# PAIRS Wave 7

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# 1 Workspace

## 1.1 Packages

```
library(ggplot2)
library(qgraph)
library(mlVAR)
library(graphicalVAR)
library(bootnet)
library(NetworkComparisonTest)
library(knitr)
library(plyr)
library(dplyr)
library(gridExtra)
library(tidyr)
library(Rmisc)
library(psych)
library(lme4)
```

## 1.2 Load Data

```
wave7_all <- read.csv("~/Box Sync/network/PAIRS/Wave 7/esm_w7_RENAMED_all.csv")
wave7_all <- tbl_df(wave7_all)
```

Going to add item table here.

## 1.3 Prepare data

```
#Getting necessary columns, subject ID in col2
#Keeping subject ID and all esm.BFI items
w7 <- dplyr::select(wave7_all, esm.IDnum.w7, esm.PRO01.w7, esm.PRO03.w7, esm.PRO04.w7, esm.PRO05.w7,  ma
w7 <- w7[,-which(colnames(w7) %in% c("esm.BFI20.w7", "esm.BFI12.w7"))]

#Renaming variables for better ease of use
varnames <- c("SID", "freq", "hourBlock", "day", "beepvar",
              "E_outgoing","E_quiet",
              "C_lazy","C_reliable",
              "N_worried","N_relaxed",
              "N_depressed", "A_rude",
              "A_kind")#,  "authentic",
              #"SE", "Happy","Lonely",
              #"pos_emotion", "neg_emotion")
colnames(w7) <- varnames
#varnames <- varnames[-c(17:18)]
#w7 <- dplyr::select(w7, -pos_emotion, -neg_emotion)
w7$SID <- factor(w7$SID)

refcols <- c("SID", "freq", "hourBlock", "day", "beepvar",
              "A_rude", "E_quiet", "C_lazy",
              "N_relaxed", "N_depressed", "E_outgoing",
```

```
              "A_kind", "C_reliable", "N_worried")#,
              #"pos_emotion", "neg_emotion", "authentic",
              #"SE", "Happy", "Lonely")
w7 <- w7[,c(refcols,setdiff(names(w7), refcols))]
```

## 1.4 Screen Participants

To be able to construct individual networks for participants, we ideally need approximately 50 measurement points. However, for current purposes, we will keep all participants who have at least 20 responses, lest we eliminate a large portion of our subjects.

```
problem <- plyr::count(w7$SID)
problem <- problem$x[which(problem$freq < 10)]

excluded <- w7[which(w7$SID %in% problem),]
w7 <- w7[-which(w7$SID %in% problem),]
```

## 1.5 Replace Agreeableness items

```
# replace NA values for agreeableness items with person average #
for (i in unique(w7$SID)){
  mean_A_rude <- mean(w7$A_rude[w7$SID == i])
  w7$A_rude[is.na(w7$A_rude)] <- mean_A_rude
  mean_A_kind <- mean(w7$A_kind[w7$SID == i])
  w7$A_kind[is.na(w7$A_kind)] <- mean_A_kind
}
```

## 1.6 Within-Person Centering

```
w7 <- w7[order(w7$SID, w7$day, w7$hourBlock),]
w7_com <- w7[complete.cases(w7),]
w7_com <- w7_com[order(w7_com$SID, w7_com$day, w7_com$hourBlock),]
w7_com$beepvar2 <- NA
w7_com$beepvar3 <- NA
for (i in unique(w7_com$SID)){
  for (k in unique(w7_com$day[which(w7_com$SID == i)])){
    n <- dim(w7_com[which(w7_com$SID == i & w7_com$day == k),])[1]
    w7_com$beepvar2[which(i == w7_com$SID & w7_com$day == k)] <- seq(1,n,1)
  }
  n2 <- dim(w7_com[which(w7_com$SID == i),])[1]
  w7_com$beepvar3[which(w7_com$SID == i)] <- seq(1,n2,1)
}

w7_centered <- data.frame(ddply(w7_com[,-c(2:5,15:16)], .(SID), colwise(function(x) x-mean(x, na.rm = T

# Make numeric subject IDs for each df because mlVAR #
# won't run for factors #
w7_com$SID2 <- as.numeric(w7_com$SID)
w7_centered$SID2 <- as.numeric(w7_centered$SID)
```

```r
write.csv(w7, "~/Box Sync/network/PAIRS/Wave 7/esm_w7_networks.csv", row.names = F)

write.csv(w7, "~/Box Sync/network/PAIRS/Wave 7/esm_w7_centered.csv", row.names = F)
```

| Variable | New Name | Description |
|---|---|---|
| esm.IDnum.w7 | SID | numeric variable; identification number |
| esm.BFI37.w7 | A_rude | agreeablness, negative; "During the last hour, how rude were you?" Likert scale from 1 to 5; 1 = Not a lot, 3 = Somewhat, 5 = Very |
| esm.BFI21.w7 | E_quiet | extraversion, negative; "During the last hour, how quiet were you?" Likert scale from 1 to 5; 1 = Not a lot, 3 = Somewhat, 5 = Very |
| esm.BFI23.w7 | C_lazy | conscientiousness, negative; "During the last hour, how lazy were you?" Likert scale from 1 to 5; 1 = Not a lot, 3 = Somewhat, 5 = Very |
| esm.BFI09.w7 | N_relaxed | neuroticism, positive; "During the last hour, how relaxed were you?" Likert scale from 1 to 5; 1 = Not a lot, 3 = Somewhat, 5 = Very |
| esm.BFI04.w7 | N_depressed | neuroticism, positive; "During the last hour, did you feel 'depressed, blue'?" Likert scale from 1 to 5; 1 = Not a lot, 3 = Somewhat, 5 = Very |
| esm.BFI36.w7 | E_outgoing | extraversion, positive; "During the last hour, how 'outgoing, sociable' were you?" Likert scale from 1 to 5; 1 = Not a lot, 3 = Somewhat, 5 = Very |
| esm.BFI32.w7 | A_kind | agreeablness, positive; "During the last hour, how 'considerate, kind' were you?" Likert scale from 1 to 5; 1 = Not a lot, 3 = Somewhat, 5 = Very |
| esm.BFI13.w7 | C_reliable | conscientiousness, positive; "During the last hour, how reliable were you?" Likert scale from 1 to 5; 1 = Not a lot, 3 = Somewhat, 5 = Very |
| esm.BFI19.w7 | N_worried | neuroticism, positive; "During the last hour, how worried were you?" Likert scale from 1 to 5; 1 = Not a lot, 3 = Somewhat, 5 = Very |
| esm.BFI20.w7 | O_imagine | openness, positive; "During the last hour, how actively imaginative were you?" Likert scale from 1 to 5; 1 = Not a lot, 3 = Somewhat, 5 = Very |
| esm.BFI12.w7 | A_quarrel | neuroticism, positive; "During the last hour, how quarrelsome were you?" Likert scale from 1 to 5; 1 = Not a lot, 3 = Somewhat, 5 = Very |

```r
# raw data #
fit1_w7 <-
  mlVAR_test(w7_com,
        vars = colnames(w7)[6:14], #4:18
        idvar = "SID2",
        lags = 1,
        #dayvar = "day",
        beepvar = "beepvar3",
        temporal = "orthogonal",
        verbose = FALSE,
        scale = FALSE)
```

```
# within-person centered data #
fit1_w7_centered <-
  mlVAR_test(w7_centered,
        vars = colnames(w7_centered)[2:10], #2:16
        idvar = "SID2",
        lags = 1,
        #dayvar = "day",
        beepvar = "beepvar3",
        temporal = "orthogonal",
        verbose = FALSE,
        scale = FALSE)
```

