Between and Within-level Variations in Delta-Beta Synchrony

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List of necessary packages

```
list.of.packages <- c("tidyverse", "psych", "ggplot2","RColorBrewer","gcookbook", "lme4","nlme",
                      "effects", "backports", "interactions", "corrplot", "lmerTest")
```

Data Preparation

Reading the Person-level data

```
path="C:/Users/bua25/Documents/BRAIN project/SecondbySecond/"
setwd(path)

#questionnaires
QST<-read.csv("BRAINquestionnaires.csv", header = T)
QST<-QST[, c(1,32:34,36,38,40,43,154,208)]
colnames(QST)[1]<-"id"

#Demographics
Demo<-read.csv("BRAINS_Demographics.csv", header = T)
Demo<-Demo[, c(1,4,5,25)]
colnames(Demo)[1]<-"id"

#Social Reticence and Dyad ids
dyad<- read.csv("BehComp.csv", header = T)
dID<-read.csv("BLNdyadIds.csv", header =T)

#Mergin person-level variables
Pdata<-merge(Demo, QST, by="id")
```

The person level data include a larger number of participants, who provided BIQ data but were either not enrolled in the study, or were not part of the Baseline wave. Next we narrow the Person level data to the number of participants who actually have repeated measures of EEG

Second-by-second level data (T= 1-284)

```
#reading repeated EEG power data
DBs<-read.csv("DBsecbysec.csv", header = T)

#adding variable for number of segments
DBs<- DBs%>%
 dplyr::group_by(id)%>%
  dplyr::add_tally()
```

```r
#subseting the segment variable as unique to each participant
EEGseg<- DBs%>%
  dplyr::select(id, n) %>% unique()
#merging this subset into the Pdata to reduce to the number of actual participants with EEG data
Pdata<-merge(Pdata, EEGseg, by="id")
Pdata<-Pdata[, c(1,5:14)]
#Pdata<-Pdata[-51,]

enrolled<-read.csv("BRAINSenrolledCorrectNumbers.csv")
Pdata<-merge(enrolled, Pdata, by="id")
Pdata<-Pdata[-89,]
```

Person level data now contains all the participants who also have data for the EEG data

```r
Pdata$ScaredSoc.c <- scale(Pdata$SCARED_P_psocphf_P_BLN, center=TRUE, scale=FALSE)
Pdata$ScaredSep.c <- scale(Pdata$SCARED_P_psepax_P_BLN, center=TRUE,scale=FALSE)
Pdata$ScaredGen.c <- scale(Pdata$SCARED_P_pgenax_P_BLN, center=TRUE,scale=FALSE)
Pdata$ScaredTot.c <- scale(Pdata$SCARED_P_psctotal_P_BLN, center=TRUE,scale=FALSE)
Pdata$BIQ.c <- scale(Pdata$Total_BIQ, center = TRUE, scale = FALSE)


describe(Pdata)
```

```
##                          vars   n    mean     sd  median trimmed    mad
## id                          1 174 3290.33 173.38 3254.50 3278.07 177.17
## Gender                      2 174    1.54   0.50    2.00    1.55   0.00
## Ethnicity                   3 174    4.06   2.31    3.00    3.67   0.00
## age.BLNinyears              4 174   10.86   1.03   10.72   10.81   1.07
## SCARED_P_pgenax_P_BLN       5 157    3.73   3.46    3.00    3.31   2.97
## SCARED_P_psepax_P_BLN       6 157    2.37   2.81    2.00    1.87   2.97
## SCARED_P_psocphf_P_BLN      7 157    4.12   3.60    3.00    3.76   4.45
## SCARED_P_psctotal_P_BLN     8 157   11.44   9.00   10.00   10.34   8.90
## SCAS_P_sepanx_P_BLN         9 156    2.18   2.50    2.00    1.78   2.97
## SCAS_P_socanx_P_BLN        10 156    3.07   2.74    3.00    2.73   2.97
## SCAS_P_total_P_BLN         11 156   10.61   8.23    9.00    9.51   7.41
## BI                         12 173    0.45   0.50    0.00    0.43   0.00
## Total_BIQ                  13 173   97.57  32.85   99.00   96.94  37.06
## n                          14 174   99.24  55.45   93.50   98.31  68.94
## ScaredSoc.c                15 157    0.00   3.60   -1.12   -0.36   4.45
## ScaredSep.c                16 157    0.00   2.81   -0.37   -0.50   2.97
## ScaredGen.c                17 157    0.00   3.46   -0.73   -0.42   2.97
## ScaredTot.c                18 157    0.00   9.00   -1.44   -1.10   8.90
## BIQ.c                      19 173    0.00  32.85    1.43   -0.64  37.06
##                             min     max  range  skew kurtosis    se
## id                      3005.00 3695.00 690.00  0.55    -0.57 13.14
## Gender                     1.00    2.00   1.00 -0.16    -1.99  0.04
## Ethnicity                  1.00    9.00   8.00  1.51     0.60  0.18
## age.BLNinyears             9.16   13.22   4.06  0.43    -0.70  0.08
## SCARED_P_pgenax_P_BLN      0.00   15.00  15.00  0.92     0.22  0.28
## SCARED_P_psepax_P_BLN      0.00   15.00  15.00  1.76     3.66  0.22
## SCARED_P_psocphf_P_BLN     0.00   13.00  13.00  0.58    -0.69  0.29
## SCARED_P_psctotal_P_BLN    0.00   40.00  40.00  1.05     0.72  0.72
## SCAS_P_sepanx_P_BLN        0.00   13.00  13.00  1.60     3.39  0.20
```

```
## SCAS_P_socanx_P_BLN        0.00   14.00  14.00  1.08     1.23  0.22
## SCAS_P_total_P_BLN         0.00   45.00  45.00  1.34     2.03  0.66
## BI                         0.00    1.00   1.00  0.22    -1.96  0.04
## Total_BIQ                 34.00  165.00 131.00  0.11    -0.91  2.50
## n                          1.00  225.00 224.00  0.14    -0.97  4.20
## ScaredSoc.c               -4.12    8.88  13.00  0.58    -0.69  0.29
## ScaredSep.c               -2.37   12.63  15.00  1.76     3.66  0.22
## ScaredGen.c               -3.73   11.27  15.00  0.92     0.22  0.28
## ScaredTot.c              -11.44   28.56  40.00  1.05     0.72  0.72
## BIQ.c                    -63.57   67.43 131.00  0.11    -0.91  2.50
```

Between- and within- components

We now split the time-varying predictor into "trait" (between-person differences) and "state" (within-person deviations) components. Specifically, the reapeated variables of Delta and Beta power are split into two varaibles: Delta_trait is the sample-mean centered between-person component, and Delta_state is the person-centered within-person component.

```
#Person-level Delta
FDelta_imeans <- DBs %>%
                  group_by(id) %>%
  dplyr::summarise(FDelta_trait=mean(FrontalDelta, na.rm=TRUE))


CDelta_imeans <- DBs %>%
                  group_by(id) %>%
                  dplyr::summarize(CDelta_trait=mean(CentralDelta, na.rm=TRUE))

PDelta_imeans <- DBs %>%
                  group_by(id) %>%
                  dplyr::summarize(PDelta_trait=mean(ParietalDelta, na.rm=TRUE))


#merging into person-level file
Pdata <- merge(Pdata, FDelta_imeans, by="id")
Pdata <- merge(Pdata, CDelta_imeans, by="id")
Pdata <- merge(Pdata, PDelta_imeans, by="id")

#getting rid of duplicate case
Pdata<-Pdata[-51,]

#make centered versions of the person-level scores
Pdata$FDelta_trait_c <- scale(Pdata$FDelta_trait,center=TRUE,scale=FALSE)
Pdata$CDelta_trait_c <- scale(Pdata$CDelta_trait,center=TRUE,scale=FALSE)
Pdata$PDelta_trait_c <- scale(Pdata$PDelta_trait,center=TRUE,scale=FALSE)

#describe person-level data
describe(Pdata)
```

```
##                          vars   n    mean     sd  median trimmed    mad
## id                          1 173 3291.02 173.64 3255.00 3278.84 177.91
## Gender                      2 173    1.54   0.50    2.00    1.55   0.00
## Ethnicity                   3 173    4.03   2.29    3.00    3.63   0.00
## age.BLNinyears              4 173   10.85   1.03   10.72   10.80   1.08
```

```
## SCARED_P_pgenax_P_BLN      5 157    3.73   3.46    3.00    3.31   2.97
## SCARED_P_psepax_P_BLN      6 157    2.37   2.81    2.00    1.87   2.97
## SCARED_P_psocphf_P_BLN     7 157    4.12   3.60    3.00    3.76   4.45
## SCARED_P_psctotal_P_BLN    8 157   11.44   9.00   10.00   10.34   8.90
## SCAS_P_sepanx_P_BLN        9 156    2.18   2.50    2.00    1.78   2.97
## SCAS_P_socanx_P_BLN       10 156    3.07   2.74    3.00    2.73   2.97
## SCAS_P_total_P_BLN        11 156   10.61   8.23    9.00    9.51   7.41
## BI                        12 172    0.45   0.50    0.00    0.43   0.00
## Total_BIQ                 13 172   97.65  32.93   99.00   97.02  37.81
## n                         14 173   99.09  55.58   92.00   98.12  66.72
## ScaredSoc.c               15 157    0.00   3.60   -1.12   -0.36   4.45
## ScaredSep.c               16 157    0.00   2.81   -0.37   -0.50   2.97
## ScaredGen.c               17 157    0.00   3.46   -0.73   -0.42   2.97
## ScaredTot.c               18 157    0.00   9.00   -1.44   -1.10   8.90
## BIQ.c                     19 172    0.07  32.93    1.43   -0.55  37.81
## FDelta_trait              20 173    1.58   0.44    1.61    1.58   0.39
## CDelta_trait              21 173    0.69   0.56    0.63    0.67   0.52
## PDelta_trait              22 173    1.04   0.64    1.04    1.02   0.64
## FDelta_trait_c            23 173    0.00   0.44    0.03    0.01   0.39
## CDelta_trait_c            24 173    0.00   0.56   -0.06   -0.02   0.52
## PDelta_trait_c            25 173    0.00   0.64    0.00   -0.01   0.64
##                             min     max  range  skew kurtosis    se
## id                      3005.00 3695.00 690.00  0.55    -0.59 13.20
## Gender                     1.00    2.00   1.00 -0.17    -1.98  0.04
## Ethnicity                  1.00    9.00   8.00  1.54     0.73  0.17
## age.BLNinyears             9.16   13.22   4.06  0.44    -0.67  0.08
## SCARED_P_pgenax_P_BLN      0.00   15.00  15.00  0.92     0.22  0.28
## SCARED_P_psepax_P_BLN      0.00   15.00  15.00  1.76     3.66  0.22
## SCARED_P_psocphf_P_BLN     0.00   13.00  13.00  0.58    -0.69  0.29
## SCARED_P_psctotal_P_BLN    0.00   40.00  40.00  1.05     0.72  0.72
## SCAS_P_sepanx_P_BLN        0.00   13.00  13.00  1.60     3.39  0.20
## SCAS_P_socanx_P_BLN        0.00   14.00  14.00  1.08     1.23  0.22
## SCAS_P_total_P_BLN         0.00   45.00  45.00  1.34     2.03  0.66
## BI                         0.00    1.00   1.00  0.21    -1.97  0.04
## Total_BIQ                 34.00  165.00 131.00  0.10    -0.92  2.51
## n                          1.00  225.00 224.00  0.15    -0.98  4.23
## ScaredSoc.c               -4.12    8.88  13.00  0.58    -0.69  0.29
## ScaredSep.c               -2.37   12.63  15.00  1.76     3.66  0.22
## ScaredGen.c               -3.73   11.27  15.00  0.92     0.22  0.28
## ScaredTot.c              -11.44   28.56  40.00  1.05     0.72  0.72
## BIQ.c                    -63.57   67.43 131.00  0.10    -0.92  2.51
## FDelta_trait              -0.08    2.88   2.96 -0.24     1.06  0.03
## CDelta_trait              -0.63    2.89   3.51  0.41     0.56  0.04
## PDelta_trait              -0.54    2.81   3.34  0.19    -0.38  0.05
## FDelta_trait_c            -1.65    1.31   2.96 -0.24     1.06  0.03
## CDelta_trait_c            -1.31    2.20   3.51  0.41     0.56  0.04
## PDelta_trait_c            -1.57    1.77   3.34  0.19    -0.38  0.05
```

```
#Repeating the same for Beta power
#Person-level Delta
FBeta_imeans <- DBs %>%
                  group_by(id) %>%
                  dplyr::summarize(FBeta_trait=mean(FrontalBeta, na.rm=TRUE))
```

```r
CBeta_imeans <- DBs %>%
                  group_by(id) %>%
                  dplyr::summarize(CBeta_trait=mean(CentralBeta, na.rm=TRUE))

PBeta_imeans <- DBs %>%
                  group_by(id) %>%
                  dplyr::summarize(PBeta_trait=mean(ParietalBeta, na.rm=TRUE))


#merging into person-level file
Pdata <- merge(Pdata, FBeta_imeans, by="id")
Pdata <- merge(Pdata, CBeta_imeans, by="id")
Pdata <- merge(Pdata, PBeta_imeans, by="id")

#make centered versions of the person-level scores
Pdata$FBeta_trait_c <- scale(Pdata$FBeta_trait,center=TRUE,scale=FALSE)
Pdata$CBeta_trait_c <- scale(Pdata$CBeta_trait,center=TRUE,scale=FALSE)
Pdata$PBeta_trait_c <- scale(Pdata$PBeta_trait,center=TRUE,scale=FALSE)

#describe person-level data
describe(Pdata)
```

```
##                          vars   n    mean     sd  median trimmed    mad
## id                          1 173 3291.02 173.64 3255.00 3278.84 177.91
## Gender                      2 173    1.54   0.50    2.00    1.55   0.00
## Ethnicity                   3 173    4.03   2.29    3.00    3.63   0.00
## age.BLNinyears              4 173   10.85   1.03   10.72   10.80   1.08
## SCARED_P_pgenax_P_BLN       5 157    3.73   3.46    3.00    3.31   2.97
## SCARED_P_psepax_P_BLN       6 157    2.37   2.81    2.00    1.87   2.97
## SCARED_P_psocphf_P_BLN      7 157    4.12   3.60    3.00    3.76   4.45
## SCARED_P_psctotal_P_BLN     8 157   11.44   9.00   10.00   10.34   8.90
## SCAS_P_sepanx_P_BLN         9 156    2.18   2.50    2.00    1.78   2.97
## SCAS_P_socanx_P_BLN        10 156    3.07   2.74    3.00    2.73   2.97
## SCAS_P_total_P_BLN         11 156   10.61   8.23    9.00    9.51   7.41
## BI                         12 172    0.45   0.50    0.00    0.43   0.00
## Total_BIQ                  13 172   97.65  32.93   99.00   97.02  37.81
## n                          14 173   99.09  55.58   92.00   98.12  66.72
## ScaredSoc.c                15 157    0.00   3.60   -1.12   -0.36   4.45
## ScaredSep.c                16 157    0.00   2.81   -0.37   -0.50   2.97
## ScaredGen.c                17 157    0.00   3.46   -0.73   -0.42   2.97
## ScaredTot.c                18 157    0.00   9.00   -1.44   -1.10   8.90
## BIQ.c                      19 172    0.07  32.93    1.43   -0.55  37.81
## FDelta_trait               20 173    1.58   0.44    1.61    1.58   0.39
## CDelta_trait               21 173    0.69   0.56    0.63    0.67   0.52
## PDelta_trait               22 173    1.04   0.64    1.04    1.02   0.64
## FDelta_trait_c             23 173    0.00   0.44    0.03    0.01   0.39
## CDelta_trait_c             24 173    0.00   0.56   -0.06   -0.02   0.52
## PDelta_trait_c             25 173    0.00   0.64    0.00   -0.01   0.64
## FBeta_trait                26 173   -1.17   0.53   -1.20   -1.20   0.51
## CBeta_trait                27 173   -1.81   0.56   -1.84   -1.84   0.54
## PBeta_trait                28 173   -1.41   0.61   -1.41   -1.42   0.57
## FBeta_trait_c              29 173    0.00   0.53   -0.04   -0.03   0.51
## CBeta_trait_c              30 173    0.00   0.56   -0.04   -0.03   0.54
```

```
## PBeta_trait_c             31 173    0.00   0.61    0.00   -0.01   0.57
##                             min     max  range  skew kurtosis    se
## id                      3005.00 3695.00 690.00  0.55    -0.59 13.20
## Gender                     1.00    2.00   1.00 -0.17    -1.98  0.04
## Ethnicity                  1.00    9.00   8.00  1.54     0.73  0.17
## age.BLNinyears             9.16   13.22   4.06  0.44    -0.67  0.08
## SCARED_P_pgenax_P_BLN      0.00   15.00  15.00  0.92     0.22  0.28
## SCARED_P_psepax_P_BLN      0.00   15.00  15.00  1.76     3.66  0.22
## SCARED_P_psocphf_P_BLN     0.00   13.00  13.00  0.58    -0.69  0.29
## SCARED_P_psctotal_P_BLN    0.00   40.00  40.00  1.05     0.72  0.72
## SCAS_P_sepanx_P_BLN        0.00   13.00  13.00  1.60     3.39  0.20
## SCAS_P_socanx_P_BLN        0.00   14.00  14.00  1.08     1.23  0.22
## SCAS_P_total_P_BLN         0.00   45.00  45.00  1.34     2.03  0.66
## BI                         0.00    1.00   1.00  0.21    -1.97  0.04
## Total_BIQ                 34.00  165.00 131.00  0.10    -0.92  2.51
## n                          1.00  225.00 224.00  0.15    -0.98  4.23
## ScaredSoc.c               -4.12    8.88  13.00  0.58    -0.69  0.29
## ScaredSep.c               -2.37   12.63  15.00  1.76     3.66  0.22
## ScaredGen.c               -3.73   11.27  15.00  0.92     0.22  0.28
## ScaredTot.c              -11.44   28.56  40.00  1.05     0.72  0.72
## BIQ.c                    -63.57   67.43 131.00  0.10    -0.92  2.51
## FDelta_trait              -0.08    2.88   2.96 -0.24     1.06  0.03
## CDelta_trait              -0.63    2.89   3.51  0.41     0.56  0.04
## PDelta_trait              -0.54    2.81   3.34  0.19    -0.38  0.05
## FDelta_trait_c            -1.65    1.31   2.96 -0.24     1.06  0.03
## CDelta_trait_c            -1.31    2.20   3.51  0.41     0.56  0.04
## PDelta_trait_c            -1.57    1.77   3.34  0.19    -0.38  0.05
## FBeta_trait               -2.46    0.47   2.93  0.57     0.35  0.04
## CBeta_trait               -2.90    0.24   3.15  0.58     0.38  0.04
## PBeta_trait               -2.79    0.58   3.37  0.27     0.18  0.05
## FBeta_trait_c             -1.29    1.64   2.93  0.57     0.35  0.04
## CBeta_trait_c             -1.10    2.05   3.15  0.58     0.38  0.04
## PBeta_trait_c             -1.38    1.99   3.37  0.27     0.18  0.05
```

