# JA_Analyses_Final

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## Packages

```r
library(rstatix) # Basic analyses like ANOVA etc

library(lme4) # For multilevel models

library(lmerTest) # For lmm p-values

library(tidyverse) # For pivotting longer etc

library(sjPlot) #for exporting nice tables of our output

library(flextable) #another package to make apa tables

library(robustlmm) #For robust lmm when normality violated

library(multilevelTools)

library(JWileymisc) # To use modelDiagnostics

library(ggpubr) # Plotting

library(emmeans) # to follow up on sig mixed models interactions

library(Hmisc) # Correlation analyses

library(knitr) # For printing nice tables

library(papaja) # To format figures in APA

library(reshape2) # Can use functions like melt

library(chisq.posthoc.test) # For post hoc chisq tests

library(RVAideMemoire) # Another post hoc test package
```

## Load in data

```
load(file = "Judge_Advisor_2022_preprocessed.RData")

#turning off scientific notation
options(scipen=999)
```

## Opinion difference

```
### Put data in a long dataframe

pracs <- select(full_ja_df, ID, AGEGROUP, PRAC1_1n, PRAC1_2n, PRAC1_3n)

pracs$ID <- as.factor(pracs$ID)

# Actual prac jars values
## Jar 1 = 188
## Jar 2 = 141
## Jar 3 = 71

# Create opinion difference scores (initial minus actual coins)
pracs <- pracs %>%
  rowwise() %>%
  mutate(PRAC1_OP = PRAC1_1n-188)

pracs <- pracs %>%
  rowwise() %>%
  mutate(PRAC2_OP = PRAC1_2n-141)

pracs <- pracs %>%
  rowwise() %>%
  mutate(PRAC3_OP = PRAC1_3n-71)

pracs <-  pivot_longer(pracs, cols = c("PRAC1_OP", "PRAC2_OP","PRAC3_OP"),
                      names_to = "PRACTICE_TRIAL", values_to = "OPINIONDIFF")

pracs$PRACTICE_TRIAL <- as.factor(pracs$PRACTICE_TRIAL)

levels(pracs$PRACTICE_TRIAL)

## Appears to be some extreme outliers.
pracs %>%
  group_by(AGEGROUP) %>%
  identify_outliers(OPINIONDIFF) # 8 outliers...
```

### Adjust outliers +/- 3SDs from M

```r
# Put data back to wide

pracs <- spread(pracs, PRACTICE_TRIAL, OPINIONDIFF)

summarystats_op <- pracs %>%
  group_by(AGEGROUP) %>%
  get_summary_stats(PRAC1_OP, PRAC2_OP, PRAC3_OP, type = "mean_sd")

ungroup(pracs)

summarystats_op$M_PLUS_3SD <- summarystats_op$mean + (3*summarystats_op$sd)

summarystats_op$M_MINUS_3SD <- summarystats_op$mean - (3*summarystats_op$sd)

## Split into age groups
young <- subset(pracs, AGEGROUP == "YOUNG")

middle <- subset(pracs, AGEGROUP == "MIDDLE")

older <- subset(pracs, AGEGROUP == "OLDER")
```

### Younger adults

```r
# Change outliers to 5000 if above M+3*SDs
# Change outliers to -5000 if below M-3*SDs
# Easy to identify and sort out from other values

young <- young %>%
  mutate(PRAC1_OP = ifelse(is.na(PRAC1_OP), NA,
                           ifelse(PRAC1_OP > 402.353, 5000, PRAC1_OP)), # 1 identified
         PRAC1_OP = ifelse(is.na(PRAC1_OP), NA,
                           ifelse(PRAC1_OP < -518.353, -5000, PRAC1_OP)))

young <- young %>%
  mutate(PRAC2_OP = ifelse(is.na(PRAC2_OP), NA,
                           ifelse(PRAC2_OP > 449.818, 5000, PRAC2_OP)), # 1 identified
         PRAC2_OP = ifelse(is.na(PRAC2_OP), NA,
                           ifelse(PRAC2_OP < -488.600, -5000, PRAC2_OP)),
         PRAC3_OP= ifelse(is.na(PRAC3_OP), NA,
                           ifelse(PRAC3_OP > 237.886, 5000, PRAC3_OP)), # 1 identified
         PRAC3_OP = ifelse(is.na(PRAC3_OP), NA,
                           ifelse(PRAC3_OP < -259.460, -5000, PRAC3_OP)))

## Create new df without the outliers

young_exl_out <- select(young, PRAC1_OP, PRAC2_OP, PRAC3_OP)

young_exl_out <- young_exl_out %>%
  mutate(PRAC1_OP = ifelse(is.na(PRAC1_OP), NA,
                           ifelse(PRAC1_OP == 5000 |PRAC1_OP == -5000,
                                  as.integer(NA), PRAC1_OP)),
```

```
         PRAC2_OP = ifelse(is.na(PRAC2_OP), NA,
                           ifelse(PRAC2_OP == 5000 |PRAC2_OP == -5000,
                                  as.integer(NA), PRAC2_OP)),
         PRAC3_OP = ifelse(is.na(PRAC3_OP), NA,
                           ifelse(PRAC3_OP == 5000 |PRAC3_OP == -5000,
                                  as.integer(NA), PRAC3_OP)))

youngmsd <- young_exl_out %>%
  get_summary_stats(PRAC1_OP, PRAC2_OP, PRAC3_OP, type = "mean_sd")

youngmsd$M_PLUS_3SD <- youngmsd$mean + (3*youngmsd$sd)

# Replace the values taken

young <- young %>%
  mutate(PRAC1_OP = ifelse(is.na(PRAC1_OP), NA,
                           ifelse(PRAC1_OP == 5000, 172.012, PRAC1_OP)),
         PRAC2_OP = ifelse(is.na(PRAC2_OP), NA,
                           ifelse(PRAC2_OP == 5000, 213.740, PRAC2_OP)),
         PRAC3_OP = ifelse(is.na(PRAC3_OP), NA,
                           ifelse(PRAC3_OP == 5000, 97.689, PRAC3_OP)))
```

### Middle-aged adults

```
# Change outliers to 5000 if above M+3*SDs
# Change outliers to -5000 if below M-3*SDs
# Easy to identify and sort out from other values

middle <- middle %>%
  mutate(PRAC1_OP = ifelse(is.na(PRAC1_OP), NA,
                           ifelse(PRAC1_OP > 973.971, 5000, PRAC1_OP)), # 1 identified
         PRAC1_OP = ifelse(is.na(PRAC1_OP), NA,
                           ifelse(PRAC1_OP < -1002.711, -5000, PRAC1_OP)),
         PRAC2_OP = ifelse(is.na(PRAC2_OP), NA,
                           ifelse(PRAC2_OP > 1007.667, 5000, PRAC2_OP)), # 1 identified
         PRAC2_OP = ifelse(is.na(PRAC2_OP), NA,
                           ifelse(PRAC2_OP < -972.705, -5000, PRAC2_OP)),
         PRAC3_OP = ifelse(is.na(PRAC3_OP), NA,
                           ifelse(PRAC3_OP > 197.910, 5000, PRAC3_OP)), # 1 identified
         PRAC3_OP = ifelse(is.na(PRAC3_OP), NA,
                           ifelse(PRAC3_OP < -211.836, -5000, PRAC3_OP)))

## Create new df without the outliers

middle_exl_out <- select(middle, PRAC1_OP, PRAC2_OP, PRAC3_OP)

middle_exl_out <- middle_exl_out %>%
  mutate(PRAC1_OP = ifelse(is.na(PRAC1_OP), NA,
                           ifelse(PRAC1_OP == 5000 |PRAC1_OP == -5000,
                                  as.integer(NA), PRAC1_OP)),
         PRAC2_OP = ifelse(is.na(PRAC2_OP), NA,
                           ifelse(PRAC2_OP == 5000 |PRAC2_OP == -5000,
```

```
                                    as.integer(NA), PRAC2_OP)),
         PRAC3_OP = ifelse(is.na(PRAC3_OP), NA,
                             ifelse(PRAC3_OP == 5000 |PRAC3_OP == -5000,
                                    as.integer(NA), PRAC3_OP)))

middlemsd <- middle_exl_out %>%
  get_summary_stats(PRAC1_OP, PRAC2_OP, PRAC3_OP, type = "mean_sd")

middlemsd$M_PLUS_3SD <- middlemsd$mean + (3*middlemsd$sd)


# Replace the values taken

middle <- middle %>%
  mutate(PRAC1_OP = ifelse(is.na(PRAC1_OP), NA,
                             ifelse(PRAC1_OP == 5000, 144.812, PRAC1_OP)),
         PRAC2_OP = ifelse(is.na(PRAC2_OP), NA,
                             ifelse(PRAC2_OP == 5000, 153.545, PRAC2_OP)),
         PRAC3_OP = ifelse(is.na(PRAC3_OP), NA,
                             ifelse(PRAC3_OP == 5000, 81.057, PRAC3_OP)))
```

### Older adults

```
# Change outliers to 5000 if above M+3*SDs
# Change outliers to -5000 if below M-3*SDs
# Easy to identify and sort out from other values

older<- older %>%
  mutate(PRAC1_OP = ifelse(is.na(PRAC1_OP), NA,
                             ifelse(PRAC1_OP > 86.898, 5000, PRAC1_OP)), # No outliers
         PRAC1_OP = ifelse(is.na(PRAC1_OP), NA,
                             ifelse(PRAC1_OP < -259.734, -5000, PRAC1_OP)),
         PRAC2_OP = ifelse(is.na(PRAC2_OP), NA,
                             ifelse(PRAC2_OP > 107.020, 5000, PRAC2_OP)), # 1 identified
         PRAC2_OP = ifelse(is.na(PRAC2_OP), NA,
                             ifelse(PRAC2_OP < -218.474, -5000, PRAC2_OP)),
         PRAC3_OP = ifelse(is.na(PRAC3_OP), NA,
                             ifelse(PRAC3_OP > 56.977, 5000, PRAC3_OP)), # 1 identified
         PRAC3_OP = ifelse(is.na(PRAC3_OP), NA,
                             ifelse(PRAC3_OP < -113.495, -5000, PRAC3_OP)))


## Create new df without the outliers

older_exl_out <- select(older, PRAC1_OP, PRAC2_OP, PRAC3_OP)

older_exl_out <- older_exl_out %>%
  mutate(PRAC1_OP = ifelse(is.na(PRAC1_OP), NA,
                             ifelse(PRAC1_OP == 5000 |PRAC1_OP == -5000,
                                    as.integer(NA), PRAC1_OP)),
         PRAC2_OP = ifelse(is.na(PRAC2_OP), NA,
                             ifelse(PRAC2_OP == 5000 |PRAC2_OP == -5000,
```

```
                                    as.integer(NA), PRAC2_OP)),
         PRAC3_OP = ifelse(is.na(PRAC3_OP), NA,
                             ifelse(PRAC3_OP == 5000 |PRAC3_OP == -5000,
                                    as.integer(NA), PRAC3_OP)))

oldermsd <- older_exl_out %>%
  get_summary_stats(PRAC1_OP, PRAC2_OP, PRAC3_OP, type = "mean_sd")

oldermsd$M_PLUS_3SD <- oldermsd$mean + (3*oldermsd$sd)


# Replace the values taken

older <- older %>%
  mutate(PRAC1_OP = ifelse(is.na(PRAC1_OP), NA,
                             ifelse(PRAC1_OP == 5000, 86.898, PRAC1_OP)),
         PRAC2_OP = ifelse(is.na(PRAC2_OP), NA,
                             ifelse(PRAC2_OP == 5000, 71.314, PRAC2_OP)),
         PRAC3_OP = ifelse(is.na(PRAC3_OP), NA,
                             ifelse(PRAC3_OP == 5000, 29.254, PRAC3_OP)))
```

#### Combine adjusted value dfs

```
# Combine the age group dfs together

all_ages <- young %>% full_join(middle)

all_ages <- all_ages %>% full_join(older)

pracs <- all_ages
```

### Opinion difference between age groups

```
# Put data back into long form
pracs <-  pivot_longer(pracs, cols = c("PRAC1_OP", "PRAC2_OP","PRAC3_OP"),
                      names_to = "PRACTICE_TRIAL", values_to = "OPINIONDIFF")

pracs$PRACTICE_TRIAL <- as.factor(pracs$PRACTICE_TRIAL)

levels(pracs$PRACTICE_TRIAL)

## Analyses

op.aov <- anova_test(
  data = pracs, dv = OPINIONDIFF, wid = ID,
  between = AGEGROUP,
  within = PRACTICE_TRIAL,
  effect.size = "pes"
  )
```

```r
get_anova_table(op.aov)

pracs %>% group_by(PRACTICE_TRIAL) %>%
  get_summary_stats(OPINIONDIFF, type = "mean_sd")

ungroup(pracs)

# Pairwise comparisons between practice trials

practrial <- pracs %>%
  pairwise_t_test(
    OPINIONDIFF ~ PRACTICE_TRIAL, paired = TRUE,
    p.adjust.method = "bonferroni"
    )
practrial

# Pairwise comparisons between the age groups

pracages <- pracs %>%
  pairwise_t_test(
    OPINIONDIFF ~ AGEGROUP,
    p.adjust.method = "bonferroni"
    )

pracages

avg_grp_op <- pracs %>% group_by(AGEGROUP) %>%
  get_summary_stats(OPINIONDIFF, type = "mean_sd")


## Create descriptives table of opinion differences by age groups

avg_grp_op <- select(avg_grp_op, AGEGROUP, n, mean, sd)

avg_grp_op$AGEGROUP <- recode_factor(avg_grp_op$AGEGROUP,YOUNG = "Young adults",
                                     MIDDLE = "Middle-aged adults",
                                     OLDER = "Older adults")

## change the descriptives df to 2 decimal places
avg_grp_op$mean <- format(round(avg_grp_op$mean,2))
avg_grp_op$sd <- format(round(avg_grp_op$sd,2))

avg_grp_op_table <- flextable(avg_grp_op)


# Make new column names
avg_grp_op_table <- avg_grp_op_table %>%

   set_header_labels(         # Rename the columns in original header row
      AGEGROUP = "Age group",
      n = "N",
      mean = "M",
      sd = "SD")
```

```r
avg_grp_op_table <- align(avg_grp_op_table, align = "center", j = 2:4,
                          part = "all")

avg_grp_op_table %>% autofit() # Auto fits the columns

# save_as_docx("age group averages" = avg_grp_op_table, path = "file.docx")
```