## 1.7 Random Networks for Comparison

```
npeople <- length(names(fit1_w7$results$Beta$subject))
nv <- 9
subs <- names(fit1_w7$results$Beta$subject)
nTime <- mean(plyr::count(w7$SID2[which(w7$SID2 %in% subs)])$freq)
Model <- mlVARsim(nPerson = npeople, nNode = nv, nTime = nTime, lag=1)
colnames(Model$Data)[1:9] <- varnames[6:14]
Model$vars <- varnames[6:14]
fit_random <- mlVAR_test(Model$Data, vars = Model$vars, idvar = Model$idvar, lags = 1,
                         temporal = "orthogonal", scale = FALSE, verbose = FALSE)
```

## 1.8 Temporal Relationships

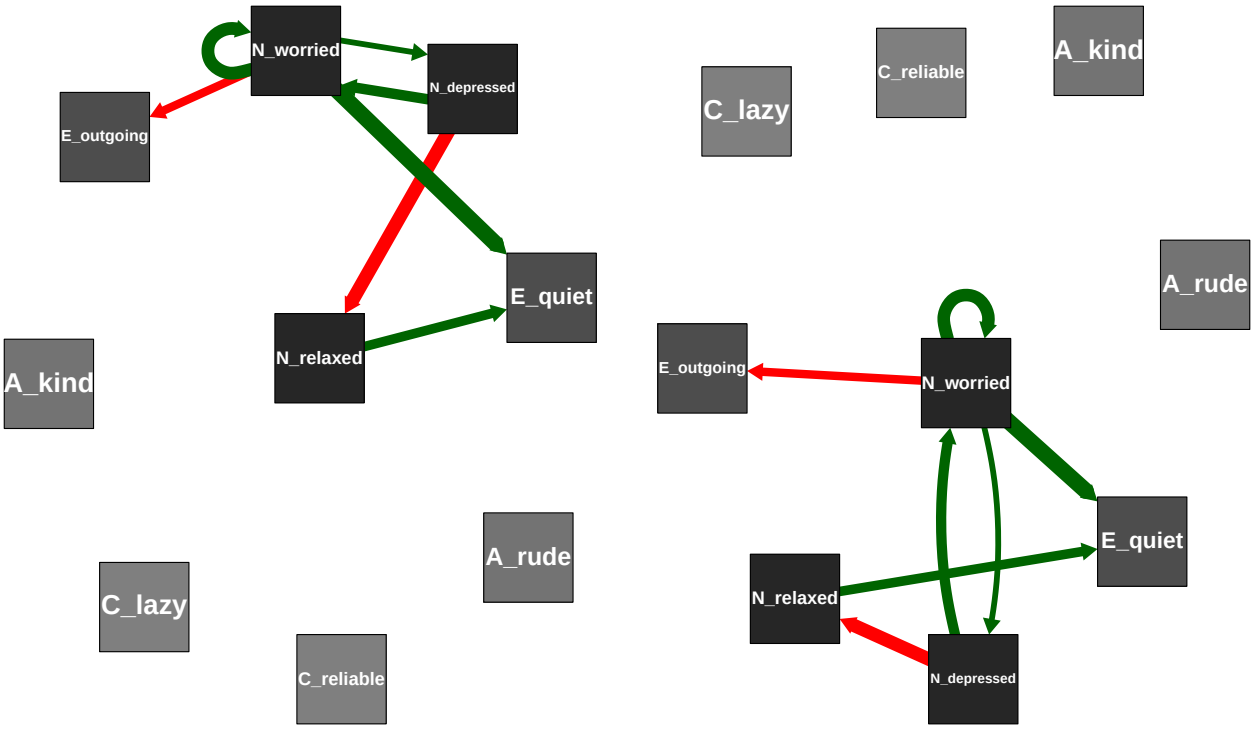
The graphs below show (1) the raw, directed network using gLASSO estimation and (2) the estimated, directed network using a univariate multilevel vector autoregressive models.

```
# Compare temporal relationships
cors <- cor_auto(w7[,6:14], detectOrdinal = F)
par(mfrow = c(1,2))
# graph <- qgraph(
#   cors,
#   title = "True temporal relationships",
#   layout = "spring",
#   graph = "glasso",
#   sampleSize = length(unique(w7$SID2)),
#   tuning = .5,
#   directed = T,
#   details = T)#,
#   #minimum = .2)
#qgraph(getWmat(graph), directed = T)

plot_w7 <-
#makeBW(
  plot(fit1_w7,
     "temporal",
     #title = "Raw Estimated temporal relationships",
     layout = "spring",
```

```
    groups = list(Neuroticism = c(4,5,9),
                  Extraversion = c(2,6),
                  Agreeableness = c(1,7),
                  Conscientiousness = c(3,8)),
    shape = "square",
    cut = .015,
    label.color = "white",
    label.font = 2,
    nonsig = 'hide',
    curve = -1,
    #legend.cex = .3,
    legend = FALSE,
    repulsion = .5,
    node.width = 1.4,
    edge.width = 2,
    label.cex = 6,
    label.fill.vertical = 1,
    label.fill.horizontal = 1,
    #gray = T,#),
    color = c("gray15", "gray30", "gray45", "gray50"))
# text(.7,1, labels = "negative", adj = 0, cex = 1.2)
# text(.7,1.1, labels = "positive", adj = 0, cex = 1.2)
# text(.55, 1.2, labels = "Edge Weights", adj = 0, cex = 1.2)
# segments(.55, 1, x1 = .65, lty = 2, lwd = 1.5)
# segments(.55, 1.1, x1 = .65, lty = 1, lwd = 1.5)

plot_w7_centered <-
#makeBW(
  plot(fit1_w7_centered,
    "temporal",
    #title = "Raw Estimated temporal relationships",
    layout = "spring",
    groups = list(Neuroticism = c(4,5,9),
                  Extraversion = c(2,6),
                  Agreeableness = c(1,7),
                  Conscientiousness = c(3,8)),
    shape = "square",
    cut = .015,
    label.color = "white",
    label.font = 2,
    nonsig = 'hide',
    curve = -1,
    #legend.cex = .3,
    legend = FALSE,
    repulsion = .5,
    node.width = 1.4,
    edge.width = 2,
    label.cex = 6,
    label.fill.vertical = 1,
    label.fill.horizontal = 1,
    gray = F,#),
    color = c("gray15", "gray30", "gray45", "gray50"))
```




```
# text(.7,1, labels = "negative", adj = 0, cex = 1.2)
# text(.7,1.1, labels = "positive", adj = 0, cex = 1.2)
# text(.55, 1.2, labels = "Edge Weights", adj = 0, cex = 1.2)
# segments(.55, 1, x1 = .65, lty = 2, lwd = 1.5)
# segments(.55, 1.1, x1 = .65, lty = 1, lwd = 1.5)
```

```
#model summary
sum_fit1_w7              <- summary(fit1_w7)
sum_fit1_w7_centered     <- summary(fit1_w7_centered)
```

```
kable(sum_fit1_w7$temporal, caption = "Estimated Temporal Relationships")
```