Making state variables in long data (as deviations from uncentered trait variable)

```
#merging person-level data into daily data
DBlong <- merge(DBs,Pdata,by="id")

#calculating state variables for Delta
DBlong$FDelta_state <- DBlong$FrontalDelta - DBlong$FDelta_trait
DBlong$CDelta_state <- DBlong$CentralDelta - DBlong$CDelta_trait
DBlong$PDelta_state <- DBlong$ParietalDelta - DBlong$PDelta_trait

#calculating state variables for Beta
DBlong$FBeta_state <- DBlong$FrontalBeta - DBlong$FBeta_trait
DBlong$CBeta_state <-  DBlong$CentralBeta - DBlong$CBeta_trait
DBlong$PBeta_state <-  DBlong$ParietalBeta - DBlong$PBeta_trait

#describing data
describe(DBlong)
```

```
##                        vars     n    mean     sd  median trimmed    mad
```

```
##                          vars     n    mean     sd  median trimmed     mad
## id                          1 17143 3266.18 167.57 3232.00 3249.44  160.12
## time                        2 17143   34.64  25.03   30.00   32.33   26.69
## condition*                  3 17143    1.95   1.00    1.00    1.94    0.00
## FrontalDelta                4 17143    1.51   0.86    1.53    1.52    0.85
## CentralDelta                5 17143    0.54   0.82    0.54    0.54    0.81
## ParietalDelta               6 17143    0.89   0.88    0.89    0.89    0.88
## FrontalBeta                 7 17143   -1.23   0.61   -1.27   -1.25    0.60
## CentralBeta                 8 17143   -1.93   0.61   -1.97   -1.95    0.59
## ParietalBeta                9 17143   -1.53   0.67   -1.53   -1.54    0.67
## seconds                    10 17143   65.54  46.91   57.00   61.43   50.41
## n.x                        11 17143  130.08  48.68  132.00  131.52   54.86
## Gender                     12 17143    1.57   0.49    2.00    1.59    0.00
## Ethnicity                  13 17143    4.08   2.33    3.00    3.68    0.00
## age.BLNinyears             14 17143   10.98   1.02   10.81   10.95    1.04
## SCARED_P_pgenax_P_BLN      15 15319    3.65   3.41    3.00    3.21    2.97
## SCARED_P_psepax_P_BLN      16 15319    2.42   2.85    1.00    1.89    1.48
## SCARED_P_psocphf_P_BLN     17 15319    4.05   3.66    3.00    3.64    4.45
## SCARED_P_psctotal_P_BLN    18 15319   11.44   9.30   10.00   10.18    8.90
## SCAS_P_sepanx_P_BLN        19 15260    2.31   2.63    2.00    1.87    2.97
## SCAS_P_socanx_P_BLN        20 15260    3.17   2.78    3.00    2.83    2.97
## SCAS_P_total_P_BLN         21 15260   10.84   8.42    9.00    9.69    7.41
## BI                         22 17001    0.41   0.49    0.00    0.39    0.00
## Total_BIQ                  23 17001   96.11  33.91   97.00   95.16   38.55
## n.y                        24 17143  130.08  48.68  132.00  131.52   54.86
## ScaredSoc.c                25 15319   -0.07   3.66   -1.12   -0.49    4.45
## ScaredSep.c                26 15319    0.05   2.85   -1.37   -0.48    1.48
## ScaredGen.c                27 15319   -0.08   3.41   -0.73   -0.52    2.97
## ScaredTot.c                28 15319    0.00   9.30   -1.44   -1.26    8.90
## BIQ.c                      29 17001   -1.46  33.91   -0.57   -2.41   38.55
## FDelta_trait               30 17143    1.51   0.41    1.55    1.53    0.39
## CDelta_trait               31 17143    0.54   0.50    0.52    0.53    0.47
## PDelta_trait               32 17143    0.89   0.58    0.81    0.88    0.59
## FDelta_trait_c             33 17143   -0.07   0.41   -0.03   -0.05    0.39
## CDelta_trait_c             34 17143   -0.14   0.50   -0.16   -0.15    0.47
## PDelta_trait_c             35 17143   -0.14   0.58   -0.23   -0.16    0.59
## FBeta_trait                36 17143   -1.23   0.49   -1.25   -1.25    0.49
## CBeta_trait                37 17143   -1.93   0.51   -2.01   -1.95    0.49
## PBeta_trait                38 17143   -1.53   0.56   -1.54   -1.54    0.52
## FBeta_trait_c              39 17143   -0.06   0.49   -0.08   -0.08    0.49
## CBeta_trait_c              40 17143   -0.12   0.51   -0.20   -0.15    0.49
## PBeta_trait_c              41 17143   -0.12   0.56   -0.12   -0.13    0.52
## FDelta_state               42 17143    0.00   0.76    0.02    0.01    0.74
## CDelta_state               43 17143    0.00   0.64    0.01    0.00    0.62
## PDelta_state               44 17143    0.00   0.66    0.01    0.01    0.65
## FBeta_state                45 17143    0.00   0.36   -0.02   -0.01    0.34
## CBeta_state                46 17143    0.00   0.33   -0.01    0.00    0.32
## PBeta_state                47 17143    0.00   0.37    0.00    0.00    0.36
##                             min     max  range  skew kurtosis   se
## id                      3005.00 3695.00 690.00  0.82     0.00 1.28
## time                       1.00  120.00 119.00  0.70    -0.31 0.19
## condition*                 1.00    4.00   3.00  0.11    -1.96 0.01
## FrontalDelta              -2.02    4.52   6.54 -0.14     0.09 0.01
## CentralDelta              -2.75    4.25   7.00  0.05     0.20 0.01
## ParietalDelta             -2.56    4.12   6.69  0.04     0.04 0.01
```

```
## FrontalBeta               -3.29    1.98   5.28  0.42     0.54 0.00
## CentralBeta               -4.05    1.21   5.26  0.39     0.40 0.00
## ParietalBeta              -3.55    1.77   5.31  0.15     0.01 0.01
## seconds                    1.00  225.00 224.00  0.68    -0.30 0.36
## n.x                        1.00  225.00 224.00 -0.26    -0.64 0.37
## Gender                     1.00    2.00   1.00 -0.30    -1.91 0.00
## Ethnicity                  1.00    9.00   8.00  1.50     0.55 0.02
## age.BLNinyears             9.16   13.22   4.06  0.32    -0.74 0.01
## SCARED_P_pgenax_P_BLN      0.00   15.00  15.00  0.96     0.19 0.03
## SCARED_P_psepax_P_BLN      0.00   15.00  15.00  1.49     2.00 0.02
## SCARED_P_psocphf_P_BLN     0.00   13.00  13.00  0.66    -0.56 0.03
## SCARED_P_psctotal_P_BLN    0.00   40.00  40.00  1.08     0.58 0.08
## SCAS_P_sepanx_P_BLN        0.00   13.00  13.00  1.51     2.69 0.02
## SCAS_P_socanx_P_BLN        0.00   14.00  14.00  1.11     1.36 0.02
## SCAS_P_total_P_BLN         0.00   45.00  45.00  1.23     1.37 0.07
## BI                         0.00    1.00   1.00  0.36    -1.87 0.00
## Total_BIQ                 34.00  165.00 131.00  0.16    -0.92 0.26
## n.y                        1.00  225.00 224.00 -0.26    -0.64 0.37
## ScaredSoc.c               -4.12    8.88  13.00  0.66    -0.56 0.03
## ScaredSep.c               -2.37   12.63  15.00  1.49     2.00 0.02
## ScaredGen.c               -3.73   11.27  15.00  0.96     0.19 0.03
## ScaredTot.c              -11.44   28.56  40.00  1.08     0.58 0.08
## BIQ.c                    -63.57   67.43 131.00  0.16    -0.92 0.26
## FDelta_trait              -0.08    2.88   2.96 -0.57     1.23 0.00
## CDelta_trait              -0.63    2.89   3.51  0.25     0.57 0.00
## PDelta_trait              -0.54    2.81   3.34  0.20    -0.24 0.00
## FDelta_trait_c            -1.65    1.31   2.96 -0.57     1.23 0.00
## CDelta_trait_c            -1.31    2.20   3.51  0.25     0.57 0.00
## PDelta_trait_c            -1.57    1.77   3.34  0.20    -0.24 0.00
## FBeta_trait               -2.46    0.47   2.93  0.38     0.27 0.00
## CBeta_trait               -2.90    0.24   3.15  0.57     0.40 0.00
## PBeta_trait               -2.79    0.58   3.37  0.21     0.11 0.00
## FBeta_trait_c             -1.29    1.64   2.93  0.38     0.27 0.00
## CBeta_trait_c             -1.10    2.05   3.15  0.57     0.40 0.00
## PBeta_trait_c             -1.38    1.99   3.37  0.21     0.11 0.00
## FDelta_state              -2.95    3.24   6.19 -0.08     0.24 0.01
## CDelta_state              -3.06    3.33   6.38 -0.01     0.47 0.00
## PDelta_state              -2.84    2.79   5.63 -0.11     0.26 0.01
## FBeta_state               -1.37    2.23   3.60  0.36     0.96 0.00
## CBeta_state               -1.41    1.49   2.89  0.16     0.46 0.00
## PBeta_state               -1.50    2.13   3.63  0.07     0.28 0.00
```

Descriptive analyses of Delta and Beta power

We now computing power means in a wide dataset, to assess mean differences in EEG power across regions, demographic variables, and task condition

```
func <- function(DBlong)
{
  return(data.frame(FD = mean(DBlong$FrontalDelta),
                    CD = mean(DBlong$CentralDelta),
                    PD = mean(DBlong$ParietalDelta),
```

```
                    FB = mean(DBlong$FrontalBeta),
                    CB = mean(DBlong$CentralBeta),
                    PB = mean(DBlong$ParietalBeta)))
}
library(plyr)
```

```
## ------------------------------------------------------------------------

## You have loaded plyr after dplyr - this is likely to cause problems.
## If you need functions from both plyr and dplyr, please load plyr first, then dplyr:
## library(plyr); library(dplyr)

## ------------------------------------------------------------------------

##
## Attaching package: 'plyr'

## The following objects are masked from 'package:dplyr':
##
##     arrange, count, desc, failwith, id, mutate, rename, summarise,
##     summarize

## The following object is masked from 'package:purrr':
##
##     compact
```

```
Power<-ddply(DBlong, .(id, condition), func)

#checking the condition variable
table(Power$condition)
```

```
##
##  CL  L_  OP  P_
## 165   2 169   2
```

```
#recoding the wrong labels
Power$condition[Power$condition=="L_"] <- "CL"
Power$condition[Power$condition=="P_"] <- "OP"
```

Analyses of Variance (ANOVAs) testing EEG power differences across eyes-open/ eyes-closed conditions

```
#Delta across regions
summary(aov(FD ~ condition +
              Error(id/condition), data=Power))
```

```
##
## Error: id
##           Df Sum Sq Mean Sq
## condition  1  1.457   1.457
##
```

```
## Error: id:condition
##           Df Sum Sq Mean Sq
## condition  1  3.687   3.687
##
## Error: Within
##            Df Sum Sq Mean Sq F value Pr(>F)
## condition   1   0.10  0.1024   0.498  0.481
## Residuals 334  68.64  0.2055
```

```
summary(aov(CD ~ condition +
              Error(id/condition), data=Power))
```

```
##
## Error: id
##           Df Sum Sq Mean Sq
## condition  1  11.26   11.26
##
## Error: id:condition
##           Df Sum Sq Mean Sq
## condition  1  1.272   1.272
##
## Error: Within
##            Df Sum Sq Mean Sq F value Pr(>F)
## condition   1   0.09 0.08624     0.3  0.584
## Residuals 334  96.12 0.28778
```

```
summary(aov(PD ~ condition +
              Error(id/condition), data=Power))
```

```
##
## Error: id
##           Df Sum Sq Mean Sq
## condition  1   11.4    11.4
##
## Error: id:condition
##           Df Sum Sq Mean Sq
## condition  1   2.76    2.76
##
## Error: Within
##            Df Sum Sq Mean Sq F value Pr(>F)
## condition   1    0.5  0.5044   1.234  0.268
## Residuals 334  136.6  0.4089
```

```
#Beta across regions
summary(aov(FB ~ condition +
              Error(id/condition), data=Power))
```

```
##
## Error: id
##           Df Sum Sq Mean Sq
## condition  1  1.401   1.401
##
```

```
## Error: id:condition
##           Df Sum Sq Mean Sq
## condition  1 0.3033  0.3033
##
## Error: Within
##            Df Sum Sq Mean Sq F value Pr(>F)
## condition   1   0.05 0.04917    0.18  0.672
## Residuals 334  91.34 0.27346
```

```
summary(aov(CB ~ condition +
              Error(id/condition), data=Power))
```

```
##
## Error: id
##           Df Sum Sq Mean Sq
## condition  1  10.55   10.55
##
## Error: id:condition
##           Df Sum Sq Mean Sq
## condition  1  1.485   1.485
##
## Error: Within
##            Df Sum Sq Mean Sq F value Pr(>F)
## condition   1   0.25  0.2546    0.92  0.338
## Residuals 334  92.42  0.2767
```

```
summary(aov(PB ~ condition +
              Error(id/condition), data=Power))
```

```
##
## Error: id
##           Df Sum Sq Mean Sq
## condition  1   6.76    6.76
##
## Error: id:condition
##           Df Sum Sq Mean Sq
## condition  1  5.441   5.441
##
## Error: Within
##            Df Sum Sq Mean Sq F value Pr(>F)
## condition   1   0.41  0.4146   1.114  0.292
## Residuals 334 124.33  0.3723
```

We now melt or shape this data set by region, in order to test power differences across regions with a repeated mmeasures ANOVA

```
#melting by region
Power<- Power %>%
  group_by(id)%>%
  dplyr::summarise(mean(FD),
                   mean(CD),
                   mean(PD),
```

```
                    mean(FB),
                    mean(CB),
                    mean(PB))

demovars<- Pdata[, c("id","Gender","Ethnicity","age.BLNinyears","BI","Total_BIQ")]
Power<-merge(Power,demovars, by="id")

colnames(Power)<-c("id","Delta_F","Delta_C", "Delta_P","Beta_F","Beta_C", "Beta_P","Gender",
                   "Eth","Age","BI","TotalBIQ")

#removing extra row that participant 3165 creates
Power<-Power[-48,]

powerLong<- reshape(Power,
                    timevar = "BrainRegion",
                    varying = c("Delta_F","Delta_C", "Delta_P","Beta_F","Beta_C", "Beta_P"),
                    idvar = "id",
                    sep = "_",
                    direction = "long")
```

Testing BI, gender, and ethnicity differences

```
#Differences in Delta power
summary(aov(Delta ~ BrainRegion*Gender + BrainRegion*TotalBIQ, data=powerLong)) #sig between BI, higher
```

```
##                       Df Sum Sq Mean Sq F value   Pr(>F)
## BrainRegion            2  69.85   34.93 140.266  < 2e-16 ***
## Gender                 1  27.04   27.04 108.593  < 2e-16 ***
## TotalBIQ               1   4.58    4.58  18.405 2.14e-05 ***
## BrainRegion:Gender     2   1.47    0.74   2.960   0.0527 .
## BrainRegion:TotalBIQ   2   0.17    0.08   0.339   0.7126
## Residuals            507 126.24    0.25
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#means
describeBy(powerLong$Delta, group = powerLong$Gender)
```

```
##
##  Descriptive statistics by group
## group: 1
##    vars   n mean   sd median trimmed  mad  min  max range  skew kurtosis
## X1    1 234 1.35 0.59   1.37    1.36 0.67 0.02 2.98  2.96 -0.02    -0.59
##      se
## X1 0.04
## ------------------------------------------------------------
## group: 2
##    vars   n mean   sd median trimmed  mad   min  max range skew kurtosis
## X1    1 282 0.89 0.66   0.89    0.89 0.69 -0.63 2.89  3.52 0.12    -0.36
##      se
## X1 0.04
```

```r
describeBy(powerLong$Delta, group = powerLong$BI)
```

```
##
##  Descriptive statistics by group
## group: 0
##    vars   n mean   sd median trimmed  mad   min  max range  skew kurtosis
## X1    1 285 1.01 0.63   1.05    1.01 0.71 -0.54 2.81  3.34 -0.06    -0.63
##      se
## X1 0.04
## ------------------------------------------------------------
## group: 1
##    vars   n mean   sd median trimmed  mad   min  max range  skew kurtosis
## X1    1 231 1.22 0.69   1.29    1.22 0.72 -0.63 2.98  3.61 -0.09    -0.37
##      se
## X1 0.05
```

```r
describeBy(powerLong$Delta, group = powerLong$BrainRegion)
```

```
##
##  Descriptive statistics by group
## group: C
##    vars   n mean   sd median trimmed  mad   min  max range skew kurtosis
## X1    1 172 0.69 0.56   0.65    0.67 0.55 -0.63 2.89  3.52 0.37      0.6
##      se
## X1 0.04
## ------------------------------------------------------------
## group: F
##    vars   n mean   sd median trimmed  mad  min  max range  skew kurtosis
## X1    1 172 1.58 0.44    1.6    1.58 0.41 0.03 2.98  2.95 -0.09     1.05
##      se
## X1 0.03
## ------------------------------------------------------------
## group: P
##    vars   n mean   sd median trimmed  mad   min  max range skew kurtosis
## X1    1 172 1.04 0.65   1.03    1.02 0.66 -0.54 2.81  3.34 0.25    -0.38
##      se
## X1 0.05
```

```r
#ethnicity
summary(lm(Delta ~ BrainRegion*Eth, data=powerLong, na.action = na.exclude)) #not sig between ethnic gr
```

```
##
## Call:
## lm(formula = Delta ~ BrainRegion * Eth, data = powerLong, na.action = na.exclude)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.59031 -0.37430  0.00337  0.32606  2.19172
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)       0.722143   0.086440   8.354 6.27e-16 ***
```

```
## BrainRegionF      0.936225   0.122245   7.659 9.51e-14 ***
## BrainRegionP      0.374119   0.122245   3.060  0.00233 **
## Eth              -0.008930   0.018620  -0.480  0.63172
## BrainRegionF:Eth -0.010372   0.026332  -0.394  0.69381
## BrainRegionP:Eth -0.005805   0.026332  -0.220  0.82560
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.5582 on 510 degrees of freedom
## Multiple R-squared:  0.3072, Adjusted R-squared:  0.3004
## F-statistic: 45.22 on 5 and 510 DF,  p-value: < 2.2e-16
```

```
#Differences in Beta power
summary(aov(Beta ~ BrainRegion*Gender + BrainRegion*TotalBIQ, data=powerLong)) #sig between BI, higher
```

```
##                       Df Sum Sq Mean Sq F value   Pr(>F)
## BrainRegion            2  35.63  17.813  62.118  < 2e-16 ***
## Gender                 1  13.51  13.506  47.096 1.98e-11 ***
## TotalBIQ               1   4.96   4.962  17.304 3.74e-05 ***
## BrainRegion:Gender     2   0.88   0.439   1.531    0.217
## BrainRegion:TotalBIQ   2   0.05   0.026   0.090    0.914
## Residuals            507 145.39   0.287
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#means
describeBy(powerLong$Beta, group = powerLong$Gender)
```

```
##
##  Descriptive statistics by group
## group: 1
##    vars   n  mean   sd median trimmed  mad   min  max range skew kurtosis
## X1    1 234 -1.29 0.62  -1.34   -1.31 0.59 -2.68 0.59  3.26 0.31     0.07
##      se
## X1 0.04
## ------------------------------------------------------------
## group: 2
##    vars   n  mean   sd median trimmed  mad   min  max range skew kurtosis
## X1    1 282 -1.62 0.59  -1.63   -1.63 0.62 -2.92 0.24  3.16 0.29    -0.02
##      se
## X1 0.04
```

```
describeBy(powerLong$Beta, group = powerLong$BI)
```

```
##
##  Descriptive statistics by group
## group: 0
##    vars   n  mean   sd median trimmed  mad   min  max range skew kurtosis
## X1    1 285 -1.56 0.59  -1.55   -1.56 0.61 -2.92 0.46  3.37  0.1    -0.33
##      se
## X1 0.03
## ------------------------------------------------------------
```

```
## group: 1
##    vars   n  mean   sd median trimmed  mad   min  max range skew kurtosis
## X1    1 231 -1.36 0.65  -1.42   -1.38 0.63 -2.87 0.59  3.45 0.41     0.06
##      se
## X1 0.04
```

```
describeBy(powerLong$Beta, group=powerLong$BrainRegion)
```

```
##
##  Descriptive statistics by group
## group: C
##    vars   n  mean   sd median trimmed  mad   min  max range skew kurtosis
## X1    1 172 -1.81 0.56  -1.84   -1.84 0.55 -2.92 0.24  3.16 0.59     0.42
##      se
## X1 0.04
## ------------------------------------------------------------
## group: F
##    vars   n  mean   sd median trimmed mad   min  max range skew kurtosis
## X1    1 172 -1.17 0.53  -1.21   -1.21 0.5 -2.45 0.46  2.91 0.55     0.34
##      se
## X1 0.04
## ------------------------------------------------------------
## group: P
##    vars   n  mean   sd median trimmed mad   min  max range skew kurtosis
## X1    1 172 -1.42 0.61  -1.44   -1.43 0.6 -2.81 0.59  3.39 0.33     0.13
##      se
## X1 0.05
```

```
#ethnicity
summary(lm(Beta ~ BrainRegion*Eth, data=powerLong, na.action = na.exclude)) #not sig between ethnic gro
```

```
##
## Call:
## lm(formula = Beta ~ BrainRegion * Eth, data = powerLong, na.action = na.exclude)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.39809 -0.38366 -0.03528  0.36498  2.04909
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)      -1.797738   0.088007 -20.427  < 2e-16 ***
## BrainRegionF      0.633819   0.124461   5.093 4.98e-07 ***
## BrainRegionP      0.412186   0.124461   3.312 0.000993 ***
## Eth              -0.003541   0.018957  -0.187 0.851897
## BrainRegionF:Eth  0.000936   0.026809   0.035 0.972162
## BrainRegionP:Eth -0.004267   0.026809  -0.159 0.873619
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.5683 on 510 degrees of freedom
## Multiple R-squared:  0.1781, Adjusted R-squared:  0.1701
## F-statistic: 22.11 on 5 and 510 DF,  p-value: < 2.2e-16
```

