_studyid:esid__Intercept          1          1

Multivariate psrf

1
```

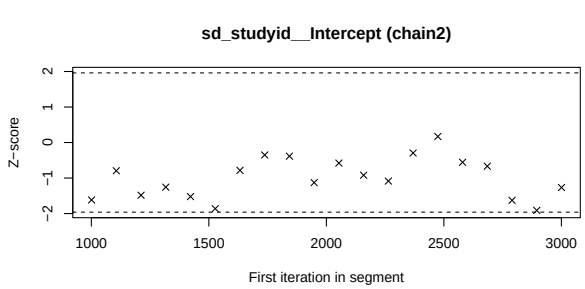


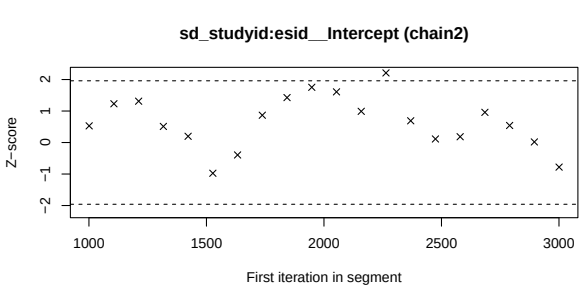

b_Intercept (chain1)
Z−score
First iteration in segment

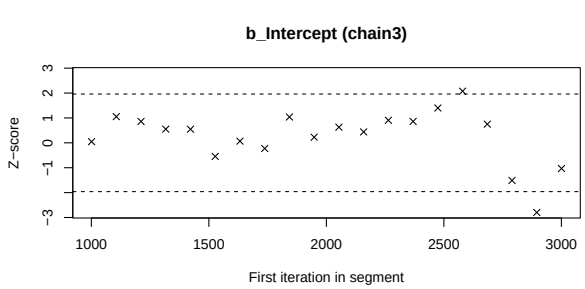

sd_studyid__Intercept (chain1)
Z−score
First iteration in segment

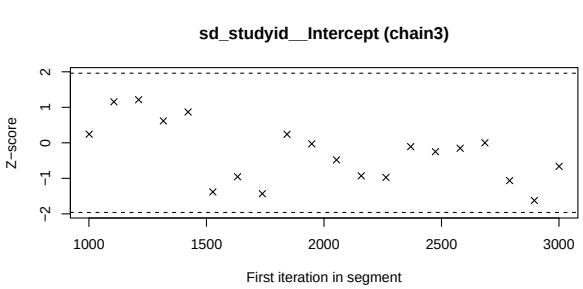

sd_studyid:esid__Intercept (chain1)
Z−score
First iteration in segment

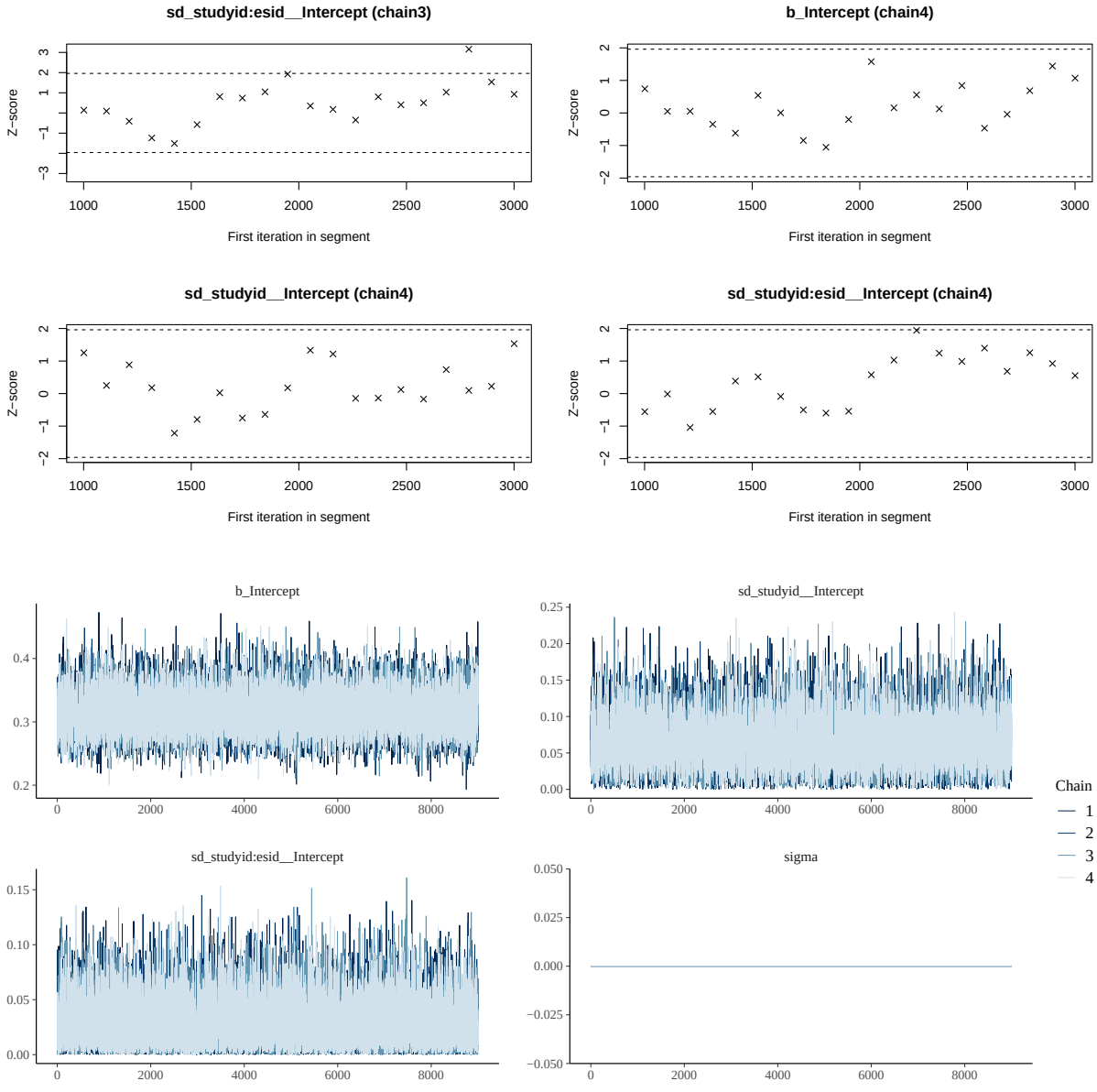

b_Intercept (chain2)
Z−score
First iteration in segment


sd_studyid__Intercept (chain2)
Z−score
First iteration in segment


sd_studyid:esid__Intercept (chain2)
Z−score