Table 2: Estimated Temporal Relationships

| from | to | lag | fixed | SE | P | ran_SD |
|---|---|---|---|---|---|---|
| A_rude | A_rude | 1 | 0.022 | 0.024 | 0.370 | 0.059 |
| A_rude | E_quiet | 1 | -0.050 | 0.047 | 0.284 | 0.000 |
| A_rude | C_lazy | 1 | -0.025 | 0.050 | 0.625 | 0.140 |
| A_rude | N_relaxed | 1 | 0.019 | 0.039 | 0.629 | 0.019 |
| A_rude | N_depressed | 1 | 0.010 | 0.030 | 0.736 | 0.042 |
| A_rude | E_outgoing | 1 | 0.057 | 0.047 | 0.220 | 0.000 |
| A_rude | A_kind | 1 | -0.017 | 0.036 | 0.635 | 0.084 |
| A_rude | C_reliable | 1 | 0.015 | 0.037 | 0.689 | 0.061 |
| A_rude | N_worried | 1 | 0.037 | 0.036 | 0.305 | 0.000 |
| E_quiet | A_rude | 1 | -0.009 | 0.016 | 0.597 | 0.000 |
| E_quiet | E_quiet | 1 | 0.001 | 0.035 | 0.984 | 0.000 |
| E_quiet | C_lazy | 1 | 0.002 | 0.033 | 0.951 | 0.021 |
| E_quiet | N_relaxed | 1 | -0.025 | 0.029 | 0.380 | 0.000 |
| E_quiet | N_depressed | 1 | 0.011 | 0.021 | 0.582 | 0.000 |
| E_quiet | E_outgoing | 1 | 0.011 | 0.035 | 0.754 | 0.000 |

| from | to | lag | fixed | SE | P | ran_SD |
|---|---|---|---|---|---|---|
| E_quiet | A_kind | 1 | 0.044 | 0.024 | 0.068 | 0.000 |
| E_quiet | C_reliable | 1 | 0.037 | 0.026 | 0.156 | 0.000 |
| E_quiet | N_worried | 1 | 0.003 | 0.027 | 0.903 | 0.000 |
| C_lazy | A_rude | 1 | 0.012 | 0.017 | 0.496 | 0.064 |
| C_lazy | E_quiet | 1 | -0.004 | 0.029 | 0.896 | 0.000 |
| C_lazy | C_lazy | 1 | 0.024 | 0.035 | 0.501 | 0.138 |
| C_lazy | N_relaxed | 1 | 0.019 | 0.024 | 0.416 | 0.000 |
| C_lazy | N_depressed | 1 | -0.006 | 0.019 | 0.753 | 0.037 |
| C_lazy | E_outgoing | 1 | 0.010 | 0.030 | 0.734 | 0.048 |
| C_lazy | A_kind | 1 | 0.020 | 0.020 | 0.326 | 0.013 |
| C_lazy | C_reliable | 1 | -0.010 | 0.027 | 0.713 | 0.091 |
| C_lazy | N_worried | 1 | -0.029 | 0.022 | 0.189 | 0.000 |
| N_relaxed | A_rude | 1 | -0.027 | 0.017 | 0.106 | 0.000 |
| N_relaxed | E_quiet | 1 | 0.096 | 0.037 | 0.009 | 0.069 |
| N_relaxed | C_lazy | 1 | 0.007 | 0.033 | 0.823 | 0.000 |
| N_relaxed | N_relaxed | 1 | -0.021 | 0.032 | 0.514 | 0.081 |
| N_relaxed | N_depressed | 1 | -0.007 | 0.021 | 0.738 | 0.000 |
| N_relaxed | E_outgoing | 1 | -0.056 | 0.035 | 0.112 | 0.000 |
| N_relaxed | A_kind | 1 | -0.041 | 0.025 | 0.099 | 0.000 |
| N_relaxed | C_reliable | 1 | -0.045 | 0.027 | 0.093 | 0.000 |
| N_relaxed | N_worried | 1 | 0.019 | 0.033 | 0.558 | 0.120 |
| N_depressed | A_rude | 1 | -0.013 | 0.021 | 0.529 | 0.000 |
| N_depressed | E_quiet | 1 | 0.025 | 0.045 | 0.574 | 0.000 |
| N_depressed | C_lazy | 1 | 0.002 | 0.042 | 0.960 | 0.000 |
| N_depressed | N_relaxed | 1 | -0.134 | 0.041 | 0.001 | 0.083 |
| N_depressed | N_depressed | 1 | 0.029 | 0.040 | 0.466 | 0.175 |
| N_depressed | E_outgoing | 1 | -0.036 | 0.044 | 0.412 | 0.000 |
| N_depressed | A_kind | 1 | -0.059 | 0.040 | 0.139 | 0.134 |
| N_depressed | C_reliable | 1 | -0.035 | 0.038 | 0.355 | 0.082 |
| N_depressed | N_worried | 1 | 0.104 | 0.035 | 0.003 | 0.000 |
| E_outgoing | A_rude | 1 | 0.011 | 0.017 | 0.538 | 0.000 |
| E_outgoing | E_quiet | 1 | 0.014 | 0.037 | 0.708 | 0.000 |
| E_outgoing | C_lazy | 1 | 0.017 | 0.035 | 0.622 | 0.000 |
| E_outgoing | N_relaxed | 1 | -0.043 | 0.030 | 0.161 | 0.000 |
| E_outgoing | N_depressed | 1 | 0.005 | 0.022 | 0.820 | 0.023 |
| E_outgoing | E_outgoing | 1 | -0.019 | 0.037 | 0.613 | 0.000 |
| E_outgoing | A_kind | 1 | 0.007 | 0.026 | 0.785 | 0.000 |
| E_outgoing | C_reliable | 1 | 0.005 | 0.028 | 0.863 | 0.019 |
| E_outgoing | N_worried | 1 | -0.012 | 0.029 | 0.662 | 0.023 |
| A_kind | A_rude | 1 | -0.007 | 0.018 | 0.691 | 0.021 |
| A_kind | E_quiet | 1 | -0.021 | 0.038 | 0.578 | 0.000 |
| A_kind | C_lazy | 1 | 0.014 | 0.036 | 0.687 | 0.000 |
| A_kind | N_relaxed | 1 | 0.043 | 0.031 | 0.166 | 0.000 |
| A_kind | N_depressed | 1 | -0.022 | 0.025 | 0.384 | 0.067 |
| A_kind | E_outgoing | 1 | 0.042 | 0.038 | 0.260 | 0.000 |
| A_kind | A_kind | 1 | 0.030 | 0.030 | 0.307 | 0.081 |
| A_kind | C_reliable | 1 | 0.045 | 0.029 | 0.123 | 0.000 |
| A_kind | N_worried | 1 | -0.012 | 0.029 | 0.689 | 0.000 |
| C_reliable | A_rude | 1 | -0.014 | 0.017 | 0.408 | 0.015 |
| C_reliable | E_quiet | 1 | -0.021 | 0.036 | 0.565 | 0.000 |
| C_reliable | C_lazy | 1 | 0.012 | 0.034 | 0.722 | 0.000 |
| C_reliable | N_relaxed | 1 | -0.002 | 0.030 | 0.943 | 0.000 |