We now compute mean level stability of Delta and Beta power across regions

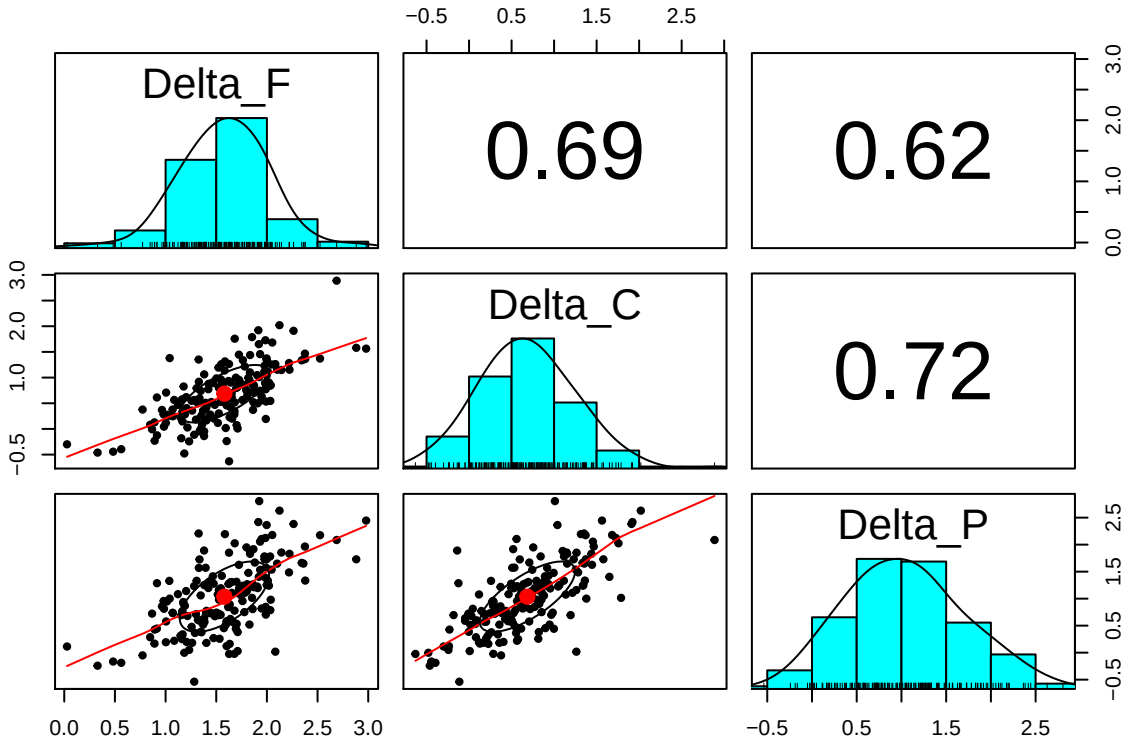
```
#Delta
print(corr.test(Power[,c(2:4)],
                use = "pairwise",method="pearson",adjust="holm", alpha=.05,ci=TRUE),
      short=FALSE)
```

```
## Call:corr.test(x = Power[, c(2:4)], use = "pairwise", method = "pearson",
##     adjust = "holm", alpha = 0.05, ci = TRUE)
## Correlation matrix
##         Delta_F Delta_C Delta_P
## Delta_F    1.00    0.69    0.62
## Delta_C    0.69    1.00    0.72
## Delta_P    0.62    0.72    1.00
## Sample Size
## [1] 172
## Probability values (Entries above the diagonal are adjusted for multiple tests.)
##         Delta_F Delta_C Delta_P
## Delta_F       0       0       0
## Delta_C       0       0       0
## Delta_P       0       0       0
##
##  Confidence intervals based upon normal theory.  To get bootstrapped values, try cor.ci
##             raw.lower raw.r raw.upper raw.p lower.adj upper.adj
## Dlt_F-Dlt_C      0.60  0.69      0.76     0      0.59      0.77
## Dlt_F-Dlt_P      0.51  0.62      0.70     0      0.51      0.70
## Dlt_C-Dlt_P      0.64  0.72      0.78     0      0.61      0.79
```

```
cor.test(Power$Delta_F, Power$Delta_C, method = "pearson")
```

```
##
##  Pearson's product-moment correlation
##
## data:  Power$Delta_F and Power$Delta_C
## t = 12.451, df = 170, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.6033365 0.7615563
## sample estimates:
##       cor
## 0.6906217
```

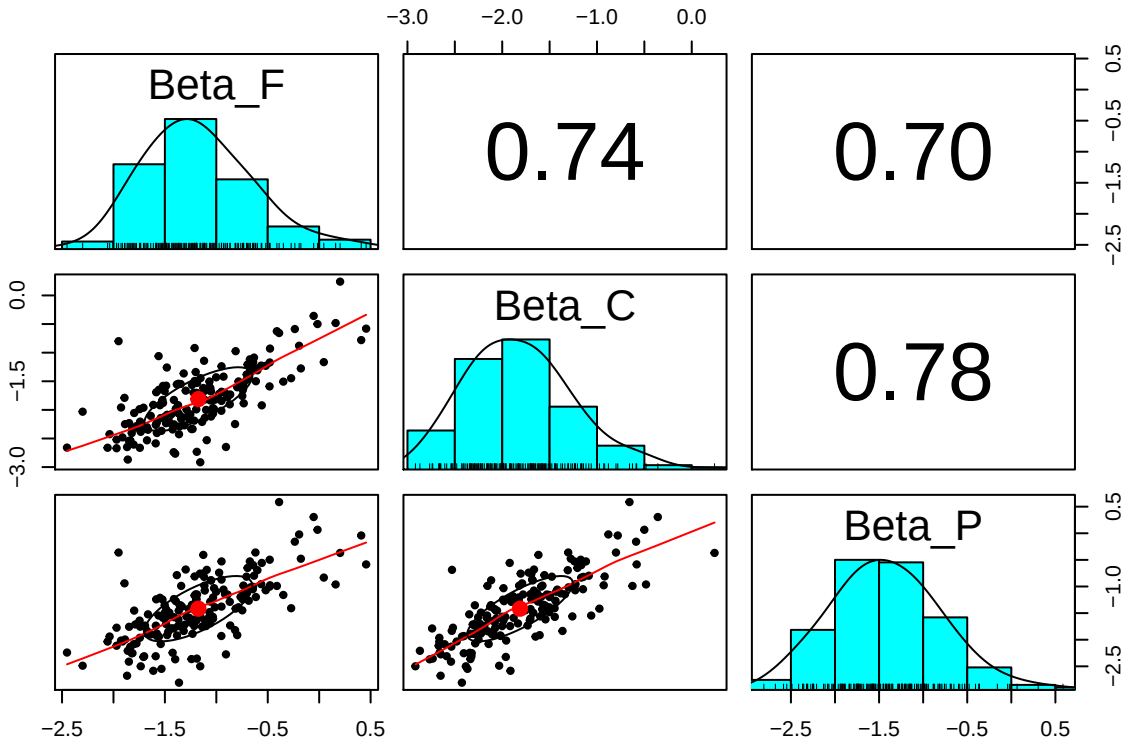
```
#visual
pairs.panels(Power[,c(2:4)])
```




```
#Beta
print(corr.test(Power[,c(5:7)],
                        use = "pairwise",method="pearson",adjust="holm", alpha=.05,ci=TRUE),
              short=FALSE)
```

```
## Call:corr.test(x = Power[, c(5:7)], use = "pairwise", method = "pearson",
##     adjust = "holm", alpha = 0.05, ci = TRUE)
## Correlation matrix
##        Beta_F Beta_C Beta_P
## Beta_F   1.00   0.74   0.70
## Beta_C   0.74   1.00   0.78
## Beta_P   0.70   0.78   1.00
## Sample Size
## [1] 172
## Probability values (Entries above the diagonal are adjusted for multiple tests.)
##        Beta_F Beta_C Beta_P
## Beta_F      0      0      0
## Beta_C      0      0      0
## Beta_P      0      0      0
##
##  Confidence intervals based upon normal theory.  To get bootstrapped values, try cor.ci
##             raw.lower raw.r raw.upper raw.p lower.adj upper.adj
## Bet_F-Bet_C      0.66  0.74      0.80     0      0.65      0.81
## Bet_F-Bet_P      0.61  0.70      0.77     0      0.61      0.77
## Bet_C-Bet_P      0.71  0.78      0.83     0      0.70      0.84
```

```
pairs.panels(Power[,c(5:7)])
```



Delta-Beta synchrony overtime

Before examining inter and intraindividual variability, we examine the effect of time (in seconds) spent in the resting state task on delta-beta synchrony.

```
Bc<-lmeControl(maxIter = 100, msMaxIter = 100, tolerance = 1e-6, niterEM = 50,
               msMaxEval = 400,
               msTol = 1e-7, msVerbose = FALSE,
               returnObject = FALSE, gradHess = TRUE, apVar = TRUE,
               .relStep = .Machine$double.eps^(1/3), minAbsParApVar = 0.05,
               opt = "optim")

#frontal
model_time.f <- lme(FDelta_state ~ 1 + FBeta_state + seconds +
                      FBeta_state:seconds,
                    random = ~ 1 + FBeta_state + seconds |id,
                    data = DBlong,
                    control = Bc,
                    na.action = na.exclude)
summary(model_time.f)
```

```
## Linear mixed-effects model fit by REML
```

```
##  Data: DBlong
##        AIC      BIC    logLik
##   39177.07 39262.31 -19577.53
##
## Random effects:
##  Formula: ~1 + FBeta_state + seconds | id
##  Structure: General positive-definite, Log-Cholesky parametrization
##             StdDev      Corr
## (Intercept) 0.081596465 (Intr) FBt_st
## FBeta_state 0.141465000  0.168
## seconds     0.001232537 -0.984 -0.149
## Residual    0.754236019
##
## Fixed effects: FDelta_state ~ 1 + FBeta_state + seconds + FBeta_state:seconds
##                            Value   Std.Error    DF   t-value p-value
## (Intercept)          0.08741453 0.012180557 16968  7.176563  0.0000
## FBeta_state          0.10534363 0.030015419 16968  3.509650  0.0004
## seconds             -0.00132091 0.000173685 16968 -7.605215  0.0000
## FBeta_state:seconds  0.00036189 0.000360228 16968  1.004612  0.3151
##  Correlation:
##                     (Intr) FBt_st secnds
## FBeta_state         -0.017
## seconds             -0.863 -0.006
## FBeta_state:seconds  0.033 -0.735  0.003
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -3.92915138 -0.64673004  0.02696084  0.65821512  4.31195966
##
## Number of Observations: 17143
## Number of Groups: 172
```

```
#central
model_time.c <- lme(CDelta_state ~ 1 + CBeta_state + seconds +
                      CBeta_state:seconds,
                    random = ~ 1 + CBeta_state + seconds |id,
                    data = DBlong,
                    control = Bc,
                    na.action = na.exclude)
summary(model_time.c)
```

```
## Linear mixed-effects model fit by REML
##  Data: DBlong
##        AIC      BIC    logLik
##   33036.72 33121.96 -16507.36
##
## Random effects:
##  Formula: ~1 + CBeta_state + seconds | id
##  Structure: General positive-definite, Log-Cholesky parametrization
##             StdDev      Corr
## (Intercept) 0.070369153 (Intr) CBt_st
## CBeta_state 0.148906871  0.705
## seconds     0.001125308 -0.988 -0.730
## Residual    0.630243621
```

```
##
## Fixed effects: CDelta_state ~ 1 + CBeta_state + seconds + CBeta_state:seconds
##                           Value   Std.Error    DF   t-value p-value
## (Intercept)          0.04796261 0.010352651 16968  4.632882  0.0000
## CBeta_state          0.20861499 0.028428445 16968  7.338248  0.0000
## seconds             -0.00071356 0.000150667 16968 -4.736005  0.0000
## CBeta_state:seconds  0.00017466 0.000333244 16968  0.524120  0.6002
##  Correlation:
##                     (Intr) CBt_st secnds
## CBeta_state          0.054
## seconds             -0.868 -0.123
## CBeta_state:seconds  0.084 -0.724 -0.034
##
## Standardized Within-Group Residuals:
##          Min           Q1          Med           Q3          Max
## -4.925240686 -0.649368503  0.006977623  0.647232874  4.868534532
##
## Number of Observations: 17143
## Number of Groups: 172
```

```
#parietal
model_time.p <- lme(PDelta_state ~ 1 + PBeta_state + seconds +
                      PBeta_state:seconds,
                    random = ~ 1 + PBeta_state + seconds |id,
                    data = DBlong,
                    control = Bc,
                    na.action = na.exclude)
summary(model_time.p)
```

```
## Linear mixed-effects model fit by REML
##  Data: DBlong
##        AIC      BIC    logLik
##   33633.39 33718.63 -16805.69
##
## Random effects:
##  Formula: ~1 + PBeta_state + seconds | id
##  Structure: General positive-definite, Log-Cholesky parametrization
##             StdDev      Corr
## (Intercept) 0.086263352 (Intr) PBt_st
## PBeta_state 0.193979640  0.813
## seconds     0.001364983 -0.990 -0.823
## Residual    0.640167929
##
## Fixed effects: PDelta_state ~ 1 + PBeta_state + seconds + PBeta_state:seconds
##                            Value   Std.Error    DF   t-value p-value
## (Intercept)           0.0602782 0.011360416 16968  5.305985  0.0000
## PBeta_state           0.3392510 0.029118778 16968 11.650590  0.0000
## seconds              -0.0009290 0.000166746 16968 -5.571365  0.0000
## PBeta_state:seconds -0.0008211 0.000324798 16968 -2.527948  0.0115
##  Correlation:
##                     (Intr) PBt_st secnds
## PBeta_state          0.116
## seconds             -0.883 -0.217
## PBeta_state:seconds  0.112 -0.671 -0.013
```

```
##
## Standardized Within-Group Residuals:
##        Min         Q1        Med         Q3        Max
## -4.3126946 -0.6431657  0.0221403  0.6657884  3.9773335
##
## Number of Observations: 17143
## Number of Groups: 172
```

Variability in Delta power

Unconditional means models reveal how much individual variation is the outcome measures, as estimated by the ICC. We ran these models on Delta power, which was the variable placed on the outcome side of the equation. This choice was arbitrary, as we are interested in the synchrony of delta and beta power, so either Delta or Beta could have been placed on the outcome.

```
#Frontal
model0_fit <- lmer(formula = FrontalDelta ~ 1 + (1|id),
              data=DBlong,
              na.action=na.exclude)
summary(model0_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: FrontalDelta ~ 1 + (1 | id)
##    Data: DBlong
##
## REML criterion at convergence: 40078.4
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.8448 -0.6522  0.0208  0.6557  4.2147
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  id       (Intercept) 0.1667   0.4083
##  Residual             0.5875   0.7665
## Number of obs: 17143, groups:  id, 172
##
## Fixed effects:
##             Estimate Std. Error       df t value Pr(>|t|)
## (Intercept)   1.5548     0.0322 166.4006   48.29   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
VarCorr(model0_fit)
```

```
##  Groups   Name        Std.Dev.
##  id       (Intercept) 0.40826
##  Residual             0.76649
```

```
RandomEffects <- as.data.frame(VarCorr(model0_fit))
RandomEffects
```

```
##        grp        var1 var2      vcov     sdcor
## 1       id (Intercept) <NA> 0.1666759 0.4082596
## 2 Residual        <NA> <NA> 0.5875038 0.7664880
```

```
ICC_between <- RandomEffects[1,4]/(RandomEffects[1,4]+RandomEffects[2,4])
ICC_between
```

```
## [1] 0.2210029
```

From the unconditional means model, the ICC was calculated, which indicated that of the total variance in Frontal Delta power, 21.79% is attributable to between-person variation whereas 78.21% is attributatable to within-person variation.

```
#Central
model0_fit <- lmer(formula = CentralDelta ~ 1 + (1|id),
              data=DBlong,
              na.action=na.exclude)
summary(model0_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: CentralDelta ~ 1 + (1 | id)
##    Data: DBlong
##
## REML criterion at convergence: 34238.1
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.7331 -0.6497  0.0067  0.6510  5.1669
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  id       (Intercept) 0.3040   0.5514
##  Residual             0.4141   0.6435
## Number of obs: 17143, groups:  id, 172
##
## Fixed effects:
##             Estimate Std. Error       df t value Pr(>|t|)
## (Intercept)   0.6737     0.0427 168.4086   15.78   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
VarCorr(model0_fit)
```

```
##  Groups   Name        Std.Dev.
##  id       (Intercept) 0.55137
##  Residual             0.64352
```

```
RandomEffects <- as.data.frame(VarCorr(model0_fit))
RandomEffects
```

```
##        grp        var1 var2      vcov     sdcor
## 1       id (Intercept) <NA> 0.3040073 0.5513686
## 2 Residual        <NA> <NA> 0.4141117 0.6435151
```

```
ICC_between <- RandomEffects[1,4]/(RandomEffects[1,4]+RandomEffects[2,4])
ICC_between
```

```
## [1] 0.4233384
```

For Central Delta power 41.73% is attributable to between-person variation and only 58.27% attributable to within person variation

```
#Parietal Delta
model0_fit <- lmer(formula = ParietalDelta ~ 1 + (1|id),
              data=DBlong,
              na.action=na.exclude)
summary(model0_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: ParietalDelta ~ 1 + (1 | id)
##    Data: DBlong
##
## REML criterion at convergence: 35458
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.2645 -0.6445  0.0175  0.6704  4.1819
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  id       (Intercept) 0.3841   0.6198
##  Residual             0.4439   0.6663
## Number of obs: 17143, groups:  id, 172
##
## Fixed effects:
##             Estimate Std. Error       df t value Pr(>|t|)
## (Intercept)   1.0220     0.0479 168.0241   21.34   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
VarCorr(model0_fit)
```

```
##  Groups   Name        Std.Dev.
##  id       (Intercept) 0.61977
##  Residual             0.66629
```

```
RandomEffects <- as.data.frame(VarCorr(model0_fit))
RandomEffects
```

```
##        grp        var1 var2      vcov     sdcor
## 1       id (Intercept) <NA> 0.3841134 0.6197688
## 2 Residual        <NA> <NA> 0.4439488 0.6662948
```

```
ICC_between <- RandomEffects[1,4]/(RandomEffects[1,4]+RandomEffects[2,4])
ICC_between
```

```
## [1] 0.4638702
```

For Parietal Delta power 45.86% is attributable to between-person variation and only 54.14% attributable to within person variation

