Linear Mixed-Effects Models for Transitions

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# Load packages  
library(lme4)  
library(lmerTest)  
library(emmeans)  
library(sjstats)  
library(MuMIn)  
library(MASS)  
library(stats)  
library(nlme)  
library(effectsize)  
library(car)  
library(rstatix)  
library(dabestr)

# Turn off scientific notation  
options(scipen = 999)

# FromA\_ToB

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromA\_ToB)  
outliers

## # A tibble: 6 × 24  
## time simple\_id FromA…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 2two 305 0.647 1.05 0.962 1.11 0.919 1.21 0.848 1.00 0.946 1.14 1.05 0.826 1.01   
## 2 2two 519 0.579 1.39 0.932 0.908 1.13 1.06 0.829 1.14 0.829 1.20 0.883 0.964 1.01   
## 3 3three 209 0.812 1.30 0.826 0.903 1.02 1.21 0.650 1.09 1.07 1.01 1.07 0.921 0.839  
## 4 3three 305 0.768 1.10 1.01 0.880 0.858 1.24 0.929 0.935 1.01 1.02 1.01 0.977 0.962  
## 5 3three 313 0.754 1.36 1.02 0.734 1.28 1.17 0.877 0.738 0.909 0.981 0.973 1.08 0.616  
## 6 3three 519 0.746 1.21 1.13 0.862 0.924 1.19 0.760 1.06 1.02 1.15 0.841 1.01 0.870  
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromA\_ToB, data\_two$FromA\_ToB)

## [1] 0.6352178

cor(data\_one$FromA\_ToB, data\_three$FromA\_ToB)

## [1] 0.4301219

cor(data\_one$FromA\_ToB, data\_four$FromA\_ToB)

## [1] 0.5471771

cor(data\_one$FromA\_ToB, data\_five$FromA\_ToB)

## [1] 0.4633524

cor(data\_two$FromA\_ToB, data\_three$FromA\_ToB)

## [1] 0.7256985

cor(data\_two$FromA\_ToB, data\_four$FromA\_ToB)

## [1] 0.7595702

cor(data\_two$FromA\_ToB, data\_five$FromA\_ToB)

## [1] 0.7508762

cor(data\_three$FromA\_ToB, data\_four$FromA\_ToB)

## [1] 0.7292552

cor(data\_three$FromA\_ToB, data\_five$FromA\_ToB)

## [1] 0.767857

cor(data\_four$FromA\_ToB, data\_five$FromA\_ToB)

## [1] 0.8252376

# Model  
FromA\_ToB\_model <- lme(FromA\_ToB ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromA\_ToB\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 3426.514 <.0001  
## time 4 188 0.514 0.7256

effectsize::eta\_squared(FromA\_ToB\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 0.01 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromA\_ToB\_model)

## R2m R2c  
## [1,] 0.004902125 0.3460345

emmeans(FromA\_ToB\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 1.03 0.0217 47 0.989 1.08  
## 2two 1.03 0.0217 47 0.982 1.07  
## 3three 1.03 0.0217 47 0.986 1.07  
## 4four 1.01 0.0217 47 0.966 1.05  
## 5five 1.01 0.0217 47 0.963 1.05  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two 0.00607 0.0167 188 0.364 0.9979  
## 1one - 3three 0.00257 0.0208 188 0.124 1.0000  
## 1one - 4four 0.02265 0.0227 188 0.997 0.9102  
## 1one - 5five 0.02521 0.0237 188 1.063 0.8889  
## 2two - 3three -0.00350 0.0167 188 -0.210 0.9998  
## 2two - 4four 0.01658 0.0208 188 0.798 0.9586  
## 2two - 5five 0.01914 0.0227 188 0.843 0.9498  
## 3three - 4four 0.02008 0.0167 188 1.203 0.8356  
## 3three - 5five 0.02264 0.0208 188 1.089 0.8799  
## 4four - 5five 0.00255 0.0167 188 0.153 0.9999  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromA\_ToB,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:51 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromA\_ToB  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## 0.00607 [95CI -0.0719; 0.0815]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## 0.00257 [95CI -0.0678; 0.0717]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## 0.0227 [95CI -0.049; 0.0893]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## 0.0252 [95CI -0.0436; 0.0907]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## -0.0035 [95CI -0.0587; 0.0506]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## 0.0166 [95CI -0.0398; 0.0682]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## 0.0191 [95CI -0.0351; 0.0682]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## 0.0201 [95CI -0.0267; 0.0618]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## 0.0226 [95CI -0.0206; 0.0619]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## 0.00255 [95CI -0.0364; 0.0404]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromA\_ToC

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromA\_ToC)  
outliers

## # A tibble: 3 × 24  
## time simple\_id FromA…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 3three 313 0.754 1.36 1.02 0.734 1.28 1.17 0.877 0.738 0.909 0.981 0.973 1.08 0.616  
## 2 4four 355 1.16 0.921 1.08 0.830 1.18 1.10 0.768 0.823 0.933 0.973 1.06 1.09 0.890  
## 3 5five 220 1.14 0.926 0.909 0.934 0.939 1.20 0.875 0.765 0.845 1.06 0.972 1.10 1.03   
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromA\_ToC, data\_two$FromA\_ToC)

## [1] 0.5410726

cor(data\_one$FromA\_ToC, data\_three$FromA\_ToC)

## [1] 0.6181615

cor(data\_one$FromA\_ToC, data\_four$FromA\_ToC)

## [1] 0.527084

cor(data\_one$FromA\_ToC, data\_five$FromA\_ToC)

## [1] 0.5042769

cor(data\_two$FromA\_ToC, data\_three$FromA\_ToC)

## [1] 0.6663142

cor(data\_two$FromA\_ToC, data\_four$FromA\_ToC)

## [1] 0.6315078

cor(data\_two$FromA\_ToC, data\_five$FromA\_ToC)

## [1] 0.5604827

cor(data\_three$FromA\_ToC, data\_four$FromA\_ToC)

## [1] 0.7487875

cor(data\_three$FromA\_ToC, data\_five$FromA\_ToC)

## [1] 0.7060381

cor(data\_four$FromA\_ToC, data\_five$FromA\_ToC)

## [1] 0.8305697

# Model  
FromA\_ToC\_model <- lme(FromA\_ToC ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromA\_ToC\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 8271.804 <.0001  
## time 4 188 2.432 0.049

effectsize::eta\_squared(FromA\_ToC\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 0.05 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromA\_ToC\_model)

## R2m R2c  
## [1,] 0.01633484 0.5107831

emmeans(FromA\_ToC\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 1.10 0.0152 47 1.07 1.13  
## 2two 1.14 0.0152 47 1.11 1.17  
## 3three 1.14 0.0152 47 1.11 1.17  
## 4four 1.13 0.0152 47 1.10 1.16  
## 5five 1.13 0.0152 47 1.10 1.16  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two -0.037004 0.0126 188 -2.936 0.0758  
## 1one - 3three -0.036069 0.0144 188 -2.500 0.1862  
## 1one - 4four -0.030206 0.0150 188 -2.020 0.3980  
## 1one - 5five -0.023773 0.0151 188 -1.573 0.6495  
## 2two - 3three 0.000935 0.0126 188 0.074 1.0000  
## 2two - 4four 0.006798 0.0144 188 0.471 0.9942  
## 2two - 5five 0.013231 0.0150 188 0.885 0.9404  
## 3three - 4four 0.005863 0.0126 188 0.465 0.9945  
## 3three - 5five 0.012296 0.0144 188 0.852 0.9478  
## 4four - 5five 0.006433 0.0126 188 0.510 0.9922  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromA\_ToC,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:51 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromA\_ToC  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## -0.037 [95CI -0.0902; 0.0129]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## -0.0361 [95CI -0.0864; 0.00924]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## -0.0302 [95CI -0.0783; 0.0154]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## -0.0238 [95CI -0.0694; 0.0213]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## 0.000935 [95CI -0.0408; 0.0411]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## 0.0068 [95CI -0.0315; 0.0464]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## 0.0132 [95CI -0.0235; 0.0519]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## 0.00586 [95CI -0.0281; 0.0426]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## 0.0123 [95CI -0.0206; 0.0474]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## 0.00643 [95CI -0.0243; 0.0396]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromA\_ToD

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromA\_ToD)  
outliers

## # A tibble: 9 × 24  
## time simple\_id FromA\_…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 1one 312 1.26 1.23 0.413 0.775 0.808 1.18 1.28 0.759 1.16 0.865 0.834 1.26 0.789  
## 2 2two 280 1.25 1.17 0.563 0.815 0.884 1.11 0.792 1.03 1.04 1.06 1.08 0.828 1.04   
## 3 2two 354 0.760 1.24 1.20 0.744 1.14 1.02 0.770 1.02 0.982 1.17 0.876 1.06 0.822  
## 4 2two 395 1.12 1.12 0.588 0.853 0.985 1.19 0.980 0.804 1.02 0.972 0.885 1.20 1.01   
## 5 4four 395 1.01 1.12 0.631 0.982 0.865 1.31 1.04 0.790 1.06 0.978 0.968 1.07 0.971  
## 6 4four 519 0.767 1.18 1.20 0.863 0.952 1.20 0.790 1.00 0.988 1.19 0.869 0.989 0.903  
## 7 5five 308 0.994 1.16 0.681 1.00 0.946 1.23 0.922 0.844 1.10 0.958 1.08 0.921 0.911  
## 8 5five 395 1.03 1.11 0.660 0.996 0.885 1.30 0.956 0.780 1.10 0.941 0.968 1.08 0.968  
## 9 5five 519 0.777 1.18 1.15 0.855 1.03 1.14 0.858 0.966 0.905 1.17 0.885 1.09 0.929  
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromA\_ToD, data\_two$FromA\_ToD)

## [1] 0.6464857

cor(data\_one$FromA\_ToD, data\_three$FromA\_ToD)

## [1] 0.5669066

cor(data\_one$FromA\_ToD, data\_four$FromA\_ToD)

## [1] 0.4334858

cor(data\_one$FromA\_ToD, data\_five$FromA\_ToD)

## [1] 0.4787071

cor(data\_two$FromA\_ToD, data\_three$FromA\_ToD)

## [1] 0.6675921

cor(data\_two$FromA\_ToD, data\_four$FromA\_ToD)

## [1] 0.6520591

cor(data\_two$FromA\_ToD, data\_five$FromA\_ToD)

## [1] 0.6225714

cor(data\_three$FromA\_ToD, data\_four$FromA\_ToD)

