Supplementary materials

Bayesian Brain in ADHD: potential catecholaminergic pathway of volatility estimation

Plank et al.

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Contents

S1   Package versions

The following packages are used in this RMarkdown file:

```
## [1] "R version 4.5.1 (2025-06-13)"
```

```
## [1] "knitr version 1.50"
## [1] "ggplot2 version 4.0.0"
## [1] "brms version 2.22.0"
## [1] "designr version 0.1.13"
## [1] "bridgesampling version 1.1.2"
## [1] "tidyverse version 2.0.0"
## [1] "ggpubr version 0.6.1"
## [1] "ggrain version 0.0.4"
## [1] "bayesplot version 1.13.0"
## [1] "SBC version 0.3.0.9000"
## [1] "rstatix version 0.7.2"
## [1] "BayesFactor version 0.9.12.4.7"
## [1] "effectsize version 1.0.1"
```

```
## [1] "bayestestR version 0.17.0"
```

S2   Methods: additional details

S2.1   Procedure
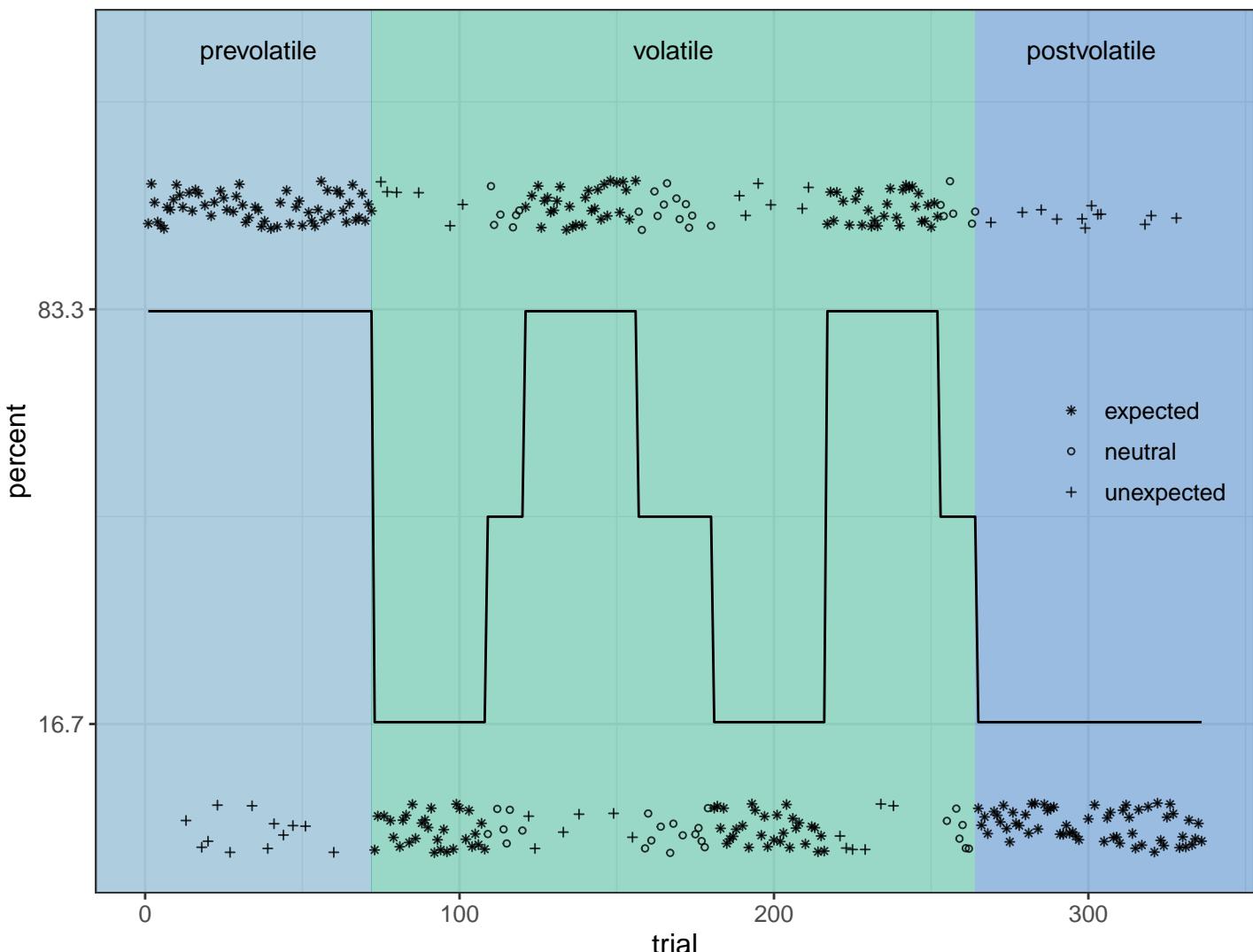
Behavioural tasks were performed in a small, soundproof testing chamber with consistent lighting on a Lenovo Legion Pro 5 mounted in a laptop stand (resolution: 2560x1600 pixel; size: 344x215mm; refresh rate: 60Hz). Eye-tracking data was collected with a LiveTrack Lightning eye tracker (Cambridge RS, sampling rate 500Hz) using a headrest to ensure a stable viewing distance of 57cm. The eye tracker was individually calibrated before each task based on 9-points.

S2.2   Stimulus creation

Stimuli were created using KDEF pictures of people portraying three expressions: emotionally neutral, fearful and happy (Lundqvist et al., 1998). Happy and fearful pictures were morphed with emotionally neutral pictures of the same person using WinMorph 3.01 to create videos of the person gradually and continually taking on an emotional expression. Independent samples of 21 and 25 participants rated the naturalness of videos of female-presenting and male-presenting faces, respectively (online surveys on SoSci, Leiner, 2019). We selected six identities based on these ratings (F02, F05, F09, M10, M11 and M13; naturalness of selected videos: range = 70.04-82.81; mean = 76.55). Of these videos, we extracted still images capturing 50%, 75% and 100% of the emotional expression to create hard, medium and easy stimuli, respectively.

S2.3   Development of associations across PAL task

High tone > positive, low tone > negative emotion

2

S2.4 Computational modelling of reaction times: Hierarchical Gaussian Filter

To ensure model reliability and faithfulness, we followed the Bayesian workflow adaptation for computational modelling as proposed by Hess and colleagues (2025). This workflow includes the computation of empirical priors, in our case based on the publicly available data from Lawson et al. (2021) as well as our own pilot data, simulation-based evaluation of parameter recovery and model identifiability, posterior predictive checks and model comparison.

S2.5 Comparison of LME across groups

```
##                    bf       error            time         code
## diagnosis -0.5840522 9.993788e-05 Thu Oct 30 11:19:46 2025 eca1873f721
```

S2.6 Analysis of extracted HGF parameters

We analysed HGF parameters using a Bayesian linear model with a Gaussian distribution and included group as the population-level predictor. Additionally, we explored whether ADHD diagnosis or ADHD medication could be predicted using scaled HGF parameters by fitting two Bernoulli models. For these Bernoulli models, we did not distinguish between adults with ADHD alone and those with comorbid ASD. We used a lognormal Bayesian linear mixed model to assess the influence of alpha level (second, third level), change (prevolatile to volatile, volatile to postvolatile) and their interaction on learning rate updates. The model also includes participants (level and change slopes) on the group-level.

S2.7 Computational modelling of reaction times: Wiener Diffusion Model

We used the ggdmc package to implement a Bayesian version of a hierarchical Wiener diffusion model (Lin & Strickland, 2020), since Bayesian versions of DDM are more robust to designs with fewer trials (Myers et al., 2022). We constructed three separate hierarchical DDMs, one for each group, as a single model for all groups did not converge. Each model included one drift rate per task phase (prevolatile, volatile, postvolatile) to assess differences between task phases with high and low environmental volatility. We assessed model reliability with simulation-based parameter recovery. Only models where all potential scale reduction factors assessing convergence of the Markov chains were smaller than 1.1 were included in the analysis (Gelman et al., 2003). To achieve convergence, we increased the thinning until stable models were obtained. Then, we extracted participant-specific DDM parameters and analysed the drift rates with a Bayesian linear mixed model with a Gaussian distribution (population-level predictors group, phase and their interaction; group-level intercept for participants). A similar model focusing on adults with ADHD, regardless of comorbid ASD, investigated the influence of medication on drift rates.

S2.8 Conventional analysis of reaction time variance, reaction times and error rates

We included only reaction times on correct trials in the analysis of the reaction times and reaction time variances. Additionally, we excluded extreme reaction times defined by the interquartile method. Participants whose accuracy was below 66.67% were excluded from all analyses. Additionally, reaction time variance was only computed as standard deviation for conditions where at least two-thirds of the trials' reaction times were included in the analysis. We used a shifted lognormal distribution to model correct reaction times with the model including group, expectancy, phase and difficulty on the population level. On the group level, we added trials (slope for group) and participants (slopes for expectancy, phase, difficulty and their interactions). We analysed reaction time variance with a lognormal model including the population-level predictors group, expectancy, phase and their interaction as well as participants with slopes for expectancy and phase on the group-level. We dropped the predictor difficulty due to poor posterior predictive fit, slightly deviating from the preregistration. Additionally, we used a Bayesian ANOVA on the rank transformed accuracies to explore differences.

S3 Participant-specific HGF and DDM parameters

S3.1 H3c: second level tonic volatility

```
##  Family: gaussian
##   Links: mu = identity; sigma = identity
## Formula: om2 ~ diagnosis
##    Data: df.hgf (Number of observations: 66)
##   Draws: 4 chains, each with iter = 3000; warmup = 1000; thin = 1;
##          total post-warmup draws = 8000
##
## Regression Coefficients:
##            Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
```

```
## Intercept      -5.93      0.28     -6.48     -5.37 1.00      8326      6174
## diagnosis1      0.19      0.30     -0.39      0.78 1.00      7098      6186
## diagnosis2      0.15      0.30     -0.45      0.73 1.00      7272      5704
##
## Further Distributional Parameters:
##        Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sigma      2.28      0.16     1.99      2.61 1.00      8008      5792
##
## Draws were sampled using sample(hmc). 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).
```

S3.2   Predicting ADHD diagnosis with HGF parameters

```
##  Family: bernoulli
##   Links: mu = logit
## Formula: group ~ sbe1 + sbe2 + sbe3 + sze + som2 + som3
##    Data: df.hgf (Number of observations: 41)
##   Draws: 4 chains, each with iter = 3000; warmup = 1000; thin = 1;
##          total post-warmup draws = 8000
##
## Regression Coefficients:
##           Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## Intercept     0.06      0.29     -0.52      0.63 1.00     11663      5569
## sbe1          0.18      0.36     -0.53      0.91 1.00     11572      5518
## sbe2         -0.09      0.37     -0.81      0.65 1.00     10220      6430
## sbe3         -0.19      0.36     -0.89      0.51 1.00     12722      6120
## sze           0.33      0.42     -0.48      1.17 1.00     10045      5970
## som2          0.66      0.36     -0.01      1.40 1.00     11259      6381
## som3         -0.04      0.44     -0.89      0.82 1.00      9145      6332
##
## Draws were sampled using sample(hmc). 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).
```

S3.3   Predicting ADHD medication with HGF parameters

```
##  Family: bernoulli
##   Links: mu = logit
## Formula: group.meds ~ sbe1 + sbe2 + sbe3 + sze + som2 + som3
##    Data: df.hgf (Number of observations: 44)
##   Draws: 4 chains, each with iter = 3000; warmup = 1000; thin = 1;
##          total post-warmup draws = 8000
##
## Regression Coefficients:
##           Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## Intercept     0.39      0.29     -0.17      0.96 1.00     13857      5726
## sbe1          0.19      0.35     -0.49      0.90 1.00     11114      6722
## sbe2          0.28      0.36     -0.43      1.00 1.00      9999      6075
## sbe3          0.04      0.33     -0.60      0.69 1.00     11532      6472
## sze           0.20      0.35     -0.46      0.91 1.00     11852      6181
## som2         -0.52      0.33     -1.20      0.11 1.00     10907      6430
## som3         -0.18      0.38     -0.94      0.56 1.00     11295      5957
##
## Draws were sampled using sample(hmc). 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).
```

S3.4 Learning rate update
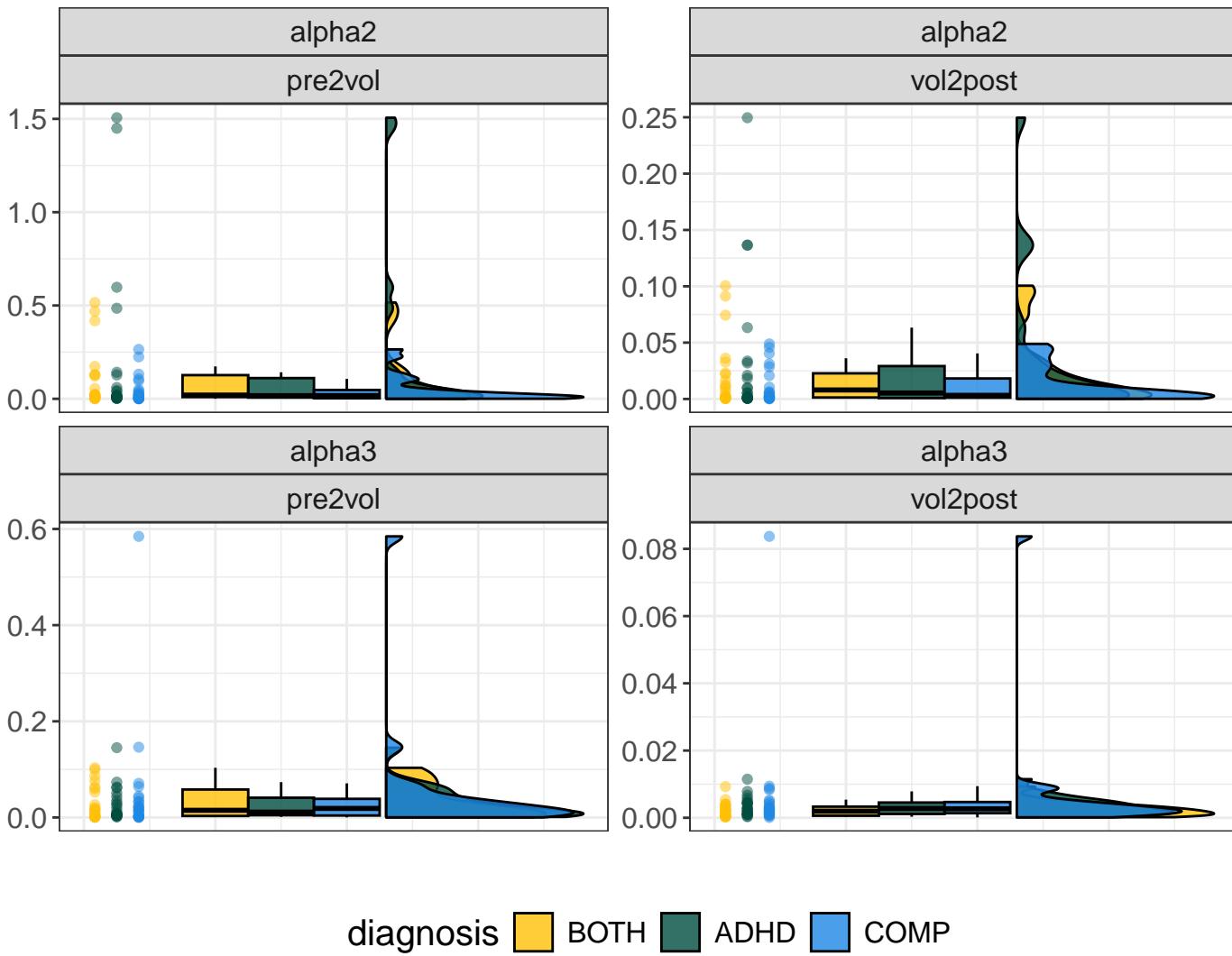
```
##  Family: lognormal
##   Links: mu = identity; sigma = identity
## Formula: value ~ diagnosis * level * change + (level + change | subID)
##    Data: df.upd (Number of observations: 264)
##   Draws: 4 chains, each with iter = 3000; warmup = 1000; thin = 1;
##         total post-warmup draws = 8000
##
## Multilevel Hyperparameters:
## ~subID (Number of levels: 66)
##                       Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS
## sd(Intercept)             1.11      0.12     0.90     1.35 1.00     2373
## sd(level1)                0.82      0.10     0.63     1.03 1.00     2986
## sd(change1)               0.21      0.08     0.05     0.36 1.00     2793
## cor(Intercept,level1)     0.41      0.13     0.15     0.65 1.00     2399
## cor(Intercept,change1)    0.60      0.23     0.02     0.92 1.00     5210
## cor(level1,change1)       0.62      0.23     0.03     0.92 1.00     5018
##                       Tail_ESS
## sd(Intercept)             4179
## sd(level1)                5020
## sd(change1)               1653
## cor(Intercept,level1)     4229
## cor(Intercept,change1)    3847
## cor(level1,change1)       3687
##
## Regression Coefficients:
##                         Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS
## Intercept                  -4.95      0.15    -5.24    -4.66 1.00     1627
## diagnosis1                  0.18      0.21    -0.22     0.59 1.00     1712
## diagnosis2                 -0.07      0.21    -0.48     0.33 1.00     1640
## level1                      0.33      0.12     0.10     0.56 1.00     2420
## change1                     0.77      0.07     0.64     0.90 1.00     6477
## diagnosis1:level1           0.06      0.17    -0.26     0.39 1.00     2513
## diagnosis2:level1           0.15      0.16    -0.17     0.47 1.00     2632
## diagnosis1:change1          0.05      0.10    -0.14     0.24 1.00     5609
## diagnosis2:change1          0.04      0.10    -0.15     0.23 1.00     6322
## level1:change1             -0.10      0.06    -0.22     0.03 1.00    12332
## diagnosis1:level1:change1   0.06      0.09    -0.11     0.24 1.00     7030
## diagnosis2:level1:change1  -0.07      0.09    -0.24     0.10 1.00     7296
##                         Tail_ESS
## Intercept                   2760
## diagnosis1                  2534
## diagnosis2                  2841
## level1                      3706
## change1                     5573
## diagnosis1:level1           4210
## diagnosis2:level1           4199
## diagnosis1:change1          5829
## diagnosis2:change1          5894
## level1:change1              5555
## diagnosis1:level1:change1   6185
## diagnosis2:level1:change1   5620
##
## Further Distributional Parameters:
##       Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sigma     1.01      0.07     0.89     1.15 1.00     2726     4036
##
## Draws were sampled using sample(hmc). For each parameter, Bulk_ESS
## and Tail_ESS are effective sample size measures, and Rhat is the potential
```