Between and within-person differences

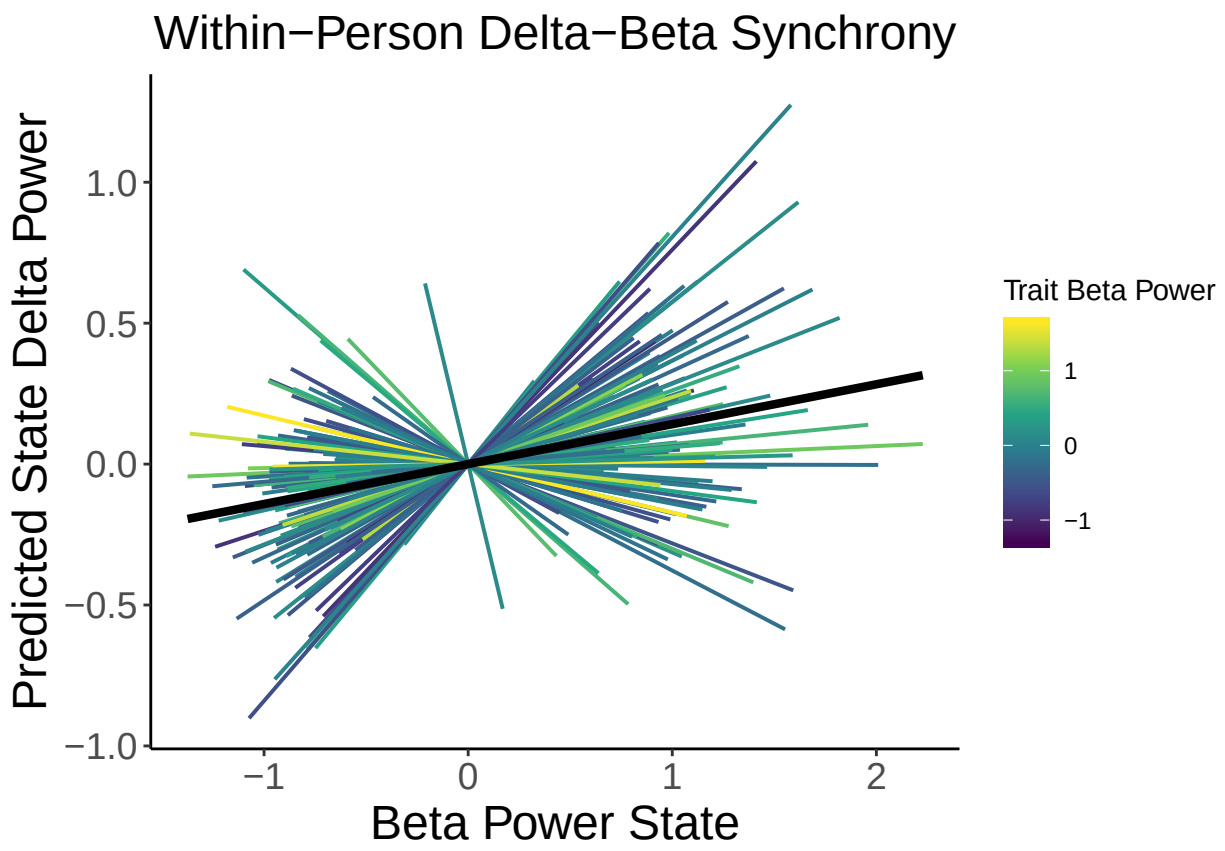
Multilevel models examining Between and within-person differences in Delta~Beta synchrony Model for Frontal region

```
model1_fit <- lmer(formula = FrontalDelta ~ 1 + seconds + FBeta_trait_c +
                     FBeta_state + FBeta_state:FBeta_trait_c +
                     (1 + FBeta_state|id),
                   data=DBlong,
                   na.action=na.exclude)
summary(model1_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## FrontalDelta ~ 1 + seconds + FBeta_trait_c + FBeta_state + FBeta_state:FBeta_trait_c +
##     (1 + FBeta_state | id)
##    Data: DBlong
##
## REML criterion at convergence: 39761.6
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.0269 -0.6458  0.0229  0.6572  4.3541
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  id       (Intercept) 0.09841  0.3137
##           FBeta_state 0.01824  0.1350   -0.01
##  Residual             0.57665  0.7594
## Number of obs: 17143, groups:  id, 172
##
## Fixed effects:
##                             Estimate Std. Error         df t value
## (Intercept)                1.654e+00  2.627e-02  1.967e+02  62.970
```

```
## seconds                   -1.845e-03  1.443e-04  1.667e+04 -12.787
## FBeta_trait_c              4.823e-01  4.885e-02  1.699e+02   9.874
## FBeta_state                1.241e-01  2.007e-02  1.262e+02   6.182
## FBeta_trait_c:FBeta_state -7.174e-02  3.920e-02  1.221e+02  -1.830
##                           Pr(>|t|)
## (Intercept)                < 2e-16 ***
## seconds                    < 2e-16 ***
## FBeta_trait_c              < 2e-16 ***
## FBeta_state               8.07e-09 ***
## FBeta_trait_c:FBeta_state   0.0696 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) secnds FBt_t_ FBt_st
## seconds     -0.286
## FBeta_trt_c  0.021  0.032
## FBeta_state -0.025  0.067  0.002
## FBt_tr_:FB_  0.003 -0.013 -0.006  0.013
```

```
#Visual
ggplot(data=DBlong, aes(x=FBeta_state, y=FDelta_state, group=factor(id), color=FBeta_trait_c), legend=F
  geom_smooth(method=lm, se=FALSE, fullrange=FALSE, lty=1, size=.7) +
  scale_color_viridis_c("Trait Beta Power")+
  geom_smooth(aes(group=1), method=lm, se=FALSE, fullrange=FALSE, lty=1, size=1.5, color="black") +
  xlab("Beta Power State") + ylab("Predicted State Delta Power") +
  theme_classic() +
  theme(axis.title=element_text(size=18),
        axis.text=element_text(size=14),
        plot.title=element_text(size=18, hjust=.5)) +
  ggtitle("Within-Person Delta-Beta Synchrony")
```



Central synchrony model

```
model1_fit <- lmer(formula = CentralDelta ~ 1 + seconds + CBeta_trait_c +
                     CBeta_state + CBeta_trait_c:CBeta_state +
                     (1 + CBeta_state|id),
                   data=DBlong,
                   na.action=na.exclude)
summary(model1_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## CentralDelta ~ 1 + seconds + CBeta_trait_c + CBeta_state + CBeta_trait_c:CBeta_state +
##     (1 + CBeta_state | id)
##    Data: DBlong
##
## REML criterion at convergence: 33751.9
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.7836 -0.6471  0.0074  0.6452  4.8669
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  id       (Intercept) 0.12647  0.3556
##           CBeta_state 0.02594  0.1610   -0.07
```

```
##  Residual             0.40317  0.6350
## Number of obs: 17143, groups:  id, 172
##
## Fixed effects:
##                             Estimate Std. Error         df t value
## (Intercept)                7.349e-01  2.869e-02  1.826e+02  25.615
## seconds                   -1.089e-03  1.233e-04  1.696e+04  -8.828
## CBeta_trait_c              7.301e-01  5.082e-02  1.694e+02  14.367
## CBeta_state                2.113e-01  2.059e-02  1.250e+02  10.260
## CBeta_trait_c:CBeta_state -5.942e-02  3.766e-02  1.263e+02  -1.578
##                            Pr(>|t|)
## (Intercept)                  <2e-16 ***
## seconds                      <2e-16 ***
## CBeta_trait_c                <2e-16 ***
## CBeta_state                  <2e-16 ***
## CBeta_trait_c:CBeta_state    0.117
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) secnds CBt_t_ CBt_st
## seconds     -0.220
## CBeta_trt_c  0.019  0.045
## CBeta_state -0.065  0.117  0.004
## CBt_tr_:CB_  0.005 -0.026 -0.041  0.136
```

Parietal synchrony

```
model1_fit <- lmer(formula = ParietalDelta ~ 1 + seconds + PBeta_trait_c +
                     PBeta_state + PBeta_trait_c:PBeta_state +
                     (1 + PBeta_state|id),
                   data=DBlong,
                   na.action=na.exclude)
summary(model1_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## ParietalDelta ~ 1 + seconds + PBeta_trait_c + PBeta_state + PBeta_trait_c:PBeta_state +
##     (1 + PBeta_state | id)
##    Data: DBlong
##
## REML criterion at convergence: 34356.9
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.2138 -0.6426  0.0249  0.6608  3.9611
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  id       (Intercept) 0.11673  0.3417
##           PBeta_state 0.05253  0.2292   0.05
##  Residual             0.41645  0.6453
```

```
## Number of obs: 17143, groups:  id, 172
##
## Fixed effects:
##                              Estimate Std. Error         df t value
## (Intercept)                 1.099e+00  2.778e-02  1.849e+02  39.558
## seconds                    -1.418e-03  1.303e-04  1.671e+04 -10.879
## PBeta_trait_c               8.218e-01  4.463e-02  1.690e+02  18.414
## PBeta_state                 2.871e-01  2.401e-02  1.655e+02  11.953
## PBeta_trait_c:PBeta_state -5.352e-02  4.065e-02  1.775e+02  -1.317
##                             Pr(>|t|)
## (Intercept)                   <2e-16 ***
## seconds                       <2e-16 ***
## PBeta_trait_c                 <2e-16 ***
## PBeta_state                   <2e-16 ***
## PBeta_trait_c:PBeta_state       0.19
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) secnds PBt_t_ PBt_st
## seconds     -0.241
## PBeta_trt_c  0.016  0.045
## PBeta_state  0.000  0.152  0.007
## PBt_tr_:PB_  0.004 -0.014  0.036  0.099
```

Delta-Beta Synchrony and Behavioral Inhibition

Multilevel models examining if and how between person differences in BI are related to trait and state-level synchrony

Frontal synchrony and Continuous BI

```
model1_fit <- lmer(formula = FrontalDelta ~ 1 + FBeta_trait_c + FBeta_state + BIQ.c +
                     FBeta_trait_c:BIQ.c + FBeta_state:BIQ.c + FBeta_trait_c:FBeta_state +
                     FBeta_trait_c:FBeta_state:BIQ.c +
                      (1 + FBeta_state|id),
                    data=DBlong,
                    na.action=na.exclude)
summary(model1_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## FrontalDelta ~ 1 + FBeta_trait_c + FBeta_state + BIQ.c + FBeta_trait_c:BIQ.c +
##     FBeta_state:BIQ.c + FBeta_trait_c:FBeta_state + FBeta_trait_c:FBeta_state:BIQ.c +
##     (1 + FBeta_state | id)
##    Data: DBlong
##
## REML criterion at convergence: 39653.2
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
```

```
## -3.8273 -0.6391  0.0248  0.6504  4.2832
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  id       (Intercept) 0.09950  0.3154
##           FBeta_state 0.02078  0.1442   -0.02
##  Residual             0.58288  0.7635
## Number of obs: 17001, groups:  id, 172
##
## Fixed effects:
##                                  Estimate Std. Error         df t value
## (Intercept)                     1.553e+00  2.557e-02  1.608e+02  60.741
## FBeta_trait_c                   4.978e-01  4.955e-02  1.655e+02  10.046
## FBeta_state                     1.437e-01  2.066e-02  1.256e+02   6.956
## BIQ.c                           2.916e-04  7.761e-04  1.585e+02   0.376
## FBeta_trait_c:BIQ.c             2.248e-03  1.580e-03  1.604e+02   1.423
## FBeta_state:BIQ.c               8.498e-04  6.139e-04  1.190e+02   1.384
## FBeta_trait_c:FBeta_state      -8.139e-02  4.085e-02  1.342e+02  -1.992
## FBeta_trait_c:FBeta_state:BIQ.c -8.254e-04  1.271e-03  1.265e+02  -0.649
##                                 Pr(>|t|)
## (Intercept)                      < 2e-16 ***
## FBeta_trait_c                    < 2e-16 ***
## FBeta_state                     1.71e-10 ***
## BIQ.c                             0.7076
## FBeta_trait_c:BIQ.c               0.1566
## FBeta_state:BIQ.c                 0.1688
## FBeta_trait_c:FBeta_state         0.0484 *
## FBeta_trait_c:FBeta_state:BIQ.c   0.5173
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) FBt_t_ FBt_st BIQ.c  FB__:B FB_:BI FBt__:FB_
## FBeta_trt_c  0.033
## FBeta_state -0.010  0.000
## BIQ.c        0.012 -0.132  0.000
## FBt_t_:BIQ. -0.141 -0.020  0.001 -0.044
## FBt_st:BIQ.  0.000  0.001  0.039 -0.010  0.000
## FBt_tr_:FB_  0.000 -0.010  0.011  0.001  0.000 -0.077
## FB__:FB_:BI  0.001  0.000 -0.073  0.000 -0.010 -0.082  0.124
```

Central synchrony and BIQ

```
model1_fit <- lmer(formula = CentralDelta ~ 1 + CBeta_trait_c + CBeta_state + BIQ.c +
                     CBeta_trait_c:BIQ.c + CBeta_state:BIQ.c + CBeta_trait_c:CBeta_state +
                     CBeta_trait_c:CBeta_state:BIQ.c+
                      (1 + CBeta_state|id),
                    data=DBlong,
                    na.action=na.exclude)
summary(model1_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
```

```
## Formula:
## CentralDelta ~ 1 + CBeta_trait_c + CBeta_state + BIQ.c + CBeta_trait_c:BIQ.c +
##     CBeta_state:BIQ.c + CBeta_trait_c:CBeta_state + CBeta_trait_c:CBeta_state:BIQ.c +
##     (1 + CBeta_state | id)
##    Data: DBlong
##
## REML criterion at convergence: 33609.7
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.7405 -0.6522  0.0071  0.6455  4.9190
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  id       (Intercept) 0.13159  0.3627
##           CBeta_state 0.02712  0.1647   -0.11
##  Residual             0.40547  0.6368
## Number of obs: 17001, groups:  id, 172
##
## Fixed effects:
##                                  Estimate Std. Error         df t value
## (Intercept)                     6.719e-01  2.897e-02  1.630e+02  23.194
## CBeta_trait_c                   7.308e-01  5.428e-02  1.660e+02  13.463
## CBeta_state                     2.280e-01  2.097e-02  1.196e+02  10.873
## BIQ.c                           2.732e-05  8.810e-04  1.620e+02   0.031
## CBeta_trait_c:BIQ.c             2.369e-03  1.637e-03  1.618e+02   1.447
## CBeta_state:BIQ.c              -3.738e-04  6.178e-04  1.080e+02  -0.605
## CBeta_trait_c:CBeta_state      -7.970e-02  4.010e-02  1.284e+02  -1.987
## CBeta_trait_c:CBeta_state:BIQ.c  1.461e-03  1.158e-03  1.164e+02   1.261
##                                 Pr(>|t|)
## (Intercept)                       <2e-16 ***
## CBeta_trait_c                     <2e-16 ***
## CBeta_state                       <2e-16 ***
## BIQ.c                              0.975
## CBeta_trait_c:BIQ.c                0.150
## CBeta_state:BIQ.c                  0.546
## CBeta_trait_c:CBeta_state          0.049 *
## CBeta_trait_c:CBeta_state:BIQ.c    0.210
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) CBt_t_ CBt_st BIQ.c  CB__:B CB_:BI CBt__:CB_
## CBeta_trt_c  0.073
## CBeta_state -0.065 -0.004
## BIQ.c       -0.012 -0.176  0.001
## CBt_t_:BIQ. -0.175 -0.259  0.011  0.074
## CBt_st:BIQ.  0.001  0.012 -0.035 -0.067 -0.005
## CBt_tr_:CB_ -0.004 -0.063  0.179  0.011  0.016 -0.149
## CB__:CB_:BI  0.012  0.017 -0.156 -0.005 -0.066  0.143 -0.294
```

Parietal synchrony and BIQ

```r
model1_fit <- lmer(formula = ParietalDelta ~ 1 + PBeta_trait_c + PBeta_state + BIQ.c +
                     PBeta_trait_c:BIQ.c + PBeta_state:BIQ.c + PBeta_trait_c:PBeta_state +
                     PBeta_trait_c:PBeta_state:BIQ.c+
                      (1 + PBeta_state|id),
                    data=DBlong,
                    na.action=na.exclude)
summary(model1_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## ParietalDelta ~ 1 + PBeta_trait_c + PBeta_state + BIQ.c + PBeta_trait_c:BIQ.c +
##     PBeta_state:BIQ.c + PBeta_trait_c:PBeta_state + PBeta_trait_c:PBeta_state:BIQ.c +
##     (1 + PBeta_state | id)
##    Data: DBlong
##
## REML criterion at convergence: 34247.7
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.2437 -0.6446  0.0258  0.6664  4.0051
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  id       (Intercept) 0.12074  0.3475
##           PBeta_state 0.05766  0.2401   0.02
##  Residual             0.41963  0.6478
## Number of obs: 17001, groups:  id, 172
##
## Fixed effects:
##                                  Estimate Std. Error         df t value
## (Intercept)                     1.022e+00  2.761e-02  1.610e+02  37.031
## PBeta_trait_c                   8.345e-01  4.590e-02  1.654e+02  18.182
## PBeta_state                     3.238e-01  2.459e-02  1.534e+02  13.169
## BIQ.c                           5.022e-04  8.388e-04  1.597e+02   0.599
## PBeta_trait_c:BIQ.c             1.607e-03  1.378e-03  1.590e+02   1.166
## PBeta_state:BIQ.c              -4.746e-04  7.290e-04  1.400e+02  -0.651
## PBeta_trait_c:PBeta_state      -5.984e-02  4.215e-02  1.716e+02  -1.420
## PBeta_trait_c:PBeta_state:BIQ.c  4.874e-04  1.213e-03  1.529e+02   0.402
##                                 Pr(>|t|)
## (Intercept)                       <2e-16 ***
## PBeta_trait_c                     <2e-16 ***
## PBeta_state                       <2e-16 ***
## BIQ.c                              0.550
## PBeta_trait_c:BIQ.c                0.245
## PBeta_state:BIQ.c                  0.516
## PBeta_trait_c:PBeta_state          0.158
## PBeta_trait_c:PBeta_state:BIQ.c    0.688
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) PBt_t_ PBt_st BIQ.c  PB__:B PB_:BI PBt__:PB_
```

```
## PBeta_trt_c  0.040
## PBeta_state  0.013  0.000
## BIQ.c        0.004 -0.118  0.000
## PBt_t_:BIQ. -0.122 -0.108 -0.002 -0.007
## PBt_st:BIQ.  0.000 -0.002  0.018  0.013  0.000
## PBt_tr_:PB_  0.000  0.012  0.105 -0.002 -0.001 -0.086
## PB__:PB_:BI -0.002 -0.001 -0.090  0.000  0.013  0.047 -0.090
```

Delta-Beta synchrony and BI temperament profiles

Frontal synchrony and BI

```
DBlong$BI<-as.factor(DBlong$BI)
model1_fit <- lmer(formula = FrontalDelta ~ 1 + FBeta_trait_c + FBeta_state + BI +
                     FBeta_trait_c:BI + FBeta_state:BI + FBeta_trait_c:FBeta_state +
                     FBeta_trait_c:FBeta_state:BI +
                      (1 + FBeta_state|id),
                    data=DBlong,
                    na.action=na.exclude)
summary(model1_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## FrontalDelta ~ 1 + FBeta_trait_c + FBeta_state + BI + FBeta_trait_c:BI +
##     FBeta_state:BI + FBeta_trait_c:FBeta_state + FBeta_trait_c:FBeta_state:BI +
##     (1 + FBeta_state | id)
##    Data: DBlong
##
## REML criterion at convergence: 39619.1
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.8255 -0.6392  0.0259  0.6510  4.2756
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  id       (Intercept) 0.09979  0.3159
##           FBeta_state 0.02091  0.1446   -0.04
##  Residual             0.58283  0.7634
## Number of obs: 17001, groups:  id, 172
##
## Fixed effects:
##                                Estimate Std. Error        df t value
## (Intercept)                     1.52770    0.03431 158.56865  44.530
## FBeta_trait_c                   0.48752    0.06895 157.58056   7.071
## FBeta_state                     0.12074    0.02711 121.76577   4.454
## BI1                             0.06837    0.05154 161.28461   1.326
## FBeta_trait_c:BI1               0.01132    0.09937 166.10164   0.114
## FBeta_state:BI1                 0.05476    0.04195 129.89202   1.306
## FBeta_trait_c:FBeta_state      -0.03776    0.05277 106.28686  -0.716
## FBeta_trait_c:FBeta_state:BI1  -0.10095    0.08267 141.02258  -1.221
```

```
##                                Pr(>|t|)
## (Intercept)                     < 2e-16 ***
## FBeta_trait_c                  4.72e-11 ***
## FBeta_state                    1.89e-05 ***
## BI1                               0.187
## FBeta_trait_c:BI1                 0.909
## FBeta_state:BI1                   0.194
## FBeta_trait_c:FBeta_state         0.476
## FBeta_trait_c:FBeta_state:BI1     0.224
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) FBt_t_ FBt_st BI1    FB__:B FB_:BI FBt__:FB_
## FBeta_trt_c  0.160
## FBeta_state -0.021 -0.003
## BI1         -0.666 -0.107  0.014
## FBt_tr_:BI1 -0.111 -0.694  0.002  0.010
## FBt_stt:BI1  0.014  0.002 -0.646 -0.020  0.000
## FBt_tr_:FB_ -0.003 -0.022  0.091  0.002  0.015 -0.059
## FB__:FB_:BI  0.002  0.014 -0.058  0.000 -0.020 -0.006 -0.638
```