## [1] 0.7736449

cor(data\_three$FromA\_ToD, data\_five$FromA\_ToD)

## [1] 0.7532231

cor(data\_four$FromA\_ToD, data\_five$FromA\_ToD)

## [1] 0.8125953

# Model  
FromA\_ToD\_model <- lme(FromA\_ToD ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromA\_ToD\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 3105.7616 <.0001  
## time 4 188 0.2208 0.9266

effectsize::eta\_squared(FromA\_ToD\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 4.68e-03 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromA\_ToD\_model)

## R2m R2c  
## [1,] 0.001269971 0.373034

emmeans(FromA\_ToD\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 0.910 0.0201 47 0.869 0.950  
## 2two 0.897 0.0201 47 0.856 0.937  
## 3three 0.898 0.0201 47 0.857 0.938  
## 4four 0.906 0.0201 47 0.865 0.946  
## 5five 0.904 0.0201 47 0.864 0.945  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two 0.012943 0.0156 188 0.832 0.9520  
## 1one - 3three 0.012004 0.0192 188 0.625 0.9831  
## 1one - 4four 0.003702 0.0209 188 0.178 0.9999  
## 1one - 5five 0.005307 0.0217 188 0.245 0.9996  
## 2two - 3three -0.000939 0.0156 188 -0.060 1.0000  
## 2two - 4four -0.009241 0.0192 188 -0.481 0.9937  
## 2two - 5five -0.007637 0.0209 188 -0.366 0.9978  
## 3three - 4four -0.008301 0.0156 188 -0.533 0.9907  
## 3three - 5five -0.006697 0.0192 188 -0.349 0.9982  
## 4four - 5five 0.001604 0.0156 188 0.103 1.0000  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromA\_ToD,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:51 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromA\_ToD  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## 0.0129 [95CI -0.0541; 0.0829]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## 0.012 [95CI -0.052; 0.0793]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## 0.0037 [95CI -0.0597; 0.0681]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## 0.00531 [95CI -0.0535; 0.0677]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## -0.000939 [95CI -0.0522; 0.052]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## -0.00924 [95CI -0.0587; 0.0413]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## -0.00764 [95CI -0.0528; 0.0396]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## -0.0083 [95CI -0.0544; 0.0411]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## -0.0067 [95CI -0.0473; 0.038]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## 0.0016 [95CI -0.0378; 0.0428]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromA\_ToF

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromA\_ToF)  
outliers

## # A tibble: 4 × 24  
## time simple\_id FromA\_…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 1one 305 0.626 0.953 0.924 1.27 1.06 1.18 1.12 0.777 0.916 1.14 0.924 0.822 0.974  
## 2 1one 307 0.964 0.796 1.04 1.25 1.04 1.13 0.755 1.13 1.03 1.05 0.947 1.00 0.901  
## 3 2two 296 1.14 1.34 0.869 0.588 0.974 1.05 0.880 1.05 1.23 0.744 0.874 1.13 0.885  
## 4 2two 529 1.09 1.04 0.883 1.18 1.21 1.07 0.970 0.714 0.974 0.908 1.12 0.932 1.01   
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromA\_ToF, data\_two$FromA\_ToF)

## [1] 0.4977507

cor(data\_one$FromA\_ToF, data\_three$FromA\_ToF)

## [1] 0.3929354

cor(data\_one$FromA\_ToF, data\_four$FromA\_ToF)

## [1] 0.2370064

cor(data\_one$FromA\_ToF, data\_five$FromA\_ToF)

## [1] 0.2582798

cor(data\_two$FromA\_ToF, data\_three$FromA\_ToF)

## [1] 0.5869916

cor(data\_two$FromA\_ToF, data\_four$FromA\_ToF)

## [1] 0.445971

cor(data\_two$FromA\_ToF, data\_five$FromA\_ToF)

## [1] 0.4368749

cor(data\_three$FromA\_ToF, data\_four$FromA\_ToF)

## [1] 0.6108877

cor(data\_three$FromA\_ToF, data\_five$FromA\_ToF)

## [1] 0.6549978

cor(data\_four$FromA\_ToF, data\_five$FromA\_ToF)

## [1] 0.784685

# Model  
FromA\_ToF\_model <- lme(FromA\_ToF ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromA\_ToF\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 4887.349 <.0001  
## time 4 188 0.316 0.867

effectsize::eta\_squared(FromA\_ToF\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 6.68e-03 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromA\_ToF\_model)

## R2m R2c  
## [1,] 0.001863067 0.2568218

emmeans(FromA\_ToF\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 0.876 0.0168 47 0.842 0.909  
## 2two 0.871 0.0168 47 0.837 0.905  
## 3three 0.876 0.0168 47 0.842 0.910  
## 4four 0.867 0.0168 47 0.833 0.900  
## 5five 0.882 0.0168 47 0.848 0.915  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two 0.00474 0.0151 188 0.314 0.9988  
## 1one - 3three -0.00021 0.0182 188 -0.012 1.0000  
## 1one - 4four 0.00900 0.0195 188 0.461 0.9947  
## 1one - 5five -0.00586 0.0201 188 -0.292 0.9991  
## 2two - 3three -0.00495 0.0151 188 -0.328 0.9986  
## 2two - 4four 0.00426 0.0182 188 0.233 0.9996  
## 2two - 5five -0.01060 0.0195 188 -0.544 0.9900  
## 3three - 4four 0.00921 0.0151 188 0.610 0.9846  
## 3three - 5five -0.00565 0.0182 188 -0.310 0.9989  
## 4four - 5five -0.01485 0.0151 188 -0.984 0.9142  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromA\_ToF,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:51 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromA\_ToF  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## 0.00474 [95CI -0.05; 0.0616]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## -0.00021 [95CI -0.0507; 0.0515]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## 0.009 [95CI -0.0403; 0.0577]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## -0.00586 [95CI -0.0533; 0.0428]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## -0.00495 [95CI -0.0503; 0.0442]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## 0.00426 [95CI -0.0419; 0.0484]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## -0.0106 [95CI -0.0533; 0.0342]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## 0.00921 [95CI -0.0322; 0.0487]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## -0.00565 [95CI -0.0442; 0.032]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## -0.0149 [95CI -0.0511; 0.021]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromB\_ToA

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromB\_ToA)  
outliers

## # A tibble: 8 × 24  
## time simple\_id FromA…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 1one 382 1.14 1.08 1.28 0.728 1.44 1.21 0.628 0.670 0.715 1.11 0.885 1.21 1.05   
## 2 3three 232 1.00 1.08 0.863 0.937 0.719 1.34 0.987 1.08 1.05 0.915 1.08 0.955 0.980  
## 3 3three 313 0.754 1.36 1.02 0.734 1.28 1.17 0.877 0.738 0.909 0.981 0.973 1.08 0.616  
## 4 3three 382 1.08 1.31 0.887 0.693 1.30 1.01 0.993 0.735 0.831 0.957 0.926 1.22 1.03   
## 5 3three 523 0.911 1.12 0.795 1.10 0.756 1.24 0.871 0.900 1.13 1.01 0.949 0.961 0.937  
## 6 4four 313 0.873 1.24 1.05 0.691 1.27 1.13 0.863 0.841 0.979 1.05 0.991 0.955 0.577  
## 7 4four 382 1.03 1.12 0.943 0.966 1.31 0.999 1.01 0.691 0.859 1.14 0.860 1.14 0.868  
## 8 5five 382 1.13 1.11 0.840 0.835 1.34 1.03 0.974 0.738 0.952 1.06 0.911 1.09 0.845  
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromB\_ToA, data\_two$FromB\_ToA)

## [1] 0.5704594

cor(data\_one$FromB\_ToA, data\_three$FromB\_ToA)

## [1] 0.4504049

cor(data\_one$FromB\_ToA, data\_four$FromB\_ToA)

## [1] 0.466014

cor(data\_one$FromB\_ToA, data\_five$FromB\_ToA)

## [1] 0.5096289

cor(data\_two$FromB\_ToA, data\_three$FromB\_ToA)

## [1] 0.5671387

cor(data\_two$FromB\_ToA, data\_four$FromB\_ToA)

## [1] 0.684084

cor(data\_two$FromB\_ToA, data\_five$FromB\_ToA)

## [1] 0.5883946

cor(data\_three$FromB\_ToA, data\_four$FromB\_ToA)

## [1] 0.7964133

cor(data\_three$FromB\_ToA, data\_five$FromB\_ToA)

## [1] 0.7338485

cor(data\_four$FromB\_ToA, data\_five$FromB\_ToA)

## [1] 0.78854

# Model  
FromB\_ToA\_model <- lme(FromB\_ToA ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromB\_ToA\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 4283.616 <.0001  
## time 4 188 1.650 0.1636

effectsize::eta\_squared(FromB\_ToA\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 0.03 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromB\_ToA\_model)

## R2m R2c  
## [1,] 0.01017549 0.4854975

emmeans(FromB\_ToA\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 0.964 0.0186 47 0.926 1.00  
## 2two 0.992 0.0186 47 0.955 1.03  
## 3three 0.972 0.0186 47 0.935 1.01  
## 4four 0.994 0.0186 47 0.956 1.03  
## 5five 0.996 0.0186 47 0.958 1.03  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two -0.02864 0.0155 188 -1.846 0.4939  
## 1one - 3three -0.00856 0.0179 188 -0.479 0.9939  
## 1one - 4four -0.02996 0.0186 188 -1.610 0.6290  
## 1one - 5five -0.03202 0.0188 188 -1.699 0.5779  
## 2two - 3three 0.02008 0.0155 188 1.294 0.7950  
## 2two - 4four -0.00132 0.0179 188 -0.074 1.0000  
## 2two - 5five -0.00337 0.0186 188 -0.181 0.9999  
## 3three - 4four -0.02140 0.0155 188 -1.379 0.7537  
## 3three - 5five -0.02345 0.0179 188 -1.311 0.7872  
## 4four - 5five -0.00206 0.0155 188 -0.133 1.0000  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromB\_ToA,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:51 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromB\_ToA  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## -0.0286 [95CI -0.0895; 0.0318]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## -0.00856 [95CI -0.0641; 0.0479]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## -0.03 [95CI -0.0867; 0.0265]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## -0.032 [95CI -0.085; 0.0216]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## 0.0201 [95CI -0.03; 0.0697]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## -0.00132 [95CI -0.051; 0.0466]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## -0.00337 [95CI -0.0493; 0.0437]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## -0.0214 [95CI -0.0669; 0.022]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## -0.0235 [95CI -0.0655; 0.0195]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## -0.00206 [95CI -0.0427; 0.0417]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromB\_ToC