First iteration in segment

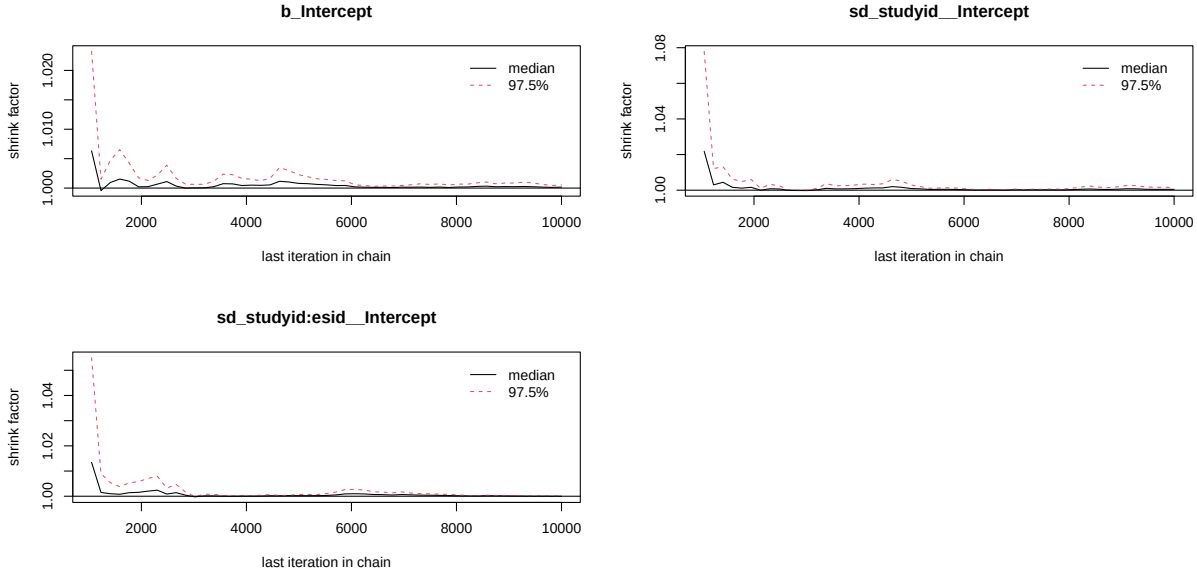

b_Intercept (chain3)
Z−score
First iteration in segment

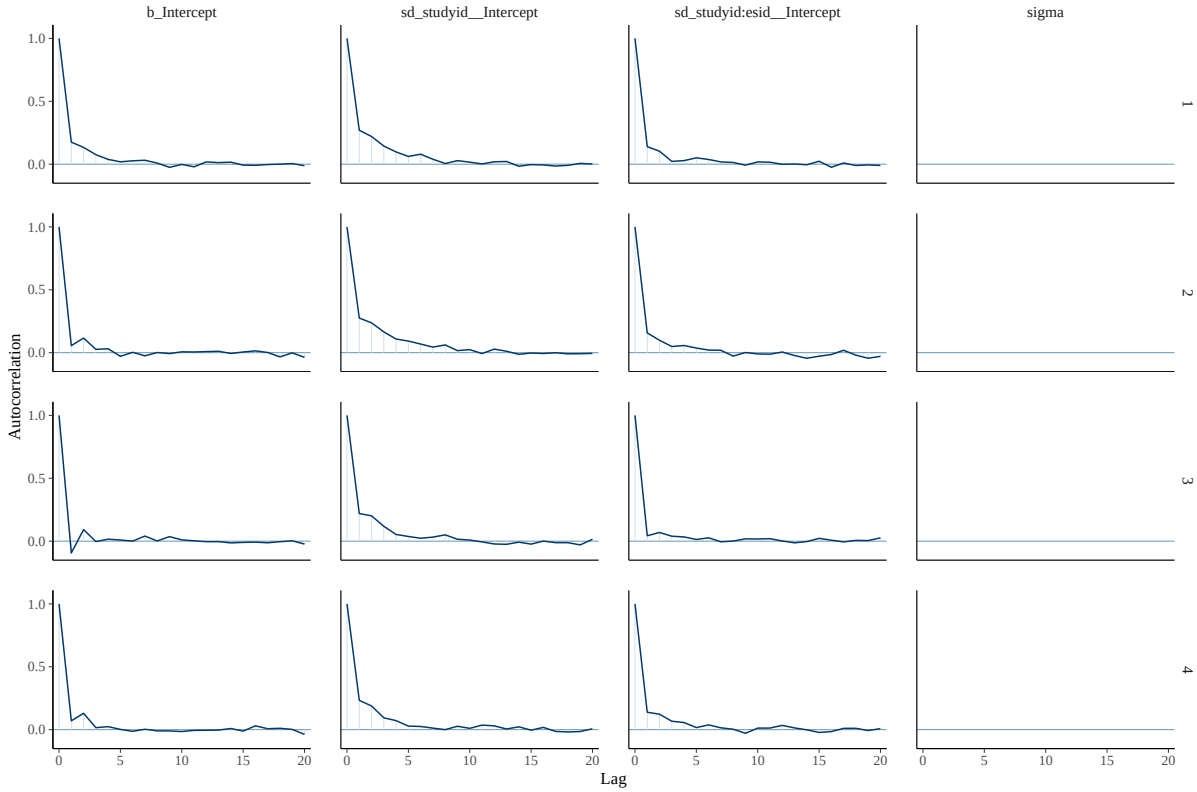

sd_studyid__Intercept (chain3)
Z−score
First iteration in segment

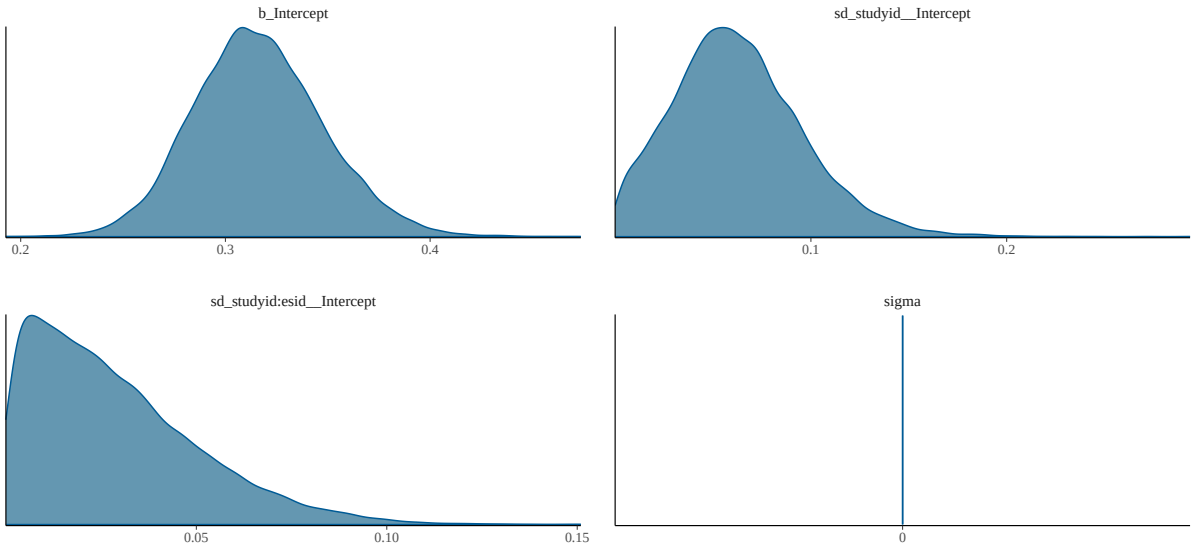


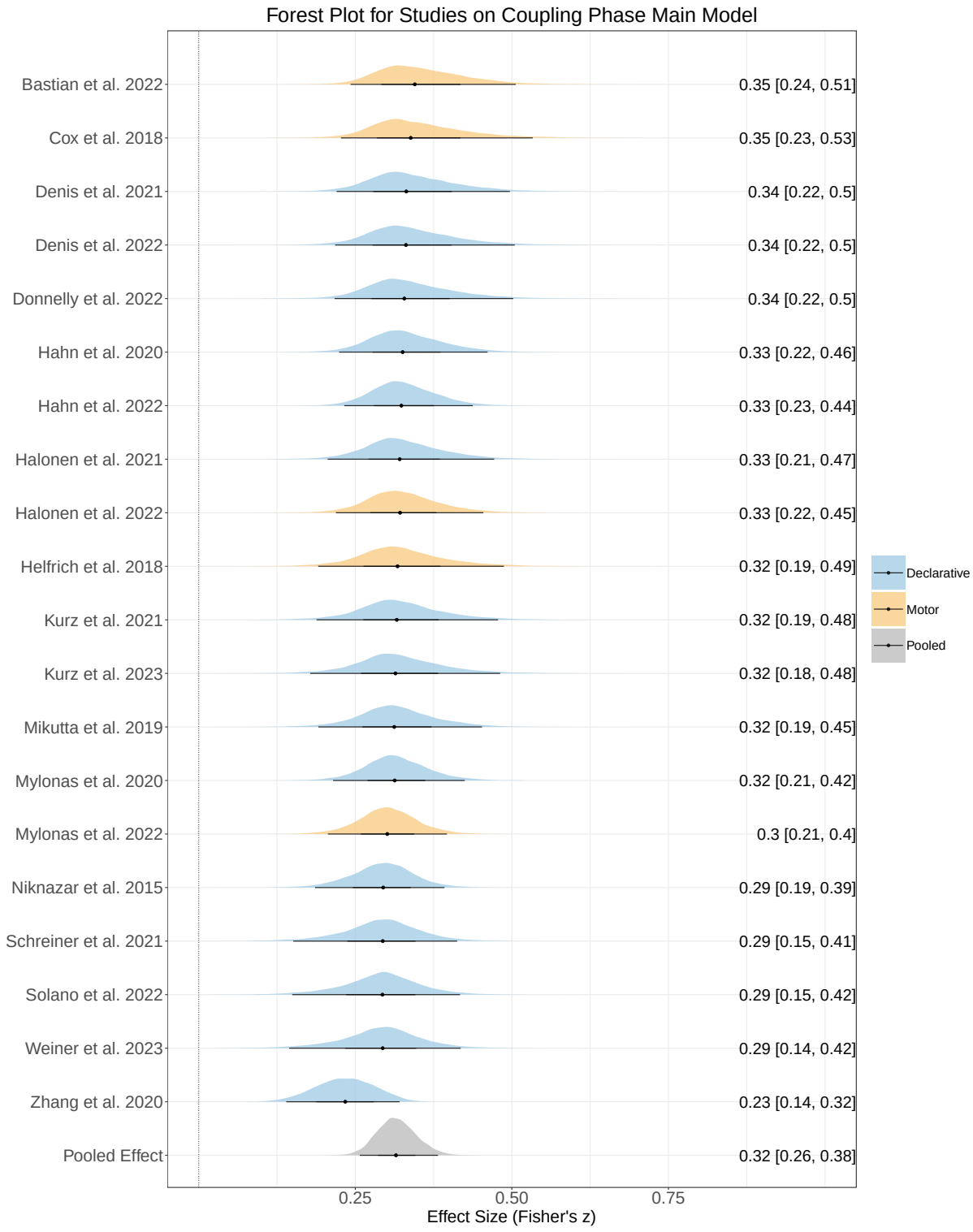

```
Potential scale reduction factors:

                           Point est. Upper C.I.
b_Intercept                         1          1
sd_studyid__Intercept               1          1
sd_studyid:esid__Intercept          1          1

Multivariate psrf
```

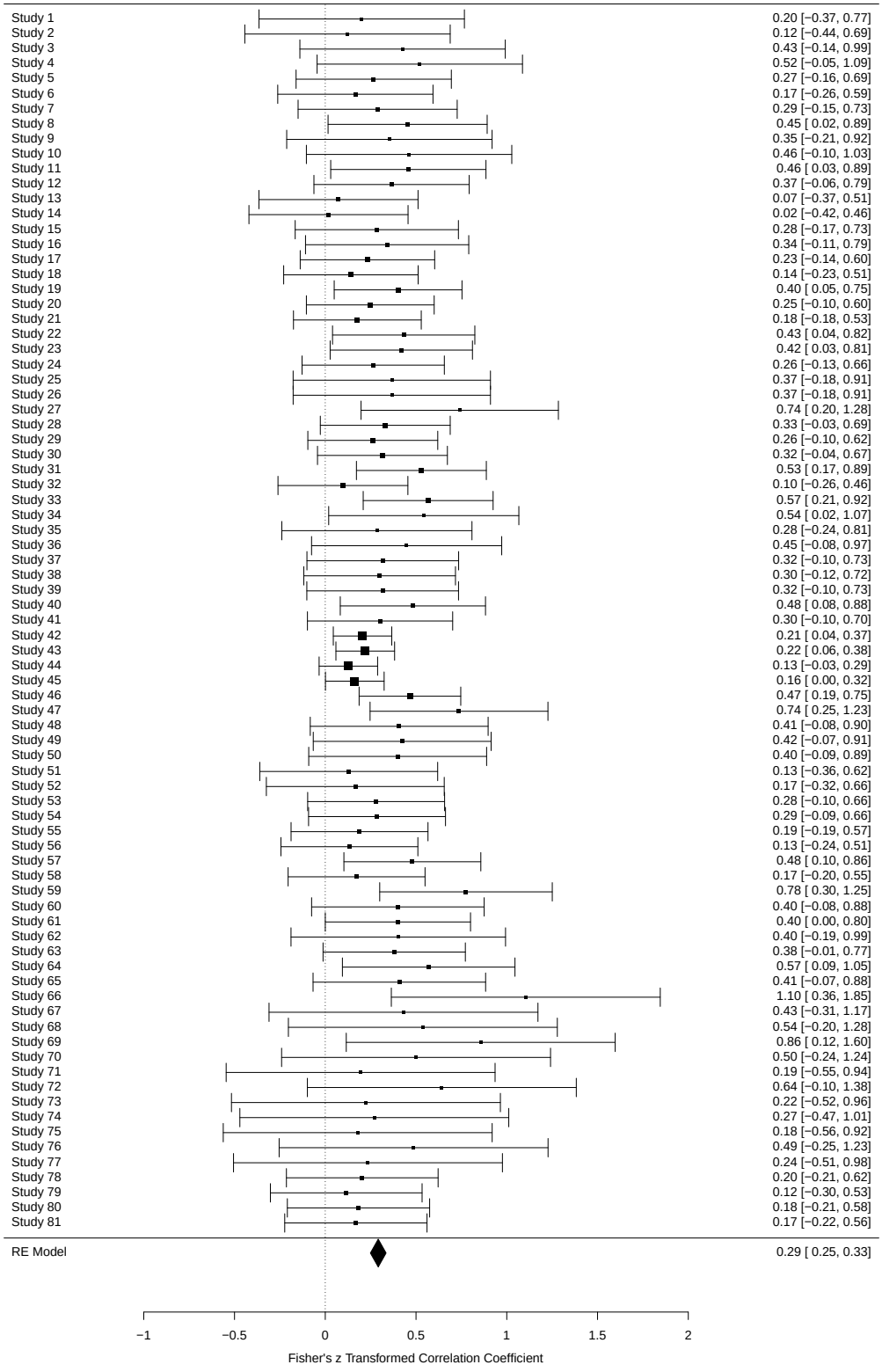
1

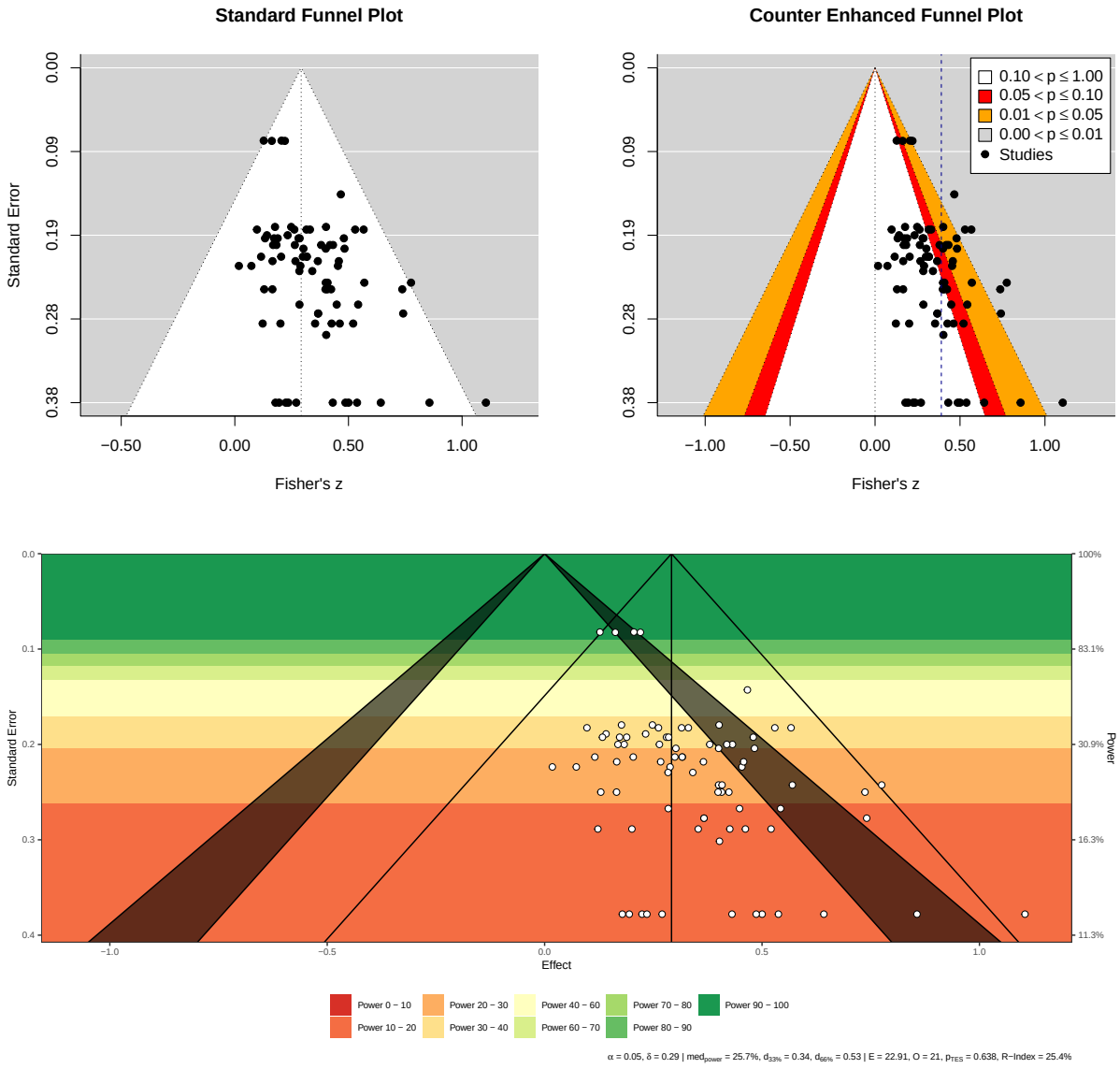