## Check age group differences

### Depressive symptom score

```r
levels(full_ja_df$AGEGROUP)

ungroup(full_ja_df)

dep_diff <- full_ja_df %>%
  anova_test(DASS~AGEGROUP)

dep_diff

full_ja_df %>% tukey_hsd(DASS~AGEGROUP)

dep_diff_lm <- lm(DASS~AGEGROUP, data = full_ja_df)

summary(dep_diff_lm) # Less depressive symptoms for older adults

full_ja_df %>%
  group_by(AGEGROUP) %>%
  get_summary_stats(DASS)
```

### Pre-Confidence

```r
pre_conf_diff <- full_ja_df %>%
  anova_test(PRE_CONFIDENCEn~AGEGROUP)

pre_conf_diff

pre_conf_diff_lm <- lm(PRE_CONFIDENCEn~AGEGROUP, data = full_ja_df)

summary(pre_conf_diff_lm) # No differences
```

### Post-Confidence

```
post_conf_diff <- full_ja_df %>%
  anova_test(POST_CONFIDENCEn~AGEGROUP)

post_conf_diff

post_conf_diff_lm <- lm(POST_CONFIDENCEn~AGEGROUP, data = full_ja_df)

summary(post_conf_diff_lm) # Difference between young and older - older less confident

estimates(post_conf_diff_lm)
```

```
## Error in estimates(post_conf_diff_lm): could not find function "estimates"
```

### Perceived Advice Accuracy

```
advice_acc_diff <- full_ja_df %>%
  anova_test(PERCEIVED_ADVICE_ACCURACYn~AGEGROUP)

advice_acc_diff

advice_acc_diff_lm <- lm(PERCEIVED_ADVICE_ACCURACYn~AGEGROUP, data = full_ja_df)

summary(advice_acc_diff_lm) # Difference between young and older -
#Older perceive the advice as less accurate

estimates(advice_acc_diff_lm)
```

```
## Error in estimates(advice_acc_diff_lm): could not find function "estimates"
```

### Average Fluid IQ

```
fluidiq_diff <- full_ja_df %>%
  anova_test(AVFLUIDIQ~AGEGROUP)

fluidiq_diff

fluidiq_diff_lm <- lm(AVFLUIDIQ~AGEGROUP, data = full_ja_df)

summary(fluidiq_diff_lm) # No difference

visualize(fluidiq_diff_lm)
```

```
## Error in visualize(fluidiq_diff_lm): could not find function "visualize"
```

# Mixed Model Analyses

## Hypothesis 1: With increasing age, and increasing depressive symptoms,

there would be greater advice-taking.

```
# Get dataframe ready

ja_df1 <- full_ja_df

ja_df1 <- pivot_longer(ja_df1, cols = c("JAR01_WOA":"JAR12_WOA"),
                       names_to = "JAR", values_to = "WOA")

ja_df1$JAR <- as.factor(ja_df1$JAR)

ja_df1$ID <- as.factor(ja_df1$ID)

## Center age

ja_df1 <- ja_df1 %>% mutate(GMC_AGE = scale(AGEn, scale = FALSE))

## Center DASS

ja_df1 <- ja_df1 %>% mutate(GMC_DASS = scale(DASS, scale = FALSE))

## Basic model with predictors

model1 <- lmer(WOA~GMC_AGE + GMC_DASS + (1|ID), data = ja_df1,
               control=lmerControl(optimizer="bobyqa", optCtrl=list(maxfun=2e5)))

# Interaction model

model2 <- lmer(WOA~GMC_AGE*GMC_DASS + (1|ID), data = ja_df1,
               control=lmerControl(optimizer="bobyqa", optCtrl=list(maxfun=2e5)))

# Compare main effects and interaction models
anova(model1, model2)

# Retain model 1
summary(model1)
```

### Check assumptions

```
#Linearity of relationships
linearity_model1 <- plot_model(model1, type = "resid",  show.data = TRUE)
linearity_model1
```


```
#Normality of residuals

model1_diagnostics <- visualize(model1, plot = "residuals")
```

```
## Error in visualize(model1, plot = "residuals"): could not find function "visualize"
```

```
model1_diagnostics
```

```
## Error in eval(expr, envir, enclos): object 'model1_diagnostics' not found
```

```
tab_model(model1)
```

**Table of model1**

```
tab_model(model1,
          show.re.var = FALSE,
          show.icc = FALSE,
          show.se = TRUE,
          show.r2 = FALSE,
          show.ci = 0.95,
          string.ci = "95% CI",
          p.val = "satterthwaite",
```

```
          collapse.se = TRUE,
          string.est = "Estimate (SE)",
          pred.labels = c("Intercept","Age"),
          dv.labels = c("Weight of Advice"),
          file = "model1.html")
```

# Emotion regulators

## Create variable

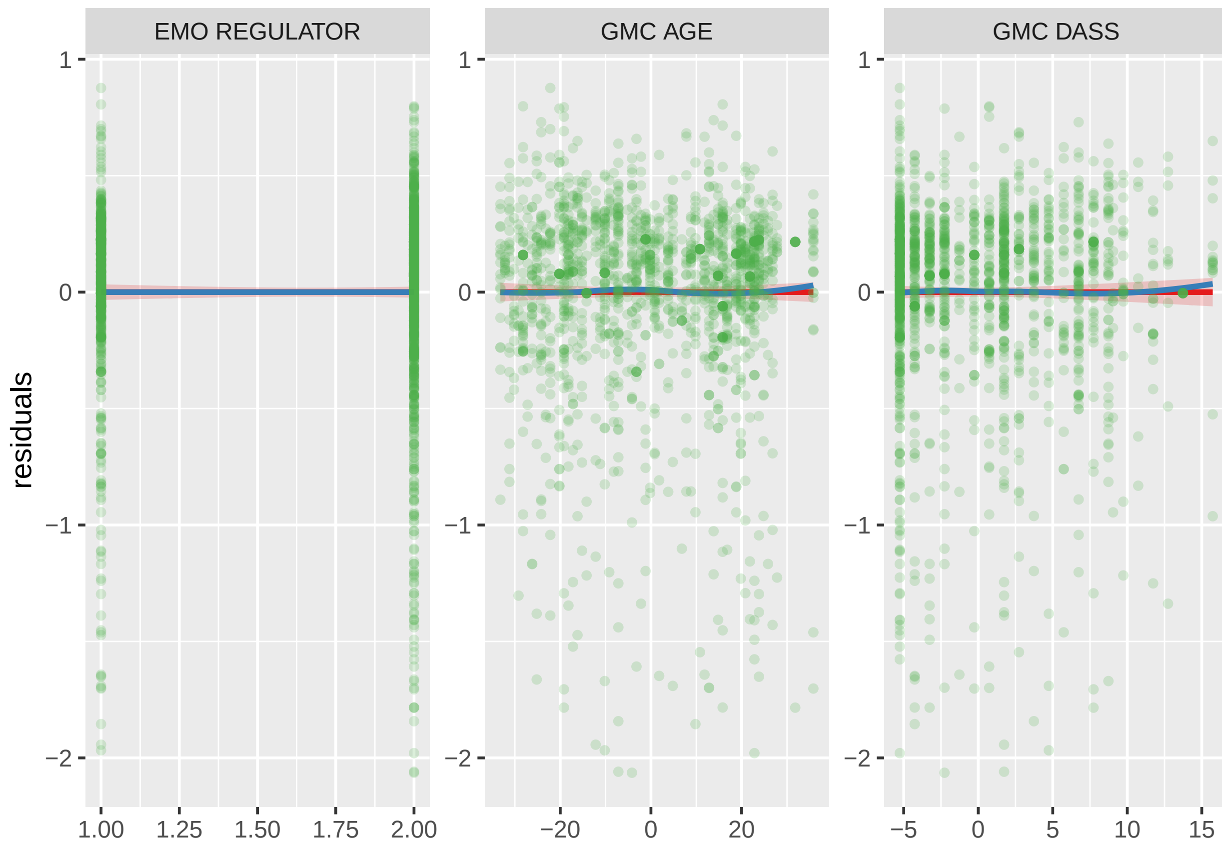
```
ja_df1$EMO_REGn <- as.factor(ja_df1$EMO_REGn)
ja_df2 <- ja_df1 %>%
  rowwise() %>%
  mutate(EMO_REGULATOR = ifelse(is.na(EMO_REG_EFFORT1n) & is.na(EMO_REG_EFFORT2n),
                                                            "NO", "YES"))
```

## LMM Analysis

```
# Age, DSS, Emotion Regulation

model3 <- lmer(WOA~GMC_AGE + GMC_DASS + EMO_REGULATOR + (1|ID), data = ja_df2,
               control=lmerControl(optimizer="bobyqa", optCtrl=list(maxfun=2e5)))

model4 <- lmer(WOA~GMC_DASS + GMC_AGE*EMO_REGULATOR + (1|ID), data = ja_df2,
               control=lmerControl(optimizer="bobyqa", optCtrl=list(maxfun=2e5)))

anova(model3, model4) # Retain model 3

model5 <- lmer(WOA~GMC_AGE + GMC_DASS*EMO_REGULATOR + (1|ID), data = ja_df2,
               control=lmerControl(optimizer="bobyqa", optCtrl=list(maxfun=2e5)))

anova(model3, model5)

# Retain model 5

model6 <- lmer(WOA~ EMO_REGULATOR + GMC_AGE*GMC_DASS + (1|ID), data = ja_df2,
               control=lmerControl(optimizer="bobyqa", optCtrl=list(maxfun=2e5)))

anova(model3, model6)

model7 <- lmer(WOA~GMC_AGE*GMC_DASS*EMO_REGULATOR + (1|ID), data = ja_df2,
               control=lmerControl(optimizer="bobyqa", optCtrl=list(maxfun=2e5)))

anova(model5, model7)

summary(model5) ### Significant depressive symptoms and emotion regulation interaction
```

### Check assumptions

```r
# Linearity of relationships

linearity_model5 <- plot_model(model5, type = "resid",  show.data = TRUE)
linearity_model5
```



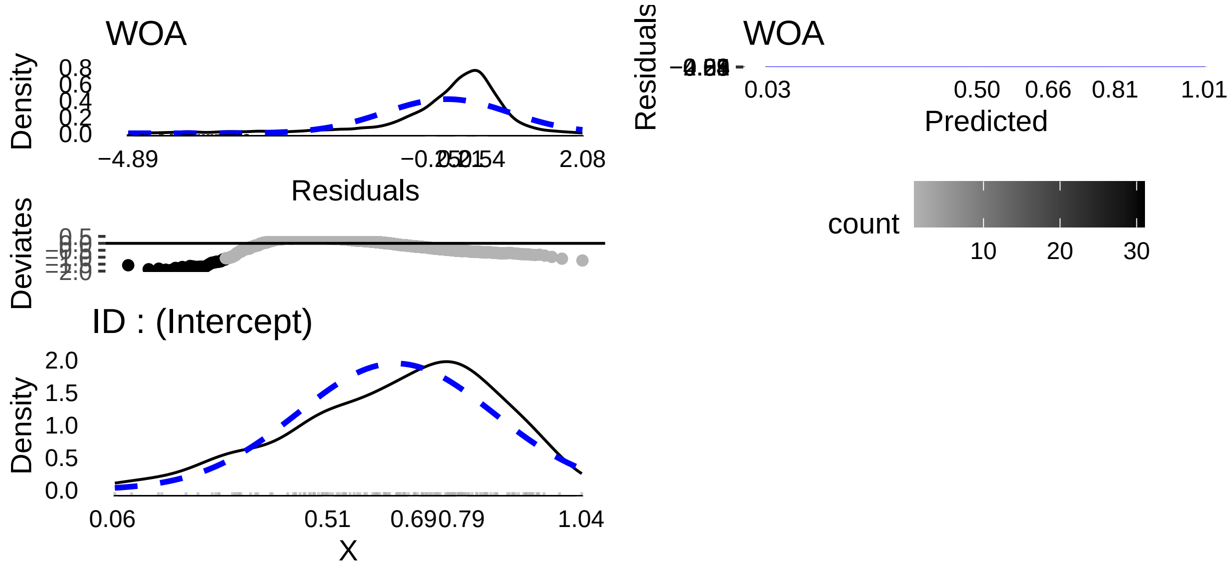

```r
# Normality of residuals

model5_diagnostics1 <- visualize(model5, plot = "residuals")
```

```
## Error in visualize(model5, plot = "residuals"): could not find function "visualize"
```

```r
model5_diagnostics1
```

```
## Error in eval(expr, envir, enclos): object 'model5_diagnostics1' not found
```

```r
tab_model(model5)

model5_diagnostics <- modelDiagnostics(model5, ev.perc = .001)

plot(model5_diagnostics, ask = FALSE, ncol = 2, nrow = 3)
```