Central synchrony and BI

```
model1_fit <- lmer(formula = CentralDelta ~ 1 + CBeta_trait_c + CBeta_state + BI +
                     CBeta_trait_c:BI + CBeta_state:BI + CBeta_trait_c:CBeta_state +
                     CBeta_trait_c:CBeta_state:BI+
                      (1 + CBeta_state|id),
                    data=DBlong,
                    na.action=na.exclude)
summary(model1_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## CentralDelta ~ 1 + CBeta_trait_c + CBeta_state + BI + CBeta_trait_c:BI +
##     CBeta_state:BI + CBeta_trait_c:CBeta_state + CBeta_trait_c:CBeta_state:BI +
##     (1 + CBeta_state | id)
##    Data: DBlong
##
## REML criterion at convergence: 33575.6
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.7377 -0.6513  0.0078  0.6475  4.9168
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  id       (Intercept) 0.13167  0.3629
##           CBeta_state 0.02656  0.1630   -0.07
##  Residual             0.40548  0.6368
## Number of obs: 17001, groups:  id, 172
##
```

```
## Fixed effects:
##                                Estimate Std. Error        df t value
## (Intercept)                     0.64343    0.03923 162.59206  16.401
## CBeta_trait_c                   0.67832    0.08029 165.41449   8.448
## CBeta_state                     0.26242    0.02830 123.14319   9.272
## BI1                             0.06726    0.05854 163.27146   1.149
## CBeta_trait_c:BI1               0.10686    0.10647 166.12218   1.004
## CBeta_state:BI1                -0.06932    0.04204 119.63820  -1.649
## CBeta_trait_c:CBeta_state      -0.06821    0.05842 127.88811  -1.168
## CBeta_trait_c:CBeta_state:BI1   0.01652    0.07735 124.77103   0.214
##                               Pr(>|t|)
## (Intercept)                    < 2e-16 ***
## CBeta_trait_c                 1.45e-14 ***
## CBeta_state                   7.66e-16 ***
## BI1                              0.252
## CBeta_trait_c:BI1                0.317
## CBeta_state:BI1                  0.102
## CBeta_trait_c:CBeta_state        0.245
## CBeta_trait_c:CBeta_state:BI1    0.831
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) CBt_t_ CBt_st BI1    CB__:B CB_:BI CBt__:CB_
## CBeta_trt_c  0.227
## CBeta_state -0.045 -0.010
## BI1         -0.670 -0.152  0.030
## CBt_tr_:BI1 -0.171 -0.754  0.008  0.034
## CBt_stt:BI1  0.030  0.007 -0.673 -0.045 -0.001
## CBt_tr_:CB_ -0.010 -0.045  0.292  0.007  0.034 -0.197
## CB__:CB_:BI  0.007  0.034 -0.221 -0.001 -0.045  0.141 -0.755
```

Visualization of state-level synchrony and BI at central region

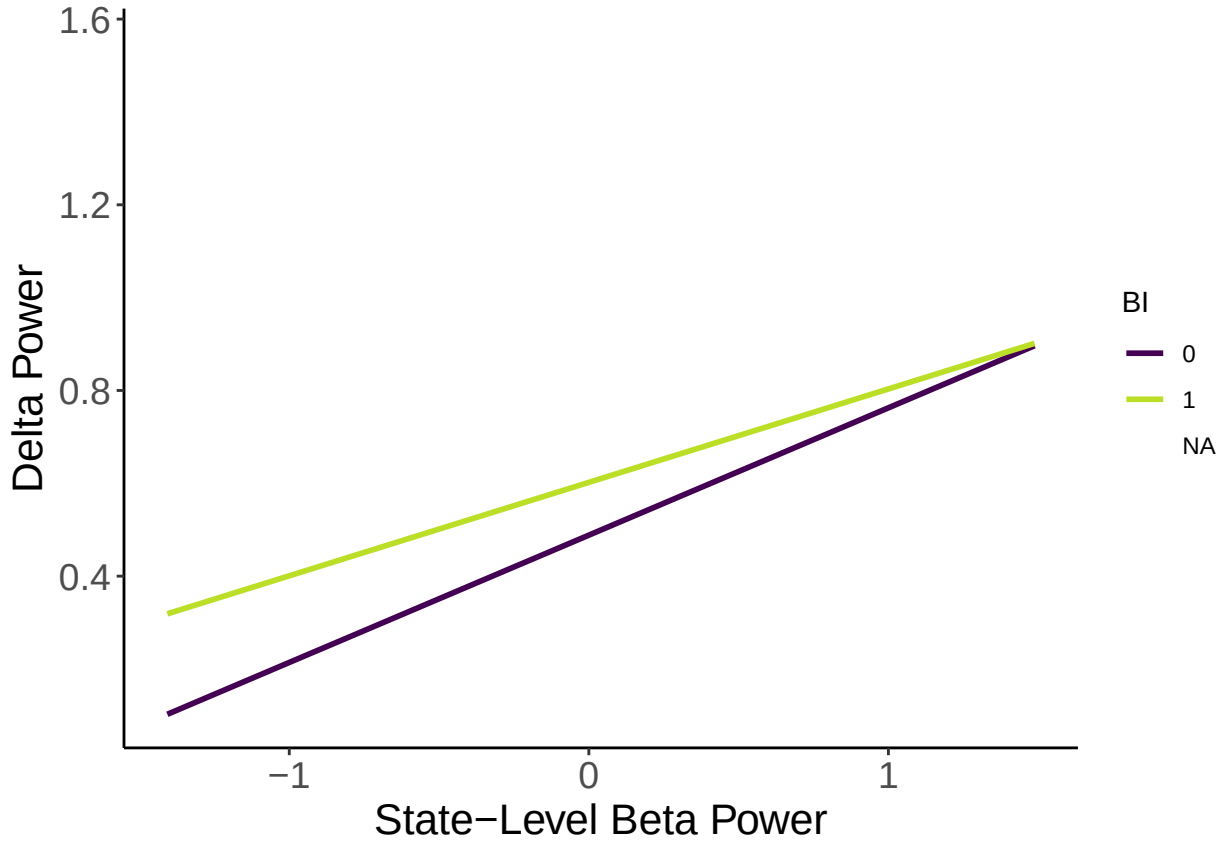
Here we show a synchrony pattern for a BI child vs. a BN child along with a simple slopes graph of the interaction

```
model3a_fit <- lme4::lmer(formula = CentralDelta ~ 1 + CBeta_trait_c + CBeta_state + BI +
                     CBeta_trait_c:BI + CBeta_state:BI + CBeta_trait_c:CBeta_state +
                     CBeta_trait_c:CBeta_state:BI+
                      (1 + CBeta_state|id),
                    data=DBlong,
                    na.action=na.exclude)
summary(model3a_fit)
```

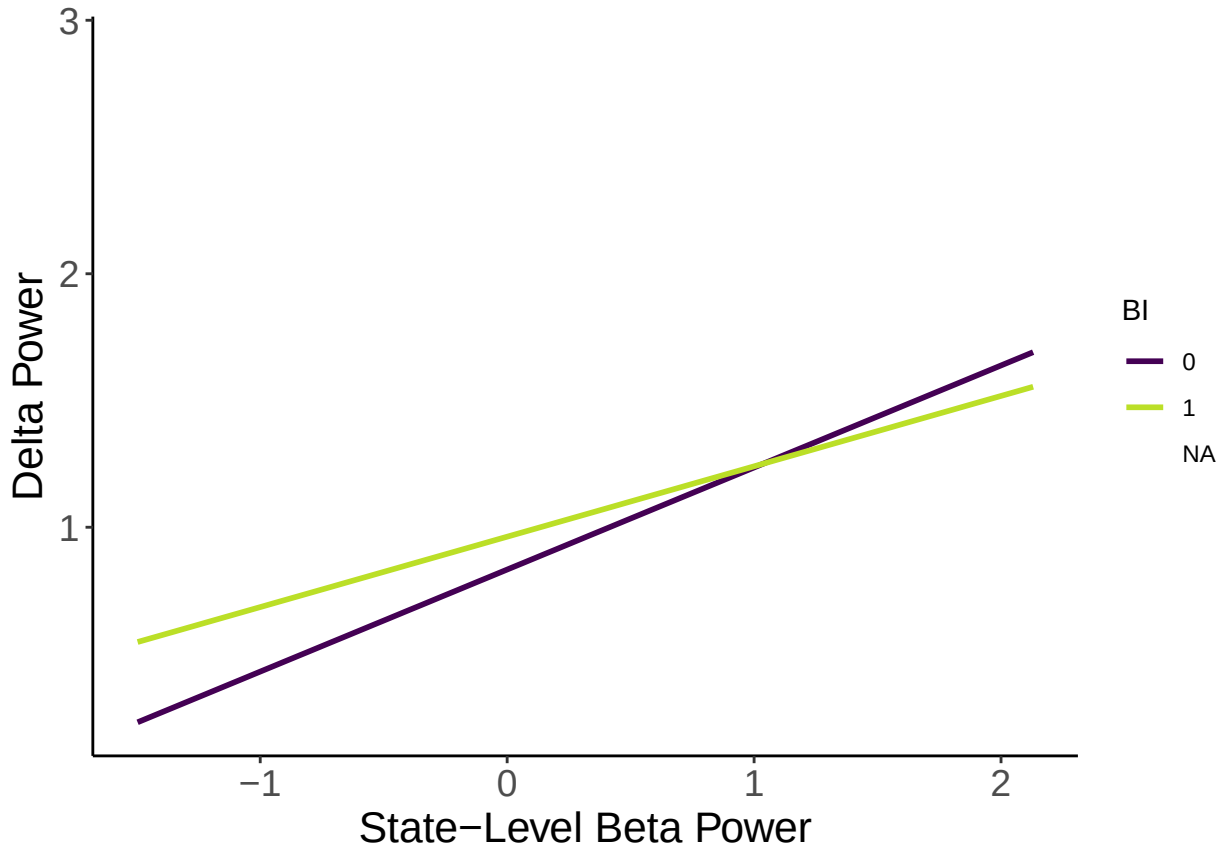
```
## Linear mixed model fit by REML ['lmerMod']
## Formula:
## CentralDelta ~ 1 + CBeta_trait_c + CBeta_state + BI + CBeta_trait_c:BI +
##     CBeta_state:BI + CBeta_trait_c:CBeta_state + CBeta_trait_c:CBeta_state:BI +
##     (1 + CBeta_state | id)
##    Data: DBlong
##
```

```
## REML criterion at convergence: 33575.6
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.7377 -0.6513  0.0078  0.6475  4.9168
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  id       (Intercept) 0.13167  0.3629
##           CBeta_state 0.02656  0.1630   -0.07
##  Residual             0.40548  0.6368
## Number of obs: 17001, groups:  id, 172
##
## Fixed effects:
##                               Estimate Std. Error t value
## (Intercept)                    0.64343    0.03923  16.401
## CBeta_trait_c                  0.67832    0.08029   8.448
## CBeta_state                    0.26242    0.02830   9.272
## BI1                            0.06726    0.05854   1.149
## CBeta_trait_c:BI1              0.10686    0.10647   1.004
## CBeta_state:BI1               -0.06932    0.04204  -1.649
## CBeta_trait_c:CBeta_state     -0.06821    0.05842  -1.168
## CBeta_trait_c:CBeta_state:BI1  0.01652    0.07735   0.214
##
## Correlation of Fixed Effects:
##             (Intr) CBt_t_ CBt_st BI1    CB__:B CB_:BI CBt__:CB_
## CBeta_trt_c  0.227
## CBeta_state -0.045 -0.010
## BI1         -0.670 -0.152  0.030
## CBt_tr_:BI1 -0.171 -0.754  0.008  0.034
## CBt_stt:BI1  0.030  0.007 -0.673 -0.045 -0.001
## CBt_tr_:CB_ -0.010 -0.045  0.292  0.007  0.034 -0.197
## CB__:CB_:BI  0.007  0.034 -0.221 -0.001 -0.045  0.141 -0.755
```

```
ggplot(data = DBlong, aes(x=CBeta_state, y=CentralDelta, color=BI))+
  geom_smooth(method="lm", fullrange=TRUE, na.rm = T, se=F)+
  scale_color_viridis_d("BI",end = .9)+
  xlab("State-Level Beta Power") + ylab("Delta Power")+
  theme_classic()+
  theme(axis.title=element_text(size=16),
        axis.text=element_text(size=14),
        strip.text=element_text(size=14))
```




```
ggplot(data = DBlong, aes(x=PBeta_state, y=ParietalDelta, color=BI))+
  geom_smooth(method="lm", fullrange=TRUE, na.rm = T, se=F)+
  scale_color_viridis_d("BI",end = .9)+
  xlab("State-Level Beta Power") + ylab("Delta Power")+
  theme_classic()+
  theme(axis.title=element_text(size=16),
        axis.text=element_text(size=14),
        strip.text=element_text(size=14))
```



Parietal synchrony and BI

```
model1_fit <- lmer(formula = ParietalDelta ~ 1 + PBeta_trait_c + PBeta_state + BI +
                     PBeta_trait_c:BI + PBeta_state:BI + PBeta_trait_c:PBeta_state +
                     PBeta_trait_c:PBeta_state:BI+
                      (1 + PBeta_state|id),
                    data=DBlong,
                    na.action=na.exclude)
summary(model1_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## ParietalDelta ~ 1 + PBeta_trait_c + PBeta_state + BI + PBeta_trait_c:BI +
##     PBeta_state:BI + PBeta_trait_c:PBeta_state + PBeta_trait_c:PBeta_state:BI +
##     (1 + PBeta_state | id)
##    Data: DBlong
##
## REML criterion at convergence: 34213.4
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.2493 -0.6464  0.0254  0.6677  4.0038
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
```

```
##  id       (Intercept) 0.12177  0.3490
##           PBeta_state 0.05612  0.2369   0.02
##  Residual             0.41965  0.6478
## Number of obs: 17001, groups:  id, 172
##
## Fixed effects:
##                                Estimate Std. Error         df t value
## (Intercept)                    1.006769   0.037607 159.983436  26.771
## PBeta_trait_c                  0.831408   0.064501 163.679618  12.890
## PBeta_state                    0.357635   0.032764 149.876102  10.915
## BI1                            0.042559   0.056367 161.086076   0.755
## PBeta_trait_c:BI1              0.011675   0.092636 165.486500   0.126
## PBeta_state:BI1               -0.074359   0.049530 150.635632  -1.501
## PBeta_trait_c:PBeta_state     -0.049690   0.057878 159.922446  -0.859
## PBeta_trait_c:PBeta_state:BI1 -0.003074   0.084043 170.538693  -0.037
##                               Pr(>|t|)
## (Intercept)                     <2e-16 ***
## PBeta_trait_c                   <2e-16 ***
## PBeta_state                     <2e-16 ***
## BI1                              0.451
## PBeta_trait_c:BI1                0.900
## PBeta_state:BI1                  0.135
## PBeta_trait_c:PBeta_state        0.392
## PBeta_trait_c:PBeta_state:BI1    0.971
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) PBt_t_ PBt_st BI1    PB__:B PB_:BI PBt__:PB_
## PBeta_trt_c  0.201
## PBeta_state  0.016  0.003
## BI1         -0.667 -0.134 -0.011
## PBt_tr_:BI1 -0.140 -0.696 -0.002  0.000
## PBt_stt:BI1 -0.011 -0.002 -0.662  0.016  0.000
## PBt_tr_:PB_  0.003  0.016  0.235 -0.002 -0.011 -0.155
## PB__:PB_:BI -0.002 -0.011 -0.162  0.000  0.016  0.070 -0.689
```

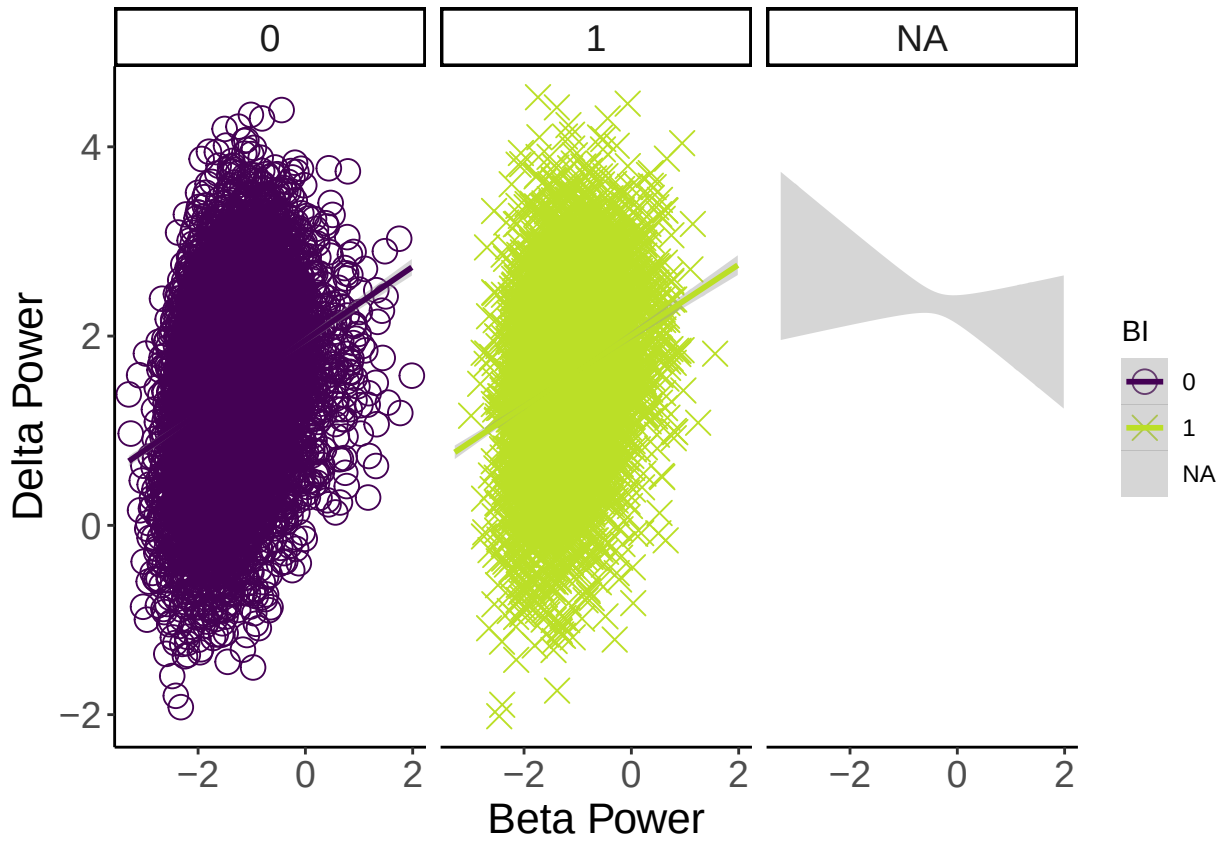
Visualizing synchrony and BI

```
DBlong$BI<-as.factor(DBlong$BI)
library(dplyr)

DBlong%>%
  dplyr::group_by(id)%>%
  ggplot(aes(x=FrontalBeta,y=FrontalDelta, color=BI, shape=BI)) +
  geom_point(size=4) +
  scale_shape_manual(values=c(1,4))+
  scale_color_viridis_d("BI",end = .9)+
  stat_smooth(method="lm", fullrange=TRUE, na.rm = T) +
  xlab("Beta Power") + ylab("Delta Power") +
  theme_classic()+
  theme(axis.title=element_text(size=16),
        axis.text=element_text(size=14),
        strip.text=element_text(size=14))+
```

```
  facet_wrap(.~BI)
```

```
## Warning: Removed 142 rows containing missing values (geom_point).
```



Delta-Beta Synchrony and social anxiety

Multilevel models examining if and how between person differences in Social Anxiety are related to within or between-person synchrony