Learning rate updates

diagnosis ▢ BOTH ▢ ADHD ▢ COMP

S3.5 Group differences in drift rate

```
##  Family: gaussian
##   Links: mu = identity; sigma = identity
## Formula: v ~ diagnosis * phase + (1 | s)
##    Data: df.lng (Number of observations: 198)
##   Draws: 4 chains, each with iter = 3000; warmup = 1000; thin = 1;
##         total post-warmup draws = 8000
##
## Multilevel Hyperparameters:
## ~s (Number of levels: 66)
##               Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sd(Intercept)     0.59      0.06     0.49     0.72 1.00     1552     3009
##
## Regression Coefficients:
##                  Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## Intercept            2.31      0.08     2.16     2.47 1.01      912     1772
## diagnosis1          -0.27      0.11    -0.48    -0.07 1.01      883     1820
## diagnosis2          -0.05      0.11    -0.26     0.16 1.01      900     1974
## phase1              -0.03      0.03    -0.09     0.04 1.00     6249     5825
## phase2               0.04      0.03    -0.02     0.11 1.00     6359     5664
## diagnosis1:phase1    0.08      0.05    -0.01     0.17 1.00     5341     5891
```

```
## diagnosis2:phase1      -0.01      0.05      -0.11      0.08 1.00      5088      5845
## diagnosis1:phase2       0.01      0.05      -0.08      0.11 1.00      5421      5318
## diagnosis2:phase2      -0.03      0.05      -0.12      0.06 1.00      4940      5486
##
## Further Distributional Parameters:
##        Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sigma      0.33      0.02      0.29      0.38 1.00      4744      5283
##
## Draws were sampled using sample(hmc). 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).
```

S3.6   Influence of medication on drift rate

```
##  Family: gaussian
##   Links: mu = identity; sigma = identity
## Formula: v ~ adhd.meds.bin * phase + (1 | s)
##     Data: df.lng.sel (Number of observations: 132)
##   Draws: 4 chains, each with iter = 3000; warmup = 1000; thin = 1;
##         total post-warmup draws = 8000
##
## Multilevel Hyperparameters:
## ~s (Number of levels: 44)
##               Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sd(Intercept)     0.55      0.07      0.44      0.70 1.00      1552      2718
##
## Regression Coefficients:
##                     Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS
## Intercept               2.14      0.09      1.97      2.32 1.00      1049
## adhd.meds.bin1          0.06      0.09     -0.11      0.22 1.00      1057
## phase1                  0.01      0.03     -0.06      0.07 1.00      6948
## phase2                  0.03      0.03     -0.03      0.10 1.00      7233
## adhd.meds.bin1:phase1   0.01      0.03     -0.06      0.08 1.00      7207
## adhd.meds.bin1:phase2  -0.00      0.03     -0.07      0.06 1.00      7282
##                     Tail_ESS
## Intercept               2335
## adhd.meds.bin1          1984
## phase1                  6272
## phase2                  6017
## adhd.meds.bin1:phase1   5843
## adhd.meds.bin1:phase2   5958
##
## Further Distributional Parameters:
##        Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sigma      0.28      0.02      0.24      0.32 1.00      4994      5476
##
## Draws were sampled using sample(hmc). 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).
```

S4   Conventional analyses of responses and pupil sizes

S4.1   Response time variance

```
##  Family: lognormal
##   Links: mu = identity; sigma = identity
## Formula: rt.var ~ diagnosis * expected * phase + (expected + phase | subID)
##     Data: df.var (Number of observations: 387)
##   Draws: 4 chains, each with iter = 6000; warmup = 1500; thin = 1;
##         total post-warmup draws = 18000
```
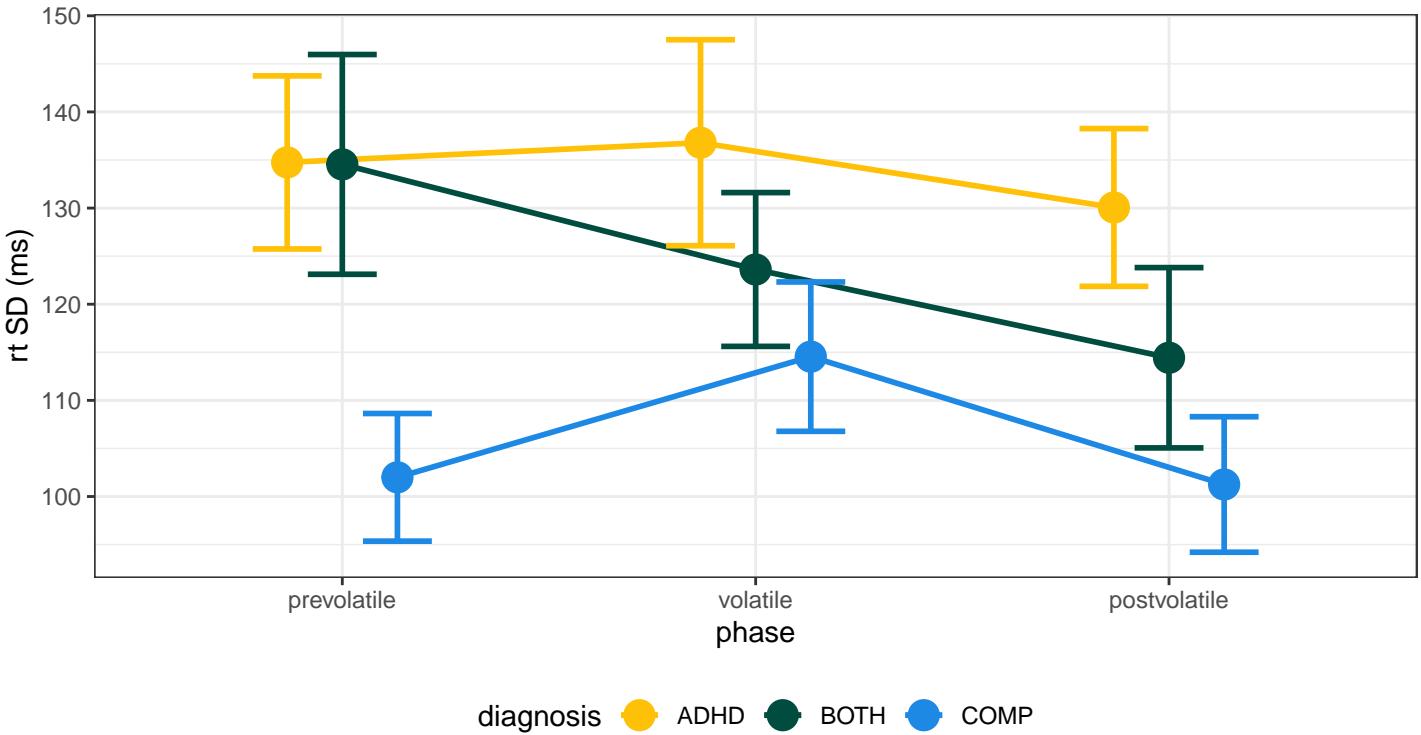
```
##
## Multilevel Hyperparameters:
## ~subID (Number of levels: 66)
##                         Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS
## sd(Intercept)               0.36      0.03     0.30     0.43 1.00     3864
## sd(expected1)               0.02      0.01     0.00     0.05 1.00     4508
## sd(phase1)                  0.09      0.02     0.05     0.12 1.00     6414
## sd(phase2)                  0.03      0.02     0.00     0.08 1.00     4058
## cor(Intercept,expected1)   -0.20      0.31    -0.74     0.47 1.00    22631
## cor(Intercept,phase1)      -0.23      0.18    -0.56     0.13 1.00    17311
## cor(expected1,phase1)       0.26      0.33    -0.48     0.81 1.00     2930
## cor(Intercept,phase2)       0.04      0.30    -0.56     0.62 1.00    22936
## cor(expected1,phase2)       0.19      0.37    -0.59     0.81 1.00     6950
## cor(phase1,phase2)          0.08      0.34    -0.58     0.70 1.00    17998
##                         Tail_ESS
## sd(Intercept)               7484
## sd(expected1)               5809
## sd(phase1)                  6234
## sd(phase2)                  6446
## cor(Intercept,expected1)   12093
## cor(Intercept,phase1)      13589
## cor(expected1,phase1)       5561
## cor(Intercept,phase2)      12392
## cor(expected1,phase2)      11325
## cor(phase1,phase2)         14323
##
## Regression Coefficients:
##                            Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS
## Intercept                      4.71      0.04     4.62     4.79 1.00     2209
## diagnosis1                     0.09      0.06    -0.03     0.21 1.00     2291
## diagnosis2                     0.03      0.06    -0.09     0.15 1.00     2444
## expected1                      0.06      0.01     0.04     0.08 1.00    30294
## phase1                         0.02      0.02    -0.01     0.05 1.00    15167
## phase2                         0.03      0.01     0.00     0.06 1.00    26066
## diagnosis1:expected1          -0.01      0.01    -0.04     0.02 1.00    22496
## diagnosis2:expected1          -0.00      0.01    -0.03     0.02 1.00    22150
## diagnosis1:phase1              0.00      0.02    -0.05     0.05 1.00    13212
## diagnosis2:phase1              0.05      0.02    -0.00     0.10 1.00    13450
## diagnosis1:phase2             -0.03      0.02    -0.07     0.01 1.00    19605
## diagnosis2:phase2             -0.02      0.02    -0.06     0.02 1.00    20126
## expected1:phase1               0.02      0.01    -0.00     0.05 1.00    27027
## expected1:phase2              -0.02      0.01    -0.05     0.00 1.00    25645
## diagnosis1:expected1:phase1   -0.01      0.02    -0.05     0.03 1.00    19059
## diagnosis2:expected1:phase1   -0.01      0.02    -0.05     0.02 1.00    19306
## diagnosis1:expected1:phase2    0.04      0.02    -0.00     0.07 1.00    19797
## diagnosis2:expected1:phase2    0.00      0.02    -0.03     0.04 1.00    18557
##                            Tail_ESS
## Intercept                      5022
## diagnosis1                     4509
## diagnosis2                     4865
## expected1                     13918
## phase1                        13959
## phase2                        13147
## diagnosis1:expected1          14370
## diagnosis2:expected1          14145
## diagnosis1:phase1             13651
## diagnosis2:phase1             13448
## diagnosis1:phase2             13824
## diagnosis2:phase2             14268
## expected1:phase1              15127
```

```
## expected1:phase2                  15707
## diagnosis1:expected1:phase1        15059
## diagnosis2:expected1:phase1        13226
## diagnosis1:expected1:phase2        14941
## diagnosis2:expected1:phase2        14865
##
## Further Distributional Parameters:
##        Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sigma      0.18      0.01     0.17     0.20 1.00     6545    10033
##
## Draws were sampled using sample(hmc). 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).
```