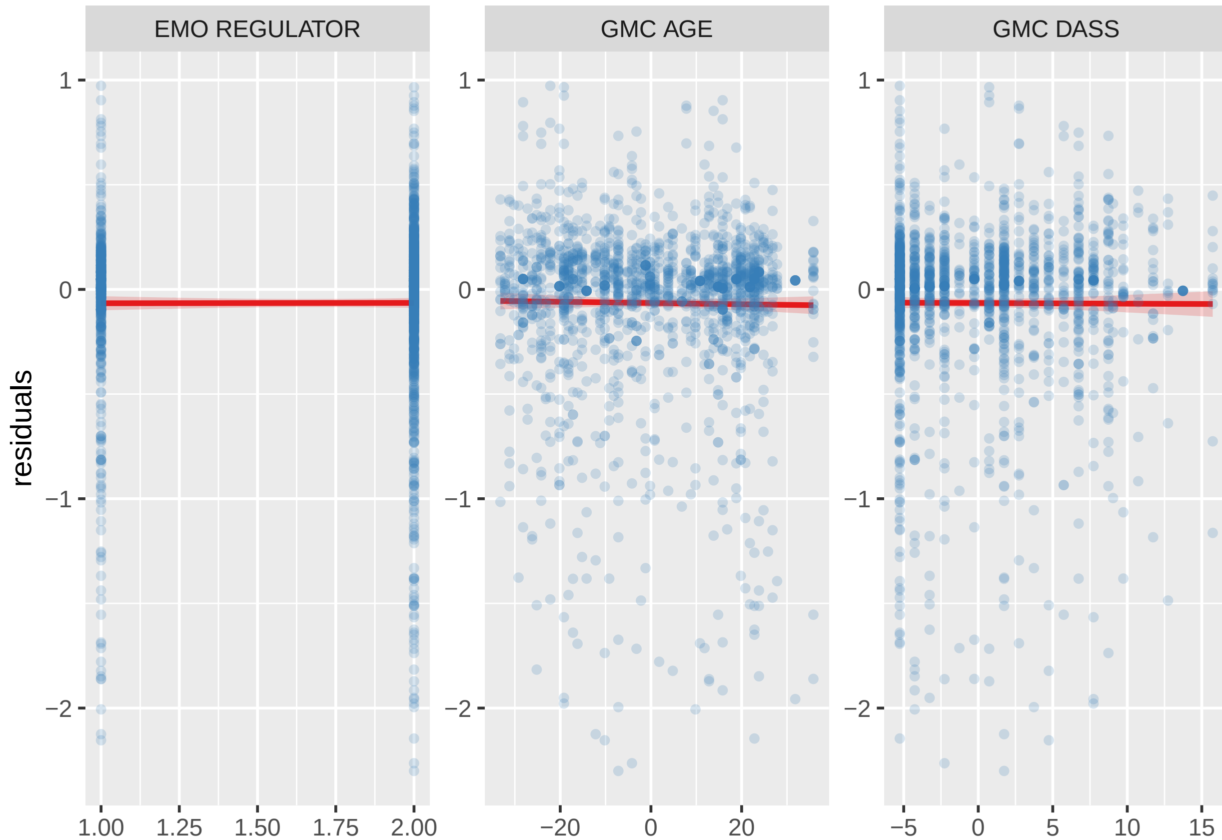

```
# Try a robust model
```

### Robust lmm

```
model5_robust <- rlmer(WOA~GMC_AGE + GMC_DASS*EMO_REGULATOR + (1|ID),
                       data = ja_df2, control=lmerControl(optimizer="bobyqa",
                                                          optCtrl=list(maxfun=2e5)))

summary(model5_robust)

summary(model5)
```

#### Diagnostics on robust lmm

```
tab_model(model5_robust)

plot_model(model5_robust, type = "resid",  show.data = TRUE, show.loess = FALSE)
```




```r
# Use the robust model given normality violations
```

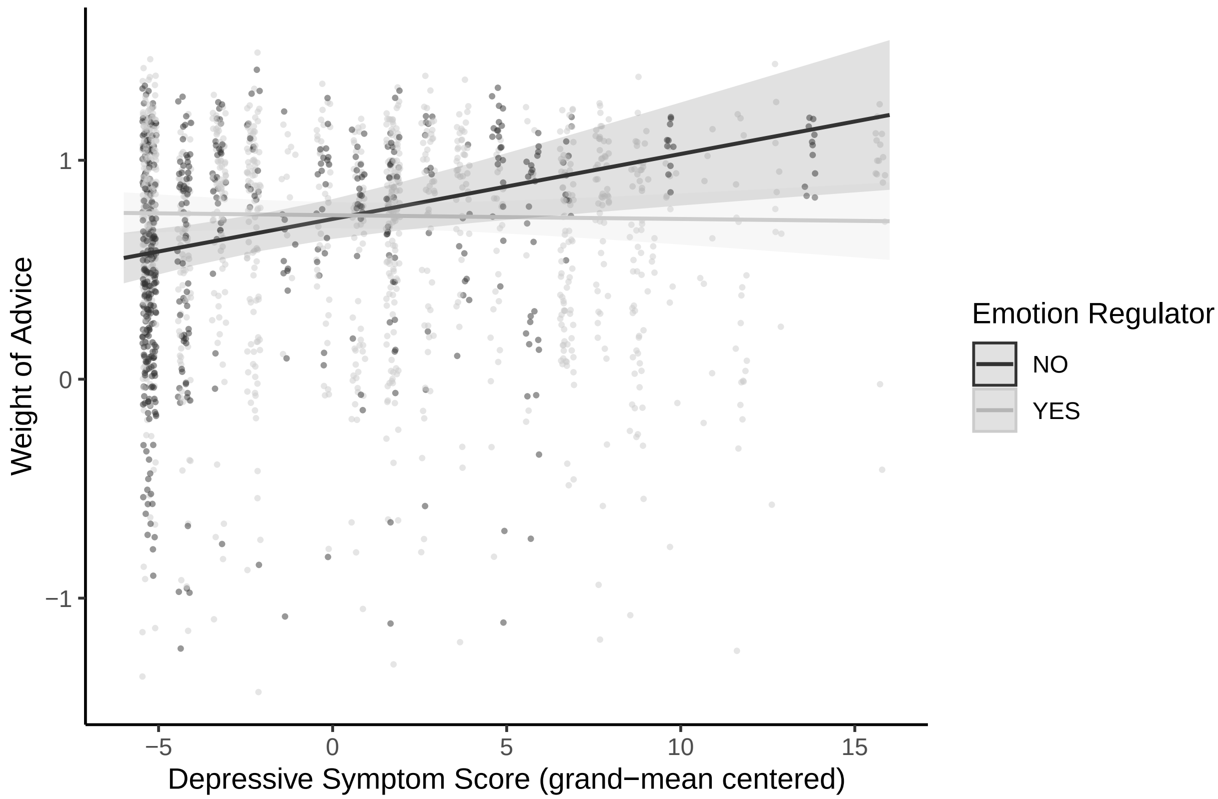
**Visualisations and report for robust model**

```r
## Tab model report
tab_model(model5_robust,
          show.re.var = FALSE,
          show.icc = TRUE, #don't show ICCs
          show.se = TRUE,
          show.ci = 0.95,
          string.ci = "95% CI",
          collapse.se = TRUE,
          string.est = "Estimate (SE)",
          pred.labels = c("Intercept","Age", "Depressive Symptom Score",
                          "Emotion Regulation Used (Yes)",
                          "Depressive Symptom Score*Emotion Regulation Used (Yes)"),
          dv.labels = c("Weight of Advice"),
          file = "model5_Robust.html")


## Visualisation of model
plot_model(model5_robust)
```


### Post hoc on interaction

```
mod5_emm <- emtrends(model5_robust, var = "GMC_DASS",
                     pairwise~GMC_DASS*EMO_REGULATOR)

mod5_emm


# Visualisation

## Make apatheme

apatheme=theme_bw()+
  theme(panel.grid.major=element_blank(),
        panel.grid.minor=element_blank(),
        panel.border=element_blank(),
        axis.line=element_line())

plot_model5_int <- plot_model(model5_robust,
                              type = "pred",
                              colors = "gs",
                                terms = c("GMC_DASS", "EMO_REGULATOR"),
                                title = " ",
                                axis.title = c("Depressive Symptom Score (grand-mean centered)",
```

```r
                                    "Weight of Advice"),
                         legend.title = "Emotion Regulator",
                         show.data = TRUE, dot.size = 0.8, jitter = 0.2,
                         ci.lvl = 0.95) + apatheme
plot_model5_int
```

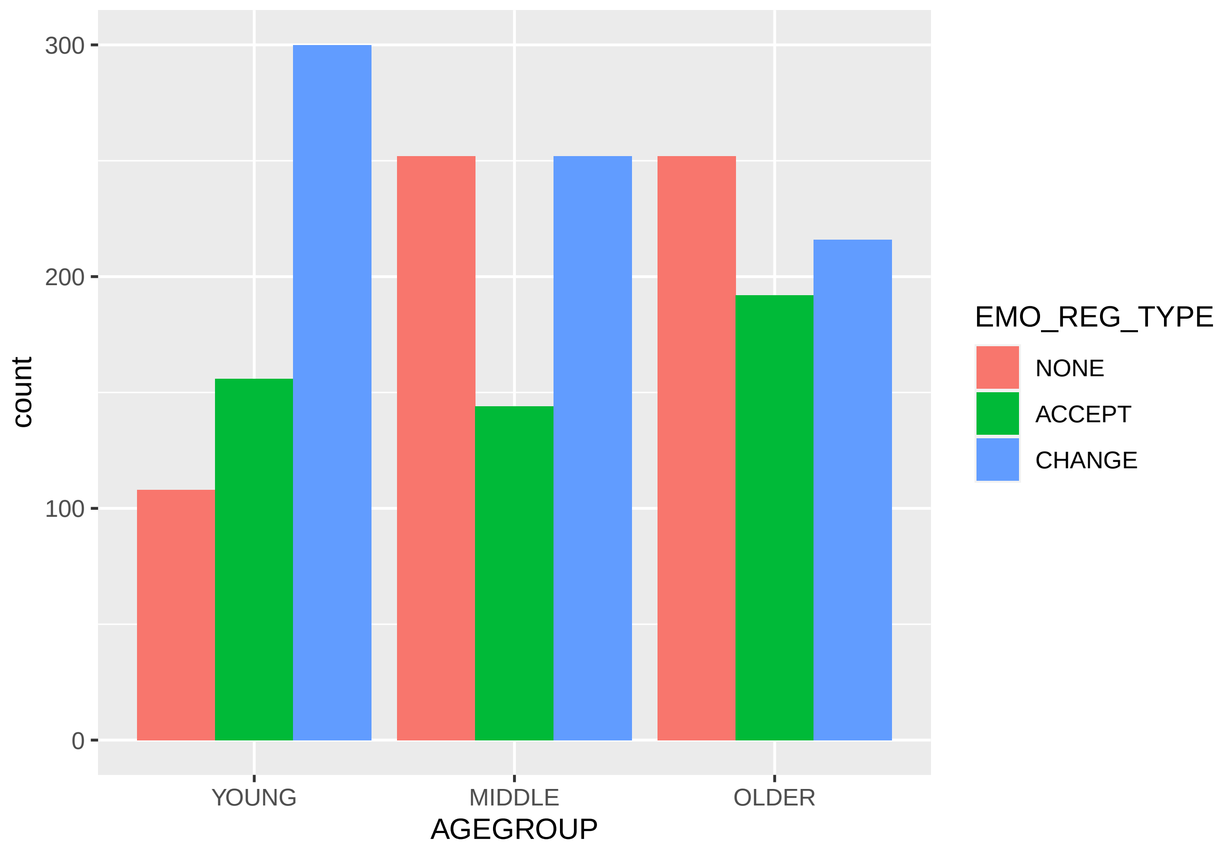



## Difference between age groups and emo regulation type

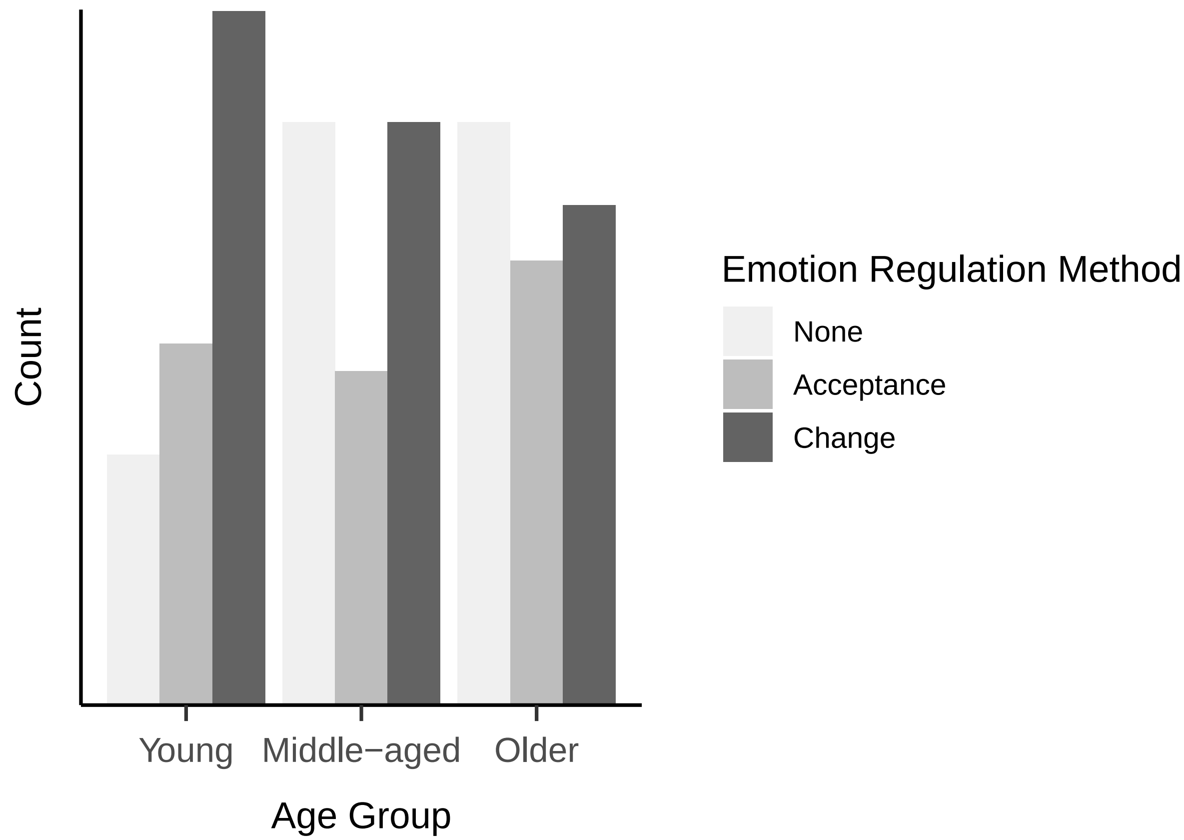
### Chi sqare analysis

```r
# Create categorical variable

# Rename emotion regulation effort 1 to effort in change
ja_df2$EMO_CHNG_EFFORT <- ja_df2$EMO_REG_EFFORT1n

# Rename emotion regulation effort 2 to effort in acceptance
ja_df2$EMO_ACPT_EFFORT <- ja_df2$EMO_REG_EFFORT2n


# Use case_when instead of ifelse

ja_df3 <- ja_df2 %>%
```

```r
  mutate(EMO_REG_TYPE = case_when(EMO_CHNG_EFFORT >= 0 ~ "CHANGE",
                                  EMO_ACPT_EFFORT >= 0 ~ "ACCEPT",
                                  TRUE ~ "NONE"))

# Set as a factor

ja_df3$EMO_REG_TYPE <- as.factor(ja_df3$EMO_REG_TYPE)

levels(ja_df3$EMO_REG_TYPE)

ja_df3$EMO_REG_TYPE <- relevel(ja_df3$EMO_REG_TYPE, "NONE")


# Create one emotion regulation effort variable

ja_df3 <- ja_df3 %>%
  mutate(EMO_REG_EFFORT = case_when(is.na(EMO_CHNG_EFFORT) & is.na(EMO_ACPT_EFFORT)~ NA_real_,
                                    !is.na(EMO_CHNG_EFFORT) & is.na(EMO_ACPT_EFFORT)~
                                      as.numeric(EMO_CHNG_EFFORT),
                                    is.na(EMO_CHNG_EFFORT) & !is.na(EMO_ACPT_EFFORT)~
                                      as.numeric(EMO_ACPT_EFFORT),
                                    TRUE ~ 0))

# Center emotion regulation effort variable

# manually get the mean
emo_effort_m <- ja_df3 %>%
  get_summary_stats(EMO_REG_EFFORT, type = "mean_sd")

ja_df3 <- ja_df3 %>% mutate(GMC_EMO_REG_EFFORT = (EMO_REG_EFFORT -
                                                    emo_effort_m$mean))


ja_df4 <- ja_df3 %>%
  group_by(ID)

ggplot(ja_df4) +
  aes(x = AGEGROUP, fill = EMO_REG_TYPE) +
  geom_bar(position = "dodge")
```




```r
chitest <- chisq.test(table(ja_df4$AGEGROUP, ja_df4$EMO_REG_TYPE))
chitest

chitest$expected

ja_df4 %>%
  count(ID)


## Create APA bar graph

emo_type_graph <- ja_df4 %>%
  ggplot(aes(x= AGEGROUP, fill = EMO_REG_TYPE)) +
    geom_bar(position = "dodge") +
  scale_x_discrete(name = "Age Group", labels = c('Young','Middle-aged',
                                                  'Older')) +
  scale_y_discrete(name = "Count") +
  scale_fill_brewer(palette = "Greys", name = "Emotion Regulation Method",
                    breaks = c("NONE", "ACCEPT", "CHANGE"),
                    labels=c("None", "Acceptance", "Change")) +
  theme_apa(base_size = 14)


emo_type_graph
```




```
ja_df4 <- ja_df4 %>% ungroup()
```