| from | to | lag | fixed | SE | P | ran_SD |
|---|---|---|---|---|---|---|
| C_reliable | N_depressed | 1 | 0.005 | 0.025 | 0.853 | 0.077 |
| C_reliable | E_outgoing | 1 | 0.037 | 0.036 | 0.293 | 0.000 |
| C_reliable | A_kind | 1 | 0.008 | 0.025 | 0.757 | 0.000 |
| C_reliable | C_reliable | 1 | 0.052 | 0.027 | 0.056 | 0.000 |
| C_reliable | N_worried | 1 | -0.016 | 0.030 | 0.595 | 0.069 |
| N_worried | A_rude | 1 | 0.023 | 0.018 | 0.195 | 0.000 |
| N_worried | E_quiet | 1 | 0.158 | 0.038 | 0.000 | 0.000 |
| N_worried | C_lazy | 1 | -0.025 | 0.035 | 0.482 | 0.000 |
| N_worried | N_relaxed | 1 | -0.043 | 0.038 | 0.254 | 0.136 |
| N_worried | N_depressed | 1 | 0.060 | 0.023 | 0.008 | 0.000 |
| N_worried | E_outgoing | 1 | -0.084 | 0.038 | 0.028 | 0.046 |
| N_worried | A_kind | 1 | -0.022 | 0.028 | 0.438 | 0.051 |
| N_worried | C_reliable | 1 | -0.051 | 0.029 | 0.075 | 0.000 |
| N_worried | N_worried | 1 | 0.127 | 0.036 | 0.000 | 0.138 |

```
kable(sum_fit1_w7_centered$temporal, caption = "Estimated Temporal Relationships")
```

Table 3: Estimated Temporal Relationships

| from | to | lag | fixed | SE | P | ran_SD |
|---|---|---|---|---|---|---|
| A_rude | A_rude | 1 | 0.021 | 0.024 | 0.376 | 0.061 |
| A_rude | E_quiet | 1 | -0.050 | 0.046 | 0.277 | 0.000 |
| A_rude | C_lazy | 1 | -0.024 | 0.050 | 0.634 | 0.145 |
| A_rude | N_relaxed | 1 | 0.018 | 0.039 | 0.640 | 0.053 |
| A_rude | N_depressed | 1 | 0.011 | 0.029 | 0.697 | 0.044 |
| A_rude | E_outgoing | 1 | 0.057 | 0.046 | 0.210 | 0.000 |
| A_rude | A_kind | 1 | -0.016 | 0.037 | 0.662 | 0.095 |
| A_rude | C_reliable | 1 | 0.015 | 0.037 | 0.688 | 0.066 |
| A_rude | N_worried | 1 | 0.039 | 0.036 | 0.279 | 0.000 |
| E_quiet | A_rude | 1 | -0.009 | 0.016 | 0.591 | 0.000 |
| E_quiet | E_quiet | 1 | 0.001 | 0.034 | 0.980 | 0.000 |
| E_quiet | C_lazy | 1 | 0.002 | 0.033 | 0.946 | 0.047 |
| E_quiet | N_relaxed | 1 | -0.025 | 0.028 | 0.373 | 0.000 |
| E_quiet | N_depressed | 1 | 0.012 | 0.020 | 0.571 | 0.000 |
| E_quiet | E_outgoing | 1 | 0.011 | 0.034 | 0.756 | 0.000 |
| E_quiet | A_kind | 1 | 0.044 | 0.024 | 0.066 | 0.000 |
| E_quiet | C_reliable | 1 | 0.037 | 0.026 | 0.152 | 0.000 |
| E_quiet | N_worried | 1 | 0.002 | 0.026 | 0.925 | 0.021 |
| C_lazy | A_rude | 1 | 0.012 | 0.017 | 0.496 | 0.065 |
| C_lazy | E_quiet | 1 | -0.004 | 0.029 | 0.892 | 0.015 |
| C_lazy | C_lazy | 1 | 0.023 | 0.035 | 0.516 | 0.139 |
| C_lazy | N_relaxed | 1 | 0.019 | 0.023 | 0.405 | 0.000 |
| C_lazy | N_depressed | 1 | -0.006 | 0.019 | 0.758 | 0.040 |
| C_lazy | E_outgoing | 1 | 0.010 | 0.030 | 0.729 | 0.056 |
| C_lazy | A_kind | 1 | 0.021 | 0.020 | 0.307 | 0.023 |
| C_lazy | C_reliable | 1 | -0.009 | 0.027 | 0.742 | 0.094 |
| C_lazy | N_worried | 1 | -0.029 | 0.022 | 0.186 | 0.000 |
| N_relaxed | A_rude | 1 | -0.027 | 0.016 | 0.103 | 0.000 |
| N_relaxed | E_quiet | 1 | 0.096 | 0.037 | 0.009 | 0.080 |
| N_relaxed | C_lazy | 1 | 0.007 | 0.033 | 0.826 | 0.000 |
| N_relaxed | N_relaxed | 1 | -0.022 | 0.032 | 0.494 | 0.086 |