Social Anxiety and Frontal synchrony

```
model1_fit <- lmer(formula = FrontalDelta ~ 1 + FBeta_trait_c + FBeta_state + BIQ.c + ScaredSoc.c +
                     FBeta_trait_c:ScaredSoc.c + FBeta_state:ScaredSoc.c + FBeta_trait_c:FBeta_state +
                     FBeta_trait_c:FBeta_state:ScaredSoc.c +
                       (1 + FBeta_state|id),
                   data=DBlong,
                   na.action=na.exclude)
summary(model1_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## FrontalDelta ~ 1 + FBeta_trait_c + FBeta_state + BIQ.c + ScaredSoc.c +
```

```
##     FBeta_trait_c:ScaredSoc.c + FBeta_state:ScaredSoc.c + FBeta_trait_c:FBeta_state +
##     FBeta_trait_c:FBeta_state:ScaredSoc.c + (1 + FBeta_state |      id)
##    Data: DBlong
##
## REML criterion at convergence: 35509.2
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.8183 -0.6437  0.0230  0.6501  4.2740
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  id       (Intercept) 0.09700  0.3114
##           FBeta_state 0.01703  0.1305   0.03
##  Residual             0.58757  0.7665
## Number of obs: 15177, groups:  id, 156
##
## Fixed effects:
##                                       Estimate Std. Error         df
## (Intercept)                          1.574e+00  2.637e-02  1.444e+02
## FBeta_trait_c                        4.945e-01  5.238e-02  1.490e+02
## FBeta_state                          1.362e-01  2.115e-02  1.181e+02
## BIQ.c                                6.117e-04  1.119e-03  1.438e+02
## ScaredSoc.c                         -1.804e-03  1.019e-02  1.442e+02
## FBeta_trait_c:ScaredSoc.c            2.079e-02  1.557e-02  1.464e+02
## FBeta_state:ScaredSoc.c              1.771e-02  5.665e-03  1.126e+02
## FBeta_trait_c:FBeta_state           -6.309e-02  4.272e-02  1.340e+02
## FBeta_trait_c:FBeta_state:ScaredSoc.c  9.453e-03  1.273e-02  1.330e+02
##                                     t value Pr(>|t|)
## (Intercept)                          59.711  < 2e-16 ***
## FBeta_trait_c                         9.440  < 2e-16 ***
## FBeta_state                           6.439 2.69e-09 ***
## BIQ.c                                 0.547  0.58551
## ScaredSoc.c                          -0.177  0.85963
## FBeta_trait_c:ScaredSoc.c             1.335  0.18379
## FBeta_state:ScaredSoc.c               3.126  0.00225 **
## FBeta_trait_c:FBeta_state            -1.477  0.14207
## FBeta_trait_c:FBeta_state:ScaredSoc.c  0.743  0.45901
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) FBt_t_ FBt_st BIQ.c  ScrdS. FB__:S FB_:SS FBt__:FB_
## FBeta_trt_c  0.020
## FBeta_state  0.015  0.000
## BIQ.c       -0.024 -0.195  0.000
## ScaredSoc.c  0.020  0.170  0.000 -0.702
## FBt_tr_:SS.  0.050  0.069  0.001 -0.003  0.031
## FBt_stt:SS.  0.000  0.001  0.009  0.001  0.010  0.001
## FBt_tr_:FB_  0.000  0.014  0.012 -0.001  0.001  0.001  0.075
## FB__:FB_:SS  0.001  0.001  0.083  0.001 -0.001  0.015  0.014  0.206
```

Social Anxiety and Central synchrony

```r
model1_fit <- lmer(formula = CentralDelta ~ 1  + CBeta_trait_c + CBeta_state + BIQ.c + ScaredSoc.c +
                     CBeta_trait_c:ScaredSoc.c + CBeta_state:ScaredSoc.c + CBeta_trait_c:CBeta_state +
                     CBeta_trait_c:CBeta_state:ScaredSoc.c+
                      (1 + CBeta_state|id),
                    data=DBlong,
                    na.action=na.exclude)
summary(model1_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## CentralDelta ~ 1 + CBeta_trait_c + CBeta_state + BIQ.c + ScaredSoc.c +
##     CBeta_trait_c:ScaredSoc.c + CBeta_state:ScaredSoc.c + CBeta_trait_c:CBeta_state +
##     CBeta_trait_c:CBeta_state:ScaredSoc.c + (1 + CBeta_state |      id)
##    Data: DBlong
##
## REML criterion at convergence: 29959.7
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.3593 -0.6486  0.0045  0.6428  4.9287
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  id       (Intercept) 0.12796  0.3577
##           CBeta_state 0.02909  0.1705   -0.04
##  Residual             0.40417  0.6357
## Number of obs: 15177, groups:  id, 156
##
## Fixed effects:
##                                          Estimate Std. Error         df
## (Intercept)                             6.925e-01  2.962e-02  1.465e+02
## CBeta_trait_c                           7.482e-01  5.461e-02  1.495e+02
## CBeta_state                             2.255e-01  2.212e-02  1.107e+02
## BIQ.c                                  -7.546e-04  1.254e-03  1.463e+02
## ScaredSoc.c                             1.607e-02  1.139e-02  1.468e+02
## CBeta_trait_c:ScaredSoc.c               3.371e-02  1.497e-02  1.493e+02
## CBeta_state:ScaredSoc.c                -5.996e-03  6.126e-03  1.154e+02
## CBeta_trait_c:CBeta_state              -7.146e-02  4.097e-02  1.162e+02
## CBeta_trait_c:CBeta_state:ScaredSoc.c -7.175e-04  1.136e-02  1.240e+02
##                                        t value Pr(>|t|)
## (Intercept)                             23.382   <2e-16 ***
## CBeta_trait_c                           13.700   <2e-16 ***
## CBeta_state                             10.196   <2e-16 ***
## BIQ.c                                   -0.602   0.5482
## ScaredSoc.c                              1.410   0.1607
## CBeta_trait_c:ScaredSoc.c                2.252   0.0258 *
## CBeta_state:ScaredSoc.c                 -0.979   0.3297
## CBeta_trait_c:CBeta_state               -1.744   0.0838 .
## CBeta_trait_c:CBeta_state:ScaredSoc.c   -0.063   0.9498
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Correlation of Fixed Effects:
##             (Intr) CBt_t_ CBt_st BIQ.c  ScrdS. CB__:S CB_:SS CBt__:CB_
## CBeta_trt_c  0.018
## CBeta_state -0.023  0.000
## BIQ.c       -0.030 -0.183  0.000
## ScaredSoc.c  0.017  0.088  0.000 -0.689
## CBt_tr_:SS. -0.037 -0.123  0.001  0.022  0.098
## CBt_stt:SS.  0.000  0.002 -0.021 -0.001 -0.016 -0.003
## CBt_tr_:CB_  0.000 -0.022  0.127  0.001  0.000  0.003 -0.035
## CB__:CB_:SS  0.001  0.003 -0.018 -0.001 -0.001 -0.022  0.264 -0.137
```

Social Anxiety and Parietal synchrony

```
model1_fit <- lmer(formula = ParietalDelta ~ 1 + PBeta_trait_c + PBeta_state + BIQ.c +ScaredSoc.c +
                     PBeta_trait_c:ScaredSoc.c + PBeta_state:ScaredSoc.c + PBeta_trait_c:PBeta_state +
                     PBeta_trait_c:PBeta_state:ScaredSoc.c+
                      (1 + PBeta_state|id),
                    data=DBlong,
                    na.action=na.exclude)
summary(model1_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## ParietalDelta ~ 1 + PBeta_trait_c + PBeta_state + BIQ.c + ScaredSoc.c +
##     PBeta_trait_c:ScaredSoc.c + PBeta_state:ScaredSoc.c + PBeta_trait_c:PBeta_state +
##     PBeta_trait_c:PBeta_state:ScaredSoc.c + (1 + PBeta_state |      id)
##    Data: DBlong
##
## REML criterion at convergence: 30456
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.2583 -0.6467  0.0238  0.6649  4.0217
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  id       (Intercept) 0.12156  0.3487
##           PBeta_state 0.05412  0.2326   0.07
##  Residual             0.41642  0.6453
## Number of obs: 15177, groups:  id, 156
##
## Fixed effects:
##                                          Estimate Std. Error         df
## (Intercept)                             1.039e+00  2.893e-02  1.443e+02
## PBeta_trait_c                           8.364e-01  4.687e-02  1.484e+02
## PBeta_state                             3.199e-01  2.530e-02  1.388e+02
## BIQ.c                                   8.018e-04  1.213e-03  1.446e+02
## ScaredSoc.c                            -4.352e-05  1.106e-02  1.445e+02
## PBeta_trait_c:ScaredSoc.c               1.012e-02  1.280e-02  1.450e+02
## PBeta_state:ScaredSoc.c                -6.746e-04  6.962e-03  1.381e+02
## PBeta_trait_c:PBeta_state              -4.427e-02  4.201e-02  1.570e+02
## PBeta_trait_c:PBeta_state:ScaredSoc.c -8.431e-03  1.159e-02  1.615e+02
```

```
##                                      t value Pr(>|t|)
## (Intercept)                           35.924   <2e-16 ***
## PBeta_trait_c                         17.848   <2e-16 ***
## PBeta_state                           12.643   <2e-16 ***
## BIQ.c                                  0.661    0.510
## ScaredSoc.c                           -0.004    0.997
## PBeta_trait_c:ScaredSoc.c              0.791    0.430
## PBeta_state:ScaredSoc.c               -0.097    0.923
## PBeta_trait_c:PBeta_state             -1.054    0.293
## PBeta_trait_c:PBeta_state:ScaredSoc.c -0.728    0.468
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) PBt_t_ PBt_st BIQ.c  ScrdS. PB__:S PB_:SS PBt__:PB_
## PBeta_trt_c  0.020
## PBeta_state  0.055  0.000
## BIQ.c       -0.028 -0.131 -0.001
## ScaredSoc.c  0.018  0.061  0.000 -0.691
## PBt_tr_:SS. -0.040 -0.021 -0.002 -0.012  0.072
## PBt_stt:SS.  0.000 -0.003  0.013  0.003  0.038  0.004
## PBt_tr_:PB_  0.000  0.052  0.086 -0.001 -0.001 -0.001  0.000
## PB__:PB_:SS -0.002 -0.002  0.000  0.001  0.002  0.052  0.157  0.007
```

Specificity of social anxiety at Frontal and Central Regions

Frontal synchrony

```
#separation anxiety
model1_fit <- lmer(formula = FrontalDelta ~ 1  + FBeta_trait_c + FBeta_state + ScaredSep.c +
                     FBeta_trait_c:ScaredSep.c + FBeta_state:ScaredSep.c + FBeta_trait_c:FBeta_state +
                     FBeta_trait_c:FBeta_state:ScaredSep.c +
                      (1 + FBeta_state|id),
                    data=DBlong,
                    na.action=na.exclude)
summary(model1_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: FrontalDelta ~ 1 + FBeta_trait_c + FBeta_state + ScaredSep.c +
##     FBeta_trait_c:ScaredSep.c + FBeta_state:ScaredSep.c + FBeta_trait_c:FBeta_state +
##     FBeta_trait_c:FBeta_state:ScaredSep.c + (1 + FBeta_state |      id)
##    Data: DBlong
##
## REML criterion at convergence: 35806.5
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.8155 -0.6416  0.0235  0.6513  4.2499
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
```

```
##  id       (Intercept) 0.09664  0.3109
##           FBeta_state 0.02106  0.1451   0.02
##  Residual             0.58650  0.7658
## Number of obs: 15319, groups:  id, 156
##
## Fixed effects:
##                                      Estimate Std. Error         df
## (Intercept)                          1.572366   0.026332 146.478224
## FBeta_trait_c                        0.496512   0.051258 151.802863
## FBeta_state                          0.133050   0.021840 117.543073
## ScaredSep.c                          0.006423   0.008197 197.779698
## FBeta_trait_c:ScaredSep.c           -0.007540   0.013687 407.747269
## FBeta_state:ScaredSep.c              0.004551   0.007749 128.261929
## FBeta_trait_c:FBeta_state           -0.078316   0.043289 116.529055
## FBeta_trait_c:FBeta_state:ScaredSep.c  0.005061   0.015695 138.263305
##                                     t value Pr(>|t|)
## (Intercept)                          59.714  < 2e-16 ***
## FBeta_trait_c                         9.687  < 2e-16 ***
## FBeta_state                           6.092 1.45e-08 ***
## ScaredSep.c                           0.784    0.434
## FBeta_trait_c:ScaredSep.c            -0.551    0.582
## FBeta_state:ScaredSep.c               0.587    0.558
## FBeta_trait_c:FBeta_state            -1.809    0.073 .
## FBeta_trait_c:FBeta_state:ScaredSep.c  0.322    0.748
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) FBt_t_ FBt_st ScrdS. FB__:S FB_:SS FBt__:FB_
## FBeta_trt_c  0.014
## FBeta_state  0.010  0.000
## ScaredSep.c -0.003  0.065  0.000
## FBt_tr_:SS.  0.062  0.033  0.001 -0.205
## FBt_stt:SS.  0.000  0.001  0.004  0.009 -0.002
## FBt_tr_:FB_  0.000  0.010 -0.001  0.001  0.000  0.075
## FB__:FB_:SS  0.000  0.000  0.063 -0.002  0.007  0.135  0.103
```

```
#general anxiety
model1_fitG <- lmer(formula = FrontalDelta ~ 1  + FBeta_trait_c + FBeta_state + ScaredGen.c +
                     FBeta_trait_c:ScaredGen.c + FBeta_state:ScaredGen.c + FBeta_trait_c:FBeta_state +
                     FBeta_trait_c:FBeta_state:ScaredGen.c +
                      (1 + FBeta_state|id),
                    data=DBlong,
                    na.action=na.exclude)
summary(model1_fitG)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: FrontalDelta ~ 1 + FBeta_trait_c + FBeta_state + ScaredGen.c +
##     FBeta_trait_c:ScaredGen.c + FBeta_state:ScaredGen.c + FBeta_trait_c:FBeta_state +
##     FBeta_trait_c:FBeta_state:ScaredGen.c + (1 + FBeta_state |      id)
##    Data: DBlong
##
## REML criterion at convergence: 35805.4
```

```
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.8158 -0.6415  0.0226  0.6508  4.2503
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  id       (Intercept) 0.09628  0.3103
##           FBeta_state 0.02029  0.1424   0.01
##  Residual             0.58652  0.7658
## Number of obs: 15319, groups:  id, 156
##
## Fixed effects:
##                                      Estimate Std. Error         df
## (Intercept)                          1.575635   0.026309 145.401123
## FBeta_trait_c                        0.496783   0.051140 150.209471
## FBeta_state                          0.134377   0.021712 115.358148
## ScaredGen.c                          0.002579   0.007558 154.676876
## FBeta_trait_c:ScaredGen.c            0.019734   0.015625 177.244060
## FBeta_state:ScaredGen.c              0.003715   0.006341 121.500645
## FBeta_trait_c:FBeta_state           -0.075713   0.043029 117.682877
## FBeta_trait_c:FBeta_state:ScaredGen.c  0.013183   0.013770 127.330634
##                                     t value Pr(>|t|)
## (Intercept)                          59.890  < 2e-16 ***
## FBeta_trait_c                         9.714  < 2e-16 ***
## FBeta_state                           6.189 9.52e-09 ***
## ScaredGen.c                           0.341   0.7334
## FBeta_trait_c:ScaredGen.c             1.263   0.2083
## FBeta_state:ScaredGen.c               0.586   0.5591
## FBeta_trait_c:FBeta_state            -1.760   0.0811 .
## FBeta_trait_c:FBeta_state:ScaredGen.c  0.957   0.3402
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) FBt_t_ FBt_st ScrdG. FB__:S FB_:SG FBt__:FB_
## FBeta_trt_c 0.013
## FBeta_state 0.005  0.000
## ScaredGen.c 0.012  0.071  0.000
## FBt_tr_:SG. 0.075  0.015  0.000  0.064
## FBt_stt:SG. 0.000  0.000  0.031  0.005  0.000
## FBt_tr_:FB_ 0.000  0.005  0.001  0.000  0.000  0.073
## FB__:FB_:SG 0.000  0.000  0.071  0.000  0.004  0.101  0.110
```

Central synchrony

```
#separation anxiety
model1_fit <- lmer(formula = CentralDelta ~ 1 + CBeta_trait_c + CBeta_state + ScaredSep.c +
                     CBeta_trait_c:ScaredSep.c + CBeta_state:ScaredSep.c + CBeta_trait_c:CBeta_state +
                     CBeta_trait_c:CBeta_state:ScaredSep.c+
                      (1 + CBeta_state|id),
                    data=DBlong,
                    na.action=na.exclude)
summary(model1_fit)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: CentralDelta ~ 1 + CBeta_trait_c + CBeta_state + ScaredSep.c +
##     CBeta_trait_c:ScaredSep.c + CBeta_state:ScaredSep.c + CBeta_trait_c:CBeta_state +
##     CBeta_trait_c:CBeta_state:ScaredSep.c + (1 + CBeta_state |      id)
##    Data: DBlong
##
## REML criterion at convergence: 30198.7
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.3873 -0.6500  0.0030  0.6453  4.9405
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  id       (Intercept) 0.1317   0.3630
##           CBeta_state 0.0286   0.1691   -0.03
##  Residual             0.4034   0.6352
## Number of obs: 15319, groups:  id, 156
##
## Fixed effects:
##                                      Estimate Std. Error         df
## (Intercept)                          0.694098   0.030002 148.240957
## CBeta_trait_c                        0.759147   0.053999 151.820470
## CBeta_state                          0.225277   0.021981 109.525955
## ScaredSep.c                          0.004061   0.008335 324.248427
## CBeta_trait_c:ScaredSep.c           -0.015306   0.020025 184.443635
## CBeta_state:ScaredSep.c             -0.002469   0.007744 123.649627
## CBeta_trait_c:CBeta_state           -0.073851   0.040424 116.978965
## CBeta_trait_c:CBeta_state:ScaredSep.c  0.017663   0.015538 105.113867
##                                     t value Pr(>|t|)
## (Intercept)                          23.135   <2e-16 ***
## CBeta_trait_c                        14.058   <2e-16 ***
## CBeta_state                          10.249   <2e-16 ***
## ScaredSep.c                           0.487   0.6264
## CBeta_trait_c:ScaredSep.c            -0.764   0.4456
## CBeta_state:ScaredSep.c              -0.319   0.7504
## CBeta_trait_c:CBeta_state            -1.827   0.0703 .
## CBeta_trait_c:CBeta_state:ScaredSep.c  1.137   0.2582
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) CBt_t_ CBt_st ScrdS. CB__:S CB_:SS CBt__:CB_
## CBeta_trt_c  0.008
## CBeta_state -0.020  0.000
## ScaredSep.c  0.005  0.017  0.000
## CBt_tr_:SS.  0.023  0.003 -0.001 -0.188
## CBt_stt:SS.  0.000  0.000  0.000 -0.016  0.003
## CBt_tr_:CB_  0.000 -0.020  0.124  0.000  0.000  0.004
## CB__:CB_:SS  0.000  0.000  0.006  0.004 -0.019  0.161 -0.040
```

```
#general anxiety
model1_fitG <- lmer(formula = CentralDelta ~ 1  + CBeta_trait_c + CBeta_state + ScaredGen.c +
```