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromB\_ToC)  
outliers

## # A tibble: 1 × 24  
## time simple\_id FromA\_…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 1one 408 0.902 1.09 0.679 0.866 0.921 0.758 1.11 0.904 1.02 1.01 0.933 1.21 0.802  
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromB\_ToC, data\_two$FromB\_ToC)

## [1] 0.7912148

cor(data\_one$FromB\_ToC, data\_three$FromB\_ToC)

## [1] 0.4587884

cor(data\_one$FromB\_ToC, data\_four$FromB\_ToC)

## [1] 0.4118169

cor(data\_one$FromB\_ToC, data\_five$FromB\_ToC)

## [1] 0.4940006

cor(data\_two$FromB\_ToC, data\_three$FromB\_ToC)

## [1] 0.576729

cor(data\_two$FromB\_ToC, data\_four$FromB\_ToC)

## [1] 0.5505955

cor(data\_two$FromB\_ToC, data\_five$FromB\_ToC)

## [1] 0.5574947

cor(data\_three$FromB\_ToC, data\_four$FromB\_ToC)

## [1] 0.7928612

cor(data\_three$FromB\_ToC, data\_five$FromB\_ToC)

## [1] 0.8337314

cor(data\_four$FromB\_ToC, data\_five$FromB\_ToC)

## [1] 0.8328116

# Model  
FromB\_ToC\_model <- lme(FromB\_ToC ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromB\_ToC\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 8505.600 <.0001  
## time 4 188 1.807 0.1292

effectsize::eta\_squared(FromB\_ToC\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 0.04 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromB\_ToC\_model)

## R2m R2c  
## [1,] 0.006856288 0.2871428

emmeans(FromB\_ToC\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 1.16 0.0154 47 1.13 1.19  
## 2two 1.15 0.0154 47 1.12 1.18  
## 3three 1.18 0.0154 47 1.14 1.21  
## 4four 1.16 0.0154 47 1.13 1.19  
## 5five 1.17 0.0154 47 1.14 1.20  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two 0.00790 0.0110 188 0.719 0.9717  
## 1one - 3three -0.01722 0.0141 188 -1.220 0.8285  
## 1one - 4four -0.00213 0.0158 188 -0.135 1.0000  
## 1one - 5five -0.01171 0.0168 188 -0.696 0.9747  
## 2two - 3three -0.02512 0.0110 188 -2.284 0.2702  
## 2two - 4four -0.01003 0.0141 188 -0.711 0.9728  
## 2two - 5five -0.01961 0.0158 188 -1.241 0.8193  
## 3three - 4four 0.01509 0.0110 188 1.372 0.7575  
## 3three - 5five 0.00551 0.0141 188 0.390 0.9972  
## 4four - 5five -0.00958 0.0110 188 -0.871 0.9437  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromB\_ToC,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:51 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromB\_ToC  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## 0.0079 [95CI -0.0418; 0.0582]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## -0.0172 [95CI -0.0637; 0.0335]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## -0.00213 [95CI -0.0472; 0.0439]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## -0.0117 [95CI -0.0551; 0.0332]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## -0.0251 [95CI -0.0654; 0.0182]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## -0.01 [95CI -0.0473; 0.0292]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## -0.0196 [95CI -0.0562; 0.0185]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## 0.0151 [95CI -0.0214; 0.0497]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## 0.00551 [95CI -0.0293; 0.0393]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## -0.00958 [95CI -0.0403; 0.0212]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromB\_ToD

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromB\_ToD)  
outliers

## # A tibble: 2 × 24  
## time simple\_id FromA\_…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 5five 398 0.979 1.17 0.876 0.928 0.947 1.22 0.647 1.01 1.18 1.05 0.922 0.866 0.887  
## 2 5five 529 1.05 1.05 0.894 1.05 0.881 1.15 1.09 0.846 1.00 1.01 1.07 0.965 1.01   
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromB\_ToD, data\_two$FromB\_ToD)

## [1] 0.5489723

cor(data\_one$FromB\_ToD, data\_three$FromB\_ToD)

## [1] 0.5050031

cor(data\_one$FromB\_ToD, data\_four$FromB\_ToD)

## [1] 0.5006651

cor(data\_one$FromB\_ToD, data\_five$FromB\_ToD)

## [1] 0.4226412

cor(data\_two$FromB\_ToD, data\_three$FromB\_ToD)

## [1] 0.5604709

cor(data\_two$FromB\_ToD, data\_four$FromB\_ToD)

## [1] 0.5608862

cor(data\_two$FromB\_ToD, data\_five$FromB\_ToD)

## [1] 0.4614241

cor(data\_three$FromB\_ToD, data\_four$FromB\_ToD)

## [1] 0.783078

cor(data\_three$FromB\_ToD, data\_five$FromB\_ToD)

## [1] 0.7928119

cor(data\_four$FromB\_ToD, data\_five$FromB\_ToD)

## [1] 0.8822732

# Model  
FromB\_ToD\_model <- lme(FromB\_ToD ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromB\_ToD\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 3217.544 <.0001  
## time 4 188 1.015 0.4008

effectsize::eta\_squared(FromB\_ToD\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 0.02 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromB\_ToD\_model)

## R2m R2c  
## [1,] 0.006794194 0.409836

emmeans(FromB\_ToD\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 0.885 0.0194 47 0.846 0.924  
## 2two 0.859 0.0194 47 0.820 0.898  
## 3three 0.855 0.0194 47 0.816 0.894  
## 4four 0.876 0.0194 47 0.837 0.915  
## 5five 0.869 0.0194 47 0.830 0.908  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two 0.02618 0.0164 188 1.593 0.6384  
## 1one - 3three 0.03032 0.0194 188 1.561 0.6567  
## 1one - 4four 0.00875 0.0205 188 0.427 0.9961  
## 1one - 5five 0.01606 0.0209 188 0.768 0.9640  
## 2two - 3three 0.00414 0.0164 188 0.252 0.9995  
## 2two - 4four -0.01743 0.0194 188 -0.897 0.9374  
## 2two - 5five -0.01012 0.0205 188 -0.494 0.9931  
## 3three - 4four -0.02158 0.0164 188 -1.313 0.7861  
## 3three - 5five -0.01427 0.0194 188 -0.734 0.9694  
## 4four - 5five 0.00731 0.0164 188 0.445 0.9954  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromB\_ToD,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:51 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromB\_ToD  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## 0.0262 [95CI -0.0386; 0.087]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## 0.0303 [95CI -0.0347; 0.0916]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## 0.00875 [95CI -0.0523; 0.066]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## 0.0161 [95CI -0.0413; 0.0732]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## 0.00414 [95CI -0.0489; 0.0566]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## -0.0174 [95CI -0.0639; 0.0299]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## -0.0101 [95CI -0.0533; 0.0348]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## -0.0216 [95CI -0.0687; 0.022]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## -0.0143 [95CI -0.0581; 0.0277]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## 0.00731 [95CI -0.0289; 0.0456]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromB\_ToF

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromB\_ToF)  
outliers

## [1] time simple\_id FromA\_ToB FromA\_ToC FromA\_ToD FromA\_ToF FromB\_ToA FromB\_ToC FromB\_ToD FromB\_ToF   
## [11] FromC\_ToA FromC\_ToB FromC\_ToD FromC\_ToF FromD\_ToA FromD\_ToB FromD\_ToC FromD\_ToF FromF\_ToA FromF\_ToB   
## [21] FromF\_ToC FromF\_ToD is.outlier is.extreme  
## <0 rows> (or 0-length row.names)

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromB\_ToF, data\_two$FromB\_ToF)

## [1] 0.6489124

cor(data\_one$FromB\_ToF, data\_three$FromB\_ToF)

## [1] 0.6080666

cor(data\_one$FromB\_ToF, data\_four$FromB\_ToF)

## [1] 0.6142281

cor(data\_one$FromB\_ToF, data\_five$FromB\_ToF)

## [1] 0.6297412

cor(data\_two$FromB\_ToF, data\_three$FromB\_ToF)

## [1] 0.791911

cor(data\_two$FromB\_ToF, data\_four$FromB\_ToF)

## [1] 0.7554737

cor(data\_two$FromB\_ToF, data\_five$FromB\_ToF)

## [1] 0.7351089

cor(data\_three$FromB\_ToF, data\_four$FromB\_ToF)

## [1] 0.8095235

cor(data\_three$FromB\_ToF, data\_five$FromB\_ToF)

## [1] 0.8078284

cor(data\_four$FromB\_ToF, data\_five$FromB\_ToF)

## [1] 0.8877309

# Model  
FromB\_ToF\_model <- lme(FromB\_ToF ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromB\_ToF\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 2251.1207 <.0001  
## time 4 188 1.4648 0.2146

effectsize::eta\_squared(FromB\_ToF\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 0.03 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromB\_ToF\_model)

## R2m R2c  
## [1,] 0.008930777 0.5822419

emmeans(FromB\_ToF\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 0.897 0.0221 47 0.853 0.942  
## 2two 0.924 0.0221 47 0.880 0.969  
## 3three 0.908 0.0221 47 0.864 0.952  
## 4four 0.894 0.0221 47 0.850 0.938  
## 5five 0.881 0.0221 47 0.837 0.925  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two -0.02697 0.0156 188 -1.727 0.5620  
## 1one - 3three -0.01076 0.0185 188 -0.581 0.9872  
## 1one - 4four 0.00321 0.0196 188 0.164 0.9999  
## 1one - 5five 0.01623 0.0200 188 0.812 0.9560  
## 2two - 3three 0.01621 0.0156 188 1.038 0.8974  
## 2two - 4four 0.03018 0.0185 188 1.630 0.6178  
## 2two - 5five 0.04320 0.0196 188 2.206 0.3050  
## 3three - 4four 0.01397 0.0156 188 0.895 0.9380  
## 3three - 5five 0.02699 0.0185 188 1.457 0.7131  
## 4four - 5five 0.01302 0.0156 188 0.834 0.9516  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromB\_ToF,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:51 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromB\_ToF  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## -0.027 [95CI -0.0956; 0.0449]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## -0.0108 [95CI -0.0792; 0.0614]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## 0.00321 [95CI -0.0595; 0.0693]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## 0.0162 [95CI -0.0455; 0.0814]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## 0.0162 [95CI -0.0469; 0.078]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## 0.0302 [95CI -0.0248; 0.0841]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## 0.0432 [95CI -0.0114; 0.0953]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## 0.014 [95CI -0.0425; 0.0696]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## 0.027 [95CI -0.0284; 0.0811]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## 0.013 [95CI -0.0323; 0.059]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromC\_ToA