| from | to | lag | fixed | SE | P | ran_SD |
|---|---|---|---|---|---|---|
| N_relaxed | N_depressed | 1 | -0.007 | 0.021 | 0.747 | 0.000 |
| N_relaxed | E_outgoing | 1 | -0.056 | 0.034 | 0.101 | 0.000 |
| N_relaxed | A_kind | 1 | -0.041 | 0.024 | 0.091 | 0.000 |
| N_relaxed | C_reliable | 1 | -0.045 | 0.026 | 0.086 | 0.000 |
| N_relaxed | N_worried | 1 | 0.019 | 0.033 | 0.563 | 0.127 |
| N_depressed | A_rude | 1 | -0.013 | 0.021 | 0.534 | 0.000 |
| N_depressed | E_quiet | 1 | 0.025 | 0.044 | 0.562 | 0.000 |
| N_depressed | C_lazy | 1 | 0.001 | 0.041 | 0.974 | 0.000 |
| N_depressed | N_relaxed | 1 | -0.133 | 0.041 | 0.001 | 0.090 |
| N_depressed | N_depressed | 1 | 0.029 | 0.040 | 0.470 | 0.175 |
| N_depressed | E_outgoing | 1 | -0.036 | 0.044 | 0.409 | 0.000 |
| N_depressed | A_kind | 1 | -0.060 | 0.040 | 0.136 | 0.137 |
| N_depressed | C_reliable | 1 | -0.034 | 0.038 | 0.369 | 0.089 |
| N_depressed | N_worried | 1 | 0.104 | 0.034 | 0.002 | 0.000 |
| E_outgoing | A_rude | 1 | 0.011 | 0.017 | 0.534 | 0.000 |
| E_outgoing | E_quiet | 1 | 0.014 | 0.036 | 0.699 | 0.000 |
| E_outgoing | C_lazy | 1 | 0.017 | 0.034 | 0.613 | 0.000 |
| E_outgoing | N_relaxed | 1 | -0.042 | 0.030 | 0.155 | 0.000 |
| E_outgoing | N_depressed | 1 | 0.006 | 0.022 | 0.801 | 0.031 |
| E_outgoing | E_outgoing | 1 | -0.019 | 0.036 | 0.599 | 0.000 |
| E_outgoing | A_kind | 1 | 0.007 | 0.025 | 0.776 | 0.000 |
| E_outgoing | C_reliable | 1 | 0.005 | 0.028 | 0.868 | 0.025 |
| E_outgoing | N_worried | 1 | -0.012 | 0.028 | 0.660 | 0.032 |
| A_kind | A_rude | 1 | -0.007 | 0.018 | 0.694 | 0.024 |
| A_kind | E_quiet | 1 | -0.021 | 0.037 | 0.573 | 0.000 |
| A_kind | C_lazy | 1 | 0.015 | 0.035 | 0.670 | 0.000 |
| A_kind | N_relaxed | 1 | 0.042 | 0.031 | 0.171 | 0.000 |
| A_kind | N_depressed | 1 | -0.022 | 0.025 | 0.384 | 0.071 |
| A_kind | E_outgoing | 1 | 0.042 | 0.037 | 0.257 | 0.000 |
| A_kind | A_kind | 1 | 0.029 | 0.030 | 0.327 | 0.085 |
| A_kind | C_reliable | 1 | 0.044 | 0.028 | 0.119 | 0.000 |
| A_kind | N_worried | 1 | -0.011 | 0.029 | 0.705 | 0.000 |
| C_reliable | A_rude | 1 | -0.014 | 0.017 | 0.400 | 0.018 |
| C_reliable | E_quiet | 1 | -0.021 | 0.035 | 0.549 | 0.000 |
| C_reliable | C_lazy | 1 | 0.012 | 0.033 | 0.717 | 0.000 |
| C_reliable | N_relaxed | 1 | -0.001 | 0.029 | 0.967 | 0.022 |
| C_reliable | N_depressed | 1 | 0.005 | 0.025 | 0.840 | 0.078 |
| C_reliable | E_outgoing | 1 | 0.038 | 0.035 | 0.282 | 0.000 |
| C_reliable | A_kind | 1 | 0.008 | 0.025 | 0.742 | 0.000 |
| C_reliable | C_reliable | 1 | 0.052 | 0.027 | 0.055 | 0.000 |
| C_reliable | N_worried | 1 | -0.016 | 0.030 | 0.585 | 0.073 |
| N_worried | A_rude | 1 | 0.023 | 0.018 | 0.186 | 0.000 |
| N_worried | E_quiet | 1 | 0.159 | 0.037 | 0.000 | 0.000 |
| N_worried | C_lazy | 1 | -0.026 | 0.035 | 0.464 | 0.000 |
| N_worried | N_relaxed | 1 | -0.041 | 0.038 | 0.274 | 0.143 |
| N_worried | N_depressed | 1 | 0.060 | 0.022 | 0.007 | 0.000 |
| N_worried | E_outgoing | 1 | -0.086 | 0.038 | 0.024 | 0.055 |
| N_worried | A_kind | 1 | -0.022 | 0.028 | 0.434 | 0.054 |
| N_worried | C_reliable | 1 | -0.052 | 0.028 | 0.067 | 0.018 |
| N_worried | N_worried | 1 | 0.126 | 0.036 | 0.000 | 0.143 |