S4.2   Response times

```
##  Family: shifted_lognormal
##   Links: mu = identity; sigma = identity; ndt = identity
## Formula: rt.cor ~ diagnosis * expected * phase * difficulty + (expected * phase * difficulty | subID) + (di
##     Data: df.pal (Number of observations: 16886)
##   Draws: 4 chains, each with iter = 6000; warmup = 1500; thin = 1;
##          total post-warmup draws = 18000
##
## Multilevel Hyperparameters:
## ~subID (Number of levels: 66)
##                                                          Estimate
## sd(Intercept)                                                0.19
## sd(expected1)                                                0.02
## sd(phase1)                                                   0.06
## sd(phase2)                                                   0.02
## sd(difficulty1)                                              0.01
## sd(difficulty2)                                              0.01
## sd(expected1:phase1)                                         0.02
## sd(expected1:phase2)                                         0.01
## sd(expected1:difficulty1)                                    0.00
## sd(expected1:difficulty2)                                    0.01
```

```
## sd(phase1:difficulty1)                                      0.01
## sd(phase2:difficulty1)                                      0.01
## sd(phase1:difficulty2)                                      0.01
## sd(phase2:difficulty2)                                      0.01
## sd(expected1:phase1:difficulty1)                            0.01
## sd(expected1:phase2:difficulty1)                            0.01
## sd(expected1:phase1:difficulty2)                            0.01
## sd(expected1:phase2:difficulty2)                            0.01
## cor(Intercept,expected1)                                    0.23
## cor(Intercept,phase1)                                       0.08
## cor(expected1,phase1)                                       0.22
## cor(Intercept,phase2)                                       0.09
## cor(expected1,phase2)                                       0.04
## cor(phase1,phase2)                                         -0.25
## cor(Intercept,difficulty1)                                 -0.25
## cor(expected1,difficulty1)                                 -0.08
## cor(phase1,difficulty1)                                    -0.17
## cor(phase2,difficulty1)                                    -0.07
## cor(Intercept,difficulty2)                                 -0.04
## cor(expected1,difficulty2)                                 -0.11
## cor(phase1,difficulty2)                                    -0.17
## cor(phase2,difficulty2)                                     0.09
## cor(difficulty1,difficulty2)                                0.02
## cor(Intercept,expected1:phase1)                             0.03
## cor(expected1,expected1:phase1)                             0.17
## cor(phase1,expected1:phase1)                                0.09
## cor(phase2,expected1:phase1)                               -0.17
## cor(difficulty1,expected1:phase1)                           0.06
## cor(difficulty2,expected1:phase1)                          -0.02
## cor(Intercept,expected1:phase2)                             0.21
## cor(expected1,expected1:phase2)                             0.07
## cor(phase1,expected1:phase2)                               -0.05
## cor(phase2,expected1:phase2)                                0.04
## cor(difficulty1,expected1:phase2)                           0.05
## cor(difficulty2,expected1:phase2)                           0.13
## cor(expected1:phase1,expected1:phase2)                      0.01
## cor(Intercept,expected1:difficulty1)                       -0.07
## cor(expected1,expected1:difficulty1)                        0.03
## cor(phase1,expected1:difficulty1)                           0.03
## cor(phase2,expected1:difficulty1)                           0.00
## cor(difficulty1,expected1:difficulty1)                     -0.01
## cor(difficulty2,expected1:difficulty1)                     -0.00
## cor(expected1:phase1,expected1:difficulty1)                 0.04
## cor(expected1:phase2,expected1:difficulty1)                 0.01
## cor(Intercept,expected1:difficulty2)                        0.01
## cor(expected1,expected1:difficulty2)                        0.05
## cor(phase1,expected1:difficulty2)                           0.10
## cor(phase2,expected1:difficulty2)                           0.07
## cor(difficulty1,expected1:difficulty2)                      0.02
## cor(difficulty2,expected1:difficulty2)                     -0.01
## cor(expected1:phase1,expected1:difficulty2)                 0.06
## cor(expected1:phase2,expected1:difficulty2)                 0.07
## cor(expected1:difficulty1,expected1:difficulty2)           -0.01
## cor(Intercept,phase1:difficulty1)                          -0.09
## cor(expected1,phase1:difficulty1)                           0.06
## cor(phase1,phase1:difficulty1)                              0.15
## cor(phase2,phase1:difficulty1)                             -0.11
## cor(difficulty1,phase1:difficulty1)                         0.07
## cor(difficulty2,phase1:difficulty1)                        -0.06
## cor(expected1:phase1,phase1:difficulty1)                    0.07
```

```
## cor(expected1:phase2,phase1:difficulty1)                              -0.04
## cor(expected1:difficulty1,phase1:difficulty1)                          0.05
## cor(expected1:difficulty2,phase1:difficulty1)                          0.01
## cor(Intercept,phase2:difficulty1)                                     -0.05
## cor(expected1,phase2:difficulty1)                                      0.05
## cor(phase1,phase2:difficulty1)                                        -0.11
## cor(phase2,phase2:difficulty1)                                         0.03
## cor(difficulty1,phase2:difficulty1)                                    0.09
## cor(difficulty2,phase2:difficulty1)                                    0.01
## cor(expected1:phase1,phase2:difficulty1)                               0.01
## cor(expected1:phase2,phase2:difficulty1)                               0.08
## cor(expected1:difficulty1,phase2:difficulty1)                          0.03
## cor(expected1:difficulty2,phase2:difficulty1)                         -0.03
## cor(phase1:difficulty1,phase2:difficulty1)                            -0.02
## cor(Intercept,phase1:difficulty2)                                      0.06
## cor(expected1,phase1:difficulty2)                                     -0.03
## cor(phase1,phase1:difficulty2)                                         0.04
## cor(phase2,phase1:difficulty2)                                        -0.06
## cor(difficulty1,phase1:difficulty2)                                   -0.05
## cor(difficulty2,phase1:difficulty2)                                    0.01
## cor(expected1:phase1,phase1:difficulty2)                              -0.03
## cor(expected1:phase2,phase1:difficulty2)                              -0.03
## cor(expected1:difficulty1,phase1:difficulty2)                         -0.04
## cor(expected1:difficulty2,phase1:difficulty2)                         -0.00
## cor(phase1:difficulty1,phase1:difficulty2)                            -0.05
## cor(phase2:difficulty1,phase1:difficulty2)                            -0.05
## cor(Intercept,phase2:difficulty2)                                      0.23
## cor(expected1,phase2:difficulty2)                                      0.13
## cor(phase1,phase2:difficulty2)                                        -0.08
## cor(phase2,phase2:difficulty2)                                         0.04
## cor(difficulty1,phase2:difficulty2)                                    0.04
## cor(difficulty2,phase2:difficulty2)                                    0.02
## cor(expected1:phase1,phase2:difficulty2)                               0.09
## cor(expected1:phase2,phase2:difficulty2)                               0.19
## cor(expected1:difficulty1,phase2:difficulty2)                         -0.02
## cor(expected1:difficulty2,phase2:difficulty2)                          0.01
## cor(phase1:difficulty1,phase2:difficulty2)                            -0.09
## cor(phase2:difficulty1,phase2:difficulty2)                            -0.04
## cor(phase1:difficulty2,phase2:difficulty2)                            -0.05
## cor(Intercept,expected1:phase1:difficulty1)                            0.06
## cor(expected1,expected1:phase1:difficulty1)                            0.07
## cor(phase1,expected1:phase1:difficulty1)                               0.13
## cor(phase2,expected1:phase1:difficulty1)                              -0.01
## cor(difficulty1,expected1:phase1:difficulty1)                         -0.01
## cor(difficulty2,expected1:phase1:difficulty1)                         -0.01
## cor(expected1:phase1,expected1:phase1:difficulty1)                     0.03
## cor(expected1:phase2,expected1:phase1:difficulty1)                     0.02
## cor(expected1:difficulty1,expected1:phase1:difficulty1)                0.02
## cor(expected1:difficulty2,expected1:phase1:difficulty1)                0.04
## cor(phase1:difficulty1,expected1:phase1:difficulty1)                  -0.05
## cor(phase2:difficulty1,expected1:phase1:difficulty1)                  -0.04
## cor(phase1:difficulty2,expected1:phase1:difficulty1)                  -0.02
## cor(phase2:difficulty2,expected1:phase1:difficulty1)                  -0.00
## cor(Intercept,expected1:phase2:difficulty1)                            0.04
## cor(expected1,expected1:phase2:difficulty1)                            0.10
## cor(phase1,expected1:phase2:difficulty1)                               0.06
## cor(phase2,expected1:phase2:difficulty1)                               0.05
## cor(difficulty1,expected1:phase2:difficulty1)                         -0.04
## cor(difficulty2,expected1:phase2:difficulty1)                         -0.03
## cor(expected1:phase1,expected1:phase2:difficulty1)                    -0.01
```

```
## cor(expected1:phase2,expected1:phase2:difficulty1)                                   -0.01
## cor(expected1:difficulty1,expected1:phase2:difficulty1)                              -0.02
## cor(expected1:difficulty2,expected1:phase2:difficulty1)                               0.01
## cor(phase1:difficulty1,expected1:phase2:difficulty1)                                 -0.02
## cor(phase2:difficulty1,expected1:phase2:difficulty1)                                 -0.05
## cor(phase1:difficulty2,expected1:phase2:difficulty1)                                 -0.01
## cor(phase2:difficulty2,expected1:phase2:difficulty1)                                 -0.01
## cor(expected1:phase1:difficulty1,expected1:phase2:difficulty1)                       -0.00
## cor(Intercept,expected1:phase1:difficulty2)                                           0.02
## cor(expected1,expected1:phase1:difficulty2)                                          -0.04
## cor(phase1,expected1:phase1:difficulty2)                                              0.02
## cor(phase2,expected1:phase1:difficulty2)                                             -0.01
## cor(difficulty1,expected1:phase1:difficulty2)                                        -0.02
## cor(difficulty2,expected1:phase1:difficulty2)                                         0.03
## cor(expected1:phase1,expected1:phase1:difficulty2)                                   -0.03
## cor(expected1:phase2,expected1:phase1:difficulty2)                                   -0.03
## cor(expected1:difficulty1,expected1:phase1:difficulty2)                              -0.02
## cor(expected1:difficulty2,expected1:phase1:difficulty2)                               0.01
## cor(phase1:difficulty1,expected1:phase1:difficulty2)                                 -0.04
## cor(phase2:difficulty1,expected1:phase1:difficulty2)                                 -0.03
## cor(phase1:difficulty2,expected1:phase1:difficulty2)                                 -0.01
## cor(phase2:difficulty2,expected1:phase1:difficulty2)                                 -0.03
## cor(expected1:phase1:difficulty1,expected1:phase1:difficulty2)                       -0.03
## cor(expected1:phase2:difficulty1,expected1:phase1:difficulty2)                       -0.01
## cor(Intercept,expected1:phase2:difficulty2)                                           0.04
## cor(expected1,expected1:phase2:difficulty2)                                           0.07
## cor(phase1,expected1:phase2:difficulty2)                                              0.09
## cor(phase2,expected1:phase2:difficulty2)                                              0.06
## cor(difficulty1,expected1:phase2:difficulty2)                                        -0.03
## cor(difficulty2,expected1:phase2:difficulty2)                                        -0.04
## cor(expected1:phase1,expected1:phase2:difficulty2)                                    0.01
## cor(expected1:phase2,expected1:phase2:difficulty2)                                    0.01
## cor(expected1:difficulty1,expected1:phase2:difficulty2)                              -0.01
## cor(expected1:difficulty2,expected1:phase2:difficulty2)                              -0.00
## cor(phase1:difficulty1,expected1:phase2:difficulty2)                                 -0.00
## cor(phase2:difficulty1,expected1:phase2:difficulty2)                                 -0.04
## cor(phase1:difficulty2,expected1:phase2:difficulty2)                                 -0.03
## cor(phase2:difficulty2,expected1:phase2:difficulty2)                                 -0.07
## cor(expected1:phase1:difficulty1,expected1:phase2:difficulty2)                        0.01
## cor(expected1:phase2:difficulty1,expected1:phase2:difficulty2)                       -0.01
## cor(expected1:phase1:difficulty2,expected1:phase2:difficulty2)                       -0.03
##                                                                               Est.Error
## sd(Intercept)                                                                      0.02
## sd(expected1)                                                                      0.00
## sd(phase1)                                                                         0.01
## sd(phase2)                                                                         0.00
## sd(difficulty1)                                                                    0.00
## sd(difficulty2)                                                                    0.00
## sd(expected1:phase1)                                                               0.01
## sd(expected1:phase2)                                                               0.01
## sd(expected1:difficulty1)                                                          0.00
## sd(expected1:difficulty2)                                                          0.00
## sd(phase1:difficulty1)                                                             0.01
## sd(phase2:difficulty1)                                                             0.00
## sd(phase1:difficulty2)                                                             0.00
## sd(phase2:difficulty2)                                                             0.01
## sd(expected1:phase1:difficulty1)                                                   0.00
## sd(expected1:phase2:difficulty1)                                                   0.00
## sd(expected1:phase1:difficulty2)                                                   0.00
## sd(expected1:phase2:difficulty2)                                                   0.00
```

```
## cor(Intercept,expected1)                                      0.14
## cor(Intercept,phase1)                                         0.12
## cor(expected1,phase1)                                         0.15
## cor(Intercept,phase2)                                         0.14
## cor(expected1,phase2)                                         0.18
## cor(phase1,phase2)                                            0.15
## cor(Intercept,difficulty1)                                   0.17
## cor(expected1,difficulty1)                                   0.19
## cor(phase1,difficulty1)                                      0.17
## cor(phase2,difficulty1)                                      0.19
## cor(Intercept,difficulty2)                                   0.19
## cor(expected1,difficulty2)                                   0.20
## cor(phase1,difficulty2)                                      0.19
## cor(phase2,difficulty2)                                      0.20
## cor(difficulty1,difficulty2)                                 0.21
## cor(Intercept,expected1:phase1)                              0.17
## cor(expected1,expected1:phase1)                              0.19
## cor(phase1,expected1:phase1)                                 0.18
## cor(phase2,expected1:phase1)                                 0.19
## cor(difficulty1,expected1:phase1)                            0.20
## cor(difficulty2,expected1:phase1)                            0.21
## cor(Intercept,expected1:phase2)                              0.17
## cor(expected1,expected1:phase2)                              0.19
## cor(phase1,expected1:phase2)                                 0.17
## cor(phase2,expected1:phase2)                                 0.19
## cor(difficulty1,expected1:phase2)                            0.20
## cor(difficulty2,expected1:phase2)                            0.21
## cor(expected1:phase1,expected1:phase2)                       0.20
## cor(Intercept,expected1:difficulty1)                         0.21
## cor(expected1,expected1:difficulty1)                         0.22
## cor(phase1,expected1:difficulty1)                            0.21
## cor(phase2,expected1:difficulty1)                            0.21
## cor(difficulty1,expected1:difficulty1)                       0.22
## cor(difficulty2,expected1:difficulty1)                       0.21
## cor(expected1:phase1,expected1:difficulty1)                  0.22
## cor(expected1:phase2,expected1:difficulty1)                  0.21
## cor(Intercept,expected1:difficulty2)                         0.19
## cor(expected1,expected1:difficulty2)                         0.21
## cor(phase1,expected1:difficulty2)                            0.20
## cor(phase2,expected1:difficulty2)                            0.21
## cor(difficulty1,expected1:difficulty2)                       0.21
## cor(difficulty2,expected1:difficulty2)                       0.22
## cor(expected1:phase1,expected1:difficulty2)                  0.21
## cor(expected1:phase2,expected1:difficulty2)                  0.21
## cor(expected1:difficulty1,expected1:difficulty2)             0.22
## cor(Intercept,phase1:difficulty1)                            0.20
## cor(expected1,phase1:difficulty1)                            0.21
## cor(phase1,phase1:difficulty1)                               0.21
## cor(phase2,phase1:difficulty1)                               0.21
## cor(difficulty1,phase1:difficulty1)                          0.21
## cor(difficulty2,phase1:difficulty1)                          0.21
## cor(expected1:phase1,phase1:difficulty1)                     0.21
## cor(expected1:phase2,phase1:difficulty1)                     0.21
## cor(expected1:difficulty1,phase1:difficulty1)                0.22
## cor(expected1:difficulty2,phase1:difficulty1)                0.22
## cor(Intercept,phase2:difficulty1)                            0.20
## cor(expected1,phase2:difficulty1)                            0.21
## cor(phase1,phase2:difficulty1)                               0.20
## cor(phase2,phase2:difficulty1)                               0.21
## cor(difficulty1,phase2:difficulty1)                          0.21
```

```
## cor(difficulty2,phase2:difficulty1)                                        0.21
## cor(expected1:phase1,phase2:difficulty1)                                   0.21
## cor(expected1:phase2,phase2:difficulty1)                                   0.21
## cor(expected1:difficulty1,phase2:difficulty1)                              0.22
## cor(expected1:difficulty2,phase2:difficulty1)                              0.22
## cor(phase1:difficulty1,phase2:difficulty1)                                 0.22
## cor(Intercept,phase1:difficulty2)                                          0.21
## cor(expected1,phase1:difficulty2)                                          0.21
## cor(phase1,phase1:difficulty2)                                             0.21
## cor(phase2,phase1:difficulty2)                                             0.21
## cor(difficulty1,phase1:difficulty2)                                        0.22
## cor(difficulty2,phase1:difficulty2)                                        0.22
## cor(expected1:phase1,phase1:difficulty2)                                   0.22
## cor(expected1:phase2,phase1:difficulty2)                                   0.22
## cor(expected1:difficulty1,phase1:difficulty2)                              0.22
## cor(expected1:difficulty2,phase1:difficulty2)                              0.22
## cor(phase1:difficulty1,phase1:difficulty2)                                 0.22
## cor(phase2:difficulty1,phase1:difficulty2)                                 0.22
## cor(Intercept,phase2:difficulty2)                                          0.17
## cor(expected1,phase2:difficulty2)                                          0.19
## cor(phase1,phase2:difficulty2)                                             0.18
## cor(phase2,phase2:difficulty2)                                             0.19
## cor(difficulty1,phase2:difficulty2)                                        0.20
## cor(difficulty2,phase2:difficulty2)                                        0.21
## cor(expected1:phase1,phase2:difficulty2)                                   0.20
## cor(expected1:phase2,phase2:difficulty2)                                   0.20
## cor(expected1:difficulty1,phase2:difficulty2)                              0.22
## cor(expected1:difficulty2,phase2:difficulty2)                              0.21
## cor(phase1:difficulty1,phase2:difficulty2)                                 0.22
## cor(phase2:difficulty1,phase2:difficulty2)                                 0.21
## cor(phase1:difficulty2,phase2:difficulty2)                                 0.22
## cor(Intercept,expected1:phase1:difficulty1)                                0.21
## cor(expected1,expected1:phase1:difficulty1)                                0.22
## cor(phase1,expected1:phase1:difficulty1)                                   0.22
## cor(phase2,expected1:phase1:difficulty1)                                   0.22
## cor(difficulty1,expected1:phase1:difficulty1)                              0.21
## cor(difficulty2,expected1:phase1:difficulty1)                              0.22
## cor(expected1:phase1,expected1:phase1:difficulty1)                         0.22
## cor(expected1:phase2,expected1:phase1:difficulty1)                         0.21
## cor(expected1:difficulty1,expected1:phase1:difficulty1)                    0.22
## cor(expected1:difficulty2,expected1:phase1:difficulty1)                    0.22
## cor(phase1:difficulty1,expected1:phase1:difficulty1)                       0.22
## cor(phase2:difficulty1,expected1:phase1:difficulty1)                       0.22
## cor(phase1:difficulty2,expected1:phase1:difficulty1)                       0.22
## cor(phase2:difficulty2,expected1:phase1:difficulty1)                       0.22
## cor(Intercept,expected1:phase2:difficulty1)                                0.21
## cor(expected1,expected1:phase2:difficulty1)                                0.22
## cor(phase1,expected1:phase2:difficulty1)                                   0.21
## cor(phase2,expected1:phase2:difficulty1)                                   0.21
## cor(difficulty1,expected1:phase2:difficulty1)                              0.22
## cor(difficulty2,expected1:phase2:difficulty1)                              0.22
## cor(expected1:phase1,expected1:phase2:difficulty1)                         0.22
## cor(expected1:phase2,expected1:phase2:difficulty1)                         0.22
## cor(expected1:difficulty1,expected1:phase2:difficulty1)                    0.22
## cor(expected1:difficulty2,expected1:phase2:difficulty1)                    0.22
## cor(phase1:difficulty1,expected1:phase2:difficulty1)                       0.22
## cor(phase2:difficulty1,expected1:phase2:difficulty1)                       0.22
## cor(phase1:difficulty2,expected1:phase2:difficulty1)                       0.22
## cor(phase2:difficulty2,expected1:phase2:difficulty1)                       0.22
## cor(expected1:phase1:difficulty1,expected1:phase2:difficulty1)             0.22
```

```
## cor(Intercept,expected1:phase1:difficulty2)                              0.21
## cor(expected1,expected1:phase1:difficulty2)                              0.21
## cor(phase1,expected1:phase1:difficulty2)                                 0.21
## cor(phase2,expected1:phase1:difficulty2)                                 0.21
## cor(difficulty1,expected1:phase1:difficulty2)                            0.21
## cor(difficulty2,expected1:phase1:difficulty2)                            0.22
## cor(expected1:phase1,expected1:phase1:difficulty2)                       0.21
## cor(expected1:phase2,expected1:phase1:difficulty2)                       0.22
## cor(expected1:difficulty1,expected1:phase1:difficulty2)                  0.22
## cor(expected1:difficulty2,expected1:phase1:difficulty2)                  0.22
## cor(phase1:difficulty1,expected1:phase1:difficulty2)                     0.22
## cor(phase2:difficulty1,expected1:phase1:difficulty2)                     0.22
## cor(phase1:difficulty2,expected1:phase1:difficulty2)                     0.22
## cor(phase2:difficulty2,expected1:phase1:difficulty2)                     0.22
## cor(expected1:phase1:difficulty1,expected1:phase1:difficulty2)           0.22
## cor(expected1:phase2:difficulty1,expected1:phase1:difficulty2)           0.21
## cor(Intercept,expected1:phase2:difficulty2)                              0.21
## cor(expected1,expected1:phase2:difficulty2)                              0.21
## cor(phase1,expected1:phase2:difficulty2)                                 0.21
## cor(phase2,expected1:phase2:difficulty2)                                 0.21
## cor(difficulty1,expected1:phase2:difficulty2)                            0.21
## cor(difficulty2,expected1:phase2:difficulty2)                            0.22
## cor(expected1:phase1,expected1:phase2:difficulty2)                       0.21
## cor(expected1:phase2,expected1:phase2:difficulty2)                       0.21
## cor(expected1:difficulty1,expected1:phase2:difficulty2)                  0.22
## cor(expected1:difficulty2,expected1:phase2:difficulty2)                  0.22
## cor(phase1:difficulty1,expected1:phase2:difficulty2)                     0.22
## cor(phase2:difficulty1,expected1:phase2:difficulty2)                     0.22
## cor(phase1:difficulty2,expected1:phase2:difficulty2)                     0.22
## cor(phase2:difficulty2,expected1:phase2:difficulty2)                     0.22
## cor(expected1:phase1:difficulty1,expected1:phase2:difficulty2)           0.22
## cor(expected1:phase2:difficulty1,expected1:phase2:difficulty2)           0.22
## cor(expected1:phase1:difficulty2,expected1:phase2:difficulty2)           0.22
##                                                                       l-95% CI
## sd(Intercept)                                                            0.16
## sd(expected1)                                                            0.01
## sd(phase1)                                                               0.05
## sd(phase2)                                                               0.01
## sd(difficulty1)                                                          0.00
## sd(difficulty2)                                                          0.00
## sd(expected1:phase1)                                                     0.00
## sd(expected1:phase2)                                                     0.00
## sd(expected1:difficulty1)                                                0.00
## sd(expected1:difficulty2)                                                0.00
## sd(phase1:difficulty1)                                                   0.00
## sd(phase2:difficulty1)                                                   0.00
## sd(phase1:difficulty2)                                                   0.00
## sd(phase2:difficulty2)                                                   0.00
## sd(expected1:phase1:difficulty1)                                         0.00
## sd(expected1:phase2:difficulty1)                                         0.00
## sd(expected1:phase1:difficulty2)                                         0.00
## sd(expected1:phase2:difficulty2)                                         0.00
## cor(Intercept,expected1)                                                -0.06
## cor(Intercept,phase1)                                                   -0.15
## cor(expected1,phase1)                                                   -0.09
## cor(Intercept,phase2)                                                   -0.19
## cor(expected1,phase2)                                                   -0.31
## cor(phase1,phase2)                                                      -0.52
## cor(Intercept,difficulty1)                                              -0.55
## cor(expected1,difficulty1)                                              -0.44
```

```
## cor(phase1,difficulty1)                                        -0.50
## cor(phase2,difficulty1)                                        -0.44
## cor(Intercept,difficulty2)                                     -0.40
## cor(expected1,difficulty2)                                     -0.49
## cor(phase1,difficulty2)                                        -0.52
## cor(phase2,difficulty2)                                        -0.31
## cor(difficulty1,difficulty2)                                   -0.38
## cor(Intercept,expected1:phase1)                                -0.30
## cor(expected1,expected1:phase1)                                -0.22
## cor(phase1,expected1:phase1)                                   -0.25
## cor(phase2,expected1:phase1)                                   -0.53
## cor(difficulty1,expected1:phase1)                              -0.33
## cor(difficulty2,expected1:phase1)                              -0.42
## cor(Intercept,expected1:phase2)                                -0.14
## cor(expected1,expected1:phase2)                                -0.30
## cor(phase1,expected1:phase2)                                   -0.38
## cor(phase2,expected1:phase2)                                   -0.33
## cor(difficulty1,expected1:phase2)                              -0.35
## cor(difficulty2,expected1:phase2)                              -0.29
## cor(expected1:phase1,expected1:phase2)                         -0.38
## cor(Intercept,expected1:difficulty1)                           -0.47
## cor(expected1,expected1:difficulty1)                           -0.39
## cor(phase1,expected1:difficulty1)                              -0.40
## cor(phase2,expected1:difficulty1)                              -0.42
## cor(difficulty1,expected1:difficulty1)                         -0.43
## cor(difficulty2,expected1:difficulty1)                         -0.42
## cor(expected1:phase1,expected1:difficulty1)                    -0.39
## cor(expected1:phase2,expected1:difficulty1)                    -0.40
## cor(Intercept,expected1:difficulty2)                           -0.37
## cor(expected1,expected1:difficulty2)                           -0.36
## cor(phase1,expected1:difficulty2)                              -0.31
## cor(phase2,expected1:difficulty2)                              -0.34
## cor(difficulty1,expected1:difficulty2)                         -0.39
## cor(difficulty2,expected1:difficulty2)                         -0.42
## cor(expected1:phase1,expected1:difficulty2)                    -0.36
## cor(expected1:phase2,expected1:difficulty2)                    -0.34
## cor(expected1:difficulty1,expected1:difficulty2)               -0.42
## cor(Intercept,phase1:difficulty1)                              -0.46
## cor(expected1,phase1:difficulty1)                              -0.36
## cor(phase1,phase1:difficulty1)                                 -0.28
## cor(phase2,phase1:difficulty1)                                 -0.51
## cor(difficulty1,phase1:difficulty1)                            -0.35
## cor(difficulty2,phase1:difficulty1)                            -0.48
## cor(expected1:phase1,phase1:difficulty1)                       -0.35
## cor(expected1:phase2,phase1:difficulty1)                       -0.44
## cor(expected1:difficulty1,phase1:difficulty1)                  -0.38
## cor(expected1:difficulty2,phase1:difficulty1)                  -0.41
## cor(Intercept,phase2:difficulty1)                              -0.42
## cor(expected1,phase2:difficulty1)                              -0.37
## cor(phase1,phase2:difficulty1)                                 -0.49
## cor(phase2,phase2:difficulty1)                                 -0.37
## cor(difficulty1,phase2:difficulty1)                            -0.34
## cor(difficulty2,phase2:difficulty1)                            -0.40
## cor(expected1:phase1,phase2:difficulty1)                       -0.40
## cor(expected1:phase2,phase2:difficulty1)                       -0.35
## cor(expected1:difficulty1,phase2:difficulty1)                  -0.40
## cor(expected1:difficulty2,phase2:difficulty1)                  -0.45
## cor(phase1:difficulty1,phase2:difficulty1)                     -0.44
## cor(Intercept,phase1:difficulty2)                              -0.36
## cor(expected1,phase1:difficulty2)                              -0.43
```

```
## cor(phase1,phase1:difficulty2)                                  -0.37
## cor(phase2,phase1:difficulty2)                                  -0.46
## cor(difficulty1,phase1:difficulty2)                             -0.46
## cor(difficulty2,phase1:difficulty2)                             -0.41
## cor(expected1:phase1,phase1:difficulty2)                        -0.45
## cor(expected1:phase2,phase1:difficulty2)                        -0.44
## cor(expected1:difficulty1,phase1:difficulty2)                   -0.46
## cor(expected1:difficulty2,phase1:difficulty2)                   -0.42
## cor(phase1:difficulty1,phase1:difficulty2)                      -0.48
## cor(phase2:difficulty1,phase1:difficulty2)                      -0.47
## cor(Intercept,phase2:difficulty2)                               -0.14
## cor(expected1,phase2:difficulty2)                               -0.26
## cor(phase1,phase2:difficulty2)                                  -0.42
## cor(phase2,phase2:difficulty2)                                  -0.33
## cor(difficulty1,phase2:difficulty2)                             -0.36
## cor(difficulty2,phase2:difficulty2)                             -0.38
## cor(expected1:phase1,phase2:difficulty2)                        -0.32
## cor(expected1:phase2,phase2:difficulty2)                        -0.22
## cor(expected1:difficulty1,phase2:difficulty2)                   -0.43
## cor(expected1:difficulty2,phase2:difficulty2)                   -0.41
## cor(phase1:difficulty1,phase2:difficulty2)                      -0.49
## cor(phase2:difficulty1,phase2:difficulty2)                      -0.44
## cor(phase1:difficulty2,phase2:difficulty2)                      -0.46
## cor(Intercept,expected1:phase1:difficulty1)                     -0.36
## cor(expected1,expected1:phase1:difficulty1)                     -0.37
## cor(phase1,expected1:phase1:difficulty1)                        -0.33
## cor(phase2,expected1:phase1:difficulty1)                        -0.43
## cor(difficulty1,expected1:phase1:difficulty1)                   -0.42
## cor(difficulty2,expected1:phase1:difficulty1)                   -0.43
## cor(expected1:phase1,expected1:phase1:difficulty1)              -0.40
## cor(expected1:phase2,expected1:phase1:difficulty1)              -0.39
## cor(expected1:difficulty1,expected1:phase1:difficulty1)         -0.41
## cor(expected1:difficulty2,expected1:phase1:difficulty1)         -0.40
## cor(phase1:difficulty1,expected1:phase1:difficulty1)            -0.47
## cor(phase2:difficulty1,expected1:phase1:difficulty1)            -0.46
## cor(phase1:difficulty2,expected1:phase1:difficulty1)            -0.44
## cor(phase2:difficulty2,expected1:phase1:difficulty1)            -0.41
## cor(Intercept,expected1:phase2:difficulty1)                     -0.37
## cor(expected1,expected1:phase2:difficulty1)                     -0.34
## cor(phase1,expected1:phase2:difficulty1)                        -0.37
## cor(phase2,expected1:phase2:difficulty1)                        -0.37
## cor(difficulty1,expected1:phase2:difficulty1)                   -0.45
## cor(difficulty2,expected1:phase2:difficulty1)                   -0.44
## cor(expected1:phase1,expected1:phase2:difficulty1)              -0.44
## cor(expected1:phase2,expected1:phase2:difficulty1)              -0.42
## cor(expected1:difficulty1,expected1:phase2:difficulty1)         -0.43
## cor(expected1:difficulty2,expected1:phase2:difficulty1)         -0.41
## cor(phase1:difficulty1,expected1:phase2:difficulty1)            -0.44
## cor(phase2:difficulty1,expected1:phase2:difficulty1)            -0.47
## cor(phase1:difficulty2,expected1:phase2:difficulty1)            -0.44
## cor(phase2:difficulty2,expected1:phase2:difficulty1)            -0.42
## cor(expected1:phase1:difficulty1,expected1:phase2:difficulty1)  -0.42
## cor(Intercept,expected1:phase1:difficulty2)                     -0.38
## cor(expected1,expected1:phase1:difficulty2)                     -0.45
## cor(phase1,expected1:phase1:difficulty2)                        -0.39
## cor(phase2,expected1:phase1:difficulty2)                        -0.43
## cor(difficulty1,expected1:phase1:difficulty2)                   -0.43
## cor(difficulty2,expected1:phase1:difficulty2)                   -0.40
## cor(expected1:phase1,expected1:phase1:difficulty2)              -0.44
## cor(expected1:phase2,expected1:phase1:difficulty2)              -0.45
```

```
## cor(expected1:difficulty1,expected1:phase1:difficulty2)                      -0.43
## cor(expected1:difficulty2,expected1:phase1:difficulty2)                      -0.41
## cor(phase1:difficulty1,expected1:phase1:difficulty2)                         -0.46
## cor(phase2:difficulty1,expected1:phase1:difficulty2)                         -0.45
## cor(phase1:difficulty2,expected1:phase1:difficulty2)                         -0.44
## cor(phase2:difficulty2,expected1:phase1:difficulty2)                         -0.45
## cor(expected1:phase1:difficulty1,expected1:phase1:difficulty2)               -0.46
## cor(expected1:phase2:difficulty1,expected1:phase1:difficulty2)               -0.43
## cor(Intercept,expected1:phase2:difficulty2)                                  -0.37
## cor(expected1,expected1:phase2:difficulty2)                                  -0.35
## cor(phase1,expected1:phase2:difficulty2)                                     -0.33
## cor(phase2,expected1:phase2:difficulty2)                                     -0.36
## cor(difficulty1,expected1:phase2:difficulty2)                                -0.44
## cor(difficulty2,expected1:phase2:difficulty2)                                -0.46
## cor(expected1:phase1,expected1:phase2:difficulty2)                           -0.40
## cor(expected1:phase2,expected1:phase2:difficulty2)                           -0.42
## cor(expected1:difficulty1,expected1:phase2:difficulty2)                      -0.42
## cor(expected1:difficulty2,expected1:phase2:difficulty2)                      -0.42
## cor(phase1:difficulty1,expected1:phase2:difficulty2)                         -0.42
## cor(phase2:difficulty1,expected1:phase2:difficulty2)                         -0.46
## cor(phase1:difficulty2,expected1:phase2:difficulty2)                         -0.45
## cor(phase2:difficulty2,expected1:phase2:difficulty2)                         -0.49
## cor(expected1:phase1:difficulty1,expected1:phase2:difficulty2)               -0.41
## cor(expected1:phase2:difficulty1,expected1:phase2:difficulty2)               -0.42
## cor(expected1:phase1:difficulty2,expected1:phase2:difficulty2)               -0.46
##                                                                       u-95% CI Rhat
## sd(Intercept)                                                             0.23 1.00
## sd(expected1)                                                             0.03 1.00
## sd(phase1)                                                                0.07 1.00
## sd(phase2)                                                                0.03 1.00
## sd(difficulty1)                                                           0.02 1.00
## sd(difficulty2)                                                           0.02 1.00
## sd(expected1:phase1)                                                      0.03 1.00
## sd(expected1:phase2)                                                      0.02 1.00
## sd(expected1:difficulty1)                                                 0.01 1.00
## sd(expected1:difficulty2)                                                 0.02 1.00
## sd(phase1:difficulty1)                                                    0.02 1.00
## sd(phase2:difficulty1)                                                    0.02 1.00
## sd(phase1:difficulty2)                                                    0.02 1.00
## sd(phase2:difficulty2)                                                    0.02 1.00
## sd(expected1:phase1:difficulty1)                                          0.02 1.00
## sd(expected1:phase2:difficulty1)                                          0.01 1.00
## sd(expected1:phase1:difficulty2)                                          0.02 1.00
## sd(expected1:phase2:difficulty2)                                          0.02 1.00
## cor(Intercept,expected1)                                                  0.50 1.00
## cor(Intercept,phase1)                                                     0.31 1.00
## cor(expected1,phase1)                                                     0.51 1.00
## cor(Intercept,phase2)                                                     0.36 1.00
## cor(expected1,phase2)                                                     0.38 1.00
## cor(phase1,phase2)                                                        0.05 1.00
## cor(Intercept,difficulty1)                                                0.10 1.00
## cor(expected1,difficulty1)                                                0.30 1.00
## cor(phase1,difficulty1)                                                   0.18 1.00
## cor(phase2,difficulty1)                                                   0.30 1.00
## cor(Intercept,difficulty2)                                                0.34 1.00
## cor(expected1,difficulty2)                                                0.30 1.00
## cor(phase1,difficulty2)                                                   0.23 1.00
## cor(phase2,difficulty2)                                                   0.47 1.00
## cor(difficulty1,difficulty2)                                              0.43 1.00
## cor(Intercept,expected1:phase1)                                           0.36 1.00
```

```
## cor(expected1,expected1:phase1)                              0.53 1.00
## cor(phase1,expected1:phase1)                                 0.44 1.00
## cor(phase2,expected1:phase1)                                 0.21 1.00
## cor(difficulty1,expected1:phase1)                            0.44 1.00
## cor(difficulty2,expected1:phase1)                            0.38 1.00
## cor(Intercept,expected1:phase2)                              0.51 1.00
## cor(expected1,expected1:phase2)                              0.45 1.00
## cor(phase1,expected1:phase2)                                 0.30 1.00
## cor(phase2,expected1:phase2)                                 0.43 1.00
## cor(difficulty1,expected1:phase2)                            0.43 1.00
## cor(difficulty2,expected1:phase2)                            0.52 1.00
## cor(expected1:phase1,expected1:phase2)                       0.41 1.00
## cor(Intercept,expected1:difficulty1)                         0.35 1.00
## cor(expected1,expected1:difficulty1)                         0.45 1.00
## cor(phase1,expected1:difficulty1)                            0.43 1.00
## cor(phase2,expected1:difficulty1)                            0.42 1.00
## cor(difficulty1,expected1:difficulty1)                       0.41 1.00
## cor(difficulty2,expected1:difficulty1)                       0.41 1.00
## cor(expected1:phase1,expected1:difficulty1)                  0.45 1.00
## cor(expected1:phase2,expected1:difficulty1)                  0.43 1.00
## cor(Intercept,expected1:difficulty2)                         0.38 1.00
## cor(expected1,expected1:difficulty2)                         0.45 1.00
## cor(phase1,expected1:difficulty2)                            0.47 1.00
## cor(phase2,expected1:difficulty2)                            0.46 1.00
## cor(difficulty1,expected1:difficulty2)                       0.42 1.00
## cor(difficulty2,expected1:difficulty2)                       0.41 1.00
## cor(expected1:phase1,expected1:difficulty2)                  0.46 1.00
## cor(expected1:phase2,expected1:difficulty2)                  0.48 1.00
## cor(expected1:difficulty1,expected1:difficulty2)             0.42 1.00
## cor(Intercept,phase1:difficulty1)                            0.31 1.00
## cor(expected1,phase1:difficulty1)                            0.45 1.00
## cor(phase1,phase1:difficulty1)                               0.53 1.00
## cor(phase2,phase1:difficulty1)                               0.31 1.00
## cor(difficulty1,phase1:difficulty1)                          0.47 1.00
## cor(difficulty2,phase1:difficulty1)                          0.36 1.00
## cor(expected1:phase1,phase1:difficulty1)                     0.47 1.00
## cor(expected1:phase2,phase1:difficulty1)                     0.38 1.00
## cor(expected1:difficulty1,phase1:difficulty1)                0.46 1.00
## cor(expected1:difficulty2,phase1:difficulty1)                0.42 1.00
## cor(Intercept,phase2:difficulty1)                            0.35 1.00
## cor(expected1,phase2:difficulty1)                            0.45 1.00
## cor(phase1,phase2:difficulty1)                               0.31 1.00
## cor(phase2,phase2:difficulty1)                               0.42 1.00
## cor(difficulty1,phase2:difficulty1)                          0.49 1.00
## cor(difficulty2,phase2:difficulty1)                          0.42 1.00
## cor(expected1:phase1,phase2:difficulty1)                     0.43 1.00
## cor(expected1:phase2,phase2:difficulty1)                     0.48 1.00
## cor(expected1:difficulty1,phase2:difficulty1)                0.44 1.00
## cor(expected1:difficulty2,phase2:difficulty1)                0.40 1.00
## cor(phase1:difficulty1,phase2:difficulty1)                   0.40 1.00
## cor(Intercept,phase1:difficulty2)                            0.45 1.00
## cor(expected1,phase1:difficulty2)                            0.39 1.00
## cor(phase1,phase1:difficulty2)                               0.44 1.00
## cor(phase2,phase1:difficulty2)                               0.36 1.00
## cor(difficulty1,phase1:difficulty2)                          0.39 1.00
## cor(difficulty2,phase1:difficulty2)                          0.43 1.00
## cor(expected1:phase1,phase1:difficulty2)                     0.39 1.00
## cor(expected1:phase2,phase1:difficulty2)                     0.38 1.00
## cor(expected1:difficulty1,phase1:difficulty2)                0.40 1.00
## cor(expected1:difficulty2,phase1:difficulty2)                0.42 1.00
```

```
## cor(phase1:difficulty1,phase1:difficulty2)                                    0.38 1.00
## cor(phase2:difficulty1,phase1:difficulty2)                                    0.38 1.00
## cor(Intercept,phase2:difficulty2)                                             0.54 1.00
## cor(expected1,phase2:difficulty2)                                             0.50 1.00
## cor(phase1,phase2:difficulty2)                                                0.28 1.00
## cor(phase2,phase2:difficulty2)                                                0.42 1.00
## cor(difficulty1,phase2:difficulty2)                                           0.42 1.00
## cor(difficulty2,phase2:difficulty2)                                           0.42 1.00
## cor(expected1:phase1,phase2:difficulty2)                                      0.47 1.00
## cor(expected1:phase2,phase2:difficulty2)                                      0.56 1.00
## cor(expected1:difficulty1,phase2:difficulty2)                                 0.41 1.00
## cor(expected1:difficulty2,phase2:difficulty2)                                 0.41 1.00
## cor(phase1:difficulty1,phase2:difficulty2)                                    0.35 1.00
## cor(phase2:difficulty1,phase2:difficulty2)                                    0.39 1.00
## cor(phase1:difficulty2,phase2:difficulty2)                                    0.38 1.00
## cor(Intercept,expected1:phase1:difficulty1)                                   0.46 1.00
## cor(expected1,expected1:phase1:difficulty1)                                   0.47 1.00
## cor(phase1,expected1:phase1:difficulty1)                                      0.54 1.00
## cor(phase2,expected1:phase1:difficulty1)                                      0.41 1.00
## cor(difficulty1,expected1:phase1:difficulty1)                                 0.41 1.00
## cor(difficulty2,expected1:phase1:difficulty1)                                 0.40 1.00
## cor(expected1:phase1,expected1:phase1:difficulty1)                            0.45 1.00
## cor(expected1:phase2,expected1:phase1:difficulty1)                            0.43 1.00
## cor(expected1:difficulty1,expected1:phase1:difficulty1)                       0.44 1.00
## cor(expected1:difficulty2,expected1:phase1:difficulty1)                       0.46 1.00
## cor(phase1:difficulty1,expected1:phase1:difficulty1)                          0.39 1.00
## cor(phase2:difficulty1,expected1:phase1:difficulty1)                          0.39 1.00
## cor(phase1:difficulty2,expected1:phase1:difficulty1)                          0.41 1.00
## cor(phase2:difficulty2,expected1:phase1:difficulty1)                          0.42 1.00
## cor(Intercept,expected1:phase2:difficulty1)                                   0.44 1.00
## cor(expected1,expected1:phase2:difficulty1)                                   0.50 1.00
## cor(phase1,expected1:phase2:difficulty1)                                      0.46 1.00
## cor(phase2,expected1:phase2:difficulty1)                                      0.46 1.00
## cor(difficulty1,expected1:phase2:difficulty1)                                 0.38 1.00
## cor(difficulty2,expected1:phase2:difficulty1)                                 0.39 1.00
## cor(expected1:phase1,expected1:phase2:difficulty1)                            0.41 1.00
## cor(expected1:phase2,expected1:phase2:difficulty1)                            0.41 1.00
## cor(expected1:difficulty1,expected1:phase2:difficulty1)                       0.41 1.00
## cor(expected1:difficulty2,expected1:phase2:difficulty1)                       0.42 1.00
## cor(phase1:difficulty1,expected1:phase2:difficulty1)                          0.40 1.00
## cor(phase2:difficulty1,expected1:phase2:difficulty1)                          0.38 1.00
## cor(phase1:difficulty2,expected1:phase2:difficulty1)                          0.42 1.00
## cor(phase2:difficulty2,expected1:phase2:difficulty1)                          0.41 1.00
## cor(expected1:phase1:difficulty1,expected1:phase2:difficulty1)                0.42 1.00
## cor(Intercept,expected1:phase1:difficulty2)                                   0.42 1.00
## cor(expected1,expected1:phase1:difficulty2)                                   0.39 1.00
## cor(phase1,expected1:phase1:difficulty2)                                      0.42 1.00
## cor(phase2,expected1:phase1:difficulty2)                                      0.40 1.00
## cor(difficulty1,expected1:phase1:difficulty2)                                 0.39 1.00
## cor(difficulty2,expected1:phase1:difficulty2)                                 0.44 1.00
## cor(expected1:phase1,expected1:phase1:difficulty2)                            0.39 1.00
## cor(expected1:phase2,expected1:phase1:difficulty2)                            0.40 1.00
## cor(expected1:difficulty1,expected1:phase1:difficulty2)                       0.41 1.00
## cor(expected1:difficulty2,expected1:phase1:difficulty2)                       0.43 1.00
## cor(phase1:difficulty1,expected1:phase1:difficulty2)                          0.39 1.00
## cor(phase2:difficulty1,expected1:phase1:difficulty2)                          0.40 1.00
## cor(phase1:difficulty2,expected1:phase1:difficulty2)                          0.41 1.00
## cor(phase2:difficulty2,expected1:phase1:difficulty2)                          0.39 1.00
## cor(expected1:phase1:difficulty1,expected1:phase1:difficulty2)                0.41 1.00
## cor(expected1:phase2:difficulty1,expected1:phase1:difficulty2)                0.40 1.00
```

```
## cor(Intercept,expected1:phase2:difficulty2)                          0.43 1.00
## cor(expected1,expected1:phase2:difficulty2)                          0.48 1.00
## cor(phase1,expected1:phase2:difficulty2)                             0.48 1.00
## cor(phase2,expected1:phase2:difficulty2)                             0.46 1.00
## cor(difficulty1,expected1:phase2:difficulty2)                        0.39 1.00
## cor(difficulty2,expected1:phase2:difficulty2)                        0.38 1.00
## cor(expected1:phase1,expected1:phase2:difficulty2)                   0.43 1.00
## cor(expected1:phase2,expected1:phase2:difficulty2)                   0.42 1.00
## cor(expected1:difficulty1,expected1:phase2:difficulty2)              0.42 1.00
## cor(expected1:difficulty2,expected1:phase2:difficulty2)              0.42 1.00
## cor(phase1:difficulty1,expected1:phase2:difficulty2)                 0.42 1.00
## cor(phase2:difficulty1,expected1:phase2:difficulty2)                 0.39 1.00
## cor(phase1:difficulty2,expected1:phase2:difficulty2)                 0.40 1.00
## cor(phase2:difficulty2,expected1:phase2:difficulty2)                 0.37 1.00
## cor(expected1:phase1:difficulty1,expected1:phase2:difficulty2)       0.44 1.00
## cor(expected1:phase2:difficulty1,expected1:phase2:difficulty2)       0.42 1.00
## cor(expected1:phase1:difficulty2,expected1:phase2:difficulty2)       0.39 1.00
##                                                                  Bulk_ESS
## sd(Intercept)                                                        2366
## sd(expected1)                                                        7066
## sd(phase1)                                                           7239
## sd(phase2)                                                           5858
## sd(difficulty1)                                                      4134
## sd(difficulty2)                                                      3095
## sd(expected1:phase1)                                                 3029
## sd(expected1:phase2)                                                 3068
## sd(expected1:difficulty1)                                            6251
## sd(expected1:difficulty2)                                            3722
## sd(phase1:difficulty1)                                               5189
## sd(phase2:difficulty1)                                               4898
## sd(phase1:difficulty2)                                               6330
## sd(phase2:difficulty2)                                               5160
## sd(expected1:phase1:difficulty1)                                     7427
## sd(expected1:phase2:difficulty1)                                     6694
## sd(expected1:phase1:difficulty2)                                     6824
## sd(expected1:phase2:difficulty2)                                     5243
## cor(Intercept,expected1)                                            14133
## cor(Intercept,phase1)                                                6683
## cor(expected1,phase1)                                                2663
## cor(Intercept,phase2)                                               12625
## cor(expected1,phase2)                                                6010
## cor(phase1,phase2)                                                  10967
## cor(Intercept,difficulty1)                                          16432
## cor(expected1,difficulty1)                                          12974
## cor(phase1,difficulty1)                                             15222
## cor(phase2,difficulty1)                                             13511
## cor(Intercept,difficulty2)                                          18051
## cor(expected1,difficulty2)                                          13174
## cor(phase1,difficulty2)                                             14317
## cor(phase2,difficulty2)                                             15036
## cor(difficulty1,difficulty2)                                        15041
## cor(Intercept,expected1:phase1)                                     18603
## cor(expected1,expected1:phase1)                                      9527
## cor(phase1,expected1:phase1)                                        13295
## cor(phase2,expected1:phase1)                                         9736
## cor(difficulty1,expected1:phase1)                                   10090
## cor(difficulty2,expected1:phase1)                                    8434
## cor(Intercept,expected1:phase2)                                     15949
## cor(expected1,expected1:phase2)                                     11900
## cor(phase1,expected1:phase2)                                        14657
```

```
## cor(phase2,expected1:phase2)                               11006
## cor(difficulty1,expected1:phase2)                           9619
## cor(difficulty2,expected1:phase2)                           6869
## cor(expected1:phase1,expected1:phase2)                      9188
## cor(Intercept,expected1:difficulty1)                       22552
## cor(expected1,expected1:difficulty1)                       23500
## cor(phase1,expected1:difficulty1)                          23198
## cor(phase2,expected1:difficulty1)                          23837
## cor(difficulty1,expected1:difficulty1)                     19936
## cor(difficulty2,expected1:difficulty1)                     17646
## cor(expected1:phase1,expected1:difficulty1)                16596
## cor(expected1:phase2,expected1:difficulty1)                18736
## cor(Intercept,expected1:difficulty2)                       20349
## cor(expected1,expected1:difficulty2)                       15884
## cor(phase1,expected1:difficulty2)                          18050
## cor(phase2,expected1:difficulty2)                          16314
## cor(difficulty1,expected1:difficulty2)                     15940
## cor(difficulty2,expected1:difficulty2)                     15629
## cor(expected1:phase1,expected1:difficulty2)                13665
## cor(expected1:phase2,expected1:difficulty2)                13394
## cor(expected1:difficulty1,expected1:difficulty2)           12206
## cor(Intercept,phase1:difficulty1)                          20678
## cor(expected1,phase1:difficulty1)                          16601
## cor(phase1,phase1:difficulty1)                             15476
## cor(phase2,phase1:difficulty1)                             15607
## cor(difficulty1,phase1:difficulty1)                        16586
## cor(difficulty2,phase1:difficulty1)                        15840
## cor(expected1:phase1,phase1:difficulty1)                   17038
## cor(expected1:phase2,phase1:difficulty1)                   17604
## cor(expected1:difficulty1,phase1:difficulty1)              13039
## cor(expected1:difficulty2,phase1:difficulty1)              14447
## cor(Intercept,phase2:difficulty1)                          21087
## cor(expected1,phase2:difficulty1)                          18351
## cor(phase1,phase2:difficulty1)                             19609
## cor(phase2,phase2:difficulty1)                             19276
## cor(difficulty1,phase2:difficulty1)                        14912
## cor(difficulty2,phase2:difficulty1)                        16387
## cor(expected1:phase1,phase2:difficulty1)                   16007
## cor(expected1:phase2,phase2:difficulty1)                   14459
## cor(expected1:difficulty1,phase2:difficulty1)              13914
## cor(expected1:difficulty2,phase2:difficulty1)              14616
## cor(phase1:difficulty1,phase2:difficulty1)                 14149
## cor(Intercept,phase1:difficulty2)                          23002
## cor(expected1,phase1:difficulty2)                          21002
## cor(phase1,phase1:difficulty2)                             21507
## cor(phase2,phase1:difficulty2)                             19294
## cor(difficulty1,phase1:difficulty2)                        18449
## cor(difficulty2,phase1:difficulty2)                        16976
## cor(expected1:phase1,phase1:difficulty2)                   18590
## cor(expected1:phase2,phase1:difficulty2)                   18237
## cor(expected1:difficulty1,phase1:difficulty2)              12947
## cor(expected1:difficulty2,phase1:difficulty2)              15489
## cor(phase1:difficulty1,phase1:difficulty2)                 12117
## cor(phase2:difficulty1,phase1:difficulty2)                 12498
## cor(Intercept,phase2:difficulty2)                          18737
## cor(expected1,phase2:difficulty2)                          11983
## cor(phase1,phase2:difficulty2)                             19341
## cor(phase2,phase2:difficulty2)                             14594
## cor(difficulty1,phase2:difficulty2)                        13320
## cor(difficulty2,phase2:difficulty2)                        11807
```

```
## cor(expected1:phase1,phase2:difficulty2)                                     12466
## cor(expected1:phase2,phase2:difficulty2)                                     10284
## cor(expected1:difficulty1,phase2:difficulty2)                                11650
## cor(expected1:difficulty2,phase2:difficulty2)                                12079
## cor(phase1:difficulty1,phase2:difficulty2)                                   11518
## cor(phase2:difficulty1,phase2:difficulty2)                                   11069
## cor(phase1:difficulty2,phase2:difficulty2)                                   11275
## cor(Intercept,expected1:phase1:difficulty1)                                  23070
## cor(expected1,expected1:phase1:difficulty1)                                  19927
## cor(phase1,expected1:phase1:difficulty1)                                     19826
## cor(phase2,expected1:phase1:difficulty1)                                     23301
## cor(difficulty1,expected1:phase1:difficulty1)                                19693
## cor(difficulty2,expected1:phase1:difficulty1)                                18241
## cor(expected1:phase1,expected1:phase1:difficulty1)                           20540
## cor(expected1:phase2,expected1:phase1:difficulty1)                           18918
## cor(expected1:difficulty1,expected1:phase1:difficulty1)                      14901
## cor(expected1:difficulty2,expected1:phase1:difficulty1)                      15363
## cor(phase1:difficulty1,expected1:phase1:difficulty1)                         13534
## cor(phase2:difficulty1,expected1:phase1:difficulty1)                         12602
## cor(phase1:difficulty2,expected1:phase1:difficulty1)                         12516
## cor(phase2:difficulty2,expected1:phase1:difficulty1)                         15330
## cor(Intercept,expected1:phase2:difficulty1)                                  23415
## cor(expected1,expected1:phase2:difficulty1)                                  19618
## cor(phase1,expected1:phase2:difficulty1)                                     22784
## cor(phase2,expected1:phase2:difficulty1)                                     20412
## cor(difficulty1,expected1:phase2:difficulty1)                                19912
## cor(difficulty2,expected1:phase2:difficulty1)                                17690
## cor(expected1:phase1,expected1:phase2:difficulty1)                           17898
## cor(expected1:phase2,expected1:phase2:difficulty1)                           19036
## cor(expected1:difficulty1,expected1:phase2:difficulty1)                      14669
## cor(expected1:difficulty2,expected1:phase2:difficulty1)                      16225
## cor(phase1:difficulty1,expected1:phase2:difficulty1)                         14340
## cor(phase2:difficulty1,expected1:phase2:difficulty1)                         12139
## cor(phase1:difficulty2,expected1:phase2:difficulty1)                         12162
## cor(phase2:difficulty2,expected1:phase2:difficulty1)                         13742
## cor(expected1:phase1:difficulty1,expected1:phase2:difficulty1)               11303
## cor(Intercept,expected1:phase1:difficulty2)                                  24977
## cor(expected1,expected1:phase1:difficulty2)                                  21984
## cor(phase1,expected1:phase1:difficulty2)                                     25112
## cor(phase2,expected1:phase1:difficulty2)                                     23846
## cor(difficulty1,expected1:phase1:difficulty2)                                18818
## cor(difficulty2,expected1:phase1:difficulty2)                                16288
## cor(expected1:phase1,expected1:phase1:difficulty2)                           18312
## cor(expected1:phase2,expected1:phase1:difficulty2)                           18233
## cor(expected1:difficulty1,expected1:phase1:difficulty2)                      13677
## cor(expected1:difficulty2,expected1:phase1:difficulty2)                      14578
## cor(phase1:difficulty1,expected1:phase1:difficulty2)                         13673
## cor(phase2:difficulty1,expected1:phase1:difficulty2)                         13249
## cor(phase1:difficulty2,expected1:phase1:difficulty2)                         12764
## cor(phase2:difficulty2,expected1:phase1:difficulty2)                         15601
## cor(expected1:phase1:difficulty1,expected1:phase1:difficulty2)               11587
## cor(expected1:phase2:difficulty1,expected1:phase1:difficulty2)               10509
## cor(Intercept,expected1:phase2:difficulty2)                                  22721
## cor(expected1,expected1:phase2:difficulty2)                                  18641
## cor(phase1,expected1:phase2:difficulty2)                                     21970
## cor(phase2,expected1:phase2:difficulty2)                                     17872
## cor(difficulty1,expected1:phase2:difficulty2)                                19510
## cor(difficulty2,expected1:phase2:difficulty2)                                16470
## cor(expected1:phase1,expected1:phase2:difficulty2)                           19280
## cor(expected1:phase2,expected1:phase2:difficulty2)                           17766
```

```
## cor(expected1:difficulty1,expected1:phase2:difficulty2)         14471
## cor(expected1:difficulty2,expected1:phase2:difficulty2)         14774
## cor(phase1:difficulty1,expected1:phase2:difficulty2)            15075
## cor(phase2:difficulty1,expected1:phase2:difficulty2)            13598
## cor(phase1:difficulty2,expected1:phase2:difficulty2)            12355
## cor(phase2:difficulty2,expected1:phase2:difficulty2)            13156
## cor(expected1:phase1:difficulty1,expected1:phase2:difficulty2)  11294
## cor(expected1:phase2:difficulty1,expected1:phase2:difficulty2)  11446
## cor(expected1:phase1:difficulty2,expected1:phase2:difficulty2)  10626
##                                                                 Tail_ESS
## sd(Intercept)                                                       4846
## sd(expected1)                                                       7666
## sd(phase1)                                                         11628
## sd(phase2)                                                          7273
## sd(difficulty1)                                                     2776
## sd(difficulty2)                                                     3998
## sd(expected1:phase1)                                                2182
## sd(expected1:phase2)                                                2836
## sd(expected1:difficulty1)                                           7980
## sd(expected1:difficulty2)                                           5876
## sd(phase1:difficulty1)                                              6095
## sd(phase2:difficulty1)                                              6781
## sd(phase1:difficulty2)                                              6790
## sd(phase2:difficulty2)                                              5173
## sd(expected1:phase1:difficulty1)                                    6748
## sd(expected1:phase2:difficulty1)                                    7628
## sd(expected1:phase1:difficulty2)                                    7751
## sd(expected1:phase2:difficulty2)                                    7346
## cor(Intercept,expected1)                                           13901
## cor(Intercept,phase1)                                              10052
## cor(expected1,phase1)                                               5453
## cor(Intercept,phase2)                                              13120
## cor(expected1,phase2)                                               8180
## cor(phase1,phase2)                                                 13010
## cor(Intercept,difficulty1)                                         10045
## cor(expected1,difficulty1)                                         13322
## cor(phase1,difficulty1)                                            11806
## cor(phase2,difficulty1)                                            12642
## cor(Intercept,difficulty2)                                         12744
## cor(expected1,difficulty2)                                         13916
## cor(phase1,difficulty2)                                            11596
## cor(phase2,difficulty2)                                            13506
## cor(difficulty1,difficulty2)                                       13240
## cor(Intercept,expected1:phase1)                                    13281
## cor(expected1,expected1:phase1)                                    11700
## cor(phase1,expected1:phase1)                                       12199
## cor(phase2,expected1:phase1)                                       12181
## cor(difficulty1,expected1:phase1)                                  11920
## cor(difficulty2,expected1:phase1)                                  13198
## cor(Intercept,expected1:phase2)                                    12123
## cor(expected1,expected1:phase2)                                    13146
## cor(phase1,expected1:phase2)                                       13417
## cor(phase2,expected1:phase2)                                       12579
## cor(difficulty1,expected1:phase2)                                  11882
## cor(difficulty2,expected1:phase2)                                  11126
## cor(expected1:phase1,expected1:phase2)                             13013
## cor(Intercept,expected1:difficulty1)                               13046
## cor(expected1,expected1:difficulty1)                               13311
## cor(phase1,expected1:difficulty1)                                  14136
## cor(phase2,expected1:difficulty1)                                  13834
```

```
## cor(difficulty1,expected1:difficulty1)                              13714
## cor(difficulty2,expected1:difficulty1)                              14953
## cor(expected1:phase1,expected1:difficulty1)                         14001
## cor(expected1:phase2,expected1:difficulty1)                         14017
## cor(Intercept,expected1:difficulty2)                                13541
## cor(expected1,expected1:difficulty2)                                13431
## cor(phase1,expected1:difficulty2)                                   13038
## cor(phase2,expected1:difficulty2)                                   13622
## cor(difficulty1,expected1:difficulty2)                              12615
## cor(difficulty2,expected1:difficulty2)                              13899
## cor(expected1:phase1,expected1:difficulty2)                         14302
## cor(expected1:phase2,expected1:difficulty2)                         14382
## cor(expected1:difficulty1,expected1:difficulty2)                    14845
## cor(Intercept,phase1:difficulty1)                                   13282
## cor(expected1,phase1:difficulty1)                                   13648
## cor(phase1,phase1:difficulty1)                                      12386
## cor(phase2,phase1:difficulty1)                                      13542
## cor(difficulty1,phase1:difficulty1)                                 13964
## cor(difficulty2,phase1:difficulty1)                                 14759
## cor(expected1:phase1,phase1:difficulty1)                            14109
## cor(expected1:phase2,phase1:difficulty1)                            13794
## cor(expected1:difficulty1,phase1:difficulty1)                       14056
## cor(expected1:difficulty2,phase1:difficulty1)                       13721
## cor(Intercept,phase2:difficulty1)                                   13027
## cor(expected1,phase2:difficulty1)                                   13619
## cor(phase1,phase2:difficulty1)                                      13105
## cor(phase2,phase2:difficulty1)                                      13993
## cor(difficulty1,phase2:difficulty1)                                 13596
## cor(difficulty2,phase2:difficulty1)                                 14732
## cor(expected1:phase1,phase2:difficulty1)                            14957
## cor(expected1:phase2,phase2:difficulty1)                            14145
## cor(expected1:difficulty1,phase2:difficulty1)                       13741
## cor(expected1:difficulty2,phase2:difficulty1)                       15255
## cor(phase1:difficulty1,phase2:difficulty1)                          15542
## cor(Intercept,phase1:difficulty2)                                   13489
## cor(expected1,phase1:difficulty2)                                   13678
## cor(phase1,phase1:difficulty2)                                      12851
## cor(phase2,phase1:difficulty2)                                      13674
## cor(difficulty1,phase1:difficulty2)                                 13341
## cor(difficulty2,phase1:difficulty2)                                 13816
## cor(expected1:phase1,phase1:difficulty2)                            13784
## cor(expected1:phase2,phase1:difficulty2)                            14706
## cor(expected1:difficulty1,phase1:difficulty2)                       13261
## cor(expected1:difficulty2,phase1:difficulty2)                       14463
## cor(phase1:difficulty1,phase1:difficulty2)                          14085
## cor(phase2:difficulty1,phase1:difficulty2)                          14235
## cor(Intercept,phase2:difficulty2)                                   12832
## cor(expected1,phase2:difficulty2)                                   13495
## cor(phase1,phase2:difficulty2)                                      13723
## cor(phase2,phase2:difficulty2)                                      13388
## cor(difficulty1,phase2:difficulty2)                                 13522
## cor(difficulty2,phase2:difficulty2)                                 13222
## cor(expected1:phase1,phase2:difficulty2)                            13607
## cor(expected1:phase2,phase2:difficulty2)                            12021
## cor(expected1:difficulty1,phase2:difficulty2)                       14430
## cor(expected1:difficulty2,phase2:difficulty2)                       13639
## cor(phase1:difficulty1,phase2:difficulty2)                          13764
## cor(phase2:difficulty1,phase2:difficulty2)                          13464
## cor(phase1:difficulty2,phase2:difficulty2)                          15136
## cor(Intercept,expected1:phase1:difficulty1)                         13700
```

```
## cor(expected1,expected1:phase1:difficulty1)                                     13061
## cor(phase1,expected1:phase1:difficulty1)                                        13947
## cor(phase2,expected1:phase1:difficulty1)                                        13971
## cor(difficulty1,expected1:phase1:difficulty1)                                   14156
## cor(difficulty2,expected1:phase1:difficulty1)                                   13666
## cor(expected1:phase1,expected1:phase1:difficulty1)                              13708
## cor(expected1:phase2,expected1:phase1:difficulty1)                              14229
## cor(expected1:difficulty1,expected1:phase1:difficulty1)                         14680
## cor(expected1:difficulty2,expected1:phase1:difficulty1)                         14001
## cor(phase1:difficulty1,expected1:phase1:difficulty1)                            13316
## cor(phase2:difficulty1,expected1:phase1:difficulty1)                            14134
## cor(phase1:difficulty2,expected1:phase1:difficulty1)                            14264
## cor(phase2:difficulty2,expected1:phase1:difficulty1)                            15749
## cor(Intercept,expected1:phase2:difficulty1)                                     13120
## cor(expected1,expected1:phase2:difficulty1)                                     13801
## cor(phase1,expected1:phase2:difficulty1)                                        13974
## cor(phase2,expected1:phase2:difficulty1)                                        14136
## cor(difficulty1,expected1:phase2:difficulty1)                                   14253
## cor(difficulty2,expected1:phase2:difficulty1)                                   14454
## cor(expected1:phase1,expected1:phase2:difficulty1)                              13891
## cor(expected1:phase2,expected1:phase2:difficulty1)                              14646
## cor(expected1:difficulty1,expected1:phase2:difficulty1)                         14325
## cor(expected1:difficulty2,expected1:phase2:difficulty1)                         15700
## cor(phase1:difficulty1,expected1:phase2:difficulty1)                            14899
## cor(phase2:difficulty1,expected1:phase2:difficulty1)                            14768
## cor(phase1:difficulty2,expected1:phase2:difficulty1)                            13772
## cor(phase2:difficulty2,expected1:phase2:difficulty1)                            14138
## cor(expected1:phase1:difficulty1,expected1:phase2:difficulty1)                  14170
## cor(Intercept,expected1:phase1:difficulty2)                                     13094
## cor(expected1,expected1:phase1:difficulty2)                                     13509
## cor(phase1,expected1:phase1:difficulty2)                                        12429
## cor(phase2,expected1:phase1:difficulty2)                                        14026
## cor(difficulty1,expected1:phase1:difficulty2)                                   14670
## cor(difficulty2,expected1:phase1:difficulty2)                                   14558
## cor(expected1:phase1,expected1:phase1:difficulty2)                              14823
## cor(expected1:phase2,expected1:phase1:difficulty2)                              14127
## cor(expected1:difficulty1,expected1:phase1:difficulty2)                         14486
## cor(expected1:difficulty2,expected1:phase1:difficulty2)                         14711
## cor(phase1:difficulty1,expected1:phase1:difficulty2)                            14330
## cor(phase2:difficulty1,expected1:phase1:difficulty2)                            14702
## cor(phase1:difficulty2,expected1:phase1:difficulty2)                            15253
## cor(phase2:difficulty2,expected1:phase1:difficulty2)                            15659
## cor(expected1:phase1:difficulty1,expected1:phase1:difficulty2)                  14662
## cor(expected1:phase2:difficulty1,expected1:phase1:difficulty2)                  13875
## cor(Intercept,expected1:phase2:difficulty2)                                     13616
## cor(expected1,expected1:phase2:difficulty2)                                     14173
## cor(phase1,expected1:phase2:difficulty2)                                        13712
## cor(phase2,expected1:phase2:difficulty2)                                        13197
## cor(difficulty1,expected1:phase2:difficulty2)                                   14104
## cor(difficulty2,expected1:phase2:difficulty2)                                   14255
## cor(expected1:phase1,expected1:phase2:difficulty2)                              14359
## cor(expected1:phase2,expected1:phase2:difficulty2)                              14830
## cor(expected1:difficulty1,expected1:phase2:difficulty2)                         15253
## cor(expected1:difficulty2,expected1:phase2:difficulty2)                         14510
## cor(phase1:difficulty1,expected1:phase2:difficulty2)                            14737
## cor(phase2:difficulty1,expected1:phase2:difficulty2)                            14498
## cor(phase1:difficulty2,expected1:phase2:difficulty2)                            13653
## cor(phase2:difficulty2,expected1:phase2:difficulty2)                            14074
## cor(expected1:phase1:difficulty1,expected1:phase2:difficulty2)                  14532
## cor(expected1:phase2:difficulty1,expected1:phase2:difficulty2)                  14123
```

```
## cor(expected1:phase1:difficulty2,expected1:phase2:difficulty2)    14521
##
## ~trl (Number of levels: 288)
##                         Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS
## sd(Intercept)               0.07      0.00     0.06     0.08 1.00     6048
## sd(diagnosis1)              0.01      0.00     0.00     0.02 1.00     3418
## sd(diagnosis2)              0.00      0.00     0.00     0.01 1.00     4559
## cor(Intercept,diagnosis1)   0.49      0.23    -0.03     0.87 1.00    10682
## cor(Intercept,diagnosis2)  -0.03      0.37    -0.72     0.69 1.00    18822
## cor(diagnosis1,diagnosis2) -0.23      0.42    -0.88     0.65 1.00     8090
##                         Tail_ESS
## sd(Intercept)              10131
## sd(diagnosis1)              3325
## sd(diagnosis2)              7185
## cor(Intercept,diagnosis1)   9190
## cor(Intercept,diagnosis2)  12435
## cor(diagnosis1,diagnosis2) 12092
##
## Regression Coefficients:
##                         Estimate Est.Error l-95% CI u-95% CI
## Intercept                   6.17      0.03     6.12     6.22
## diagnosis1                  0.02      0.03    -0.03     0.07
## diagnosis2                  0.02      0.03    -0.03     0.07
## expected1                  -0.04      0.01    -0.05    -0.03
## phase1                      0.02      0.01    -0.01     0.04
## phase2                     -0.01      0.01    -0.02     0.01
## difficulty1                -0.03      0.01    -0.05    -0.02
## difficulty2                -0.00      0.01    -0.02     0.01
## diagnosis1:expected1       -0.01      0.01    -0.02     0.00
## diagnosis2:expected1       -0.00      0.00    -0.01     0.01
## diagnosis1:phase1          -0.01      0.01    -0.03     0.01
## diagnosis2:phase1          -0.00      0.01    -0.02     0.02
## diagnosis1:phase2          -0.01      0.01    -0.02     0.01
## diagnosis2:phase2           0.00      0.01    -0.01     0.02
## expected1:phase1           -0.04      0.01    -0.06    -0.02
## expected1:phase2            0.00      0.01    -0.01     0.02
## diagnosis1:difficulty1     -0.01      0.01    -0.02     0.00
## diagnosis2:difficulty1      0.00      0.01    -0.01     0.02
## diagnosis1:difficulty2      0.02      0.01     0.01     0.03
## diagnosis2:difficulty2     -0.02      0.01    -0.03    -0.01
## expected1:difficulty1      -0.01      0.01    -0.03     0.00
## expected1:difficulty2       0.00      0.01    -0.01     0.02
## phase1:difficulty1         -0.01      0.01    -0.03     0.02
## phase2:difficulty1         -0.00      0.01    -0.02     0.02
## phase1:difficulty2          0.01      0.01    -0.01     0.04
## phase2:difficulty2         -0.01      0.01    -0.03     0.01
## diagnosis1:expected1:phase1 -0.00     0.01    -0.02     0.01
## diagnosis2:expected1:phase1  0.01     0.01    -0.00     0.02
## diagnosis1:expected1:phase2  0.00     0.01    -0.01     0.01
## diagnosis2:expected1:phase2 -0.00     0.01    -0.01     0.01
## diagnosis1:expected1:difficulty1 -0.01 0.01   -0.02     0.01
## diagnosis2:expected1:difficulty1  0.01 0.01   -0.00     0.02
## diagnosis1:expected1:difficulty2 -0.00 0.01   -0.01     0.01
## diagnosis2:expected1:difficulty2  0.00 0.01   -0.01     0.01
## diagnosis1:phase1:difficulty1     0.00 0.01   -0.01     0.02
## diagnosis2:phase1:difficulty1     0.00 0.01   -0.01     0.02
## diagnosis1:phase2:difficulty1    -0.01 0.01   -0.02     0.00
## diagnosis2:phase2:difficulty1    -0.00 0.01   -0.02     0.01
## diagnosis1:phase1:difficulty2     0.00 0.01   -0.01     0.02
## diagnosis2:phase1:difficulty2    -0.01 0.01   -0.03     0.00
```
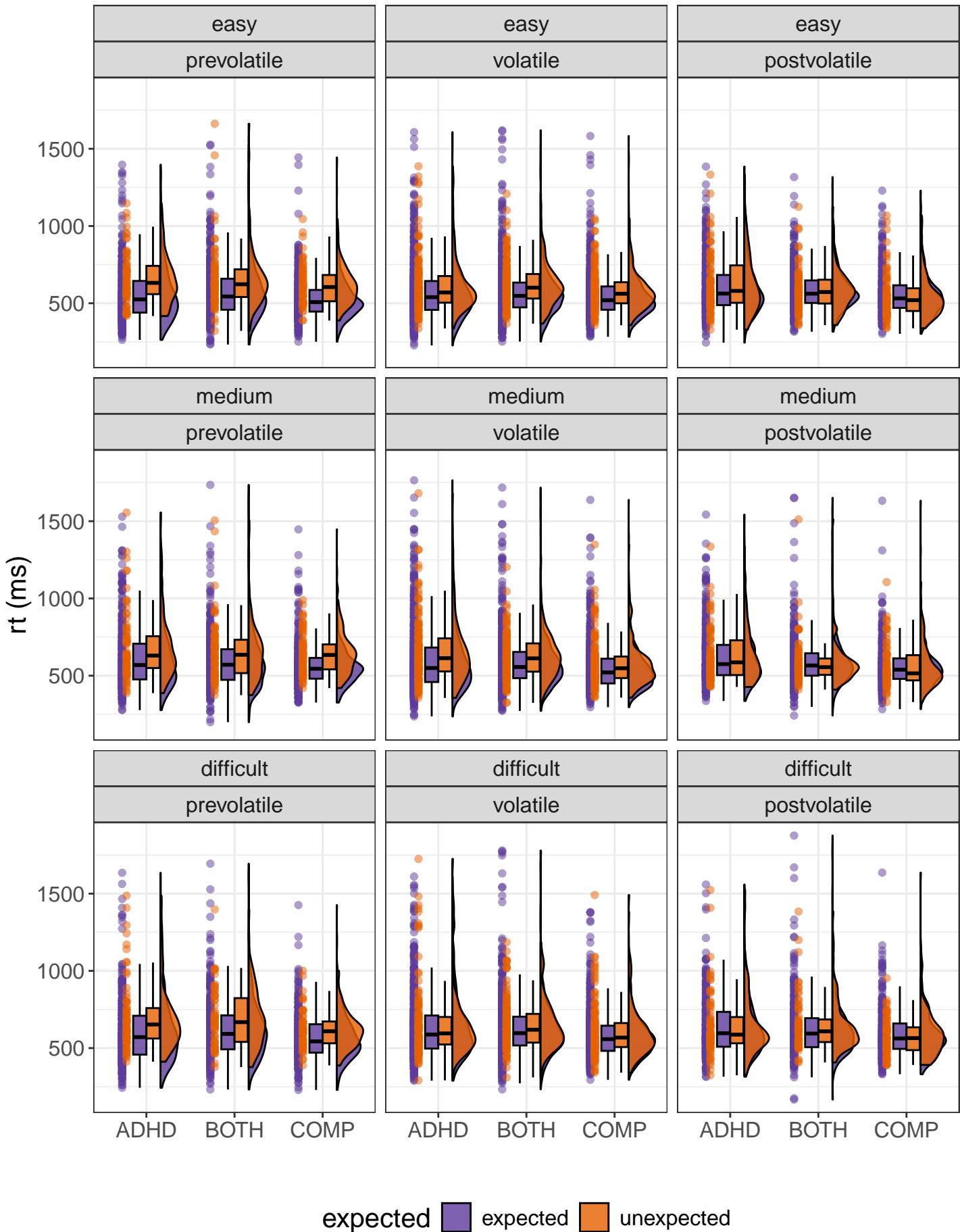
```
## diagnosis1:phase2:difficulty2                  -0.00      0.01    -0.02     0.01
## diagnosis2:phase2:difficulty2                   0.01      0.01    -0.00     0.03
## expected1:phase1:difficulty1                   -0.01      0.01    -0.03     0.02
## expected1:phase2:difficulty1                   -0.00      0.01    -0.02     0.02
## expected1:phase1:difficulty2                    0.01      0.01    -0.01     0.03
## expected1:phase2:difficulty2                   -0.01      0.01    -0.03     0.01
## diagnosis1:expected1:phase1:difficulty1         0.00      0.01    -0.01     0.02
## diagnosis2:expected1:phase1:difficulty1         0.00      0.01    -0.01     0.02
## diagnosis1:expected1:phase2:difficulty1         0.01      0.01    -0.00     0.02
## diagnosis2:expected1:phase2:difficulty1        -0.01      0.01    -0.02     0.00
## diagnosis1:expected1:phase1:difficulty2         0.00      0.01    -0.01     0.02
## diagnosis2:expected1:phase1:difficulty2        -0.00      0.01    -0.02     0.01
## diagnosis1:expected1:phase2:difficulty2        -0.01      0.01    -0.02     0.00
## diagnosis2:expected1:phase2:difficulty2         0.00      0.01    -0.01     0.01
##                                        Rhat Bulk_ESS Tail_ESS
## Intercept                              1.00     1257     2922
## diagnosis1                             1.00     1384     3130
## diagnosis2                             1.00     1632     3199
## expected1                              1.00     5728     8644
## phase1                                 1.00     5107     8540
## phase2                                 1.00     5216     9337
## difficulty1                            1.00     4814     8336
## difficulty2                            1.00     4858     8799
## diagnosis1:expected1                   1.00    10348    13271
## diagnosis2:expected1                   1.00    10286    12734
## diagnosis1:phase1                      1.00     5440     9226
## diagnosis2:phase1                      1.00     5033     8789
## diagnosis1:phase2                      1.00     9242    11314
## diagnosis2:phase2                      1.00     9484    11579
## expected1:phase1                       1.00     5887     9381
## expected1:phase2                       1.00     5239     9521
## diagnosis1:difficulty1                 1.00     9997    11062
## diagnosis2:difficulty1                 1.00    10562    12419
## diagnosis1:difficulty2                 1.00    11211    12983
## diagnosis2:difficulty2                 1.00    11525    13218
## expected1:difficulty1                  1.00     4894     8458
## expected1:difficulty2                  1.00     5300     8739
## phase1:difficulty1                     1.00     4742     8273
## phase2:difficulty1                     1.00     4199     8491
## phase1:difficulty2                     1.00     4816     9280
## phase2:difficulty2                     1.00     4547     7937
## diagnosis1:expected1:phase1            1.00    13718    14036
## diagnosis2:expected1:phase1            1.00    13722    13021
## diagnosis1:expected1:phase2            1.00    10816    12500
## diagnosis2:expected1:phase2            1.00    11218    13346
## diagnosis1:expected1:difficulty1       1.00    10306    13500
## diagnosis2:expected1:difficulty1       1.00    11979    13393
## diagnosis1:expected1:difficulty2       1.00    11054    12978
## diagnosis2:expected1:difficulty2       1.00    11268    12715
## diagnosis1:phase1:difficulty1          1.00     9380    12504
## diagnosis2:phase1:difficulty1          1.00    10149    12743
## diagnosis1:phase2:difficulty1          1.00     9314    11792
## diagnosis2:phase2:difficulty1          1.00     9906    12839
## diagnosis1:phase1:difficulty2          1.00     9038    12396
## diagnosis2:phase1:difficulty2          1.00     9988    13029
## diagnosis1:phase2:difficulty2          1.00     9117    13078
## diagnosis2:phase2:difficulty2          1.00     9025    12760
## expected1:phase1:difficulty1           1.00     5180     8462
## expected1:phase2:difficulty1           1.00     4292     7684
## expected1:phase1:difficulty2           1.00     5284     8058
```

```
## expected1:phase2:difficulty2                      1.00      4688      7872
## diagnosis1:expected1:phase1:difficulty1 1.00      9765     13094
## diagnosis2:expected1:phase1:difficulty1 1.00     10073     12791
## diagnosis1:expected1:phase2:difficulty1 1.00      9494     12343
## diagnosis2:expected1:phase2:difficulty1 1.00      9763     12819
## diagnosis1:expected1:phase1:difficulty2 1.00      9227     12066
## diagnosis2:expected1:phase1:difficulty2 1.00      9940     12701
## diagnosis1:expected1:phase2:difficulty2 1.00      9034     13206
## diagnosis2:expected1:phase2:difficulty2 1.00      9861     13223
##
## Further Distributional Parameters:
##        Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sigma      0.25      0.00     0.24     0.25 1.00    11159    11907
## ndt      106.89      5.16    96.49   116.71 1.00    10792    12313
##
## Draws were sampled using sample(hmc). 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).
```