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromC\_ToA)  
outliers

## # A tibble: 2 × 24  
## time simple\_id FromA\_…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 1one 530 0.949 1.21 0.821 0.795 0.949 0.966 0.880 1.08 0.666 1.37 1.03 1.13 1.29  
## 2 5five 220 1.14 0.926 0.909 0.934 0.939 1.20 0.875 0.765 0.845 1.06 0.972 1.10 1.03  
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromC\_ToA, data\_two$FromC\_ToA)

## [1] 0.7228914

cor(data\_one$FromC\_ToA, data\_three$FromC\_ToA)

## [1] 0.6585256

cor(data\_one$FromC\_ToA, data\_four$FromC\_ToA)

## [1] 0.6394006

cor(data\_one$FromC\_ToA, data\_five$FromC\_ToA)

## [1] 0.5811457

cor(data\_two$FromC\_ToA, data\_three$FromC\_ToA)

## [1] 0.6897626

cor(data\_two$FromC\_ToA, data\_four$FromC\_ToA)

## [1] 0.6959152

cor(data\_two$FromC\_ToA, data\_five$FromC\_ToA)

## [1] 0.6572546

cor(data\_three$FromC\_ToA, data\_four$FromC\_ToA)

## [1] 0.8479053

cor(data\_three$FromC\_ToA, data\_five$FromC\_ToA)

## [1] 0.7291654

cor(data\_four$FromC\_ToA, data\_five$FromC\_ToA)

## [1] 0.7822293

# Model  
FromC\_ToA\_model <- lme(FromC\_ToA ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromC\_ToA\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 6614.109 <.0001  
## time 4 188 1.322 0.2632

effectsize::eta\_squared(FromC\_ToA\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 0.03 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromC\_ToA\_model)

## R2m R2c  
## [1,] 0.005085417 0.4736699

emmeans(FromC\_ToA\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 1.03 0.015 47 1.003 1.06  
## 2two 1.03 0.015 47 0.995 1.06  
## 3three 1.04 0.015 47 1.012 1.07  
## 4four 1.02 0.015 47 0.992 1.05  
## 5five 1.02 0.015 47 0.993 1.05  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two 0.00757 0.0106 188 0.711 0.9728  
## 1one - 3three -0.00905 0.0132 188 -0.688 0.9759  
## 1one - 4four 0.01078 0.0143 188 0.754 0.9662  
## 1one - 5five 0.00963 0.0149 188 0.648 0.9807  
## 2two - 3three -0.01661 0.0106 188 -1.561 0.6564  
## 2two - 4four 0.00322 0.0132 188 0.245 0.9996  
## 2two - 5five 0.00206 0.0143 188 0.144 0.9999  
## 3three - 4four 0.01983 0.0106 188 1.863 0.4842  
## 3three - 5five 0.01868 0.0132 188 1.420 0.7327  
## 4four - 5five -0.00115 0.0106 188 -0.109 1.0000  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromC\_ToA,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:51 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromC\_ToA  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## 0.00757 [95CI -0.0459; 0.0562]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## -0.00905 [95CI -0.0607; 0.0376]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## 0.0108 [95CI -0.0388; 0.055]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## 0.00963 [95CI -0.039; 0.0542]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## -0.0166 [95CI -0.055; 0.0199]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## 0.00322 [95CI -0.032; 0.0378]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## 0.00206 [95CI -0.0332; 0.038]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## 0.0198 [95CI -0.0114; 0.05]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## 0.0187 [95CI -0.0136; 0.0495]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## -0.00115 [95CI -0.0302; 0.0258]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromC\_ToB

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromC\_ToB)  
outliers

## # A tibble: 4 × 24  
## time simple\_id FromA…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 2two 296 1.14 1.34 0.869 0.588 0.974 1.05 0.880 1.05 1.23 0.744 0.874 1.13 0.885  
## 2 3three 396 1.17 1.25 0.779 0.796 1.08 1.09 0.942 0.945 1.20 0.799 1.02 0.922 0.763  
## 3 4four 296 1.11 1.21 0.898 0.796 0.925 1.12 0.865 0.944 1.14 0.808 0.970 1.07 0.999  
## 4 5five 296 1.07 1.19 0.911 0.871 0.946 1.19 0.885 0.875 1.15 0.831 0.942 1.08 0.933  
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromC\_ToB, data\_two$FromC\_ToB)

## [1] 0.705639

cor(data\_one$FromC\_ToB, data\_three$FromC\_ToB)

## [1] 0.4222197

cor(data\_one$FromC\_ToB, data\_four$FromC\_ToB)

## [1] 0.5207754

cor(data\_one$FromC\_ToB, data\_five$FromC\_ToB)

## [1] 0.4652283

cor(data\_two$FromC\_ToB, data\_three$FromC\_ToB)

## [1] 0.6645767

cor(data\_two$FromC\_ToB, data\_four$FromC\_ToB)

## [1] 0.7058684

cor(data\_two$FromC\_ToB, data\_five$FromC\_ToB)

## [1] 0.6333211

cor(data\_three$FromC\_ToB, data\_four$FromC\_ToB)

## [1] 0.6731669

cor(data\_three$FromC\_ToB, data\_five$FromC\_ToB)

## [1] 0.7016564

cor(data\_four$FromC\_ToB, data\_five$FromC\_ToB)

## [1] 0.7992951

# Model  
FromC\_ToB\_model <- lme(FromC\_ToB ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromC\_ToB\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 7501.385 <.0001  
## time 4 188 2.484 0.0452

effectsize::eta\_squared(FromC\_ToB\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 0.05 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromC\_ToB\_model)

## R2m R2c  
## [1,] 0.009015965 0.3070559

emmeans(FromC\_ToB\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 1.03 0.0148 47 0.999 1.06  
## 2two 1.04 0.0148 47 1.012 1.07  
## 3three 1.02 0.0148 47 0.987 1.05  
## 4four 1.04 0.0148 47 1.013 1.07  
## 5five 1.04 0.0148 47 1.009 1.07  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two -0.01312 0.0110 188 -1.190 0.8408  
## 1one - 3three 0.01149 0.0140 188 0.824 0.9537  
## 1one - 4four -0.01430 0.0155 188 -0.925 0.9304  
## 1one - 5five -0.01008 0.0163 188 -0.619 0.9837  
## 2two - 3three 0.02462 0.0110 188 2.233 0.2927  
## 2two - 4four -0.00118 0.0140 188 -0.084 1.0000  
## 2two - 5five 0.00304 0.0155 188 0.197 0.9998  
## 3three - 4four -0.02579 0.0110 188 -2.340 0.2464  
## 3three - 5five -0.02157 0.0140 188 -1.546 0.6649  
## 4four - 5five 0.00422 0.0110 188 0.383 0.9974  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromC\_ToB,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:51 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromC\_ToB  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## -0.0131 [95CI -0.0628; 0.0363]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## 0.0115 [95CI -0.0343; 0.0564]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## -0.0143 [95CI -0.0596; 0.0291]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## -0.0101 [95CI -0.0565; 0.033]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## 0.0246 [95CI -0.0107; 0.0586]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## -0.00118 [95CI -0.0357; 0.0315]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## 0.00304 [95CI -0.0309; 0.0363]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## -0.0258 [95CI -0.0535; 0.00279]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## -0.0216 [95CI -0.0494; 0.00677]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## 0.00422 [95CI -0.0229; 0.031]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromC\_ToD

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromC\_ToD)  
outliers

## # A tibble: 8 × 24  
## time simple\_id FromA\_…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 1one 232 0.686 1.34 0.890 0.849 0.975 1.22 0.925 1.03 0.912 0.998 1.33 0.958 0.754  
## 2 1one 280 1.34 1.08 0.562 0.809 0.853 1.24 0.713 1.06 0.990 1.03 1.36 0.827 1.12   
## 3 1one 422 0.964 1.35 0.795 0.965 1.07 0.966 0.764 1.30 1.04 0.764 1.33 0.969 0.528  
## 4 2two 315 0.879 1.16 1.00 0.880 0.879 1.26 0.976 0.780 1.17 1.15 0.656 0.913 0.985  
## 5 2two 526 0.930 1.22 0.965 0.856 1.03 0.947 1.02 1.03 1.08 1.11 0.655 1.16 0.659  
## 6 4four 312 0.953 1.21 0.878 0.847 0.927 1.15 1.12 0.772 1.05 1.08 0.757 1.16 0.973  
## 7 4four 422 1.21 1.13 0.708 0.960 0.991 1.07 0.849 1.07 0.958 1.01 1.16 0.977 0.786  
## 8 4four 529 1.17 1.09 0.767 0.958 1.01 1.04 1.04 0.895 1.00 1.00 1.17 0.901 0.981  
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromC\_ToD, data\_two$FromC\_ToD)

## [1] 0.744212

cor(data\_one$FromC\_ToD, data\_three$FromC\_ToD)

## [1] 0.5932531

cor(data\_one$FromC\_ToD, data\_four$FromC\_ToD)

## [1] 0.5584169

cor(data\_one$FromC\_ToD, data\_five$FromC\_ToD)

## [1] 0.4558886

cor(data\_two$FromC\_ToD, data\_three$FromC\_ToD)

## [1] 0.7367309

cor(data\_two$FromC\_ToD, data\_four$FromC\_ToD)

## [1] 0.6556593

cor(data\_two$FromC\_ToD, data\_five$FromC\_ToD)

## [1] 0.6081227

cor(data\_three$FromC\_ToD, data\_four$FromC\_ToD)

## [1] 0.7783161

cor(data\_three$FromC\_ToD, data\_five$FromC\_ToD)

## [1] 0.7721604

cor(data\_four$FromC\_ToD, data\_five$FromC\_ToD)

## [1] 0.8068056

# Model  
FromC\_ToD\_model <- lme(FromC\_ToD ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromC\_ToD\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 4643.312 <.0001  
## time 4 188 1.366 0.2474

effectsize::eta\_squared(FromC\_ToD\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 0.03 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromC\_ToD\_model)