## Correlation

### Hypothesis 2: Depressive symptoms in older age either associated directly with a decline in cognitive ability, or via increased emotion regulation.

###In both cases, reduced cognitive capacity was expected to be associated with increased advice-taking

#### Prepare data for correlations

```
# Pivot back wider
ja_df5 <- spread(ja_df4, JAR, WOA)

# Create Grand Mean Centered emo effort scores


ja_df5 <- ja_df5 %>%
  mutate(GMC_EMO_CHNG_EFFORT = scale(EMO_CHNG_EFFORT, center = TRUE, scale = FALSE))

ja_df5 <- ja_df5 %>%
  mutate(GMC_EMO_ACPT_EFFORT  = scale(EMO_ACPT_EFFORT, center = TRUE, scale = FALSE))
```

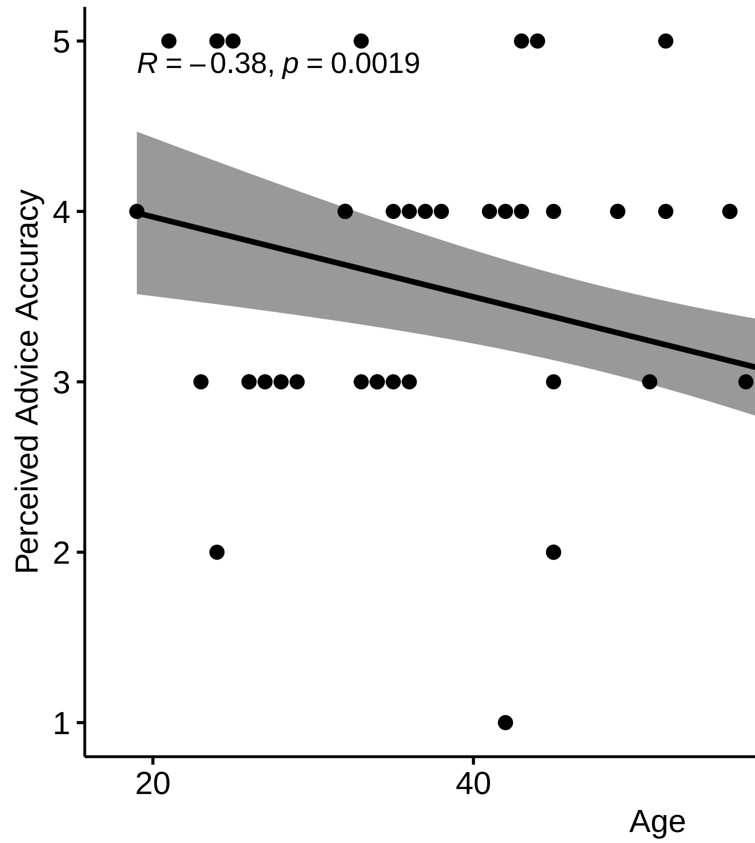
```
# Make average WOA for each person

ja_df5 <- ja_df5 %>%
  rowwise() %>%
  mutate(AVG_WOA = mean(c(JAR01_WOA, JAR02_WOA, JAR03_WOA, JAR04_WOA,
                          JAR05_WOA, JAR06_WOA, JAR07_WOA, JAR08_WOA,
                          JAR09_WOA, JAR10_WOA, JAR11_WOA, JAR12_WOA),
                        na.rm=TRUE))

# Change factored levels of emotion regulator

ja_df5$EMO_REGULATOR <- gsub("NO", "0", ja_df5$EMO_REGULATOR)

ja_df5$EMO_REGULATOR <- gsub("YES", "1", ja_df5$EMO_REGULATOR)

ja_df5$EMO_REGULATOR <- as.numeric(ja_df5$EMO_REGULATOR)

structure(ja_df5)

# Select variables for correlation
# Split by emo regulation types

cor_df_chg <- ja_df5 %>% filter(EMO_CHNG_EFFORT >= 1)

cor_df_chg <- select(cor_df_chg, AGEn, DASS, EMO_CHNG_EFFORT, PRE_CONFIDENCEn,
                     POST_CONFIDENCEn,
                 PERCEIVED_ADVICE_ACCURACYn, AVFLUIDIQ, AVG_WOA)

cor_df_acpt <- ja_df5 %>% filter(EMO_ACPT_EFFORT >= 1)

cor_df_acpt <- select(cor_df_acpt, AGEn, DASS, EMO_ACPT_EFFORT, PRE_CONFIDENCEn,
                      POST_CONFIDENCEn,
                 PERCEIVED_ADVICE_ACCURACYn, AVFLUIDIQ, AVG_WOA)
```

**Functions to create APA matrix table**

```
# mat A matrix or data frame
# p A matrix with the same dimension as `mat`
# f A function to apply
#' @return `mat` with `f` applied to each cell where `p` is TRUE.
#' @examples
#' x <- rbind(c(1,2,3), c(4,5,6), c(7,8,9))
#' apply_if(x, upper.tri(x), function(x) x + 5)
#'
apply_if <- function(mat, p, f) {
  # Fill NA with FALSE
  p[is.na(p)] <- FALSE
  mat[p] <- f(mat[p])
  mat
}
```

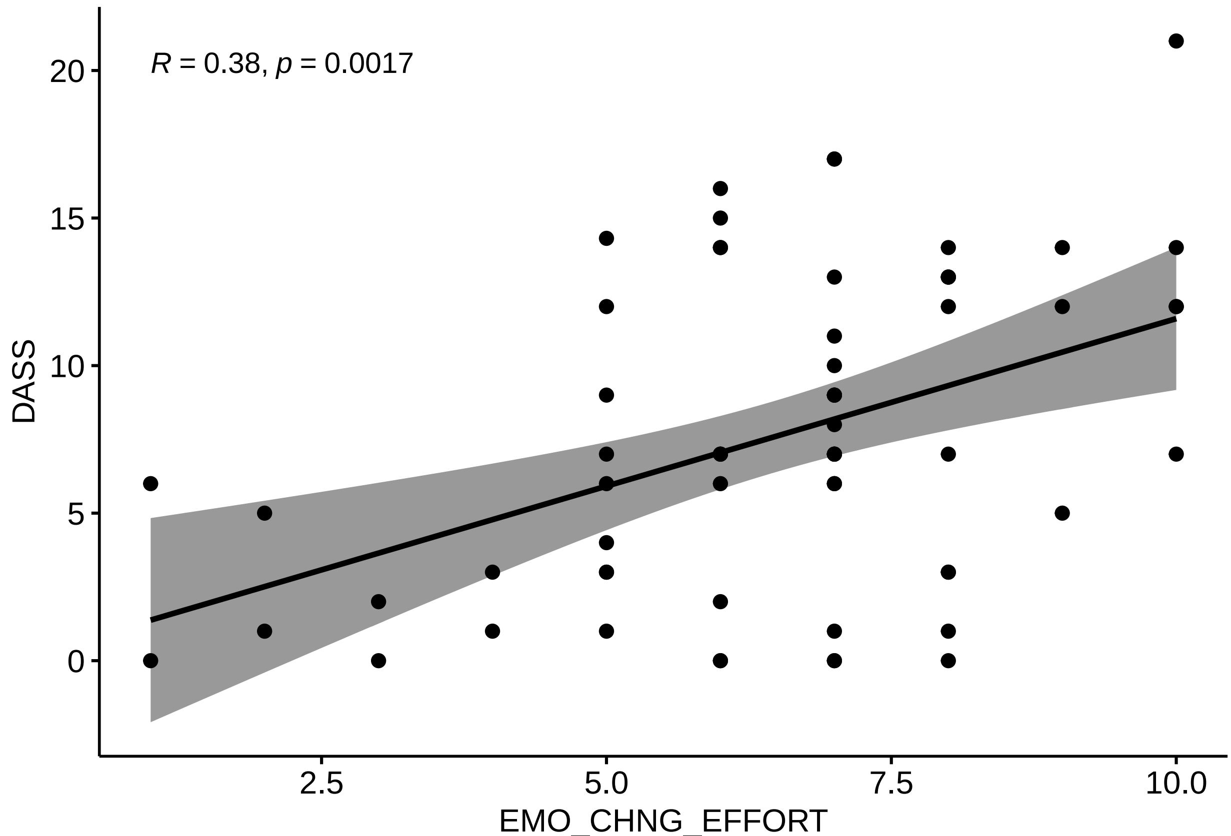
```r
#' @param mat an rcorr object or a double matrix
#' @param corrtype is either pearson or spearman. Will be passed into
#' Hmsic::rcorr if mat is not already an rcorr object
#' @return `mat` with stars appended for each level of significants
#' (p < 0.05, p < 0.01, p < 0.001)
apaCorr <- function(mat, corrtype = "pearson") {
  matCorr <- mat
  if (class(matCorr) != "rcorr") {
    matCorr <- rcorr(mat, type = corrtype)
  }

  # Add one star for each p < 0.05, 0.01, 0.001
  stars <- apply_if(round(matCorr$r, 2), matCorr$P < 0.05, function(x) paste0(x, "*"))
  stars <- apply_if(stars, matCorr$P < 0.01, function(x) paste0(x, "*"))
  stars <- apply_if(stars, matCorr$P < 0.001, function(x) paste0(x, "*"))
  # Put - on diagonal and blank on upper diagonal
  stars[upper.tri(stars, diag = T)] <- "-"
  stars[upper.tri(stars, diag = F)] <- ""
  n <- length(stars[1,])
  colnames(stars) <- 1:n
  # Remove _ and convert to title case
  row.names(stars) <- tools::toTitleCase(sapply(row.names(stars), gsub,
                                                 pattern="_", replacement = " "))
  # Add index number to row names
  row.names(stars) <- paste(paste0(1:n,"."), row.names(stars))
  stars
}
```

```r
rcorr(as.matrix(cor_df_chg), type = "spearman")

chg_corr <- apaCorr(as.matrix(cor_df_chg), corrtype = "spearman")

chg_corr


chg_corr_out <- kable(chg_corr, format = "html")

# Save the table:
# readr::write_file(chg_corr_out, "chg_corr_out.html")

# Visualisation of some sig relationships

# Age and perceived advice accuracy
ggscatter(cor_df_chg, x = "AGEn", y = "PERCEIVED_ADVICE_ACCURACYn",
          add = "reg.line", conf.int = TRUE,
          cor.coef = TRUE, cor.method = "spearman",
          xlab = "Age", ylab = "Perceived Advice Accuracy")
```