Reaction times per subject
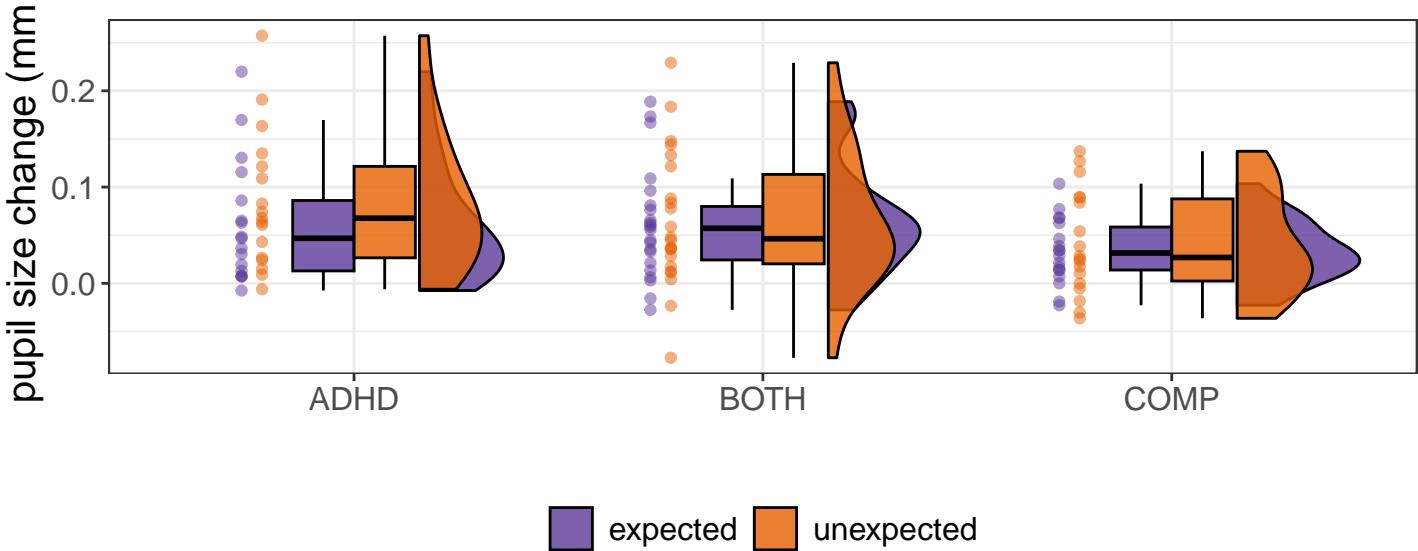
S4.3 Pupil sizes

```
##  Family: gaussian
##   Links: mu = identity; sigma = identity
## Formula: rel_pupil ~ diagnosis * expected + rts + (1 | subID)
##    Data: df (Number of observations: 14661)
##   Draws: 4 chains, each with iter = 6000; warmup = 1500; thin = 1;
##          total post-warmup draws = 18000
##
## Multilevel Hyperparameters:
## ~subID (Number of levels: 57)
##               Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sd(Intercept)     0.06      0.01     0.05     0.07 1.00     1831     3420
##
## Regression Coefficients:
##                    Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS
## Intercept              0.06      0.01     0.04     0.07 1.01     1301
## diagnosis1             0.01      0.01    -0.01     0.03 1.00     1276
## diagnosis2             0.00      0.01    -0.02     0.03 1.00     1087
## expected1             -0.00      0.00    -0.01     0.00 1.00    38787
## rts                    0.00      0.00     0.00     0.00 1.00    20007
## diagnosis1:expected1  -0.00      0.00    -0.01     0.00 1.00    21529
## diagnosis2:expected1   0.00      0.00    -0.00     0.01 1.00    21870
##                    Tail_ESS
## Intercept              2673
## diagnosis1             2062
## diagnosis2             1993
## expected1             12036
## rts                   15436
## diagnosis1:expected1  14814
## diagnosis2:expected1  13960
##
## Further Distributional Parameters:
##       Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
## sigma     0.18      0.00     0.17     0.18 1.00    20066    11972
##
## Draws were sampled using sample(hmc). 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).
```