## R2m R2c  
## [1,] 0.006926216 0.2382331

emmeans(FromC\_ToD\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 0.949 0.017 47 0.915 0.983  
## 2two 0.946 0.017 47 0.912 0.980  
## 3three 0.939 0.017 47 0.904 0.973  
## 4four 0.966 0.017 47 0.931 1.000  
## 5five 0.960 0.017 47 0.926 0.995  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two 0.00310 0.0117 188 0.264 0.9994  
## 1one - 3three 0.01059 0.0152 188 0.695 0.9750  
## 1one - 4four -0.01655 0.0173 188 -0.959 0.9214  
## 1one - 5five -0.01127 0.0185 188 -0.608 0.9848  
## 2two - 3three 0.00749 0.0117 188 0.639 0.9816  
## 2two - 4four -0.01965 0.0152 188 -1.289 0.7975  
## 2two - 5five -0.01436 0.0173 188 -0.832 0.9520  
## 3three - 4four -0.02715 0.0117 188 -2.315 0.2569  
## 3three - 5five -0.02186 0.0152 188 -1.434 0.7257  
## 4four - 5five 0.00529 0.0117 188 0.451 0.9951  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromC\_ToD,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:51 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromC\_ToD  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## 0.0031 [95CI -0.0506; 0.0614]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## 0.0106 [95CI -0.0424; 0.0656]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## -0.0166 [95CI -0.0662; 0.0374]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## -0.0113 [95CI -0.0592; 0.0406]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## 0.00749 [95CI -0.0365; 0.0491]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## -0.0197 [95CI -0.0614; 0.0181]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## -0.0144 [95CI -0.0548; 0.0205]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## -0.0271 [95CI -0.0657; 0.00859]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## -0.0219 [95CI -0.0578; 0.0133]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## 0.00529 [95CI -0.0255; 0.0355]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromC\_ToF

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromC\_ToF)  
outliers

## [1] time simple\_id FromA\_ToB FromA\_ToC FromA\_ToD FromA\_ToF FromB\_ToA FromB\_ToC FromB\_ToD FromB\_ToF   
## [11] FromC\_ToA FromC\_ToB FromC\_ToD FromC\_ToF FromD\_ToA FromD\_ToB FromD\_ToC FromD\_ToF FromF\_ToA FromF\_ToB   
## [21] FromF\_ToC FromF\_ToD is.outlier is.extreme  
## <0 rows> (or 0-length row.names)

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromC\_ToF, data\_two$FromC\_ToF)

## [1] 0.6310289

cor(data\_one$FromC\_ToF, data\_three$FromC\_ToF)

## [1] 0.6563741

cor(data\_one$FromC\_ToF, data\_four$FromC\_ToF)

## [1] 0.573429

cor(data\_one$FromC\_ToF, data\_five$FromC\_ToF)

## [1] 0.5792565

cor(data\_two$FromC\_ToF, data\_three$FromC\_ToF)

## [1] 0.8123021

cor(data\_two$FromC\_ToF, data\_four$FromC\_ToF)

## [1] 0.7615334

cor(data\_two$FromC\_ToF, data\_five$FromC\_ToF)

## [1] 0.7017862

cor(data\_three$FromC\_ToF, data\_four$FromC\_ToF)

## [1] 0.7546824

cor(data\_three$FromC\_ToF, data\_five$FromC\_ToF)

## [1] 0.7220918

cor(data\_four$FromC\_ToF, data\_five$FromC\_ToF)

## [1] 0.8998614

# Model  
FromC\_ToF\_model <- lme(FromC\_ToF ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromC\_ToF\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 6617.239 <.0001  
## time 4 188 1.538 0.1928

effectsize::eta\_squared(FromC\_ToF\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 0.03 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromC\_ToF\_model)

## R2m R2c  
## [1,] 0.005422067 0.5893019

emmeans(FromC\_ToF\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 1.017 0.0145 47 0.988 1.05  
## 2two 1.008 0.0145 47 0.979 1.04  
## 3three 1.019 0.0145 47 0.990 1.05  
## 4four 0.999 0.0145 47 0.970 1.03  
## 5five 1.018 0.0145 47 0.988 1.05  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two 0.008490 0.0104 188 0.818 0.9548  
## 1one - 3three -0.002174 0.0122 188 -0.178 0.9999  
## 1one - 4four 0.017425 0.0128 188 1.358 0.7641  
## 1one - 5five -0.000721 0.0131 188 -0.055 1.0000  
## 2two - 3three -0.010664 0.0104 188 -1.028 0.9008  
## 2two - 4four 0.008935 0.0122 188 0.732 0.9697  
## 2two - 5five -0.009212 0.0128 188 -0.718 0.9718  
## 3three - 4four 0.019600 0.0104 188 1.889 0.4700  
## 3three - 5five 0.001453 0.0122 188 0.119 1.0000  
## 4four - 5five -0.018147 0.0104 188 -1.749 0.5497  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromC\_ToF,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:51 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromC\_ToF  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## 0.00849 [95CI -0.0388; 0.0537]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## -0.00217 [95CI -0.0468; 0.0402]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## 0.0174 [95CI -0.0257; 0.0582]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## -0.000721 [95CI -0.0397; 0.0387]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## -0.0107 [95CI -0.0553; 0.0304]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## 0.00894 [95CI -0.0327; 0.0488]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## -0.00921 [95CI -0.0476; 0.0286]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## 0.0196 [95CI -0.0186; 0.0573]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## 0.00145 [95CI -0.0327; 0.0382]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## -0.0181 [95CI -0.0504; 0.0148]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromD\_ToA

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromD\_ToA)  
outliers

## # A tibble: 8 × 24  
## time simple\_id FromA…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 2two 313 0.864 1.23 0.939 0.830 1.19 1.29 0.772 0.770 0.928 1.02 1.08 0.958 0.493  
## 2 2two 394 0.972 1.20 0.959 0.824 0.940 1.17 0.844 0.887 1.08 1.13 0.825 0.939 0.560  
## 3 3three 313 0.754 1.36 1.02 0.734 1.28 1.17 0.877 0.738 0.909 0.981 0.973 1.08 0.616  
## 4 3three 394 1.04 1.12 1.02 0.751 1.05 1.28 0.748 0.617 1.06 1.10 0.822 1.01 0.642  
## 5 4four 313 0.873 1.24 1.05 0.691 1.27 1.13 0.863 0.841 0.979 1.05 0.991 0.955 0.577  
## 6 5five 225 1.07 1.12 0.842 0.900 0.934 1.17 0.805 1.00 0.996 1.07 1.10 0.947 1.11   
## 7 5five 313 0.971 1.25 0.963 0.778 1.11 1.21 0.886 0.741 0.951 1.01 0.992 1.03 0.682  
## 8 5five 406 0.913 1.03 0.911 1.01 0.911 1.28 0.906 0.812 1.08 0.991 0.943 1.04 0.686  
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromD\_ToA, data\_two$FromD\_ToA)

## [1] 0.5271748

cor(data\_one$FromD\_ToA, data\_three$FromD\_ToA)

## [1] 0.6496479

cor(data\_one$FromD\_ToA, data\_four$FromD\_ToA)

## [1] 0.4292581

cor(data\_one$FromD\_ToA, data\_five$FromD\_ToA)

## [1] 0.4493475

cor(data\_two$FromD\_ToA, data\_three$FromD\_ToA)

## [1] 0.6570807

cor(data\_two$FromD\_ToA, data\_four$FromD\_ToA)

## [1] 0.5613531

cor(data\_two$FromD\_ToA, data\_five$FromD\_ToA)

## [1] 0.5293108

cor(data\_three$FromD\_ToA, data\_four$FromD\_ToA)

## [1] 0.7194256

cor(data\_three$FromD\_ToA, data\_five$FromD\_ToA)

## [1] 0.7012442

cor(data\_four$FromD\_ToA, data\_five$FromD\_ToA)

## [1] 0.7486364

# Model  
FromD\_ToA\_model <- lme(FromD\_ToA ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromD\_ToA\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 3440.936 <.0001  
## time 4 188 0.475 0.7541

effectsize::eta\_squared(FromD\_ToA\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 0.01 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromD\_ToA\_model)

## R2m R2c  
## [1,] 0.002466514 0.4397948

emmeans(FromD\_ToA\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 0.902 0.0195 47 0.863 0.941  
## 2two 0.919 0.0195 47 0.879 0.958  
## 3three 0.902 0.0195 47 0.863 0.941  
## 4four 0.912 0.0195 47 0.873 0.952  
## 5five 0.903 0.0195 47 0.864 0.943  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two -0.0167333 0.0168 188 -0.995 0.9109  
## 1one - 3three -0.0000553 0.0195 188 -0.003 1.0000  
## 1one - 4four -0.0104135 0.0203 188 -0.513 0.9920  
## 1one - 5five -0.0015925 0.0205 188 -0.077 1.0000  
## 2two - 3three 0.0166780 0.0168 188 0.992 0.9119  
## 2two - 4four 0.0063198 0.0195 188 0.325 0.9986  
## 2two - 5five 0.0151408 0.0203 188 0.747 0.9675  
## 3three - 4four -0.0103583 0.0168 188 -0.616 0.9840  
## 3three - 5five -0.0015372 0.0195 188 -0.079 1.0000  
## 4four - 5five 0.0088210 0.0168 188 0.524 0.9913  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromD\_ToA,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:51 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromD\_ToA  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## -0.0167 [95CI -0.083; 0.0502]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## -0.0000553 [95CI -0.0633; 0.0601]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## -0.0104 [95CI -0.0737; 0.0495]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## -0.00159 [95CI -0.0645; 0.0562]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## 0.0167 [95CI -0.0324; 0.0646]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## 0.00632 [95CI -0.0413; 0.0533]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## 0.0151 [95CI -0.0327; 0.0609]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## -0.0104 [95CI -0.054; 0.0296]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## -0.00154 [95CI -0.0435; 0.0367]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## 0.00882 [95CI -0.0304; 0.0469]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromD\_ToB