b_Intercept
shrink factor
median
97.5%
last iteration in chain
sd_studyid__Intercept
shrink factor
median
97.5%
last iteration in chain
sd_studyid:esid__Intercept
shrink factor
median
97.5%
last iteration in chain


b_Intercept
sd_studyid__Intercept
sd_studyid:esid__Intercept
sigma
Autocorrelation
Lag


b_Intercept
0.2
0.3
0.4
sd_studyid__Intercept
0.1
0.2
sd_studyid:esid__Intercept
0.05
0.10
0.15
sigma
0


Forest Plot for Studies on Coupling Phase Main Model
Bastian et al. 2022
Cox et al. 2018
Denis et al. 2021
Denis et al. 2022
Donnelly et al. 2022
Hahn et al. 2020
Hahn et al. 2022
Halonen et al. 2021
Halonen et al. 2022
Helfrich et al. 2018
Kurz et al. 2021
Kurz et al. 2023
Mikutta et al. 2019
Mylonas et al. 2020
Mylonas et al. 2022
Niknazar et al. 2015
Schreiner et al. 2021
Solano et al. 2022
Weiner et al. 2023
Zhang et al. 2020
Pooled Effect
0.35 [0.24, 0.51]
0.35 [0.23, 0.53]
0.34 [0.22, 0.5]
0.34 [0.22, 0.5]
0.34 [0.22, 0.5]
0.33 [0.22, 0.46]
0.33 [0.23, 0.44]
0.33 [0.21, 0.47]
0.33 [0.22, 0.45]
0.32 [0.19, 0.49]
0.32 [0.19, 0.48]
0.32 [0.18, 0.48]
0.32 [0.19, 0.45]
0.32 [0.21, 0.42]
0.3 [0.21, 0.4]
0.29 [0.19, 0.39]
0.29 [0.15, 0.41]
0.29 [0.15, 0.42]
0.29 [0.14, 0.42]
0.23 [0.14, 0.32]
0.32 [0.26, 0.38]
0.25
0.50
0.75
Effect Size (Fisher's z)
Declarative
Motor
Pooled


Study 1 0.20 [−0.37, 0.77]