S4.4 Accuracies

```
## ---
```
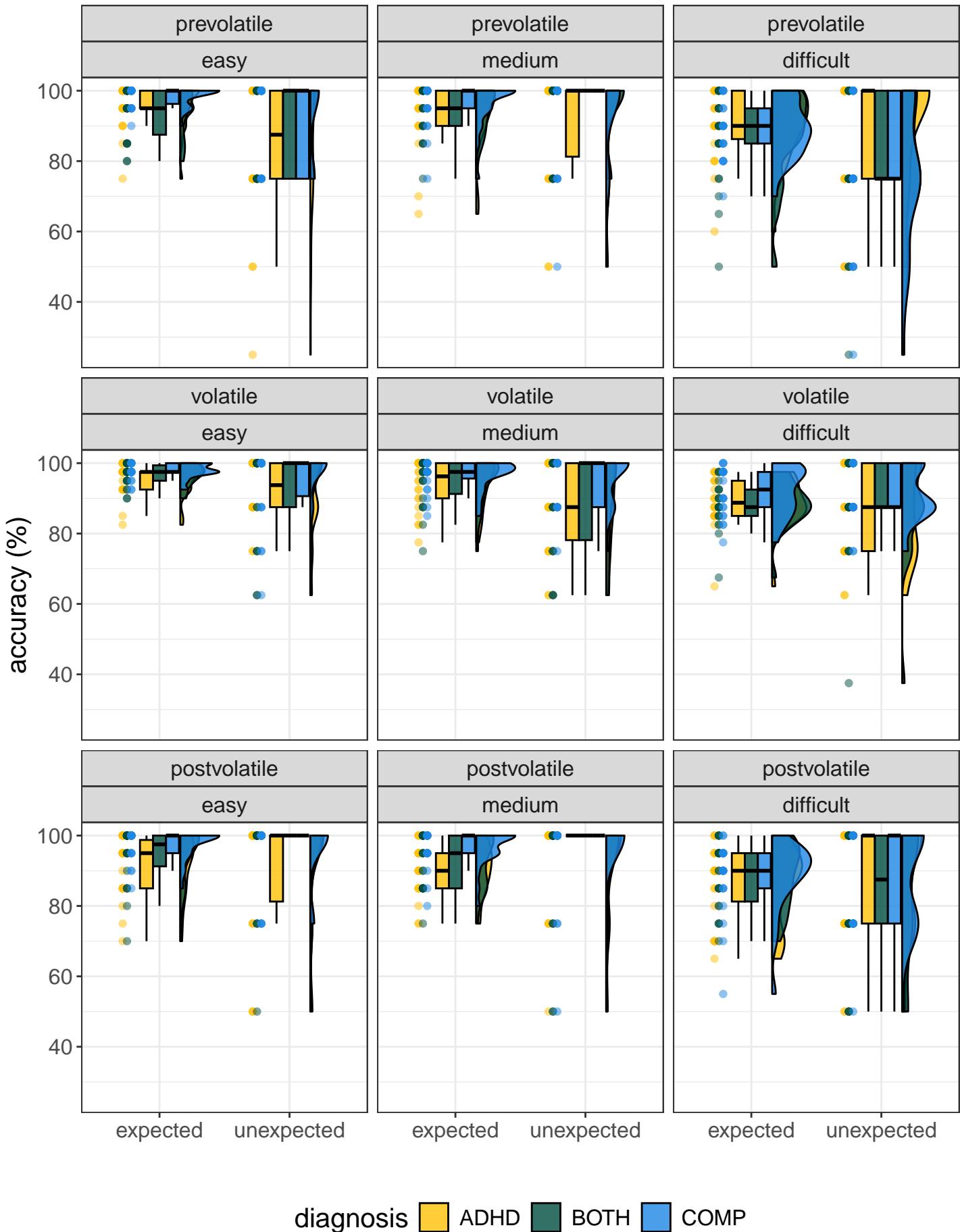
```
##  Model:
## Type: BFlinearModel, JZS
## Intercept only
## Data types:
## diagnosis :  fixed
```