## 1.9 Population Level Questions

### 1.9.1 Global Network Structure

#### 1.9.1.1 Network Size

```
network_size <- data.frame(
#temporal - significant only
temporal = c(
sum(sum_fit1_w7$temporal$P < .05),
sum(sum_fit1_w7_centered$temporal$P < .05)))
rownames(network_size) <- c("Raw", "Within-Person Centered")
kable(t(network_size), caption = "Network Size")
```

Table 4: Network Size

| | Raw | Within-Person Centered |
|---|---|---|
| temporal | 7 | 7 |

#### 1.9.1.2 Network Density

Calculating Density:

1. From Bringmann et al. (2016): averaging over the absolute values of the slopes or edges in the network of the emotions of interest
2. Per Yoed's suggestion:
   - Potential Connections: $PC = \frac{n*(n-1)}{2}$, where $n$ is the number of nodes.
   - Network Density: $\frac{ActualConnections}{PotentialConnections}$, where actual connections is the sum of the number of edges in the network.

```
n <- 9
PC <- (n * (n-1))/2
density <- data.frame(
#temporal
temporal = c(
sum(sum_fit1_w7$temporal$P < .05)/PC,
sum(sum_fit1_w7_centered$temporal$P < .05)/PC))
rownames(density) <- c("Raw", "Within-Person Centered")
kable(t(density), caption = "Network Density")
```

Table 5: Network Density

| | Raw | Within-Person Centered |
|---|---|---|
| temporal | 0.1944444 | 0.1944444 |

#### 1.9.1.3 Network Activation

```
################################
# temporal - significant only #
################################
```

```r
#raw
temporal <- data.frame(positive_edges = c(
sum(sum_fit1_w7$temporal$P < .05 & sum_fit1_w7$temporal$fixed > 0), # positive edges
sum(sum_fit1_w7_centered$temporal$P < .05 & sum_fit1_w7_centered$temporal$fixed > 0))) # positive edges

temporal$negative_edges <- c(
sum(sum_fit1_w7$temporal$P < .05 & sum_fit1_w7$temporal$fixed < 0),# negative edges
sum(sum_fit1_w7_centered$temporal$P < .05 & sum_fit1_w7_centered$temporal$fixed < 0)) # negative edges

temporal$t_value <- c(
#t test comparing positive and negative edges; not run because of too few observations
t.test(abs(sum_fit1_w7$temporal$fixed[which(sum_fit1_w7$temporal$P < .05 & sum_fit1_w7$temporal$fixed >
#centered
#t test comparing positive and negative edges; not run because of too few observations
t.test(abs(sum_fit1_w7_centered$temporal$fixed[which(sum_fit1_w7_centered$temporal$P < .05 & sum_fit1_w

rownames(temporal) <- c("Raw", "Within-Person Centered")
kable(t(temporal), caption = "Network Activation (Positive v. Negative Edges)")
```

Table 6: Network Activation (Positive v. Negative Edges)

| | Raw | Within-Person Centered |
|---|---|---|
| positive_edges | 5 | 5.0000000 |
| negative_edges | 2 | 2.0000000 |
| t_value | 0 | -0.0174453 |

#### 1.9.1.4 Bootstrapped Confidence Intervals

### 1.9.2 Local Network Structure

#### 1.9.2.1 Centrality

Not sure why centrality plots for contemporaneous and between-subjects networks are identical.

```r
#temporal
#raw
temporal_centrality_w7_raw      <- centrality_auto(sum_fit1_w7$temporal[,c(1,2,4)])
```

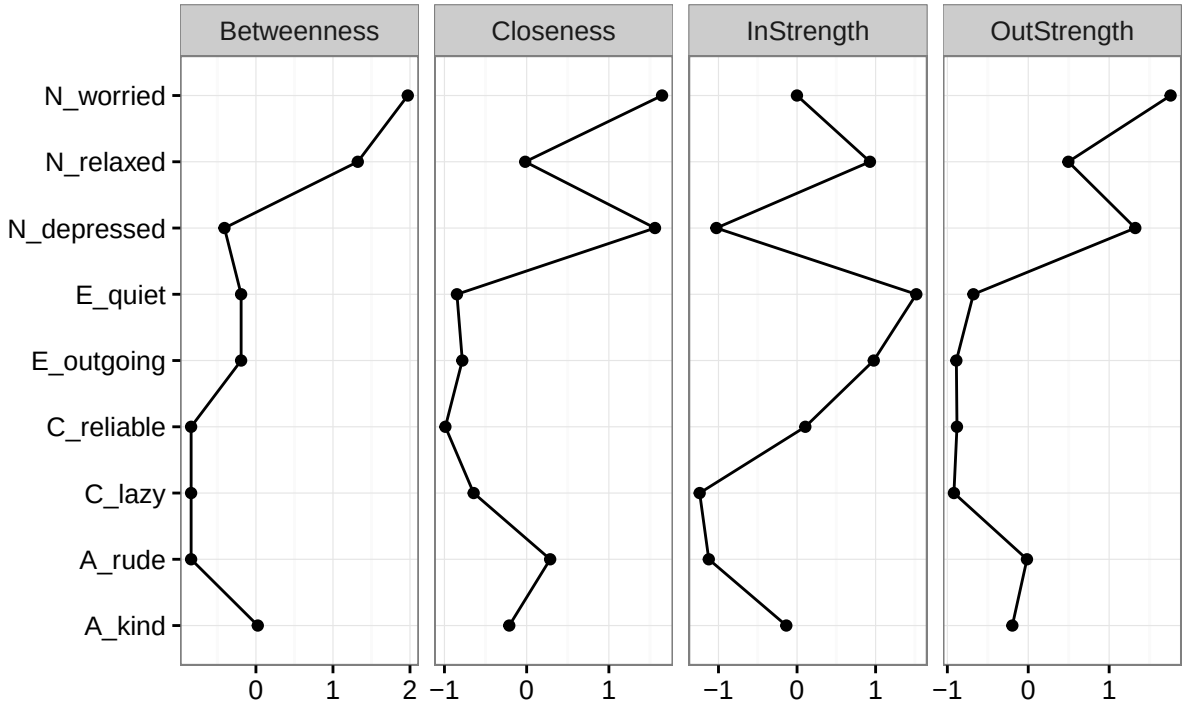
```
## Node 1, Reach 9, Total 9
## Node 2, Reach 9, Total 18
## Node 3, Reach 9, Total 27
## Node 4, Reach 9, Total 36
## Node 5, Reach 9, Total 45
## Node 6, Reach 9, Total 54
## Node 7, Reach 9, Total 63
## Node 8, Reach 9, Total 72
## Node 9, Reach 9, Total 81
```

```r
temporal_centrality_w7_raw_plot <- centralityPlot(sum_fit1_w7$temporal[,c(1,2,4)])
```

```
## Note: z-scores are shown on x-axis rather than raw centrality indices.
```

```
## Node 1, Reach 9, Total 9
## Node 2, Reach 9, Total 18
```

```
## Node 3, Reach 9, Total 27
## Node 4, Reach 9, Total 36
## Node 5, Reach 9, Total 45
## Node 6, Reach 9, Total 54
## Node 7, Reach 9, Total 63
## Node 8, Reach 9, Total 72
## Node 9, Reach 9, Total 81
```




```
#centered
temporal_centrality_w7_centered      <- centrality_auto(sum_fit1_w7_centered$temporal[,c(1,2,4)])
```