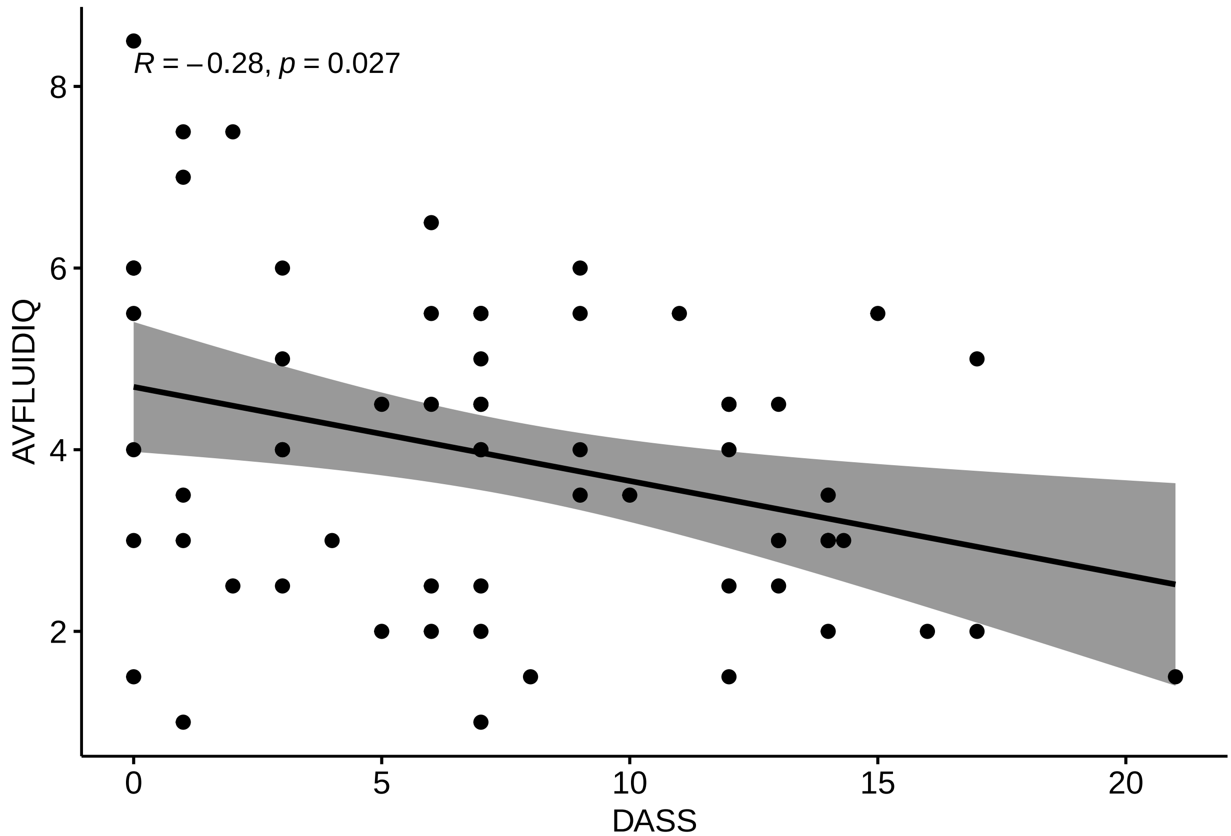



**Correlation matrix for change emotions regulators**

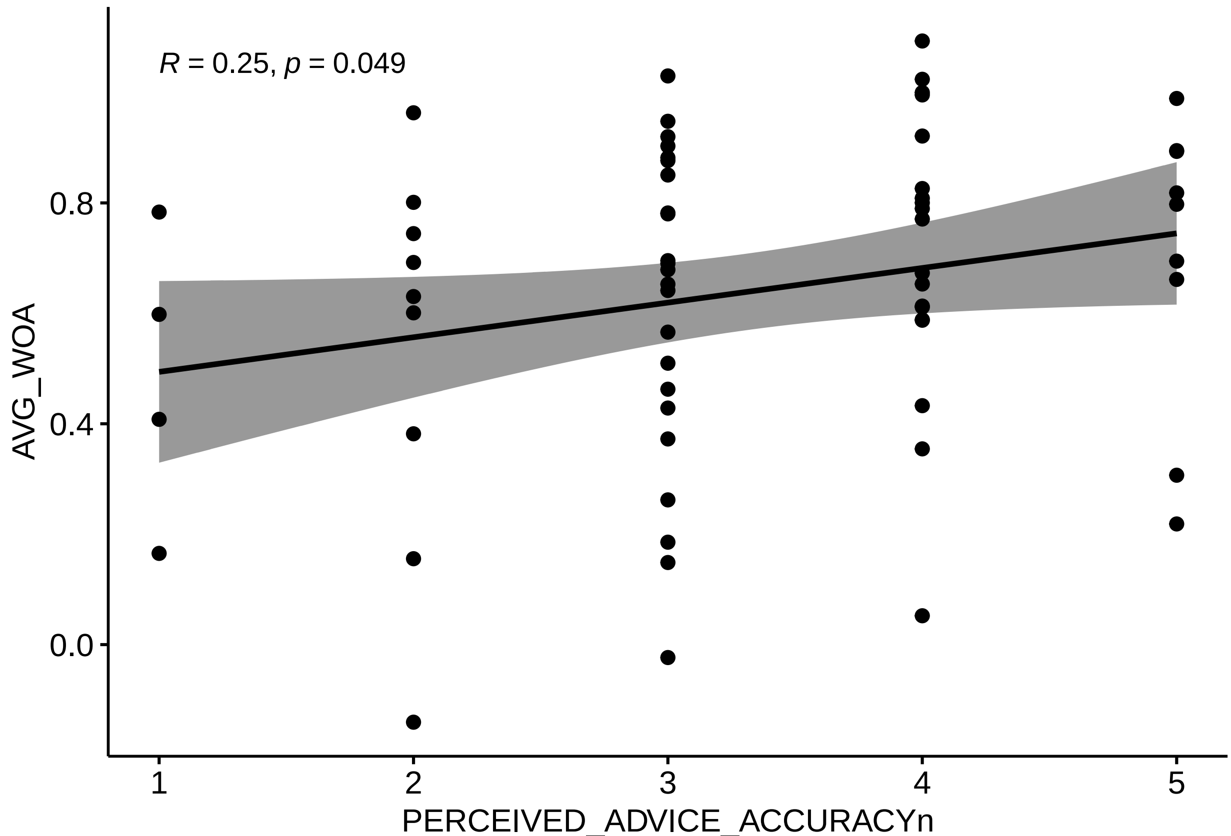
```
# Emotion regulation change effort and depressive symptoms
ggscatter(cor_df_chg, x = "EMO_CHNG_EFFORT", y = "DASS",
          add = "reg.line", conf.int = TRUE,
          cor.coef = TRUE, cor.method = "spearman")
```




```
# Depressive symptoms and fluid IQ
ggscatter(cor_df_chg, x = "DASS", y = "AVFLUIDIQ",
          add = "reg.line", conf.int = TRUE,
          cor.coef = TRUE, cor.method = "spearman")
```

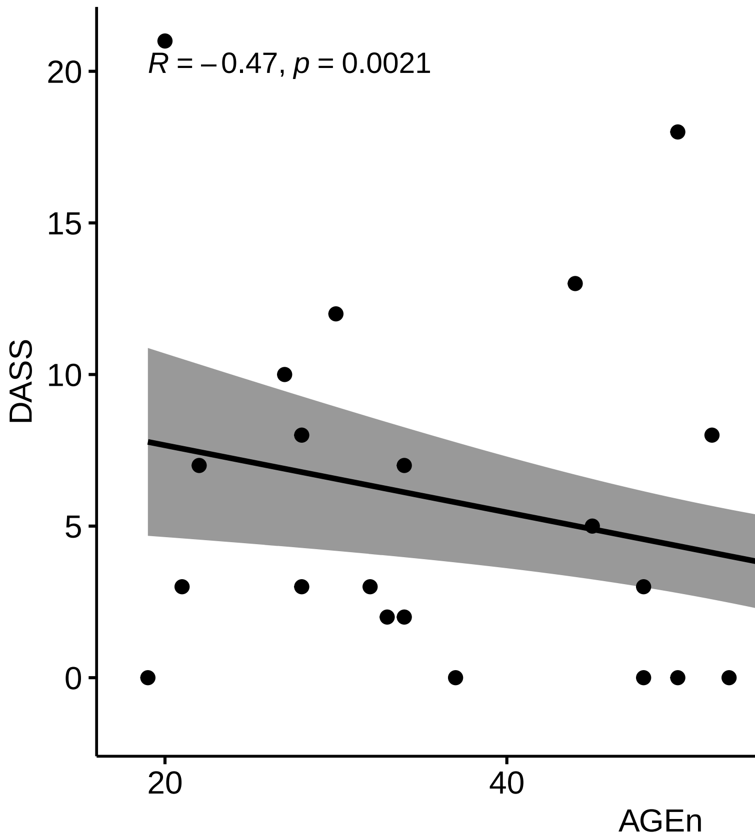



```
# Advice accuracy and WOA
ggscatter(cor_df_chg, x = "PERCEIVED_ADVICE_ACCURACYn", y = "AVG_WOA",
          add = "reg.line", conf.int = TRUE,
          cor.coef = TRUE, cor.method = "spearman")
```



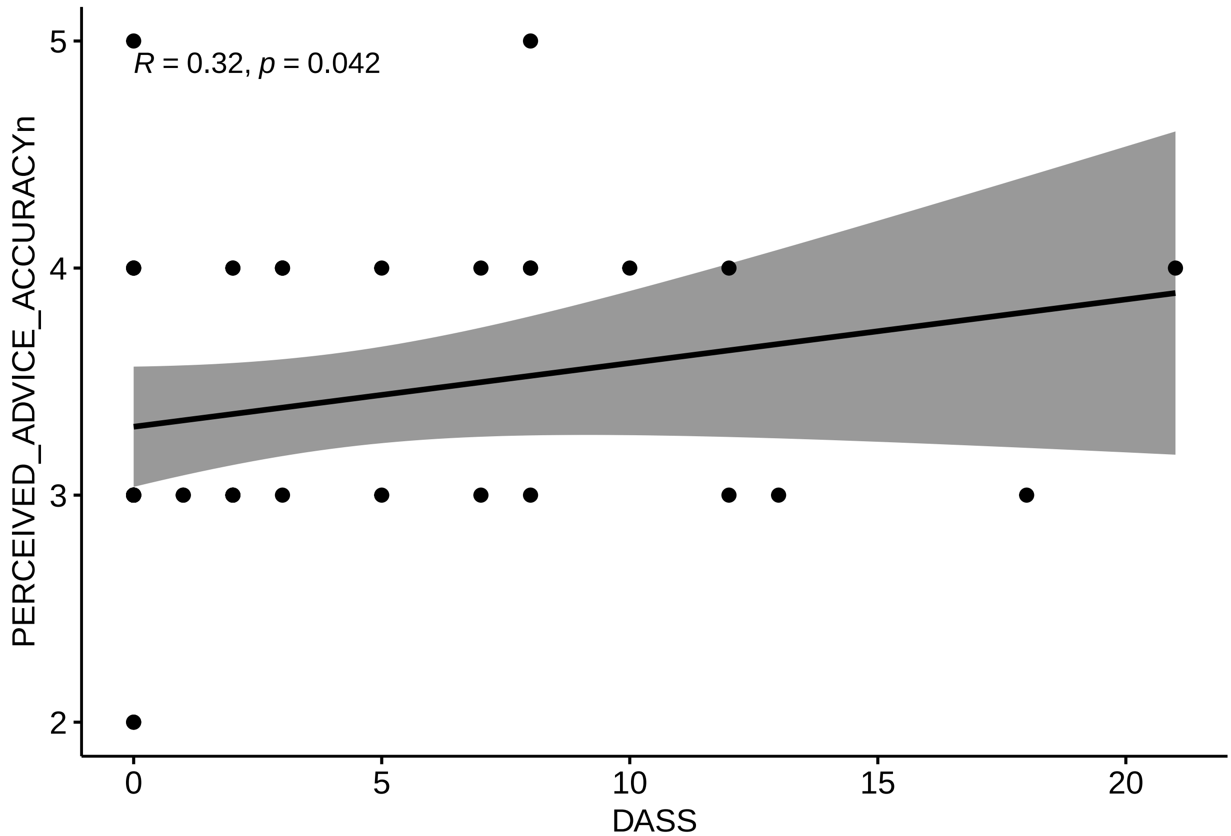

```
cor_df_chg %>%
  get_summary_stats()
```

```
rcorr(as.matrix(cor_df_acpt), type = "spearman")

acpt_corr <- apaCorr(as.matrix(cor_df_acpt), corrtype = "spearman")

acpt_corr

acpt_corr_out <- kable(acpt_corr, format = "html")

# Save the table:
# readr::write_file(acpt_corr_out, "acpt_corr_out.html")

# Visualisation of some sig relationships

# Age and depressive symptoms
ggscatter(cor_df_acpt, x = "AGEn", y = "DASS",
          add = "reg.line", conf.int = TRUE,
          cor.coef = TRUE, cor.method = "spearman")
```




**Correlation matrix for accept emotions regulators**

```
# Depressive symptoms and perceived advice accuracy
ggscatter(cor_df_acpt, x = "DASS", y = "PERCEIVED_ADVICE_ACCURACYn",
          add = "reg.line", conf.int = TRUE,
          cor.coef = TRUE, cor.method = "spearman")
```

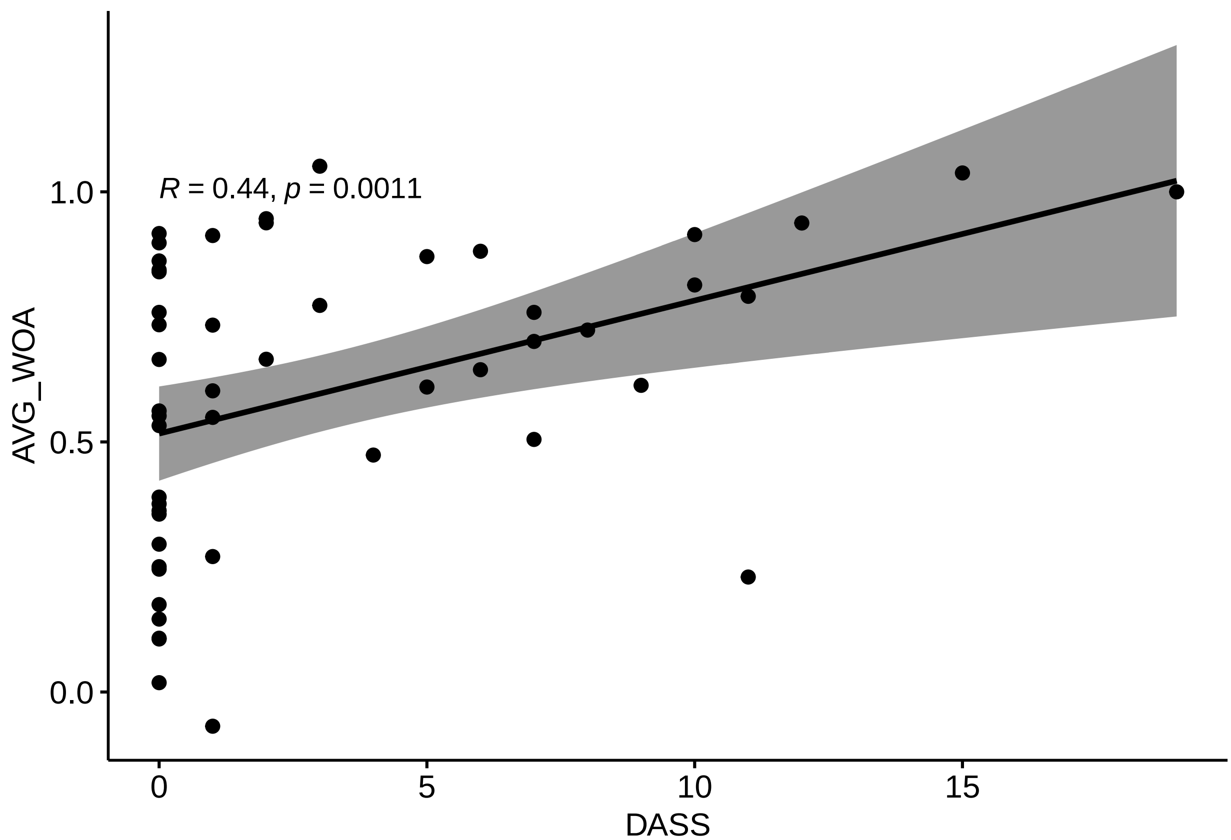



```
cor_df_acpt %>%
  get_summary_stats()
```