Study 2 0.12 [−0.44, 0.69]
Study 3 0.43 [−0.14, 0.99]
Study 4 0.52 [−0.05, 1.09]
Study 5 0.27 [−0.16, 0.69]
Study 6 0.17 [−0.26, 0.59]
Study 7 0.29 [−0.15, 0.73]
Study 8 0.45 [0.02, 0.89]
Study 9 0.35 [−0.21, 0.92]
Study 10 0.46 [−0.10, 1.03]
Study 11 0.46 [0.03, 0.89]
Study 12 0.37 [−0.06, 0.79]
Study 13 0.07 [−0.37, 0.51]
Study 14 0.02 [−0.42, 0.46]
Study 15 0.28 [−0.17, 0.73]
Study 16 0.34 [−0.11, 0.79]
Study 17 0.23 [−0.14, 0.60]
Study 18 0.14 [−0.23, 0.51]
Study 19 0.40 [0.05, 0.75]
Study 20 0.25 [−0.10, 0.60]
Study 21 0.18 [−0.18, 0.53]
Study 22 0.43 [0.04, 0.82]
Study 23 0.42 [0.03, 0.81]
Study 24 0.26 [−0.13, 0.66]
Study 25 0.37 [−0.18, 0.91]
Study 26 0.37 [−0.18, 0.91]
Study 27 0.74 [0.20, 1.28]
Study 28 0.33 [−0.03, 0.69]
Study 29 0.26 [−0.10, 0.62]
Study 30 0.32 [−0.04, 0.67]
Study 31 0.53 [0.17, 0.89]
Study 32 0.10 [−0.26, 0.46]
Study 33 0.57 [0.21, 0.92]
Study 34 0.54 [0.02, 1.07]
Study 35 0.28 [−0.24, 0.81]
Study 36 0.45 [−0.08, 0.97]
Study 37 0.32 [−0.10, 0.73]
Study 38 0.30 [−0.12, 0.72]
Study 39 0.32 [−0.10, 0.73]
Study 40 0.48 [0.08, 0.88]
Study 41 0.30 [−0.10, 0.70]
Study 42 0.21 [0.04, 0.37]
Study 43 0.22 [0.06, 0.38]
Study 44 0.13 [−0.03, 0.29]
Study 45 0.16 [0.00, 0.32]
Study 46 0.47 [0.19, 0.75]
Study 47 0.74 [0.25, 1.23]
Study 48 0.41 [−0.08, 0.90]
Study 49 0.42 [−0.07, 0.91]