	bf
diagnosis + expected + difficulty	46.41
diagnosis + difficulty	46.25
diagnosis + expected + difficulty + diagnosis:difficulty	45.02
diagnosis + difficulty + diagnosis:difficulty	44.85
diagnosis + phase + expected + phase:expected + difficulty	44.77
expected + difficulty	44.42
difficulty	44.28
diagnosis + expected + difficulty + expected:difficulty	43.35
diagnosis + phase + expected + difficulty	43.23
diagnosis + phase + expected + phase:expected + difficulty + diagnosis:difficulty	43.19
diagnosis + expected + diagnosis:expected + difficulty	43.15
diagnosis + phase + difficulty	43.00
phase + expected + phase:expected + difficulty	42.44
diagnosis + expected + difficulty + diagnosis:difficulty + expected:difficulty	42.04
diagnosis + phase + expected + difficulty + diagnosis:difficulty	41.95
diagnosis + expected + diagnosis:expected + difficulty + diagnosis:difficulty	41.72
diagnosis + phase + difficulty + diagnosis:difficulty	41.71
diagnosis + phase + expected + phase:expected + difficulty + expected:difficulty	41.53
expected + difficulty + expected:difficulty	41.35
phase + expected + difficulty	41.20
diagnosis + phase + expected + diagnosis:expected + phase:expected + difficulty	41.20
phase + difficulty	41.03
diagnosis + phase + diagnosis:phase + expected + phase:expected + difficulty	40.62
diagnosis + phase + expected + phase:expected + difficulty + diagnosis:difficulty + expected:difficulty	40.26
diagnosis + phase + expected + difficulty + expected:difficulty	40.25
diagnosis + expected + diagnosis:expected + difficulty + expected:difficulty	39.94
diagnosis + phase + expected + diagnosis:expected + difficulty	39.85
diagnosis + phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty	39.84
diagnosis + phase + expected + phase:expected + difficulty + phase:difficulty	39.46
diagnosis + phase + diagnosis:phase + expected + phase:expected + difficulty + diagnosis:difficulty	39.35
phase + expected + phase:expected + difficulty + expected:difficulty	39.33
diagnosis + phase + diagnosis:phase + expected + difficulty	39.25
diagnosis + phase + diagnosis:phase + difficulty	39.13
diagnosis + phase + expected + difficulty + diagnosis:difficulty + expected:difficulty	38.86
diagnosis + expected + diagnosis:expected + difficulty + diagnosis:difficulty + expected:difficulty	38.69
diagnosis + phase + expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty	38.62
diagnosis + phase + expected + diagnosis:expected + difficulty + diagnosis:difficulty	38.43
diagnosis + phase + expected + diagnosis:expected + phase:expected + difficulty + expected:difficulty	38.13
phase + expected + difficulty + expected:difficulty	38.13
diagnosis + phase + expected + difficulty + phase:difficulty	38.09
diagnosis + phase + diagnosis:phase + expected + difficulty + diagnosis:difficulty	38.05
diagnosis + phase + difficulty + phase:difficulty	38.04
diagnosis + phase + diagnosis:phase + difficulty + diagnosis:difficulty	37.77
diagnosis + phase + diagnosis:phase + expected + phase:expected + difficulty + expected:difficulty	37.59
phase + expected + phase:expected + difficulty + phase:difficulty	37.37
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty	37.29
diagnosis + phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + expected:difficulty	37.02
diagnosis + phase + expected + phase:expected + difficulty + phase:difficulty + expected:difficulty	36.80
diagnosis + phase + expected + difficulty + diagnosis:difficulty + phase:difficulty	36.78
diagnosis + phase + expected + diagnosis:expected + difficulty + expected:difficulty	36.78
diagnosis + phase + difficulty + diagnosis:difficulty + phase:difficulty	36.54