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromD\_ToB)  
outliers

## # A tibble: 9 × 24  
## time simple\_id FromA…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 1one 408 0.902 1.09 0.679 0.866 0.921 0.758 1.11 0.904 1.02 1.01 0.933 1.21 0.802  
## 2 3three 220 1.11 1.10 0.818 0.731 0.950 1.14 0.925 0.760 0.870 1.01 0.950 1.11 0.947  
## 3 3three 308 1.03 1.14 0.706 0.950 0.792 1.33 0.882 0.991 1.17 1.06 0.948 0.884 0.958  
## 4 3three 312 1.02 1.15 0.871 0.829 0.991 1.19 1.00 0.697 0.981 1.04 0.804 1.26 0.885  
## 5 3three 341 1.11 1.13 1.06 0.823 0.948 1.26 0.654 0.946 0.978 0.955 1.05 1.08 0.784  
## 6 3three 404 1.11 1.09 0.781 0.992 1.08 1.25 0.706 0.803 0.973 1.07 0.924 1.12 0.759  
## 7 4four 308 0.964 1.17 0.711 0.939 0.862 1.25 0.953 0.978 1.11 1.04 1.00 0.895 1.01   
## 8 4four 390 1.00 1.23 0.737 0.804 0.970 1.17 0.839 0.876 1.01 1.05 1.07 0.967 0.983  
## 9 4four 407 0.972 1.10 1.02 0.891 0.909 1.18 1.01 0.927 0.990 0.983 0.958 1.07 0.928  
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromD\_ToB, data\_two$FromD\_ToB)

## [1] 0.565167

cor(data\_one$FromD\_ToB, data\_three$FromD\_ToB)

## [1] 0.3651115

cor(data\_one$FromD\_ToB, data\_four$FromD\_ToB)

## [1] 0.5058022

cor(data\_one$FromD\_ToB, data\_five$FromD\_ToB)

## [1] 0.3719455

cor(data\_two$FromD\_ToB, data\_three$FromD\_ToB)

## [1] 0.7165869

cor(data\_two$FromD\_ToB, data\_four$FromD\_ToB)

## [1] 0.6506817

cor(data\_two$FromD\_ToB, data\_five$FromD\_ToB)

## [1] 0.5999614

cor(data\_three$FromD\_ToB, data\_four$FromD\_ToB)

## [1] 0.6230023

cor(data\_three$FromD\_ToB, data\_five$FromD\_ToB)

## [1] 0.7248818

cor(data\_four$FromD\_ToB, data\_five$FromD\_ToB)

## [1] 0.7480386

# Model  
FromD\_ToB\_model <- lme(FromD\_ToB ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromD\_ToB\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 3441.052 <.0001  
## time 4 188 1.449 0.2196

effectsize::eta\_squared(FromD\_ToB\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 0.03 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromD\_ToB\_model)

## R2m R2c  
## [1,] 0.008887013 0.3478325

emmeans(FromD\_ToB\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 0.891 0.0195 47 0.852 0.930  
## 2two 0.862 0.0195 47 0.823 0.902  
## 3three 0.896 0.0195 47 0.857 0.935  
## 4four 0.897 0.0195 47 0.858 0.936  
## 5five 0.890 0.0195 47 0.851 0.930  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two 0.028699 0.0166 188 1.732 0.5593  
## 1one - 3three -0.005097 0.0200 188 -0.255 0.9995  
## 1one - 4four -0.005725 0.0213 188 -0.269 0.9994  
## 1one - 5five 0.000678 0.0219 188 0.031 1.0000  
## 2two - 3three -0.033796 0.0166 188 -2.039 0.3880  
## 2two - 4four -0.034424 0.0200 188 -1.725 0.5634  
## 2two - 5five -0.028021 0.0213 188 -1.315 0.7852  
## 3three - 4four -0.000628 0.0166 188 -0.038 1.0000  
## 3three - 5five 0.005775 0.0200 188 0.289 0.9991  
## 4four - 5five 0.006404 0.0166 188 0.386 0.9973  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromD\_ToB,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:52 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromD\_ToB  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## 0.0287 [95CI -0.0368; 0.0972]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## -0.0051 [95CI -0.0642; 0.0594]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## -0.00573 [95CI -0.0619; 0.0554]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## 0.000678 [95CI -0.0543; 0.0621]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## -0.0338 [95CI -0.0892; 0.0215]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## -0.0344 [95CI -0.0852; 0.0156]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## -0.028 [95CI -0.0791; 0.0209]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## -0.000628 [95CI -0.045; 0.0414]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## 0.00578 [95CI -0.0383; 0.048]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## 0.0064 [95CI -0.0294; 0.041]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromD\_ToC

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromD\_ToC)  
outliers

## # A tibble: 2 × 24  
## time simple\_id FromA\_…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 2two 301 0.987 1.16 0.950 0.858 0.847 1.18 0.803 1.04 0.999 1.08 0.906 0.970 0.897  
## 2 2two 394 0.972 1.20 0.959 0.824 0.940 1.17 0.844 0.887 1.08 1.13 0.825 0.939 0.560  
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromD\_ToC, data\_two$FromD\_ToC)

## [1] 0.7405365

cor(data\_one$FromD\_ToC, data\_three$FromD\_ToC)

## [1] 0.605551

cor(data\_one$FromD\_ToC, data\_four$FromD\_ToC)

## [1] 0.4318828

cor(data\_one$FromD\_ToC, data\_five$FromD\_ToC)

## [1] 0.4041231

cor(data\_two$FromD\_ToC, data\_three$FromD\_ToC)

## [1] 0.7696221

cor(data\_two$FromD\_ToC, data\_four$FromD\_ToC)

## [1] 0.6728993

cor(data\_two$FromD\_ToC, data\_five$FromD\_ToC)

## [1] 0.6760608

cor(data\_three$FromD\_ToC, data\_four$FromD\_ToC)

## [1] 0.7962329

cor(data\_three$FromD\_ToC, data\_five$FromD\_ToC)

## [1] 0.7074872

cor(data\_four$FromD\_ToC, data\_five$FromD\_ToC)

## [1] 0.8683032

# Model  
FromD\_ToC\_model <- lme(FromD\_ToC ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromD\_ToC\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 5662.175 <.0001  
## time 4 188 0.294 0.8815

effectsize::eta\_squared(FromD\_ToC\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 6.22e-03 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromD\_ToC\_model)

## R2m R2c  
## [1,] 0.001876628 0.001876694

emmeans(FromD\_ToC\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 1.14 0.0183 47 1.11 1.18  
## 2two 1.15 0.0183 47 1.11 1.18  
## 3three 1.13 0.0183 47 1.10 1.17  
## 4four 1.13 0.0183 47 1.10 1.17  
## 5five 1.14 0.0183 47 1.10 1.17  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two -0.001242 0.0118 188 -0.105 1.0000  
## 1one - 3three 0.011318 0.0158 188 0.714 0.9723  
## 1one - 4four 0.011474 0.0184 188 0.623 0.9833  
## 1one - 5five 0.008070 0.0202 188 0.399 0.9970  
## 2two - 3three 0.012560 0.0118 188 1.061 0.8897  
## 2two - 4four 0.012715 0.0158 188 0.803 0.9578  
## 2two - 5five 0.009312 0.0184 188 0.506 0.9924  
## 3three - 4four 0.000155 0.0118 188 0.013 1.0000  
## 3three - 5five -0.003248 0.0158 188 -0.205 0.9998  
## 4four - 5five -0.003404 0.0118 188 -0.288 0.9992  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromD\_ToC,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:52 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromD\_ToC  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## -0.00124 [95CI -0.0598; 0.0607]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## 0.0113 [95CI -0.0449; 0.0703]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## 0.0115 [95CI -0.0425; 0.0679]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## 0.00807 [95CI -0.0445; 0.0629]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## 0.0126 [95CI -0.0323; 0.0606]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## 0.0127 [95CI -0.0298; 0.0589]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## 0.00931 [95CI -0.0321; 0.0546]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## 0.000155 [95CI -0.0393; 0.0422]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## -0.00325 [95CI -0.0412; 0.0377]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## -0.0034 [95CI -0.039; 0.0326]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromD\_ToF

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromD\_ToF)  
outliers

## # A tibble: 4 × 24  
## time simple\_id FromA…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 2two 389 1.12 1.18 0.802 0.724 0.929 1.18 1.20 0.567 1.16 1.09 0.694 1.04 0.898  
## 2 3three 389 1.12 1.08 1.05 0.685 0.952 1.36 0.772 0.439 1.15 1.04 0.686 1.11 0.936  
## 3 5five 389 1.13 1.09 0.847 0.711 0.914 1.37 0.745 0.615 1.11 1.05 0.906 1.05 0.935  
## 4 5five 407 0.940 1.16 0.973 0.903 0.906 1.17 1.02 0.926 0.974 1.04 0.944 1.08 0.932  
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromD\_ToF, data\_two$FromD\_ToF)

## [1] 0.5696194

cor(data\_one$FromD\_ToF, data\_three$FromD\_ToF)

## [1] 0.4758783

cor(data\_one$FromD\_ToF, data\_four$FromD\_ToF)

## [1] 0.3939169

cor(data\_one$FromD\_ToF, data\_five$FromD\_ToF)

## [1] 0.2795535

cor(data\_two$FromD\_ToF, data\_three$FromD\_ToF)

## [1] 0.7375678

cor(data\_two$FromD\_ToF, data\_four$FromD\_ToF)

## [1] 0.6438736

cor(data\_two$FromD\_ToF, data\_five$FromD\_ToF)

## [1] 0.6490435

cor(data\_three$FromD\_ToF, data\_four$FromD\_ToF)

## [1] 0.7895547

cor(data\_three$FromD\_ToF, data\_five$FromD\_ToF)

## [1] 0.7176961

cor(data\_four$FromD\_ToF, data\_five$FromD\_ToF)

## [1] 0.8802498

# Model  
FromD\_ToF\_model <- lme(FromD\_ToF ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromD\_ToF\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 4295.935 <.0001  
## time 4 188 0.886 0.4733

effectsize::eta\_squared(FromD\_ToF\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 0.02 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromD\_ToF\_model)

## R2m R2c  
## [1,] 0.008262415 0.1801394

emmeans(FromD\_ToF\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 1.13 0.0212 47 1.09 1.17  
## 2two 1.11 0.0212 47 1.06 1.15  
## 3three 1.10 0.0212 47 1.06 1.14  
## 4four 1.10 0.0212 47 1.05 1.14  
## 5five 1.09 0.0212 47 1.05 1.14  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two 0.02492 0.0156 188 1.597 0.6360  
## 1one - 3three 0.02911 0.0202 188 1.443 0.7206  
## 1one - 4four 0.03408 0.0227 188 1.499 0.6907  
## 1one - 5five 0.03804 0.0243 188 1.565 0.6543  
## 2two - 3three 0.00420 0.0156 188 0.269 0.9994  
## 2two - 4four 0.00916 0.0202 188 0.454 0.9950  
## 2two - 5five 0.01312 0.0227 188 0.577 0.9875  
## 3three - 4four 0.00497 0.0156 188 0.318 0.9987  
## 3three - 5five 0.00892 0.0202 188 0.442 0.9955  
## 4four - 5five 0.00396 0.0156 188 0.254 0.9995  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromD\_ToF,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:52 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromD\_ToF  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## 0.0249 [95CI -0.0397; 0.088]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## 0.0291 [95CI -0.0335; 0.0903]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## 0.0341 [95CI -0.0274; 0.0964]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## 0.038 [95CI -0.0217; 0.0983]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## 0.0042 [95CI -0.0541; 0.0603]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## 0.00916 [95CI -0.0461; 0.0658]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## 0.0131 [95CI -0.0388; 0.0676]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## 0.00497 [95CI -0.0492; 0.0606]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## 0.00892 [95CI -0.0418; 0.0623]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## 0.00396 [95CI -0.0484; 0.0549]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromF\_ToA