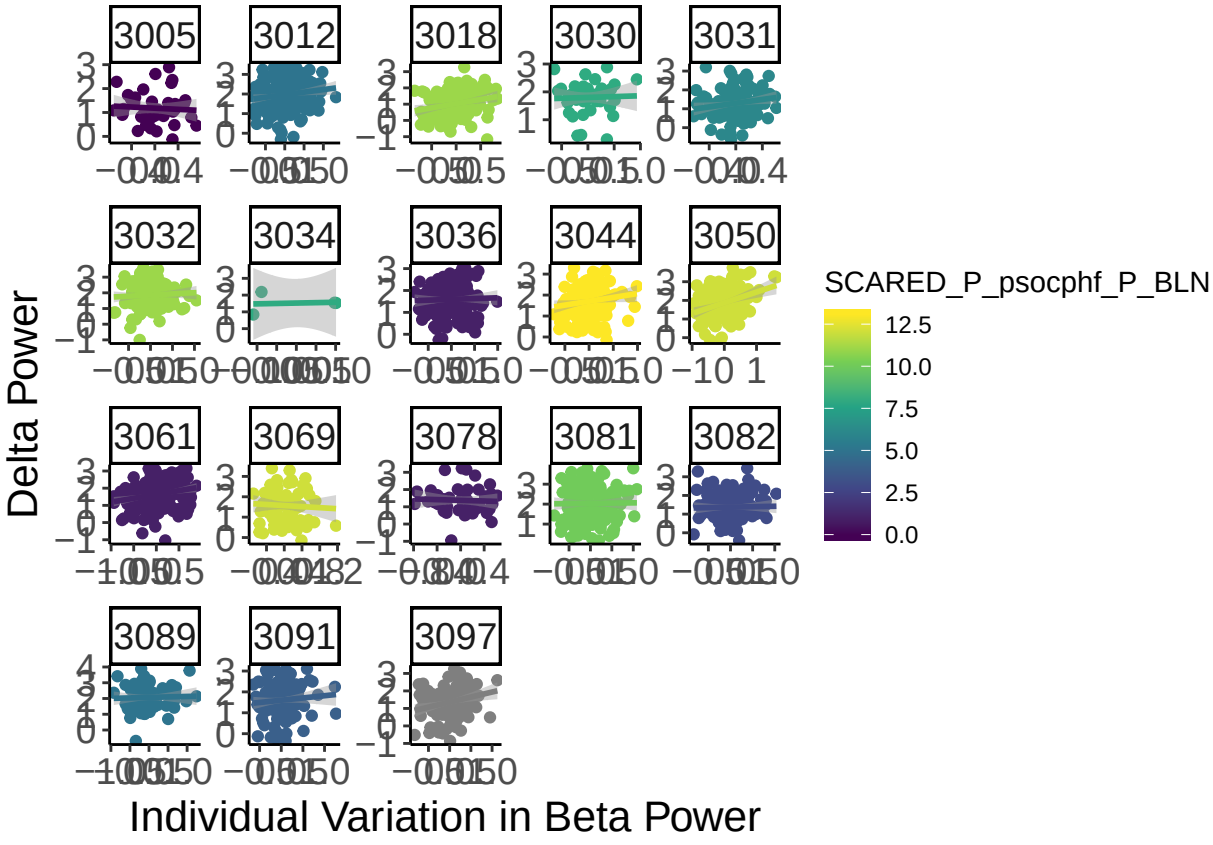
```
                     CBeta_trait_c:ScaredGen.c + CBeta_state:ScaredGen.c + CBeta_trait_c:CBeta_state +
                     CBeta_trait_c:CBeta_state:ScaredGen.c+
                      (1 + CBeta_state|id),
                    data=DBlong,
                    na.action=na.exclude)
summary(model1_fitG)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: CentralDelta ~ 1 + CBeta_trait_c + CBeta_state + ScaredGen.c +
##     CBeta_trait_c:ScaredGen.c + CBeta_state:ScaredGen.c + CBeta_trait_c:CBeta_state +
##     CBeta_trait_c:CBeta_state:ScaredGen.c + (1 + CBeta_state |      id)
##    Data: DBlong
##
## REML criterion at convergence: 30200.4
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.3812 -0.6497  0.0026  0.6451  4.9378
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  id       (Intercept) 0.13229  0.3637
##           CBeta_state 0.02892  0.1701   -0.05
##  Residual             0.40342  0.6352
## Number of obs: 15319, groups:  id, 156
##
## Fixed effects:
##                                        Estimate Std. Error         df
## (Intercept)                           6.934e-01  3.010e-02  1.475e+02
## CBeta_trait_c                         7.582e-01  5.418e-02  1.510e+02
## CBeta_state                           2.235e-01  2.208e-02  1.099e+02
## ScaredGen.c                          -8.534e-04  8.532e-03  1.629e+02
## CBeta_trait_c:ScaredGen.c             1.137e-02  1.663e-02  1.559e+02
## CBeta_state:ScaredGen.c              -4.780e-03  6.432e-03  1.186e+02
## CBeta_trait_c:CBeta_state            -7.054e-02  4.056e-02  1.164e+02
## CBeta_trait_c:CBeta_state:ScaredGen.c  8.081e-03  1.222e-02  1.129e+02
##                                      t value Pr(>|t|)
## (Intercept)                           23.040   <2e-16 ***
## CBeta_trait_c                         13.992   <2e-16 ***
## CBeta_state                           10.121   <2e-16 ***
## ScaredGen.c                           -0.100   0.9204
## CBeta_trait_c:ScaredGen.c              0.684   0.4952
## CBeta_state:ScaredGen.c               -0.743   0.4589
## CBeta_trait_c:CBeta_state             -1.739   0.0847 .
## CBeta_trait_c:CBeta_state:ScaredGen.c  0.661   0.5098
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) CBt_t_ CBt_st ScrdG. CB__:S CB_:SG CBt__:CB_
## CBeta_trt_c  0.009
## CBeta_state -0.031  0.000
```

```
## ScaredGen.c  0.006 -0.049  0.000
## CBt_tr_:SG. -0.054 -0.028  0.002 -0.018
## CBt_stt:SG.  0.000  0.001  0.012 -0.030  0.001
## CBt_tr_:CB_  0.000 -0.030  0.124  0.001  0.001 -0.059
## CB__:CB_:SG  0.002  0.001 -0.061  0.001 -0.031  0.116 -0.023
```

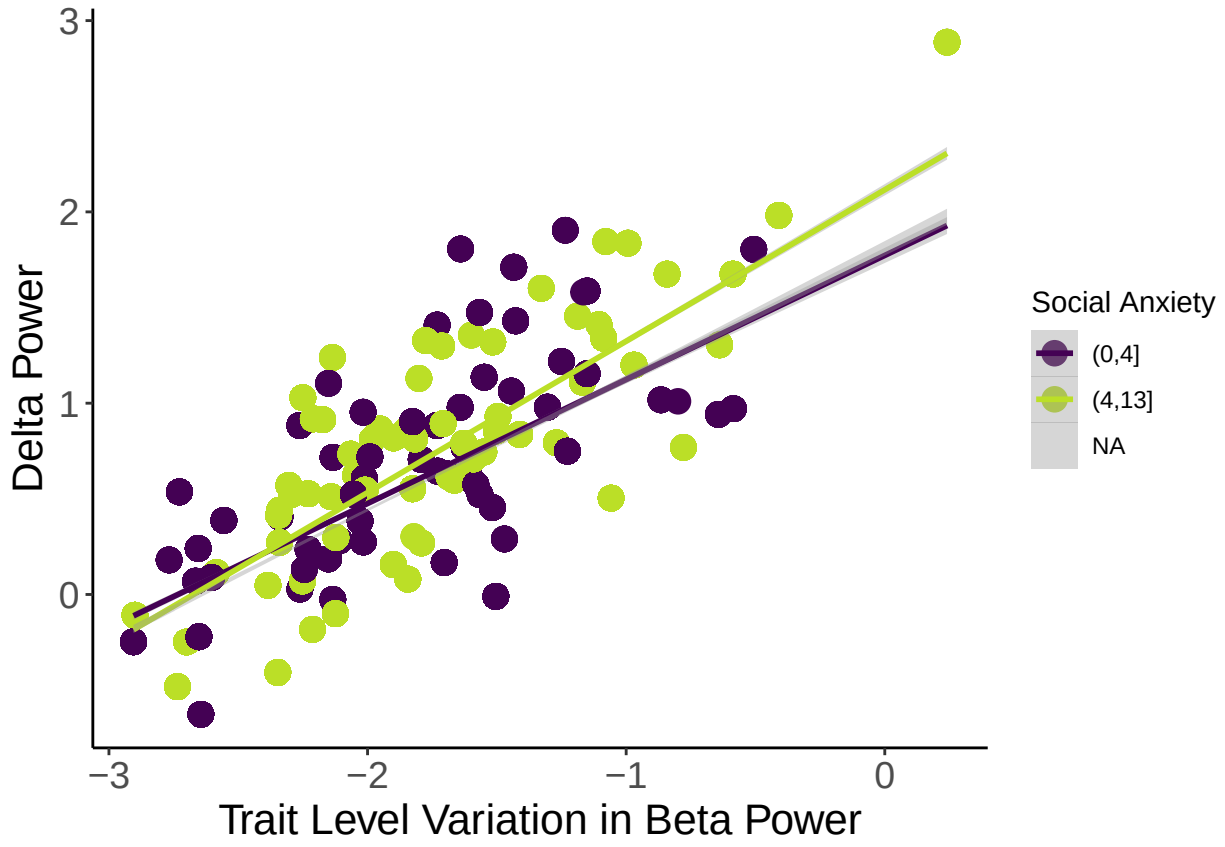
Visualization of social anxiety effects

After testing the Social anxiety specificity to the Frontal region, we can plot these slopes to see individual differences across our sample



We can also plot our sample-level effects for Central power

```
## Warning: Removed 5293 rows containing missing values (geom_point).
```



Johnson-Neyman plot of the interactions

```
#inspecting data structure to vectorize matrix variables
str(DBlong)
```

```
## Classes 'grouped_df', 'tbl_df', 'tbl' and 'data.frame':  17143 obs. of  48 variables:
##  $ id                     : int  3005 3005 3005 3005 3005 3005 3005 3005 3005 3005 ...
##  $ time                   : int  16 18 14 17 3 4 5 15 11 2 ...
##  $ condition              : Factor w/ 4 levels "CL","L_","OP",..: 3 3 3 3 1 1 1 3 3 3 ...
##  $ FrontalDelta           : num  0.336 0.794 1.137 1.11 1.036 ...
##  $ CentralDelta           : num  0.3709 -1.0404 -0.0164 1.1234 0.3994 ...
##  $ ParietalDelta          : num  0.797 0.582 0.704 1.706 0.888 ...
##  $ FrontalBeta            : num  -0.568 0.129 -0.157 -0.166 -0.188 ...
##  $ CentralBeta            : num  -1.019 -0.968 -1.177 -1.548 -1.214 ...
##  $ ParietalBeta           : num  -0.564 -0.179 -0.538 -0.265 -0.319 ...
##  $ seconds                : int  30 32 28 31 3 4 5 29 25 16 ...
##  $ n.x                    : int  40 40 40 40 40 40 40 40 40 40 ...
##  $ Gender                 : int  2 2 2 2 2 2 2 2 2 2 ...
##  $ Ethnicity              : int  3 3 3 3 3 3 3 3 3 3 ...
##  $ age.BLNinyears         : num  12.2 12.2 12.2 12.2 12.2 ...
##  $ SCARED_P_pgenax_P_BLN  : int  3 3 3 3 3 3 3 3 3 3 ...
##  $ SCARED_P_psepax_P_BLN  : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ SCARED_P_psocphf_P_BLN : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ SCARED_P_psctotal_P_BLN: int  3 3 3 3 3 3 3 3 3 3 ...
##  $ SCAS_P_sepanx_P_BLN    : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ SCAS_P_socanx_P_BLN    : int  3 3 3 3 3 3 3 3 3 3 ...
```

```
##  $ SCAS_P_total_P_BLN     : int  5 5 5 5 5 5 5 5 5 5 ...
##  $ BI                     : Factor w/ 2 levels "0","1": 1 1 1 1 1 1 1 1 1 1 ...
##  $ Total_BIQ              : num  78 78 78 78 78 78 78 78 78 78 ...
##  $ n.y                    : int  40 40 40 40 40 40 40 40 40 40 ...
##  $ ScaredSoc.c            : num [1:17143, 1] -4.12 -4.12 -4.12 -4.12 -4.12 ...
##  $ ScaredSep.c            : num [1:17143, 1] -2.37 -2.37 -2.37 -2.37 -2.37 ...
##  $ ScaredGen.c            : num [1:17143, 1] -0.732 -0.732 -0.732 -0.732 -0.732 ...
##  $ ScaredTot.c            : num [1:17143, 1] -8.44 -8.44 -8.44 -8.44 -8.44 ...
##  $ BIQ.c                  : num [1:17143, 1] -19.6 -19.6 -19.6 -19.6 -19.6 ...
##  $ FDelta_trait           : num  1.18 1.18 1.18 1.18 1.18 ...
##  $ CDelta_trait           : num  0.29 0.29 0.29 0.29 0.29 ...
##  $ PDelta_trait           : num  0.877 0.877 0.877 0.877 0.877 ...
##  $ FDelta_trait_c         : num [1:17143, 1] -0.395 -0.395 -0.395 -0.395 -0.395 ...
##  $ CDelta_trait_c         : num [1:17143, 1] -0.397 -0.397 -0.397 -0.397 -0.397 ...
##  $ PDelta_trait_c         : num [1:17143, 1] -0.16 -0.16 -0.16 -0.16 -0.16 ...
##  $ FBeta_trait            : num  -0.5 -0.5 -0.5 -0.5 -0.5 ...
##  $ CBeta_trait            : num  -1.2 -1.2 -1.2 -1.2 -1.2 ...
##  $ PBeta_trait            : num  -0.529 -0.529 -0.529 -0.529 -0.529 ...
##  $ FBeta_trait_c          : num [1:17143, 1] 0.67 0.67 0.67 0.67 0.67 ...
##  $ CBeta_trait_c          : num [1:17143, 1] 0.607 0.607 0.607 0.607 0.607 ...
##  $ PBeta_trait_c          : num [1:17143, 1] 0.883 0.883 0.883 0.883 0.883 ...
##  $ FDelta_state           : num  -0.844 -0.386 -0.043 -0.07 -0.144 ...
##  $ CDelta_state           : num  0.0811 -1.3302 -0.3062 0.8336 0.1097 ...
##  $ PDelta_state           : num  -0.0798 -0.2945 -0.1729 0.8295 0.011 ...
##  $ FBeta_state            : num  -0.0687 0.6282 0.3429 0.3339 0.3113 ...
##  $ CBeta_state            : num  0.1814 0.2322 0.023 -0.348 -0.0137 ...
##  $ PBeta_state            : num  -0.03499 0.34986 -0.00877 0.264 0.2104 ...
##  $ SAcat                  : Factor w/ 2 levels "(0,4]","(4,13]": NA NA NA NA NA NA NA NA NA NA ...
##  - attr(*, "groups")=Classes 'tbl_df', 'tbl' and 'data.frame':   172 obs. of  2 variables:
##   ..$ id   : int  3005 3012 3018 3030 3031 3032 3034 3036 3044 3050 ...
##   ..$ .rows:List of 172
##   .. ..$ : int  1 2 3 4 5 6 7 8 9 10 ...
##   .. ..$ : int  41 42 43 44 45 46 47 48 49 50 ...
##   .. ..$ : int  238 239 240 241 242 243 244 245 246 247 ...
##   .. ..$ : int  355 356 357 358 359 360 361 362 363 364 ...
##   .. ..$ : int  396 397 398 399 400 401 402 403 404 405 ...
##   .. ..$ : int  510 511 512 513 514 515 516 517 518 519 ...
##   .. ..$ : int  655 656 657 658
##   .. ..$ : int  659 660 661 662 663 664 665 666 667 668 ...
##   .. ..$ : int  828 829 830 831 832 833 834 835 836 837 ...
##   .. ..$ : int  982 983 984 985 986 987 988 989 990 991 ...
##   .. ..$ : int  1102 1103 1104 1105 1106 1107 1108 1109 1110 1111 ...
##   .. ..$ : int  1296 1297 1298 1299 1300 1301 1302 1303 1304 1305 ...
##   .. ..$ : int  1369 1370 1371 1372 1373 1374 1375 1376 1377 1378 ...
##   .. ..$ : int  1416 1417 1418 1419 1420 1421 1422 1423 1424 1425 ...
##   .. ..$ : int  1578 1579 1580 1581 1582 1583 1584 1585 1586 1587 ...
##   .. ..$ : int  1692 1693 1694 1695 1696 1697 1698 1699 1700 1701 ...
##   .. ..$ : int  1771 1772 1773 1774 1775 1776 1777 1778 1779 1780 ...
##   .. ..$ : int  1897 1898 1899 1900 1901 1902 1903 1904 1905 1906 ...
##   .. ..$ : int  2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 ...
##   .. ..$ : int  2236 2237 2238 2239 2240 2241 2242 2243 2244 2245 ...
##   .. ..$ : int  2361 2362 2363 2364 2365 2366 2367 2368 2369 2370 ...
##   .. ..$ : int  2517 2518 2519 2520 2521 2522 2523 2524 2525 2526 ...
##   .. ..$ : int  2537 2538 2539 2540 2541 2542 2543 2544 2545 2546 ...
```

```
##   .. ..$ : int  2678 2679 2680 2681 2682 2683 2684 2685 2686 2687 ...
##   .. ..$ : int  2785 2786 2787 2788 2789 2790 2791 2792 2793 2794 ...
##   .. ..$ : int  2920 2921 2922 2923 2924 2925 2926
##   .. ..$ : int  2927 2928 2929 2930 2931 2932 2933 2934 2935 2936 ...
##   .. ..$ : int  3022 3023 3024 3025 3026 3027 3028 3029 3030 3031 ...
##   .. ..$ : int  3213 3214 3215 3216 3217 3218 3219 3220 3221 3222 ...
##   .. ..$ : int  3373 3374 3375 3376 3377 3378 3379 3380 3381 3382 ...
##   .. ..$ : int  3505 3506 3507 3508 3509 3510 3511 3512 3513 3514 ...
##   .. ..$ : int  3624 3625 3626 3627 3628 3629 3630 3631 3632 3633 ...
##   .. ..$ : int  3756 3757 3758 3759 3760 3761 3762 3763 3764 3765 ...
##   .. ..$ : int  3833 3834 3835 3836 3837 3838 3839 3840 3841 3842 ...
##   .. ..$ : int  3972 3973 3974 3975 3976 3977 3978 3979 3980 3981 ...
##   .. ..$ : int  4068 4069 4070 4071 4072 4073 4074 4075 4076 4077 ...
##   .. ..$ : int  4114 4115 4116 4117 4118 4119 4120 4121 4122 4123 ...
##   .. ..$ : int  4233 4234 4235 4236 4237 4238 4239 4240 4241 4242 ...
##   .. ..$ : int  4384 4385 4386 4387 4388 4389 4390 4391 4392 4393 ...
##   .. ..$ : int  4570 4571 4572 4573 4574 4575 4576 4577 4578 4579 ...
##   .. ..$ : int  4643 4644 4645 4646 4647 4648 4649 4650 4651 4652 ...
##   .. ..$ : int  4675 4676 4677 4678 4679 4680 4681 4682 4683 4684 ...
##   .. ..$ : int  4847 4848 4849 4850 4851 4852 4853 4854 4855 4856 ...
##   .. ..$ : int  5008 5009 5010 5011 5012 5013 5014 5015 5016 5017 ...
##   .. ..$ : int  5092 5093 5094 5095 5096 5097 5098 5099 5100 5101 ...
##   .. ..$ : int  5245 5246 5247 5248 5249 5250 5251 5252 5253 5254 ...
##   .. ..$ : int  5288 5289 5290 5291 5292 5293 5294 5295 5296 5297 ...
##   .. ..$ : int  5360 5361 5362 5363 5364 5365 5366 5367 5368 5369 ...
##   .. ..$ : int  5644 5645 5646 5647 5648 5649 5650 5651 5652 5653 ...
##   .. ..$ : int  5691 5692 5693 5694 5695 5696 5697 5698 5699 5700 ...
##   .. ..$ : int  5904 5905 5906 5907 5908 5909 5910 5911 5912 5913 ...
##   .. ..$ : int  6109 6110 6111 6112 6113 6114 6115 6116 6117 6118 ...
##   .. ..$ : int  6141 6142 6143 6144 6145 6146 6147 6148 6149 6150 ...
##   .. ..$ : int  6256 6257 6258 6259 6260 6261 6262 6263 6264 6265 ...
##   .. ..$ : int  6427 6428 6429 6430 6431 6432 6433 6434 6435 6436 ...
##   .. ..$ : int  6539 6540 6541 6542 6543 6544 6545 6546 6547 6548 ...
##   .. ..$ : int  6551 6552 6553 6554 6555 6556 6557 6558 6559 6560 ...
##   .. ..$ : int  6685 6686 6687 6688 6689 6690 6691 6692 6693 6694 ...
##   .. ..$ : int  6776 6777 6778 6779 6780 6781 6782 6783 6784 6785 ...
##   .. ..$ : int  6930 6931 6932 6933 6934 6935 6936 6937 6938 6939 ...
##   .. ..$ : int  7056 7057 7058 7059 7060 7061 7062 7063 7064 7065 ...
##   .. ..$ : int  7069 7070 7071 7072 7073 7074 7075 7076 7077 7078 ...
##   .. ..$ : int  7161 7162 7163 7164 7165 7166 7167 7168 7169 7170 ...
##   .. ..$ : int  7250 7251 7252 7253 7254 7255 7256 7257 7258 7259 ...
##   .. ..$ : int  7356 7357 7358 7359 7360 7361 7362 7363 7364 7365 ...
##   .. ..$ : int  7545 7546 7547 7548 7549 7550 7551 7552 7553 7554 ...
##   .. ..$ : int  7673 7674 7675 7676 7677 7678 7679 7680 7681 7682 ...
##   .. ..$ : int  7814 7815 7816 7817 7818 7819 7820 7821 7822 7823 ...
##   .. ..$ : int  7945 7946 7947 7948 7949 7950 7951 7952 7953 7954 ...
##   .. ..$ : int  8108 8109 8110 8111 8112 8113 8114 8115 8116 8117 ...
##   .. ..$ : int  8199 8200 8201 8202 8203 8204 8205 8206 8207 8208 ...
##   .. ..$ : int  8276 8277 8278 8279 8280 8281 8282 8283 8284 8285 ...
##   .. ..$ : int  8317 8318 8319 8320 8321 8322 8323 8324 8325 8326 ...
##   .. ..$ : int  8346 8347 8348 8349 8350 8351 8352 8353 8354 8355 ...
##   .. ..$ : int  8430 8431 8432 8433 8434 8435 8436 8437 8438 8439 ...
##   .. ..$ : int  8590 8591 8592 8593 8594 8595 8596 8597 8598 8599 ...
##   .. ..$ : int  8616 8617 8618 8619 8620 8621 8622 8623 8624 8625 ...
```

```
##   .. ..$ : int  8702 8703 8704 8705 8706 8707 8708 8709 8710 8711 ...
##   .. ..$ : int  8856 8857 8858 8859 8860 8861 8862 8863 8864 8865 ...
##   .. ..$ : int  9013 9014 9015 9016 9017 9018 9019 9020 9021 9022 ...
##   .. ..$ : int  9177 9178 9179 9180 9181 9182 9183 9184 9185 9186 ...
##   .. ..$ : int  9341 9342 9343 9344 9345 9346 9347 9348 9349 9350 ...
##   .. ..$ : int  9445 9446 9447 9448 9449 9450 9451 9452 9453 9454 ...
##   .. ..$ : int  9577 9578 9579 9580 9581 9582 9583 9584 9585 9586 ...
##   .. ..$ : int  9656 9657 9658 9659 9660 9661 9662 9663 9664 9665 ...
##   .. ..$ : int  9714 9715 9716 9717 9718 9719 9720 9721 9722 9723 ...
##   .. ..$ : int  9859 9860 9861 9862 9863 9864 9865 9866 9867 9868 ...
##   .. ..$ : int  9888 9889 9890 9891 9892 9893 9894 9895 9896 9897 ...
##   .. ..$ : int  9954 9955 9956 9957 9958 9959 9960 9961 9962 9963 ...
##   .. ..$ : int  10076 10077 10078 10079 10080 10081 10082 10083 10084 10085 ...
##   .. ..$ : int  10243 10244 10245 10246 10247 10248 10249 10250 10251 10252 ...
##   .. ..$ : int  10354 10355 10356 10357 10358 10359 10360 10361 10362 10363 ...
##   .. ..$ : int  10519 10520 10521 10522 10523 10524 10525 10526 10527 10528 ...
##   .. ..$ : int  10575 10576 10577 10578 10579 10580 10581 10582 10583 10584 ...
##   .. ..$ : int  10697 10698 10699 10700 10701 10702 10703 10704 10705 10706 ...
##   .. ..$ : int  10739 10740 10741 10742 10743 10744 10745 10746 10747 10748 ...
##   .. ..$ : int  10794 10795 10796 10797 10798 10799 10800 10801 10802 10803 ...
##   .. ..$ : int  10880 10881 10882 10883 10884 10885 10886 10887 10888 10889 ...
##   .. ..$ : int  11064 11065 11066 11067 11068 11069 11070 11071 11072 11073 ...
##   .. .. [list output truncated]
##   ..- attr(*, ".drop")= logi TRUE
```

```
DBlong$ScaredSoc.c<-as.vector(DBlong$ScaredSoc.c)

#Re-running model under lm4 command
model2a_fit <- lme4::lmer(formula = FrontalDelta ~ 1 + seconds + FBeta_trait_c + FBeta_state + SCARED_P
                     FBeta_trait_c:SCARED_P_psocphf_P_BLN + FBeta_state:SCARED_P_psocphf_P_BLN + FBeta_
                     FBeta_trait_c:FBeta_state:SCARED_P_psocphf_P_BLN +
                      (1 + FBeta_state|id),
                    data=DBlong,
                    na.action=na.exclude)
summary(model2a_fit)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula:
## FrontalDelta ~ 1 + seconds + FBeta_trait_c + FBeta_state + SCARED_P_psocphf_P_BLN +
##     FBeta_trait_c:SCARED_P_psocphf_P_BLN + FBeta_state:SCARED_P_psocphf_P_BLN +
##     FBeta_trait_c:FBeta_state + FBeta_trait_c:FBeta_state:SCARED_P_psocphf_P_BLN +
##     (1 + FBeta_state | id)
##    Data: DBlong
##
## REML criterion at convergence: 35649.9
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.0345 -0.6443  0.0176  0.6562  4.3736
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  id       (Intercept) 0.09513  0.3084
##           FBeta_state 0.01396  0.1181   0.06
```

```
##  Residual             0.58054  0.7619
## Number of obs: 15319, groups:  id, 156
##
## Fixed effects:
##                                                 Estimate Std. Error
## (Intercept)                                    1.6703965  0.0401614
## seconds                                       -0.0019611  0.0001531
## FBeta_trait_c                                  0.3881151  0.0782451
## FBeta_state                                    0.0439326  0.0303203
## SCARED_P_psocphf_P_BLN                         0.0013885  0.0071551
## FBeta_trait_c:SCARED_P_psocphf_P_BLN           0.0220789  0.0152599
## FBeta_state:SCARED_P_psocphf_P_BLN             0.0176676  0.0054670
## FBeta_trait_c:FBeta_state                     -0.1034331  0.0581626
## FBeta_trait_c:FBeta_state:SCARED_P_psocphf_P_BLN  0.0099397  0.0122813
##                                                t value
## (Intercept)                                     41.592
## seconds                                        -12.811
## FBeta_trait_c                                    4.960
## FBeta_state                                      1.449
## SCARED_P_psocphf_P_BLN                           0.194
## FBeta_trait_c:SCARED_P_psocphf_P_BLN             1.447
## FBeta_state:SCARED_P_psocphf_P_BLN               3.232
## FBeta_trait_c:FBeta_state                       -1.778
## FBeta_trait_c:FBeta_state:SCARED_P_psocphf_P_BLN   0.809
##
## Correlation of Fixed Effects:
##             (Intr) secnds FBt_t_ FBt_st SCARED FB__:S FB_:SC FBt__:FB_
## seconds     -0.203
## FBeta_trt_c -0.028  0.027
## FBeta_state  0.017  0.052  0.001
## SCARED_P__P -0.734  0.008  0.006 -0.021
## FB__:SCARED  0.011 -0.007 -0.761  0.000  0.029
## FB_:SCARED_ -0.020 -0.005  0.000 -0.739  0.029  0.001
## FBt_tr_:FB_ -0.001  0.000  0.029 -0.081  0.000 -0.022  0.045
## FB__:FB_:SC  0.002 -0.010 -0.021  0.048  0.001  0.027  0.008 -0.724
```