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diagnosis + phase + diagnosis:phase + expected + phase:expected + difficulty + diagnosis:difficulty + expected:difficulty	36.33
diagnosis + phase + diagnosis:phase + expected + difficulty + expected:difficulty	36.27
diagnosis + phase + expected + diagnosis:expected + phase:expected + difficulty + phase:difficulty	36.10
phase + expected + difficulty + phase:difficulty	36.08
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty	36.01
phase + difficulty + phase:difficulty	35.92
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + difficulty	35.92
diagnosis + phase + diagnosis:phase + expected + phase:expected + difficulty + phase:difficulty	35.64
diagnosis + phase + expected + diagnosis:expected + difficulty + diagnosis:difficulty + expected:difficulty	35.45
diagnosis + phase + expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty	35.20
diagnosis + phase + expected + difficulty + phase:difficulty + expected:difficulty	35.06
diagnosis + phase + expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty	34.99
diagnosis + phase + diagnosis:phase + expected + difficulty + diagnosis:difficulty + expected:difficulty	34.87
diagnosis + phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty	34.76
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + difficulty + diagnosis:difficulty	34.74
diagnosis + phase + expected + diagnosis:expected + difficulty + phase:difficulty	34.73
phase + expected + phase:expected + difficulty + phase:difficulty + expected:difficulty	34.55
diagnosis + phase + diagnosis:phase + expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty	34.29
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + expected:difficulty	34.25
diagnosis + phase + diagnosis:phase + expected + difficulty + phase:difficulty	34.20
diagnosis + expected + diagnosis:expected + difficulty + diagnosis:difficulty + expected:difficulty + diagnosis:expected:difficulty	34.16
diagnosis + phase + diagnosis:phase + difficulty + phase:difficulty	34.01
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty	33.86
diagnosis + phase + expected + phase:expected + difficulty + phase:difficulty + expected:difficulty + phase:expected:difficulty	33.49
diagnosis + phase + expected + diagnosis:expected + difficulty + diagnosis:difficulty + phase:difficulty	33.34
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + expected:difficulty	33.06
diagnosis + phase + expected + diagnosis:expected + phase:expected + difficulty + phase:difficulty + expected:difficulty	33.05
phase + expected + difficulty + phase:difficulty + expected:difficulty	33.00
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + difficulty + expected:difficulty	32.91
diagnosis + phase + diagnosis:phase + expected + difficulty + diagnosis:difficulty + phase:difficulty	32.83
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + diagnosis:difficulty	32.74
diagnosis + phase + diagnosis:phase + difficulty + diagnosis:difficulty + phase:difficulty	32.65
diagnosis + phase + diagnosis:phase + expected + phase:expected + difficulty + phase:difficulty + expected:difficulty	32.59
diagnosis + phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + expected:difficulty + diagnosis:expected:difficulty	32.34
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + phase:difficulty	32.29
diagnosis + phase + expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty + phase:expected:difficulty	32.08
diagnosis + phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty	31.76
diagnosis + phase + expected + diagnosis:expected + difficulty + phase:difficulty + expected:difficulty	31.69
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + difficulty + diagnosis:difficulty + expected:difficulty	31.52
diagnosis + phase + diagnosis:phase + expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty	31.34
phase + expected + phase:expected + difficulty + phase:difficulty + expected:difficulty + phase:expected:difficulty	31.31
diagnosis + phase + diagnosis:phase + expected + difficulty + phase:difficulty + expected:difficulty	31.15