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromF\_ToA)  
outliers

## # A tibble: 2 × 24  
## time simple\_id FromA\_…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 4four 382 1.03 1.12 0.943 0.966 1.31 0.999 1.01 0.691 0.859 1.14 0.860 1.14 0.868  
## 2 5five 382 1.13 1.11 0.840 0.835 1.34 1.03 0.974 0.738 0.952 1.06 0.911 1.09 0.845  
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromF\_ToA, data\_two$FromF\_ToA)

## [1] 0.576793

cor(data\_one$FromF\_ToA, data\_three$FromF\_ToA)

## [1] 0.3872915

cor(data\_one$FromF\_ToA, data\_four$FromF\_ToA)

## [1] 0.2839662

cor(data\_one$FromF\_ToA, data\_five$FromF\_ToA)

## [1] 0.2916841

cor(data\_two$FromF\_ToA, data\_three$FromF\_ToA)

## [1] 0.5650838

cor(data\_two$FromF\_ToA, data\_four$FromF\_ToA)

## [1] 0.4453982

cor(data\_two$FromF\_ToA, data\_five$FromF\_ToA)

## [1] 0.4622555

cor(data\_three$FromF\_ToA, data\_four$FromF\_ToA)

## [1] 0.7404172

cor(data\_three$FromF\_ToA, data\_five$FromF\_ToA)

## [1] 0.6617435

cor(data\_four$FromF\_ToA, data\_five$FromF\_ToA)

## [1] 0.776546

# Model  
FromF\_ToA\_model <- lme(FromF\_ToA ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromF\_ToA\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 4349.526 <.0001  
## time 4 188 0.995 0.4117

effectsize::eta\_squared(FromF\_ToA\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 0.02 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromF\_ToA\_model)

## R2m R2c  
## [1,] 0.01117777 0.2131875

emmeans(FromF\_ToA\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 0.892 0.0176 47 0.857 0.928  
## 2two 0.908 0.0176 47 0.872 0.943  
## 3three 0.896 0.0176 47 0.861 0.932  
## 4four 0.876 0.0176 47 0.840 0.911  
## 5five 0.873 0.0176 47 0.838 0.909  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two -0.01538 0.0146 188 -1.052 0.8929  
## 1one - 3three -0.00428 0.0183 188 -0.234 0.9996  
## 1one - 4four 0.01647 0.0201 188 0.819 0.9545  
## 1one - 5five 0.01906 0.0210 188 0.905 0.9354  
## 2two - 3three 0.01109 0.0146 188 0.759 0.9655  
## 2two - 4four 0.03184 0.0183 188 1.740 0.5548  
## 2two - 5five 0.03443 0.0201 188 1.713 0.5699  
## 3three - 4four 0.02075 0.0146 188 1.419 0.7333  
## 3three - 5five 0.02334 0.0183 188 1.275 0.8039  
## 4four - 5five 0.00259 0.0146 188 0.177 0.9999  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromF\_ToA,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:52 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromF\_ToA  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## -0.0154 [95CI -0.0724; 0.0409]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## -0.00428 [95CI -0.0588; 0.0486]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## 0.0165 [95CI -0.0382; 0.0664]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## 0.0191 [95CI -0.0364; 0.0684]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## 0.0111 [95CI -0.0331; 0.0578]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## 0.0318 [95CI -0.0137; 0.0764]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## 0.0344 [95CI -0.01; 0.0782]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## 0.0207 [95CI -0.0198; 0.061]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## 0.0233 [95CI -0.0181; 0.0627]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## 0.00259 [95CI -0.0351; 0.0407]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromF\_ToB

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromF\_ToB)  
outliers

## # A tibble: 2 × 24  
## time simple\_id FromA\_…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 2two 305 0.647 1.05 0.962 1.11 0.919 1.21 0.848 1.00 0.946 1.14 1.05 0.826 1.01   
## 2 4four 301 0.981 1.16 0.976 0.840 0.981 1.19 0.762 0.975 0.983 1.11 0.863 0.928 0.940  
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromF\_ToB, data\_two$FromF\_ToB)

## [1] 0.6267376

cor(data\_one$FromF\_ToB, data\_three$FromF\_ToB)

## [1] 0.4170506

cor(data\_one$FromF\_ToB, data\_four$FromF\_ToB)

## [1] 0.2867438

cor(data\_one$FromF\_ToB, data\_five$FromF\_ToB)

## [1] 0.2618604

cor(data\_two$FromF\_ToB, data\_three$FromF\_ToB)

## [1] 0.7813236

cor(data\_two$FromF\_ToB, data\_four$FromF\_ToB)

## [1] 0.5237829

cor(data\_two$FromF\_ToB, data\_five$FromF\_ToB)

## [1] 0.5384971

cor(data\_three$FromF\_ToB, data\_four$FromF\_ToB)

## [1] 0.5554722

cor(data\_three$FromF\_ToB, data\_five$FromF\_ToB)

## [1] 0.527057

cor(data\_four$FromF\_ToB, data\_five$FromF\_ToB)

## [1] 0.8056821

# Model  
FromF\_ToB\_model <- lme(FromF\_ToB ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromF\_ToB\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 3623.377 <.0001  
## time 4 188 2.705 0.0318

effectsize::eta\_squared(FromF\_ToB\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 0.05 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromF\_ToB\_model)

## R2m R2c  
## [1,] 0.01668302 0.04228021

emmeans(FromF\_ToB\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 0.937 0.0202 47 0.897 0.978  
## 2two 0.889 0.0202 47 0.848 0.929  
## 3three 0.896 0.0202 47 0.856 0.937  
## 4four 0.921 0.0202 47 0.881 0.962  
## 5five 0.924 0.0202 47 0.883 0.964  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two 0.04866 0.0160 188 3.034 0.0602  
## 1one - 3three 0.04119 0.0208 188 1.984 0.4173  
## 1one - 4four 0.01610 0.0234 188 0.688 0.9759  
## 1one - 5five 0.01353 0.0251 188 0.540 0.9903  
## 2two - 3three -0.00746 0.0160 188 -0.465 0.9945  
## 2two - 4four -0.03255 0.0208 188 -1.568 0.6525  
## 2two - 5five -0.03513 0.0234 188 -1.500 0.6902  
## 3three - 4four -0.02509 0.0160 188 -1.565 0.6545  
## 3three - 5five -0.02766 0.0208 188 -1.332 0.7768  
## 4four - 5five -0.00257 0.0160 188 -0.160 0.9999  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromF\_ToB,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:52 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromF\_ToB  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## 0.0487 [95CI -0.0204; 0.113]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## 0.0412 [95CI -0.023; 0.103]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## 0.0161 [95CI -0.0489; 0.0764]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## 0.0135 [95CI -0.0472; 0.0692]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## -0.00746 [95CI -0.0595; 0.0449]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## -0.0326 [95CI -0.0855; 0.0193]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## -0.0351 [95CI -0.0833; 0.0122]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## -0.0251 [95CI -0.0748; 0.0217]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## -0.0277 [95CI -0.0684; 0.0148]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## -0.00257 [95CI -0.0421; 0.0386]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromF\_ToC

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromF\_ToC)  
outliers

## # A tibble: 3 × 24  
## time simple\_id FromA…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 3three 301 1.03 1.09 0.990 0.919 0.863 1.27 0.720 1.04 1.07 1.02 0.840 0.982 0.853  
## 2 4four 301 0.981 1.16 0.976 0.840 0.981 1.19 0.762 0.975 0.983 1.11 0.863 0.928 0.940  
## 3 5five 522 1.07 1.09 0.949 0.931 0.949 1.20 0.868 0.965 0.993 1.05 0.969 0.912 0.852  
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromF\_ToC, data\_two$FromF\_ToC)

## [1] 0.6776751

cor(data\_one$FromF\_ToC, data\_three$FromF\_ToC)

## [1] 0.5841144

cor(data\_one$FromF\_ToC, data\_four$FromF\_ToC)

## [1] 0.5600525

cor(data\_one$FromF\_ToC, data\_five$FromF\_ToC)

## [1] 0.5245609

cor(data\_two$FromF\_ToC, data\_three$FromF\_ToC)

## [1] 0.752012

cor(data\_two$FromF\_ToC, data\_four$FromF\_ToC)

## [1] 0.7388751

cor(data\_two$FromF\_ToC, data\_five$FromF\_ToC)

## [1] 0.7013925

cor(data\_three$FromF\_ToC, data\_four$FromF\_ToC)

## [1] 0.7940473

cor(data\_three$FromF\_ToC, data\_five$FromF\_ToC)

## [1] 0.8056153

cor(data\_four$FromF\_ToC, data\_five$FromF\_ToC)

## [1] 0.8058616

# Model  
FromF\_ToC\_model <- lme(FromF\_ToC ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromF\_ToC\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 6175.302 <.0001  
## time 4 188 0.133 0.9701

effectsize::eta\_squared(FromF\_ToC\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 2.82e-03 | [0.00, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromF\_ToC\_model)