Get confidence intervals for both fixed and random effects

```
confint(model2a_fit)
```

```
## Computing profile confidence intervals ...

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep
```

```
## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): Last two rows have
## identical or NA .zeta values: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): Last two rows have
## identical or NA .zeta values: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): Last two rows have
## identical or NA .zeta values: using minstep
```

```
## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): Last two rows have
## identical or NA .zeta values: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): Last two rows have
## identical or NA .zeta values: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): unexpected decrease
## in profile: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): Last two rows have
## identical or NA .zeta values: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): Last two rows have
## identical or NA .zeta values: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): Last two rows have
## identical or NA .zeta values: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): Last two rows have
## identical or NA .zeta values: using minstep

## Warning in nextpar(mat, cc, i, delta, lowcut, upcut): Last two rows have
## identical or NA .zeta values: using minstep

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## Warning in FUN(X[[i]], ...): non-monotonic profile for .sig02

## Warning in confint.thpr(pp, level = level, zeta = zeta): bad spline fit
## for .sig02: falling back to linear interpolation

## Warning in regularize.values(x, y, ties, missing(ties)): collapsing to
## unique 'x' values

##                                                    2.5 %       97.5 %
## .sig01                                       0.269381594  0.345212161
## .sig02                                      -0.330768425  0.447498387
## .sig03                                       0.048941968  0.163973110
## .sigma                                       0.753381087  0.770598675
## (Intercept)                                  1.592295900  1.748645924
## seconds                                     -0.002262487 -0.001662251
## FBeta_trait_c                                0.235807236  0.540386493
## FBeta_state                                 -0.015145311  0.103076877
## SCARED_P_psocphf_P_BLN                      -0.012538017  0.015314110
## FBeta_trait_c:SCARED_P_psocphf_P_BLN        -0.007619754  0.051782174
## FBeta_state:SCARED_P_psocphf_P_BLN           0.007003461  0.028322086
## FBeta_trait_c:FBeta_state                   -0.216489899  0.009723211
## FBeta_trait_c:FBeta_state:SCARED_P_psocphf_P_BLN -0.014006544  0.033860833
```

```r
# Save predicted scores
DBlong$pred_m2a <- predict(model2a_fit)

# Fit statistics
AIC(logLik(model2a_fit))
```

```
## [1] 35675.87
```

```
BIC(logLik(model2a_fit))
```

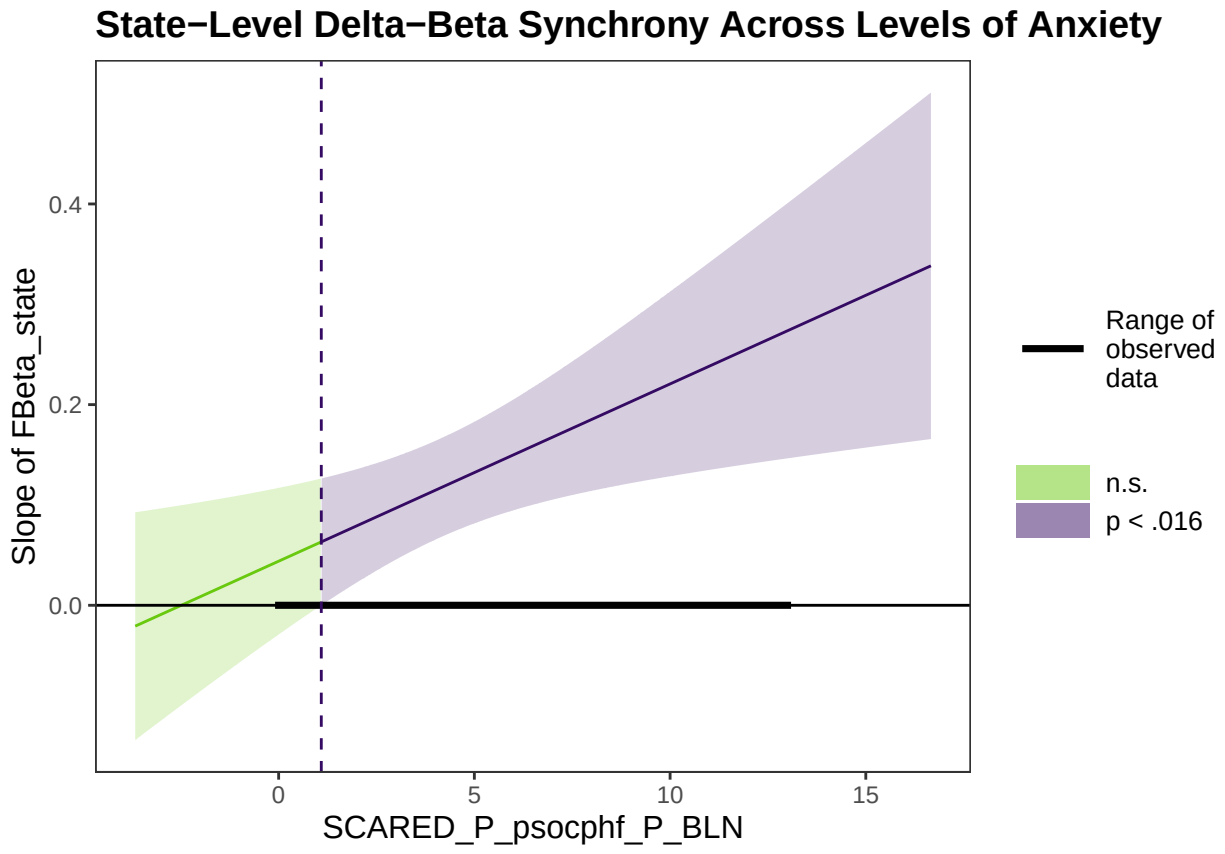
```
## [1] 35775.15
```

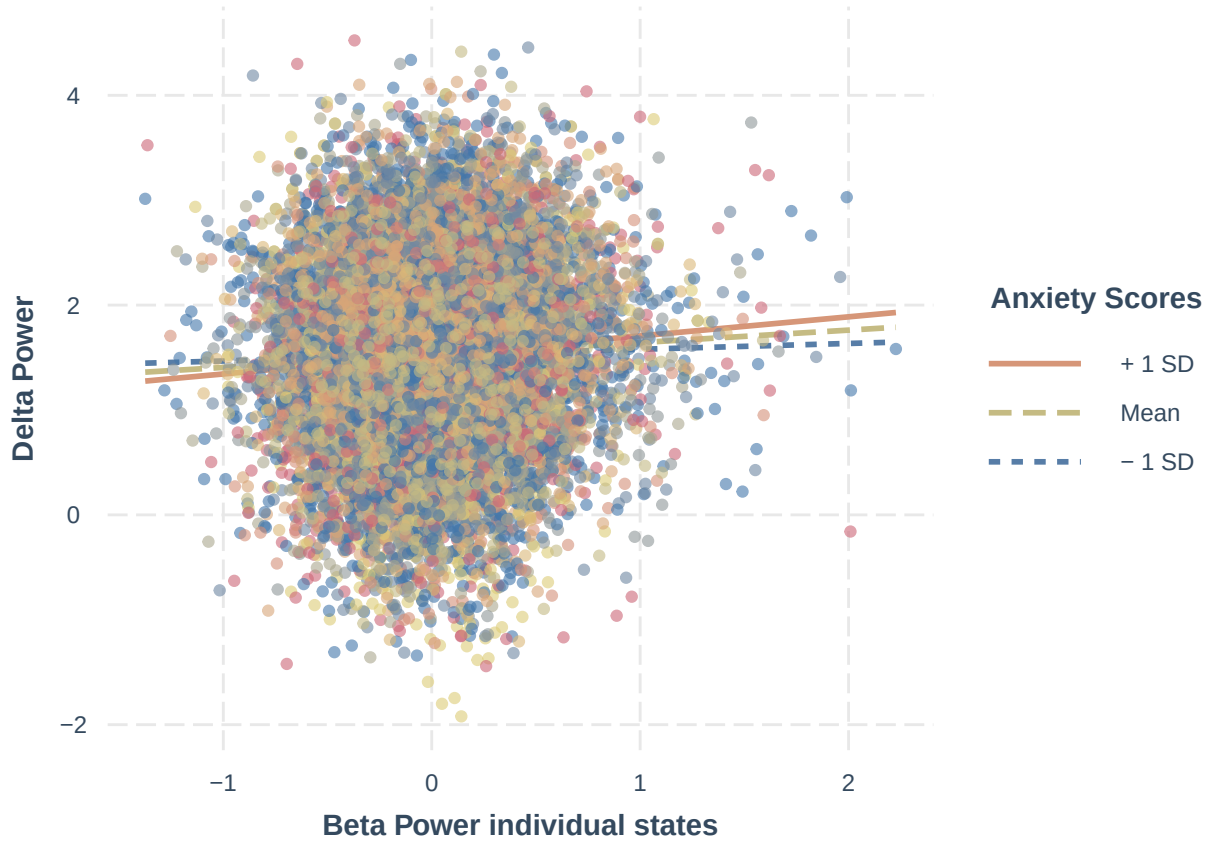
```
logLik(logLik(model2a_fit))
```

```
## 'log Lik.' -17824.93 (df=13)
```

Plotting and probing the simple slopes (within-person association between Beta Power states and Delta Power) across the full range of the moderator (Social Anxiety).

```
## JOHNSON-NEYMAN INTERVAL
##
## When SCARED_P_psocphf_P_BLN is OUTSIDE the interval [-22.54, 1.09],
## the slope of FBeta_state is p < .016.
##
## Note: The range of observed values of SCARED_P_psocphf_P_BLN is [0.00,
## 13.00]
```





Fitting the between-level differences

```
model2a_fit <- lme4::lmer(formula = CentralDelta ~ 1 + seconds + CBeta_trait_c + CBeta_state + SCARED_P_
                     CBeta_trait_c:SCARED_P_psocphf_P_BLN + CBeta_state:SCARED_P_psocphf_P_BLN + CBeta_
                     CBeta_trait_c:CBeta_state:SCARED_P_psocphf_P_BLN+
                      (1 + CBeta_state|id),
                    data=DBlong,
                    na.action=na.exclude)
summary(model2a_fit)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula:
## CentralDelta ~ 1 + seconds + CBeta_trait_c + CBeta_state + SCARED_P_psocphf_P_BLN +
##     CBeta_trait_c:SCARED_P_psocphf_P_BLN + CBeta_state:SCARED_P_psocphf_P_BLN +
##     CBeta_trait_c:CBeta_state + CBeta_trait_c:CBeta_state:SCARED_P_psocphf_P_BLN +
##     (1 + CBeta_state | id)
##    Data: DBlong
##
## REML criterion at convergence: 30144.3
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.3688 -0.6437  0.0054  0.6434  4.8647
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
```

```
##  id       (Intercept) 0.12232  0.3497
##           CBeta_state 0.02765  0.1663   -0.01
##  Residual             0.40188  0.6339
## Number of obs: 15319, groups:  id, 156
##
## Fixed effects:
##                                                  Estimate Std. Error
## (Intercept)                                     0.7010968  0.0445996
## seconds                                        -0.0010719  0.0001304
## CBeta_trait_c                                   0.5848266  0.0846139
## CBeta_state                                     0.2287171  0.0335833
## SCARED_P_psocphf_P_BLN                          0.0109560  0.0080277
## CBeta_trait_c:SCARED_P_psocphf_P_BLN            0.0333064  0.0146107
## CBeta_state:SCARED_P_psocphf_P_BLN             -0.0057505  0.0060453
## CBeta_trait_c:CBeta_state                      -0.0611996  0.0654880
## CBeta_trait_c:CBeta_state:SCARED_P_psocphf_P_BLN -0.0006593  0.0112207
##                                                 t value
## (Intercept)                                      15.720
## seconds                                          -8.222
## CBeta_trait_c                                     6.912
## CBeta_state                                       6.810
## SCARED_P_psocphf_P_BLN                            1.365
## CBeta_trait_c:SCARED_P_psocphf_P_BLN              2.280
## CBeta_state:SCARED_P_psocphf_P_BLN               -0.951
## CBeta_trait_c:CBeta_state                        -0.935
## CBeta_trait_c:CBeta_state:SCARED_P_psocphf_P_BLN  -0.059
##
## Correlation of Fixed Effects:
##             (Intr) secnds CBt_t_ CBt_st SCARED CB__:S CB_:SC CBt__:CB_
## seconds     -0.151
## CBeta_trt_c  0.122  0.027
## CBeta_state -0.020  0.079  0.001
## SCARED_P__P -0.746  0.004 -0.139  0.007
## CB__:SCARED -0.136  0.003 -0.787  0.001  0.150
## CB_:SCARED_  0.007 -0.004  0.001 -0.757 -0.009 -0.001
## CBt_tr_:CB_  0.001 -0.013 -0.009  0.214  0.001  0.006 -0.209
## CB__:CB_:SC  0.001 -0.001  0.007 -0.209 -0.001 -0.008  0.265 -0.791
```