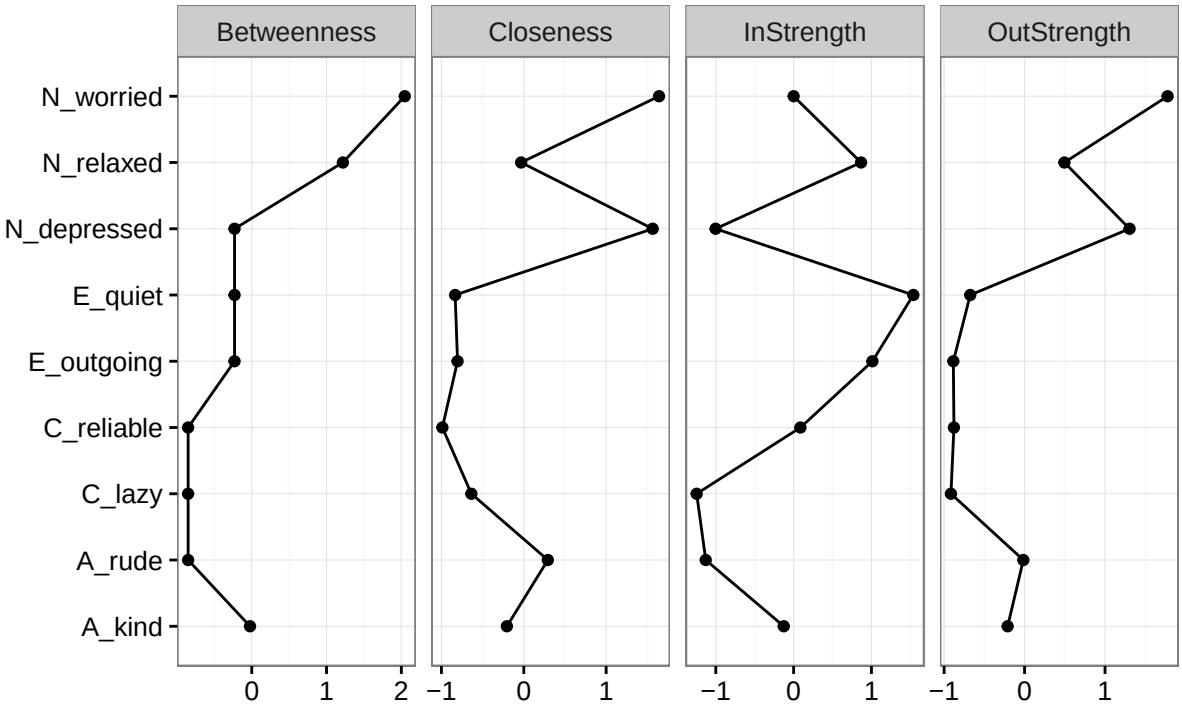
```
## Node 1, Reach 9, Total 9
## Node 2, Reach 9, Total 18
## Node 3, Reach 9, Total 27
## Node 4, Reach 9, Total 36
## Node 5, Reach 9, Total 45
## Node 6, Reach 9, Total 54
## Node 7, Reach 9, Total 63
## Node 8, Reach 9, Total 72
## Node 9, Reach 9, Total 81
```

```
temporal_centrality_w7_centered_plot <- centralityPlot(sum_fit1_w7_centered$temporal[,c(1,2,4)])
```

```
## Note: z-scores are shown on x-axis rather than raw centrality indices.
```

```
## Node 1, Reach 9, Total 9
## Node 2, Reach 9, Total 18
## Node 3, Reach 9, Total 27
## Node 4, Reach 9, Total 36
## Node 5, Reach 9, Total 45
## Node 6, Reach 9, Total 54
## Node 7, Reach 9, Total 63
## Node 8, Reach 9, Total 72
```

```
## Node 9, Reach 9, Total 81
```




#### 1.9.2.1.1 Bootstrapped Confidence Intervals

### 1.9.2.2 Clustering Coefficients

```
#temporal
temporal_clustcoef_w7_raw      <- clustZhang(sum_fit1_w7$temporal[,c(1,2,4)])
temporal_clustcoef_w7_centered <- clustZhang(sum_fit1_w7_centered$temporal[,c(1,2,4)])
#clusteringTable(sum_fit1_w7$temporal[,c(1,2,4)])

save(temporal_centrality_w7_raw, temporal_centrality_w7_centered,
     temporal_clustcoef_w7_raw, temporal_clustcoef_w7_centered,
     file = "~/Box Sync/network/PAIRS/Wave 7/centrality_w7_pers.RData")
```

## 1.10 Inter-Individual Questions

Going to duplicate the analyses below (temporal subject networks) with contemporaneous subject networks

### 1.10.1 Bootstrapped Confidence Intervals of Parameter Estimates

```
raw_models <- fit1_w7$output
raw_boot_CI <- llply(raw_models, function(X) confint(X, method = "boot"))

centered_models <- fit1_w7_centered$output
centered_boot_CI <- llply(centered_models, function(X) confint(X, method = "boot"))
```