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diagnosis + phase + expected + diagnosis:expected + difficulty + diagnosis:difficulty + expected:difficulty + diagnosis:expected:difficulty	30.95
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty	30.90
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + expected:difficulty	30.81
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + difficulty + phase:difficulty	30.76
diagnosis + phase + expected + diagnosis:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty	30.45
diagnosis + phase + expected + diagnosis:expected + phase:expected + difficulty + phase:difficulty + expected:difficulty + phase:expected:difficulty	29.98
diagnosis + phase + diagnosis:phase + expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty	29.88
diagnosis + phase + diagnosis:phase + expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty	29.86
diagnosis + phase + diagnosis:phase + expected + phase:expected + difficulty + phase:difficulty + expected:difficulty + phase:expected:difficulty	29.56
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + difficulty + diagnosis:difficulty + phase:difficulty	29.54
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + diagnosis:difficulty + expected:difficulty	29.50
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + phase:difficulty + expected:difficulty	29.13
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + phase:difficulty	28.75
diagnosis + phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty + phase:expected:difficulty	28.68
diagnosis + phase + diagnosis:phase + expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty	28.48
diagnosis + phase + diagnosis:phase + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty	28.19
diagnosis + phase + diagnosis:phase + expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty + phase:expected:difficulty	28.17
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty	28.15
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + expected:difficulty + diagnosis:expected:difficulty	27.81
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + difficulty + phase:difficulty + expected:difficulty	27.80
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + diagnosis:difficulty + phase:difficulty	27.54
diagnosis + phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty + diagnosis:expected:difficulty	27.31
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + difficulty + diagnosis:difficulty + expected:difficulty + diagnosis:expected:difficulty	27.03
diagnosis + phase + diagnosis:phase + expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty + expected:difficulty	26.76
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty	26.57
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty	26.42
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + phase:difficulty + expected:difficulty + phase:expected:difficulty	26.17
diagnosis + phase + expected + diagnosis:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty + diagnosis:expected:difficulty	25.83
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + phase:difficulty + expected:difficulty	25.81
diagnosis + phase + diagnosis:phase + expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty + expected:difficulty	25.42

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diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty	25.11
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + diagnosis:difficulty + expected:difficulty + diagnosis:expected:difficulty	25.08
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty + phase:expected:difficulty	24.94
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty	24.67
diagnosis + phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty + diagnosis:expected:difficulty + phase:expected:difficulty	24.26
diagnosis + phase + diagnosis:phase + expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty + expected:difficulty + phase:expected:difficulty	23.78
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty + expected:difficulty	23.49
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty + diagnosis:expected:difficulty	23.46
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty	23.04
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + phase:difficulty + expected:difficulty + phase:expected:difficulty	22.73
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty + expected:difficulty	22.03
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty + diagnosis:expected:difficulty	22.02
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty + phase:expected:difficulty	21.45
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty + expected:difficulty + phase:expected:difficulty	20.57
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty + diagnosis:expected:difficulty + phase:expected:difficulty	20.36
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty + expected:difficulty	20.07
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty + diagnosis:expected:difficulty	19.99
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty + expected:difficulty + diagnosis:expected:difficulty	19.07
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty + expected:difficulty + diagnosis:expected:difficulty	17.60
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty + expected:difficulty + phase:expected:difficulty	17.04
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + expected:difficulty + diagnosis:expected:difficulty + phase:expected:difficulty	16.91
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty + expected:difficulty + diagnosis:expected:difficulty + phase:expected:difficulty	16.05
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty + expected:difficulty + diagnosis:expected:difficulty	15.66
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty + expected:difficulty + diagnosis:expected:difficulty + phase:expected:difficulty	12.66
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected + difficulty + diagnosis:difficulty + phase:difficulty + diagnosis:phase:difficulty + expected:difficulty + diagnosis:expected:difficulty + phase:expected:difficulty + diagnosis:phase:expected:difficulty	8.72
diagnosis	1.45
diagnosis + expected	1.41

	bf
expected	-0.08
diagnosis + phase + expected + phase:expected	-1.05
diagnosis + phase	-1.92
diagnosis + phase + expected	-1.99
diagnosis + expected + diagnosis:expected	-2.00
phase + expected + phase:expected	-2.60
phase	-3.36
phase + expected	-3.46
diagnosis + phase + expected + diagnosis:expected + phase:expected	-4.40
diagnosis + phase + diagnosis:phase + expected + phase:expected	-5.17
diagnosis + phase + expected + diagnosis:expected	-5.19
diagnosis + phase + diagnosis:phase	-6.00
diagnosis + phase + diagnosis:phase + expected	-6.01
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected	-8.52
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected	-9.36
diagnosis + phase + diagnosis:phase + expected + diagnosis:expected + phase:expected + diagnosis:phase:expected	-12.14

Accuracies per subject