**Correlation matrix for non-emotion regulators**

```
# Change back to factored levels of emotion regulator

ja_df5$EMO_REGULATOR <- gsub("0", "NO", ja_df5$EMO_REGULATOR)

ja_df5$EMO_REGULATOR <- gsub("1", "YES", ja_df5$EMO_REGULATOR)

ja_df5$EMO_REGULATOR <- as.factor(ja_df5$EMO_REGULATOR)

# Select variables for correlation

no_er_cor_df <- select(ja_df5, AGEn, DASS, EMO_REGULATOR, PRE_CONFIDENCEn, POST_CONFIDENCEn,
                 PERCEIVED_ADVICE_ACCURACYn, AVFLUIDIQ, AVG_WOA)

no_er_cor_df <- no_er_cor_df %>% filter(EMO_REGULATOR == "NO")

# Select variables again - exclude emo regulator

no_er_cor_df <- select(no_er_cor_df, AGEn, DASS, PRE_CONFIDENCEn, POST_CONFIDENCEn,
                 PERCEIVED_ADVICE_ACCURACYn, AVFLUIDIQ, AVG_WOA)
```

```r
rcorr(as.matrix(no_er_cor_df), type = "spearman")

no_er_corr <- apaCorr(as.matrix(no_er_cor_df), corrtype = "spearman")

no_er_corr_out <- kable(no_er_corr, format = "html")

# Save the table:
#readr::write_file(no_er_corr_out, "no_er_corr_out.html")

# Visualisation of some sig relationships

# Depressive symptoms and WOA
ggscatter(no_er_cor_df, x = "DASS", y = "AVG_WOA",
          add = "reg.line", conf.int = TRUE,
          cor.coef = TRUE, cor.method = "spearman")
```




```r
no_er_cor_df %>%
  get_summary_stats()
```

## Exploratory analyses

### Prep confidence & advice accuracy variables

```
# Grand mean center pre-confidence

ja_df6 <- ja_df5 %>% ungroup()

ja_df6 <- ja_df6 %>%
  mutate(GMC_PRE_CONF = scale(PRE_CONFIDENCEn, center = TRUE, scale = FALSE))

ja_df6 <- ja_df6 %>%
  mutate(GMC_POST_CONF = scale(POST_CONFIDENCEn, center = TRUE, scale = FALSE))

ja_df6 <- ja_df6 %>%
  mutate(GMC_PERCEIVED_ACC = scale(PERCEIVED_ADVICE_ACCURACYn, center = TRUE,
                                    scale = FALSE))

# Pivot longer by WOA and Jar

ja_df6 <- pivot_longer(ja_df6, cols = c("JAR01_WOA":"JAR12_WOA"),
                       names_to = "JAR", values_to = "WOA")

ja_df6$JAR <- as.factor(ja_df6$JAR)
```

### Make fluid IQ a GMC variable

```
ja_df6 <- ja_df6 %>%
  mutate(GMC_FLUIDIQ = scale(AVFLUIDIQ, center = TRUE, scale = FALSE))
```

### Exploratory LMM

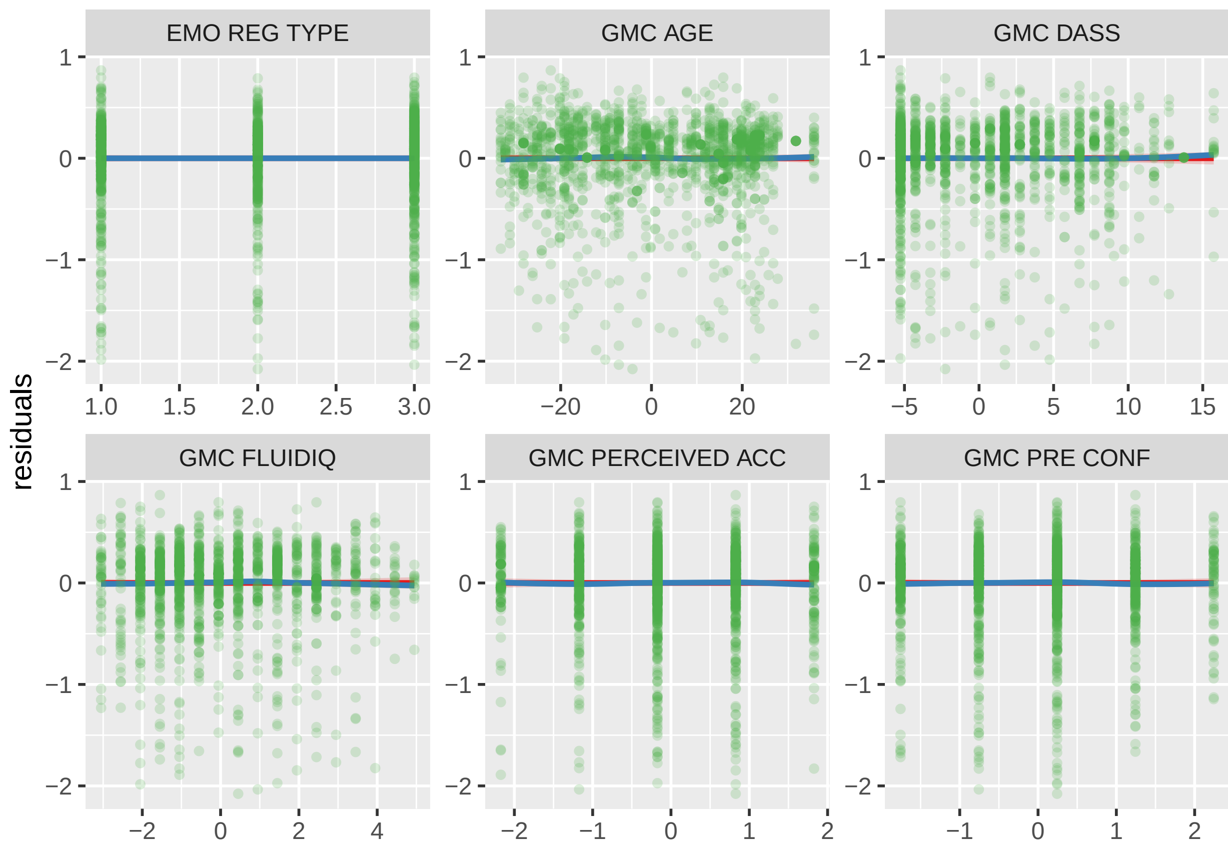
```
# Baseline LMM will have age, DSS, Emo reg type, fluid IQ, pre-conf, and perceived advice accuracy.

model8 <- lmer(WOA~GMC_AGE + GMC_DASS + EMO_REG_TYPE + GMC_FLUIDIQ +
                 GMC_PRE_CONF + GMC_PERCEIVED_ACC +
                  (1|ID), data = ja_df6,  control=lmerControl(optimizer="bobyqa",
                                                              optCtrl=list(maxfun=2e5)))

model9 <- lmer(WOA~GMC_AGE*GMC_DASS + EMO_REG_TYPE + GMC_FLUIDIQ + GMC_PRE_CONF +
                 GMC_PERCEIVED_ACC +
                  (1|ID), data = ja_df6,  control=lmerControl(optimizer="bobyqa",
                                                              optCtrl=list(maxfun=2e5)))

anova(model8, model9) # Retain model 8

model10 <- lmer(WOA~GMC_AGE + GMC_DASS*EMO_REG_TYPE + GMC_FLUIDIQ + GMC_PRE_CONF +
                  GMC_PERCEIVED_ACC +
```

```
                  (1|ID), data = ja_df6,  control=lmerControl(optimizer="bobyqa",
                                                    optCtrl=list(maxfun=2e5)))

anova(model8, model10) # Retain model 10

model11 <- lmer(WOA~GMC_AGE + GMC_DASS*EMO_REG_TYPE*GMC_FLUIDIQ + GMC_PRE_CONF +
                  GMC_PERCEIVED_ACC +
                  (1|ID), data = ja_df6,  control=lmerControl(optimizer="bobyqa",
                                                    optCtrl=list(maxfun=2e5)))

anova(model10, model11) # Retain model 10

model12 <- lmer(WOA~GMC_AGE + GMC_DASS*EMO_REG_TYPE + GMC_FLUIDIQ + GMC_PRE_CONF*GMC_DASS +
                  GMC_PERCEIVED_ACC +
                  (1|ID), data = ja_df6,  control=lmerControl(optimizer="bobyqa",
                                                    optCtrl=list(maxfun=2e5)))

anova(model10, model12) # Retain model 10

model13 <- lmer(WOA~GMC_AGE*GMC_DASS*EMO_REG_TYPE + GMC_FLUIDIQ + GMC_PRE_CONF +
                  GMC_PERCEIVED_ACC +
                  (1|ID), data = ja_df6,  control=lmerControl(optimizer="bobyqa",
                                                    optCtrl=list(maxfun=2e5)))

anova(model10, model13) # Retain model 10

model14 <- lmer(WOA~GMC_AGE +GMC_DASS*EMO_REG_TYPE*GMC_PERCEIVED_ACC + GMC_FLUIDIQ +
                  GMC_PRE_CONF +
                  (1|ID), data = ja_df6,  control=lmerControl(optimizer="bobyqa",
                                                    optCtrl=list(maxfun=2e5)))

anova(model10, model14) # Retain model 10


model15 <- lmer(WOA~GMC_AGE + GMC_DASS*EMO_REG_TYPE + GMC_FLUIDIQ +
                  GMC_PRE_CONF*GMC_PERCEIVED_ACC +
                  (1|ID), data = ja_df6,  control=lmerControl(optimizer="bobyqa",
                                                    optCtrl=list(maxfun=2e5)))

anova(model10, model15)# Retain model 10



model16 <- lmer(WOA~GMC_AGE*GMC_PRE_CONF + GMC_DASS*EMO_REG_TYPE + GMC_FLUIDIQ +
                  GMC_PERCEIVED_ACC +
                  (1|ID), data = ja_df6,  control=lmerControl(optimizer="bobyqa",
                                                    optCtrl=list(maxfun=2e5)))

anova(model10, model16) # Retain model 10

model17 <- lmer(WOA~GMC_AGE*GMC_FLUIDIQ + GMC_PRE_CONF + GMC_DASS*EMO_REG_TYPE +
                  GMC_FLUIDIQ + GMC_PERCEIVED_ACC +
                  (1|ID), data = ja_df6,  control=lmerControl(optimizer="bobyqa",
```

```
                                    optCtrl=list(maxfun=2e5)))

anova(model10, model17) # Retain model 10

summary(model10)
```

### Check assumptions

```
# Linearity of relationships
linearity_model10 <- plot_model(model10, type = "resid",  show.data = TRUE)
linearity_model10
```



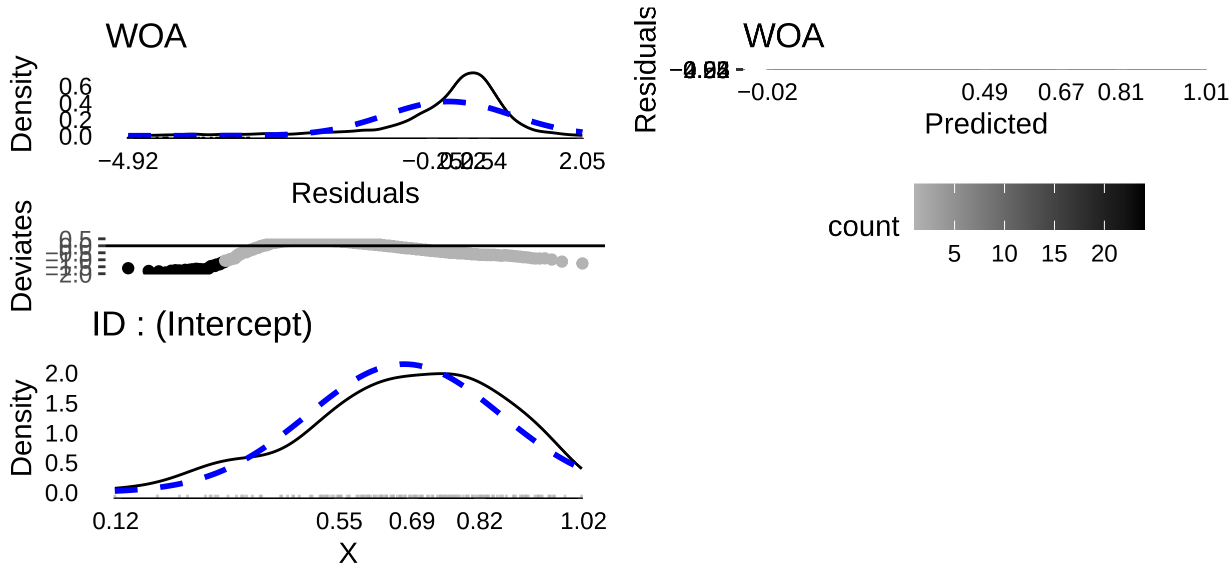

```
# Normality of residuals

model10_diagnostics1 <- visualize(model10, plot = "residuals")
```

```
## Error in visualize(model10, plot = "residuals"): could not find function "visualize"
```

```
model10_diagnostics1
```

```
## Error in eval(expr, envir, enclos): object 'model10_diagnostics1' not found
```