Study 50 0.40 [−0.09, 0.89]
Study 51 0.13 [−0.36, 0.62]
Study 52 0.17 [−0.32, 0.66]
Study 53 0.28 [−0.10, 0.66]
Study 54 0.29 [−0.09, 0.66]
Study 55 0.19 [−0.19, 0.57]
Study 56 0.13 [−0.24, 0.51]
Study 57 0.48 [0.10, 0.86]
Study 58 0.17 [−0.20, 0.55]
Study 59 0.78 [0.30, 1.25]
Study 60 0.40 [−0.08, 0.88]
Study 61 0.40 [0.00, 0.80]
Study 62 0.40 [−0.19, 0.99]
Study 63 0.38 [−0.01, 0.77]
Study 64 0.57 [0.09, 1.05]
Study 65 0.41 [−0.07, 0.88]
Study 66 1.10 [0.36, 1.85]
Study 67 0.43 [−0.31, 1.17]
Study 68 0.54 [−0.20, 1.28]
Study 69 0.86 [0.12, 1.60]
Study 70 0.50 [−0.24, 1.24]
Study 71 0.19 [−0.55, 0.94]
Study 72 0.64 [−0.10, 1.38]
Study 73 0.22 [−0.52, 0.96]
Study 74 0.27 [−0.47, 1.01]
Study 75 0.18 [−0.56, 0.92]
Study 76 0.49 [−0.25, 1.23]
Study 77 0.24 [−0.51, 0.98]
Study 78 0.20 [−0.21, 0.62]
Study 79 0.12 [−0.30, 0.53]
Study 80 0.18 [−0.21, 0.58]
Study 81 0.17 [−0.22, 0.56]
RE Model 0.29 [0.25, 0.33]
−1
−0.5
0
0.5
1
1.5
2
Fisher's z Transformed Correlation Coefficient




```
Regression Test for Funnel Plot Asymmetry

Model:     mixed-effects meta-regression model
Predictor: standard error

Test for Funnel Plot Asymmetry: z = 0.5221, p = 0.6016
Limit Estimate (as sei -> 0):   b = 0.1165 (CI: -0.5124, 0.7453)

Rank Correlation Test for Funnel Plot Asymmetry
```

```
Kendall's tau = 0.1147, p = 0.5053
```