## R2m R2c  
## [1,] 0.0006587005 0.4884179

emmeans(FromF\_ToC\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 1.06 0.0162 47 1.03 1.10  
## 2two 1.07 0.0162 47 1.03 1.10  
## 3three 1.06 0.0162 47 1.03 1.09  
## 4four 1.06 0.0162 47 1.03 1.09  
## 5five 1.06 0.0162 47 1.03 1.09  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two -0.004007 0.0119 188 -0.337 0.9984  
## 1one - 3three 0.003549 0.0144 188 0.246 0.9995  
## 1one - 4four 0.001021 0.0155 188 0.066 1.0000  
## 1one - 5five 0.003948 0.0160 188 0.247 0.9995  
## 2two - 3three 0.007556 0.0119 188 0.635 0.9821  
## 2two - 4four 0.005028 0.0144 188 0.348 0.9982  
## 2two - 5five 0.007955 0.0155 188 0.514 0.9920  
## 3three - 4four -0.002528 0.0119 188 -0.212 0.9997  
## 3three - 5five 0.000399 0.0144 188 0.028 1.0000  
## 4four - 5five 0.002927 0.0119 188 0.246 0.9995  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromF\_ToC,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:52 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromF\_ToC  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## -0.00401 [95CI -0.0599; 0.0495]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## 0.00355 [95CI -0.0458; 0.0492]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## 0.00102 [95CI -0.0501; 0.0474]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## 0.00395 [95CI -0.0461; 0.0484]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## 0.00756 [95CI -0.0331; 0.0504]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## 0.00503 [95CI -0.0388; 0.0486]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## 0.00796 [95CI -0.0329; 0.0483]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## -0.00253 [95CI -0.038; 0.0333]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## 0.000399 [95CI -0.0324; 0.032]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## 0.00293 [95CI -0.0319; 0.037]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# FromF\_ToD

# Read data  
data <- read.csv("lmem\_full\_trans\_data.csv")  
  
data$simple\_id <- as.factor(data$simple\_id)  
  
data$time <- ifelse(data$time == 1, "1one",  
 ifelse(data$time == 2, "2two",  
 ifelse(data$time == 3, "3three",  
 ifelse(data$time == 4, "4four",  
 ifelse(data$time == 5, "5five", "other")))))  
  
data$time <- as.factor(data$time)  
contrasts(data$time) <- contr.sum  
contrasts(data$time)

## [,1] [,2] [,3] [,4]  
## 1one 1 0 0 0  
## 2two 0 1 0 0  
## 3three 0 0 1 0  
## 4four 0 0 0 1  
## 5five -1 -1 -1 -1

# Outliers (this is a simple univariate measure)  
# Outlier = above Q3 + 1.5xIQR or below Q1 - 1.5xIQR  
# Extreme outlier = above Q3 + 3xIQR or below Q1 - 3xIQR   
# Only exclude extreme outliers  
outliers <- data %>%  
 group\_by(time) %>%  
 identify\_outliers(FromF\_ToD)  
outliers

## # A tibble: 1 × 24  
## time simple\_id FromA\_…¹ FromA…² FromA…³ FromA…⁴ FromB…⁵ FromB…⁶ FromB…⁷ FromB…⁸ FromC…⁹ FromC…˟ FromC…˟ FromC…˟ FromD…˟  
## <fct> <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 4four 301 0.981 1.16 0.976 0.840 0.981 1.19 0.762 0.975 0.983 1.11 0.863 0.928 0.940  
## # … with 9 more variables: FromD\_ToB <dbl>, FromD\_ToC <dbl>, FromD\_ToF <dbl>, FromF\_ToA <dbl>, FromF\_ToB <dbl>,  
## # FromF\_ToC <dbl>, FromF\_ToD <dbl>, is.outlier <lgl>, is.extreme <lgl>, and abbreviated variable names ¹​FromA\_ToB,  
## # ²​FromA\_ToC, ³​FromA\_ToD, ⁴​FromA\_ToF, ⁵​FromB\_ToA, ⁶​FromB\_ToC, ⁷​FromB\_ToD, ⁸​FromB\_ToF, ⁹​FromC\_ToA, ˟​FromC\_ToB,  
## # ˟​FromC\_ToD, ˟​FromC\_ToF, ˟​FromD\_ToA

# NO EXTREME VALUES

# Correlations  
data\_one <- data %>% filter(time == "1one")  
data\_two <- data %>% filter(time == "2two")  
data\_three <- data %>% filter(time == "3three")  
data\_four <- data %>% filter(time == "4four")  
data\_five <- data %>% filter(time == "5five")  
  
cor(data\_one$FromF\_ToD, data\_two$FromF\_ToD)

## [1] 0.6645297

cor(data\_one$FromF\_ToD, data\_three$FromF\_ToD)

## [1] 0.5705988

cor(data\_one$FromF\_ToD, data\_four$FromF\_ToD)

## [1] 0.6709765

cor(data\_one$FromF\_ToD, data\_five$FromF\_ToD)

## [1] 0.6217906

cor(data\_two$FromF\_ToD, data\_three$FromF\_ToD)

## [1] 0.7289551

cor(data\_two$FromF\_ToD, data\_four$FromF\_ToD)

## [1] 0.7529322

cor(data\_two$FromF\_ToD, data\_five$FromF\_ToD)

## [1] 0.6908359

cor(data\_three$FromF\_ToD, data\_four$FromF\_ToD)

## [1] 0.8417588

cor(data\_three$FromF\_ToD, data\_five$FromF\_ToD)

## [1] 0.825489

cor(data\_four$FromF\_ToD, data\_five$FromF\_ToD)

## [1] 0.8973176

# Model  
FromF\_ToD\_model <- lme(FromF\_ToD ~ time, random = ~1|simple\_id,   
 correlation = corAR1(form = ~1|simple\_id), data = data)  
anova(FromF\_ToD\_model)

## numDF denDF F-value p-value  
## (Intercept) 1 188 2768.1952 <.0001  
## time 4 188 4.1502 0.003

effectsize::eta\_squared(FromF\_ToD\_model, partial = TRUE)

## # Effect Size for ANOVA  
##   
## Parameter | Eta2 (partial) | 95% CI  
## -----------------------------------------  
## time | 0.08 | [0.02, 1.00]  
##   
## - One-sided CIs: upper bound fixed at [1.00].

r.squaredGLMM(FromF\_ToD\_model)

## R2m R2c  
## [1,] 0.02555897 0.641566

emmeans(FromF\_ToD\_model, list(pairwise ~ time), adjust = "scheffe")

## Warning: contrasts dropped from factor time

## $`emmeans of time`  
## time emmean SE df lower.CL upper.CL  
## 1one 1.12 0.0256 47 1.07 1.18  
## 2two 1.17 0.0256 47 1.12 1.22  
## 3three 1.20 0.0256 47 1.15 1.25  
## 4four 1.20 0.0256 47 1.15 1.25  
## 5five 1.19 0.0256 47 1.14 1.25  
##   
## Degrees-of-freedom method: containment   
## Confidence level used: 0.95   
##   
## $`pairwise differences of time`  
## 1 estimate SE df t.ratio p.value  
## 1one - 2two -0.047571 0.0174 188 -2.726 0.1196  
## 1one - 3three -0.074748 0.0204 188 -3.663 0.0111  
## 1one - 4four -0.075027 0.0214 188 -3.508 0.0175  
## 1one - 5five -0.070494 0.0217 188 -3.243 0.0359  
## 2two - 3three -0.027177 0.0174 188 -1.557 0.6585  
## 2two - 4four -0.027456 0.0204 188 -1.346 0.7704  
## 2two - 5five -0.022924 0.0214 188 -1.072 0.8860  
## 3three - 4four -0.000279 0.0174 188 -0.016 1.0000  
## 3three - 5five 0.004254 0.0204 188 0.208 0.9998  
## 4four - 5five 0.004533 0.0174 188 0.260 0.9994  
##   
## Degrees-of-freedom method: containment   
## P value adjustment: scheffe method with rank 4

# Estimation statistics-based effect sizes and confidence intervals  
paired\_mean\_diff <- dabest(data, time, FromF\_ToD,  
 idx = list(c("2two", "1one"),  
 c("3three", "1one"),  
 c("4four", "1one"),  
 c("5five", "1one"),  
 c("3three", "2two"),  
 c("4four", "2two"),  
 c("5five", "2two"),  
 c("4four", "3three"),  
 c("5five", "3three"),  
 c("5five", "4four")),  
 paired = TRUE, id.col = simple\_id) %>%   
 mean\_diff()  
paired\_mean\_diff

## dabestr (Data Analysis with Bootstrap Estimation in R) v0.3.0  
## =============================================================  
##   
## Good evening!  
## The current time is 23:52 PM on Sunday January 21, 2024.  
##   
## Dataset : data  
## X Variable : time  
## Y Variable : FromF\_ToD  
##   
## Paired mean difference of 1one (n = 48) minus 2two (n = 48)  
## -0.0476 [95CI -0.124; 0.0287]  
##   
## Paired mean difference of 1one (n = 48) minus 3three (n = 48)  
## -0.0747 [95CI -0.15; 0.00148]  
##   
## Paired mean difference of 1one (n = 48) minus 4four (n = 48)  
## -0.075 [95CI -0.151; -0.000511]  
##   
## Paired mean difference of 1one (n = 48) minus 5five (n = 48)  
## -0.0705 [95CI -0.143; 0.00262]  
##   
## Paired mean difference of 2two (n = 48) minus 3three (n = 48)  
## -0.0272 [95CI -0.0959; 0.0424]  
##   
## Paired mean difference of 2two (n = 48) minus 4four (n = 48)  
## -0.0275 [95CI -0.0947; 0.0381]  
##   
## Paired mean difference of 2two (n = 48) minus 5five (n = 48)  
## -0.0229 [95CI -0.0869; 0.0415]  
##   
## Paired mean difference of 3three (n = 48) minus 4four (n = 48)  
## -0.000279 [95CI -0.0693; 0.0647]  
##   
## Paired mean difference of 3three (n = 48) minus 5five (n = 48)  
## 0.00425 [95CI -0.0632; 0.067]  
##   
## Paired mean difference of 4four (n = 48) minus 5five (n = 48)  
## 0.00453 [95CI -0.0564; 0.0669]  
##   
##   
## 5000 bootstrap resamples.  
## All confidence intervals are bias-corrected and accelerated.

# Correction for Multiple Comparisons

# Without Outliers Removed (NO OUTLIERS IN ANY MODEL)  
p = c(  
0.7256,  
0.049,  
0.9266,  
0.867,  
0.1636,  
0.1292,  
0.4008,  
0.2146,  
0.2632,  
0.0452,  
0.2474,  
0.1928,  
0.7541,  
0.2196,  
0.8815,  
0.4733,  
0.4117,  
0.0318,  
0.9701,  
0.003  
)  
p.adjust(p, method = "bonferroni")

## [1] 1.000 0.980 1.000 1.000 1.000 1.000 1.000 1.000 1.000 0.904 1.000 1.000 1.000 1.000 1.000 1.000 1.000 0.636 1.000  
## [20] 0.060