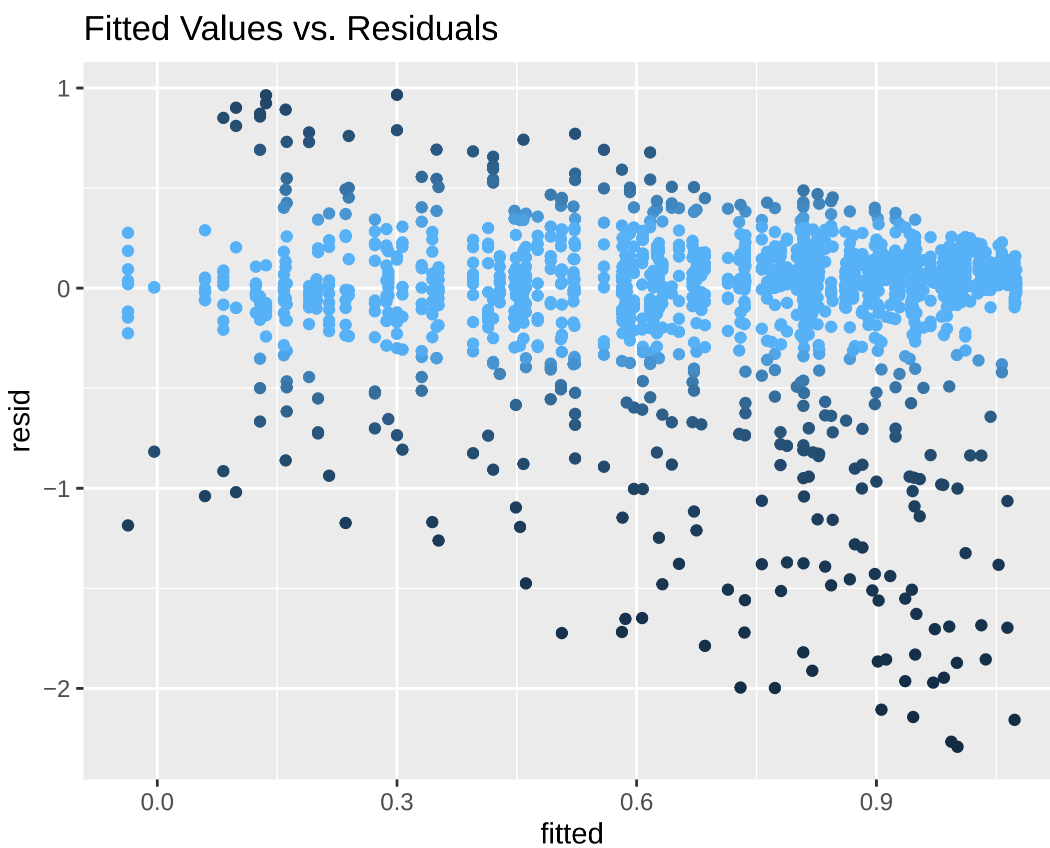
```
tab_model(model10)

model10_diagnostics2 <- modelDiagnostics(model10, ev.perc = .001)

plot(model10_diagnostics2, ask = FALSE, ncol = 2, nrow = 3)
```



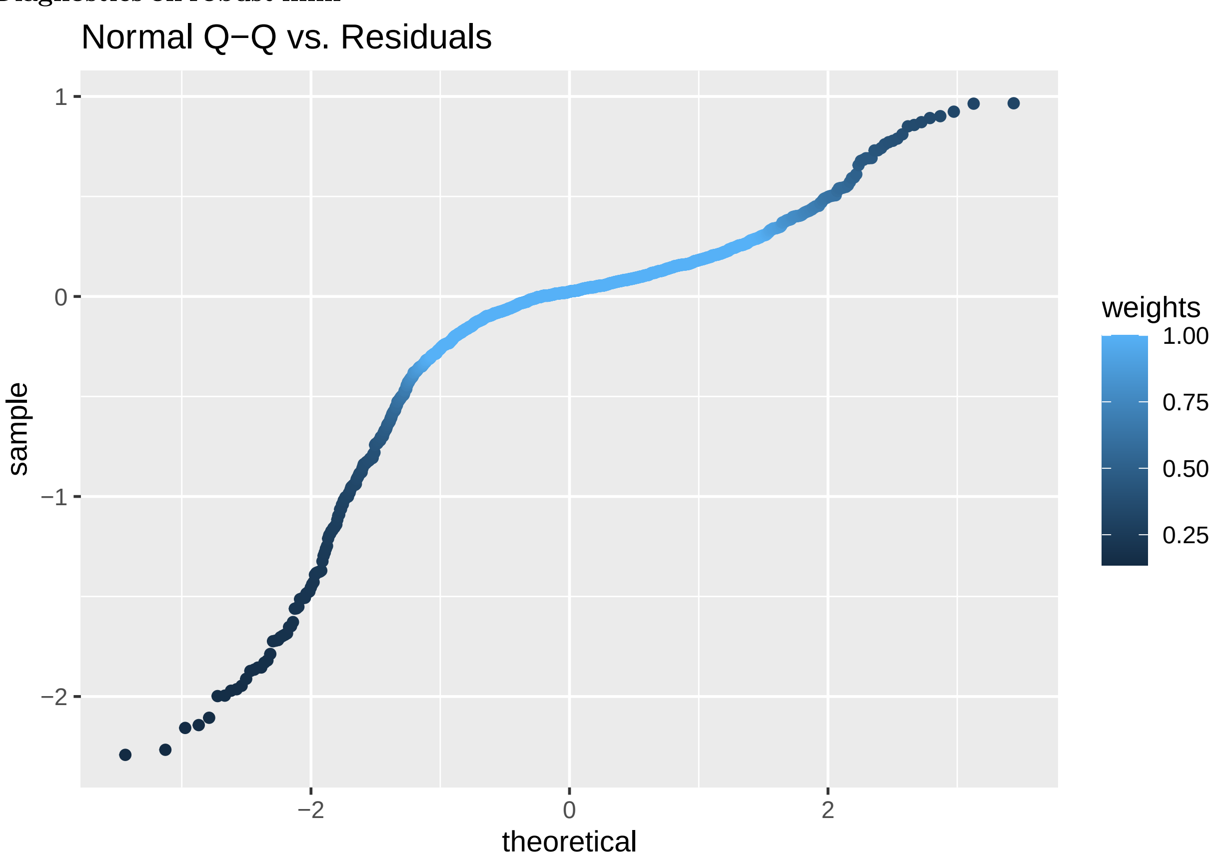

```
model10_robust <- rlmer(WOA~GMC_AGE + GMC_DASS*EMO_REG_TYPE + GMC_FLUIDIQ +
                       GMC_PRE_CONF + GMC_PERCEIVED_ACC +
                       (1|ID), data = ja_df6, control=lmerControl(optimizer="bobyqa",
                                                  optCtrl=list(maxfun=2e5)))

summary(model10_robust)

summary(model10)
```

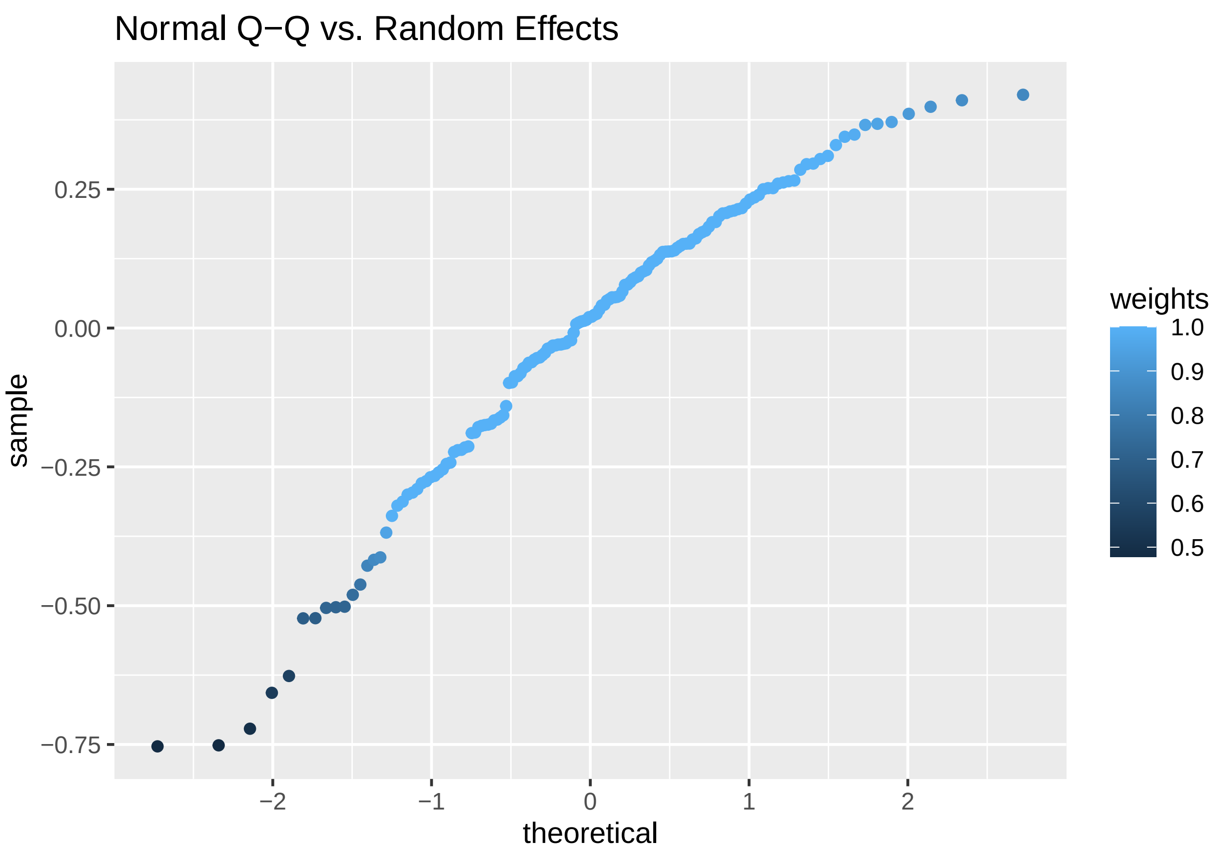
**Robust LMM**

```
plot(model10_robust)
```

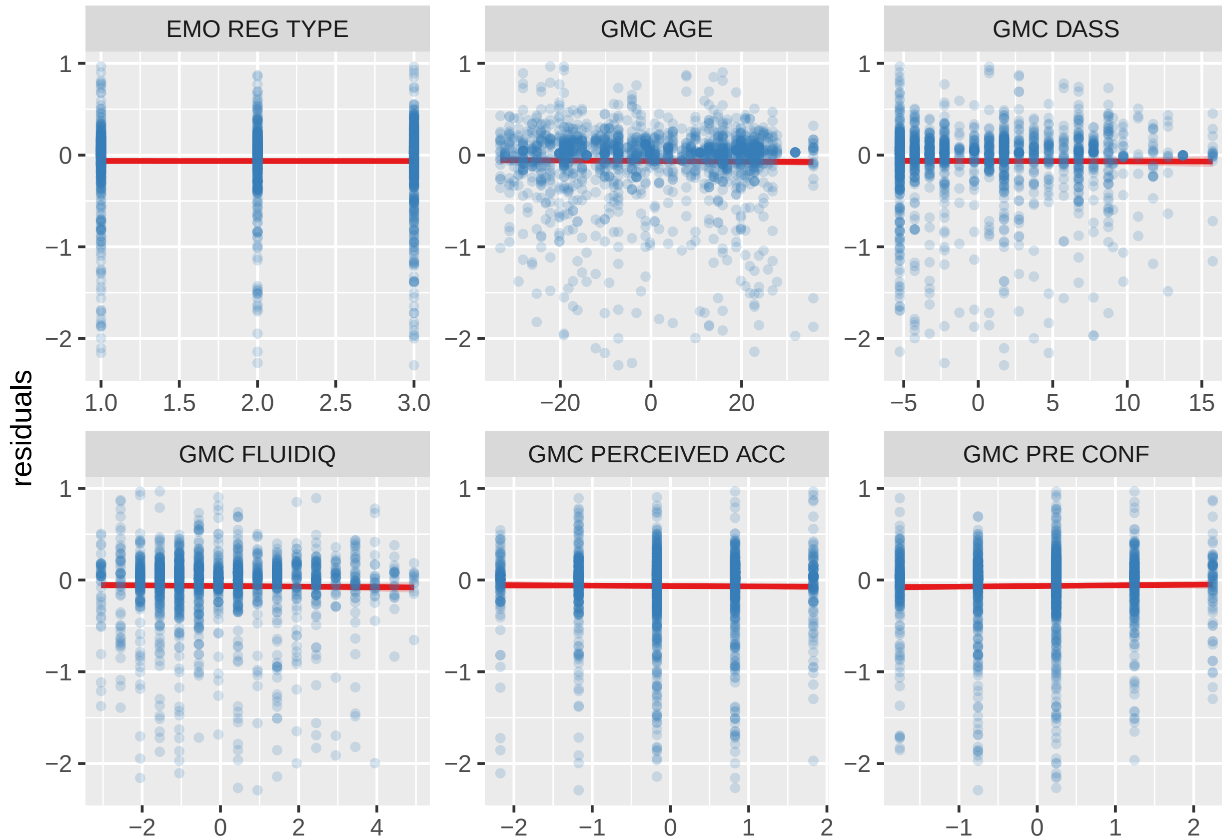



**Diagnostics on robust lmm**






```
tab_model(model10_robust)

plot_model(model10_robust, type = "resid",  show.data = TRUE, show.loess = FALSE)
```