#### 1.10.1.1 Raw Values

```
#Error in data[[idvar]] : subscript out of bounds
#Error in .subset2(x, i, exact = exact) :
#  attempt to select less than one element in get1index
#data[[beepvar]] <- ave(data[[idvar]], data[[idvar]], data[[dayvar]],
#    FUN = seq_along)
#problem appears to be in dayvar
#Error in validObject(.Object) :
  #invalid class "dgCMatrix" object: invalid object for slot "i" in class "dgCMatrix":
  #got class "numeric", should be or extend class "integer"
w7$beepvar <- ave(w7[["SID"]], w7[["SID"]], w7[["day"]],
                  FUN = seq_along)
bootnet(w7,
        default = "none",
        nBoots = 25,
        type = "nonparametric",
        prepFun = null,
        prepArgs = list(),
        estFun = mlVAR::mlVAR,
        estArgs = list(data = w7,
                       vars = colnames(w7)[4:16],
                       idvar = "SID2",
                       dayvar = "day",
                       beepvar = "beepvar",
                       lags = 1,temporal = "orthogonal",
                       verbose = FALSE),
        graphFun = function(x)x,
        graphArgs = list(type = "temporal",
                         title = "Estimated temporal relationships",
                         layout = "spring"),
        intFun = null,
        intArgs = list())
```

#### 1.10.1.2 Centered Values

```
#Error in data[[idvar]] : subscript out of bounds
#Error in .subset2(x, i, exact = exact) :
#  attempt to select less than one element in get1index
#data[[beepvar]] <- ave(data[[idvar]], data[[idvar]], data[[dayvar]],
```

```
#    FUN = seq_along)
#problem appears to be in dayvar
#Error in validObject(.Object) :
  #invalid class "dgCMatrix" object: invalid object for slot "i" in class "dgCMatrix":
  #got class "numeric", should be or extend class "integer"
w7_centered$beepvar <- ave(w7_centered[["SID"]], w7_centered[["SID"]], w7_centered[["day"]],
                  FUN = seq_along)
bootnet(w7_centered,
        default = "none",
        nBoots = 25,
        type = "nonparametric",
        prepFun = null,
        prepArgs = list(),
        estFun = mlVAR::mlVAR,
        estArgs = list(data = w7_centered,
                       vars = colnames(w7_centered)[2:14],
                       idvar = "SID2",
                       dayvar = "day",
                       beepvar = "beepvar",
                       lags = 1,temporal = "orthogonal",
                       verbose = FALSE),
        graphFun = function(x)x,
        graphArgs = list(type = "temporal",
                         title = "Estimated temporal relationships",
                         layout = "spring"),
        intFun = null,
        intArgs = list())
```

# 2 Graphical VAR Models

```
comp <- ddply(w7, .(SID), numcolwise(mean))

with(comp, {
  comp <- comp[order(E_quiet, C_lazy, N_relaxed, N_depressed, E_outgoing, C_reliable, N_worried,A_rude,

#10308 and 27 have similar composite profiles

fit10308 <- graphicalVAR(w7[which(w7$SID == 10308),4:16],
                      gamma = 0, verbose = F)
fit10219 <- graphicalVAR(w7[which(w7$SID == 10219),4:16],
                      gamma = 0, verbose = F)

#compare plots of partial contemporaneous correlations for both subjects
par(mfcol = c(1,2))
plot(fit10308, include = "PCC", layout = "spring")
plot(fit10219, include = "PCC", layout = "spring")

#compare plots of partial directed correlations for both subjects
plot(fit10308, include = "PDC", layout = "spring")
plot(fit10219, include = "PDC", layout = "spring")
```

## 2.1 Idiographic Questions

### 2.1.1 Global Network Structure

#### 2.1.1.1 Network Size

```
#Partial Contemporaneous Correlations (PCC)
sum(fit10308$PCC != 0)
sum(fit10219$PCC != 0)

#Partial Directed Correlations (PDC)
sum(fit10308$PDC != 0)
sum(fit10219$PDC != 0)
```

#### 2.1.1.2 Network Density

```
n <- 13
PC <- (n * (n-1))/2

#PCC
sum(fit10308$PCC != 0) / PC
sum(fit10219$PCC != 0) / PC

#PDC
sum(fit10308$PDC != 0) / PC
sum(fit10219$PDC != 0) / PC
```

#### 2.1.1.3 Network Activation

```r
#Partial Contemporaneous Correlations (PCC)
#Subject 10308
sum(fit10308$PCC > 0) # positive edges
sum(fit10308$PCC < 0) # negative edges
#t test comparing positive and negative edges; not run because of too few observations
#t.test(abs(sum(fit10308$PCC > 0)), abs(sum(fit10308$PCC < 0)), equal.var = T)

#Subject 10219
sum(fit10219$PCC > 0) # positive edges
sum(fit10219$PCC < 0) # negative edges
#t test comparing positive and negative edges; not run because of too few observations
#t.test(abs(sum(fit10219$PCC > 0)), abs(sum(fit10219$PCC < 0)), equal.var = T)

#Partial Directed Correlations (PDC)
#Subject 10308
sum(fit10308$PDC > 0) # positive edges
sum(fit10308$PDC > 0) # positive edges
#t test comparing positive and negative edges; not run because of too few observations
#t.test(abs(sum(fit10308$PCC > 0)), abs(sum(fit10308$PCC < 0)), equal.var = T)

#Subject 10219
sum(fit10219$PDC < 0) # negative edges
sum(fit10219$PDC < 0) # negative edges
#t test comparing positive and negative edges; not run because of too few observations
#t.test(abs(sum(fit10219$PCC > 0)), abs(sum(fit10219$PCC < 0)), equal.var = T)
```

### 2.1.2 Local Network Structure

#### 2.1.2.1 Centrality

```r
#PCC
#adjacency matrices
PCC_adj_10308 <- melt(fit10308$PCC)
PCC_adj_10219 <- melt(fit10219$PCC)

#Subject 10308
PCC_centrality_10308 <- centrality_auto(PCC_adj_10308)
centralityPlot(PCC_adj_10308)
#Subject 10219
PCC_centrality_10219 <- centrality(PCC_adj_10219)
centralityPlot(PCC_adj_10219)

#PCC
#adjacency matrices
PDC_adj_10308 <- melt(fit10308$PDC)
PDC_adj_10219 <- melt(fit10219$PDC)

#Subject 10308
PDC_centrality_10308 <- centrality_auto(PDC_adj_10308)
centralityPlot(PDC_adj_10308)
#Subject 10219
PDC_centrality_10219 <- centrality_auto(PDC_adj_10219)
centralityPlot(PDC_adj_10219)
```