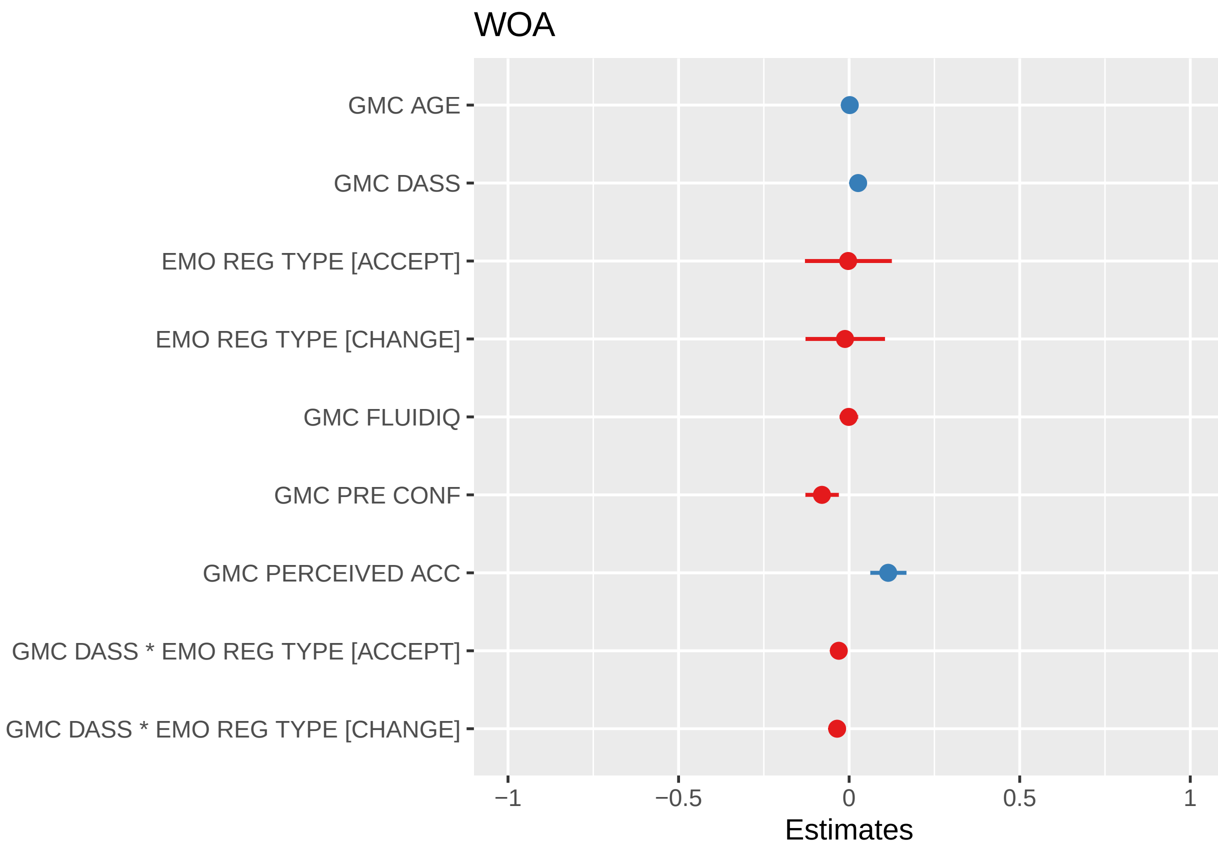



```
# Use the robust model given normality violations
```

**Visualisations and report for robust model**

```
## Tab model report
tab_model(model10_robust,
          show.re.var = FALSE,
          show.icc = TRUE,
          show.se = TRUE,
          show.ci = 0.95,
          string.ci = "95% CI",
          collapse.se = TRUE,
          string.est = "Estimate (SE)",
          #pred.labels = c("Intercept","Age", "Emotion Regulation (Accept)",
                        #  "Emotion Regulation (Change)",
                        #  "Depressive Symptom Score", "Pre-Confidence Score",
                        #  "Perceived Advice Accuracy",
                        #  "Emotion Regulation (Accept)*DSS",
                        #  "Emotion Regulation (Change)*DSS"),
          dv.labels = c("Weight of Advice"),
          file = "model10_Robust.html")
```

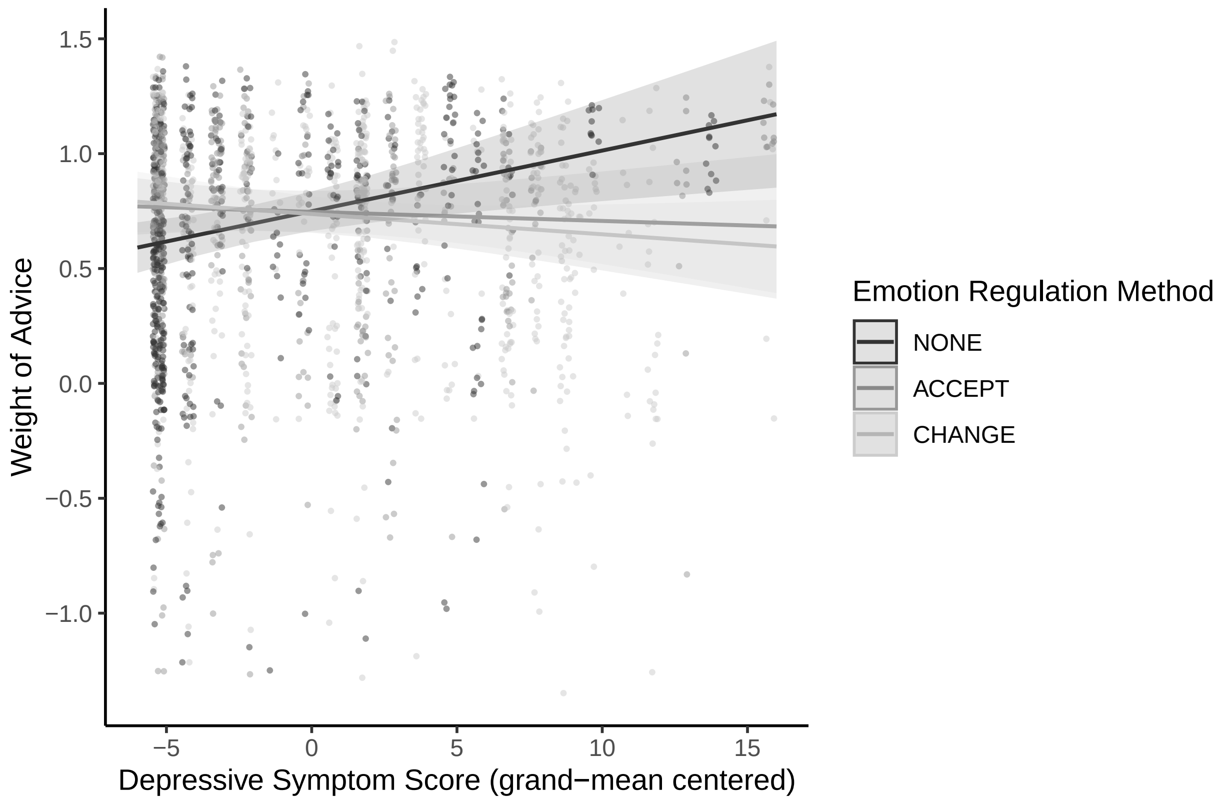
```r
## Visualisation of model
plot_model(model10_robust)
```




#### Post hoc on interaction

```r
mod10_emm <- emtrends(model10_robust, var = "GMC_DASS",
                      pairwise~GMC_DASS*EMO_REG_TYPE)

mod10_emm


## Visualisation

# Make apatheme

apatheme=theme_bw()+
  theme(panel.grid.major=element_blank(),
        panel.grid.minor=element_blank(),
        panel.border=element_blank(),
        axis.line=element_line())

plot_model10_int <- plot_model(model10_robust,
                               colors = "gs",
```

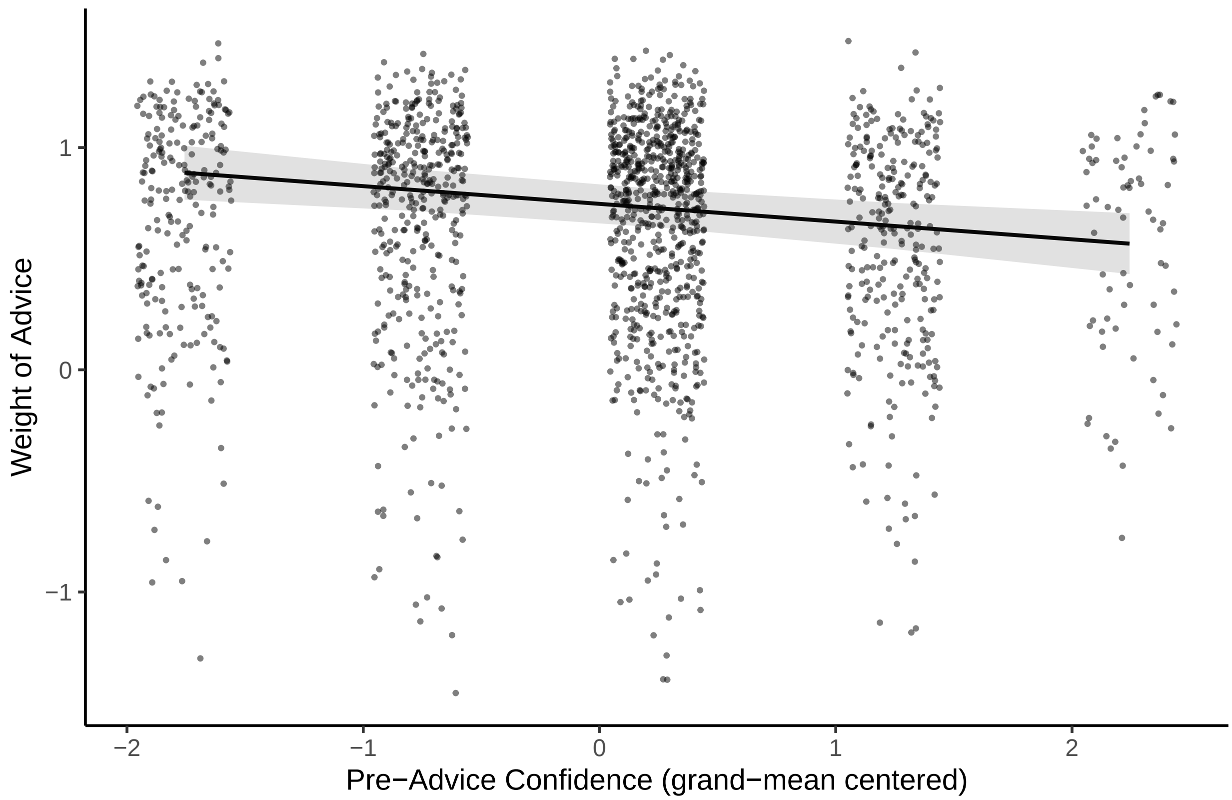
```
                                type = "pred",
                                 terms = c("GMC_DASS", "EMO_REG_TYPE"),
                                 title = " ",
                                 axis.title = c("Depressive Symptom Score (grand-mean centered)",
                                                "Weight of Advice"),
                                 legend.title = "Emotion Regulation Method",
                                 show.data = TRUE, dot.size = 0.8, jitter = 0.2,
                                 ci.lvl = 0.95) + apatheme
plot_model10_int
```



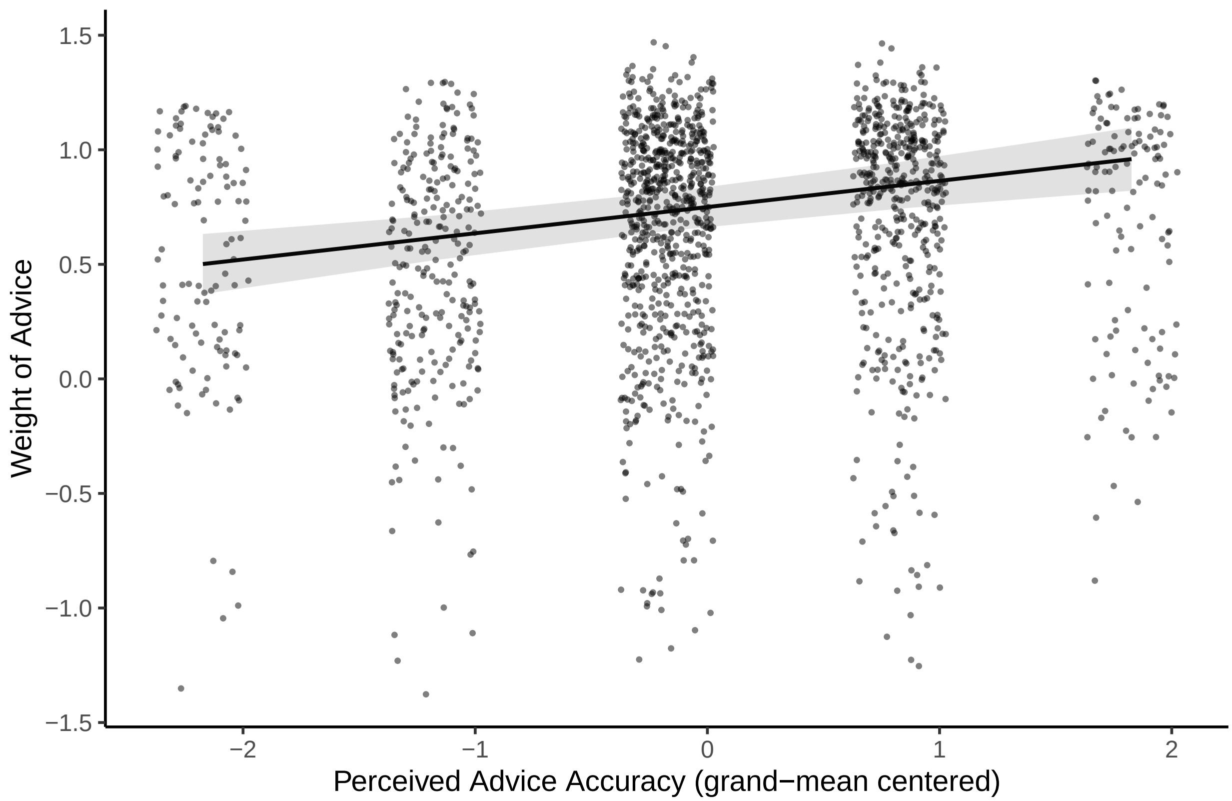

#### Main effects visualisations

```
apatheme=theme_bw()+
  theme(panel.grid.major=element_blank(),
        panel.grid.minor=element_blank(),
        panel.border=element_blank(),
        axis.line=element_line())

# Pre-confidence plot
pre_conf_plot <- plot_model(model10_robust,
                            colors = "gs",
                            type = "pred",
                                terms = "GMC_PRE_CONF",
```

```r
                                title = " ",
                                axis.title = c("Pre-Advice Confidence (grand-mean centered)",
                                               "Weight of Advice"),
                                show.data = TRUE, dot.size = 0.8, jitter = 0.2,
                                ci.lvl = 0.95) + apatheme
pre_conf_plot
```




```r
# Perceived advice accuracy plot

per_advice_acc_plot <- plot_model(model10_robust,
                                  colors = "gs",
                                  type = "pred",
                                terms = "GMC_PERCEIVED_ACC",
                                title = " ",
                                axis.title = c("Perceived Advice Accuracy (grand-mean centered)",
                                               "Weight of Advice"),
                                show.data = TRUE, dot.size = 0.8, jitter = 0.2,
                                ci.lvl = 0.95) + apatheme
per_advice_acc_plot
```



Weight of Advice
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2
−1
0
1
2
Perceived Advice Accuracy (grand−mean centered)