Prochoice Analysis

Load the data

```r
library(readxl)

file_path <- "/Users/daryani/Desktop/prochoice_intervention.xlsx"

data <- read_excel(file_path)
```

Pepare the data

```r
library(dplyr)
```

```
Attaching package: 'dplyr'

The following objects are masked from 'package:stats':

    filter, lag

The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
```

```
# Create mean scores for your key variables
data <- data %>%
  mutate(
    threat_score = rowMeans(select(., threat_1:threat_6), na.rm = TRUE),
    trust_score = rowMeans(select(., trust_1:trust_6), na.rm = TRUE),
    perspective_taking = rowMeans(select(., emp_1:emp_14), na.rm = TRUE)
  )

# Convert intervention to a factor with meaningful labels
data <- data %>%
  mutate(
    intervention_factor = factor(intervention, levels = c(1, 2, 3),
                                 labels = c("Better", "Worse", "Control")),
    group_factor = factor(group, levels = c(1, 2),
                          labels = c("Individualizing", "Binding"))
  )
```

Run the ANCOVA Models with Moderation

```
# For trust outcome
trust_model <- aov(trust_score ~ ideology + intervention_factor * group_factor,
               data = data)

# For threat outcome
threat_model <- aov(threat_score ~ ideology + intervention_factor * group_factor,
               data = data)

# Check results for trust model
summary(trust_model)
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
ideology	1	144.8	144.82	79.361	< 2e-16 ***
intervention_factor	2	31.5	15.75	8.633	0.000201 ***
group_factor	1	4.0	3.98	2.179	0.140423
intervention_factor:group_factor	2	2.3	1.14	0.627	0.534642
Residuals	597	1089.4	1.82		

```
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# Check results for threat model
summary(threat_model)
```

```
                            Df Sum Sq Mean Sq F value   Pr(>F)
ideology                     1  226.9  226.91 108.418  < 2e-16 ***
intervention_factor          2   54.3   27.15  12.974 3.05e-06 ***
group_factor                 1   10.1   10.09   4.823   0.0285 *
intervention_factor:group_factor 2    1.8    0.90   0.431   0.6498
Residuals                  597 1249.5    2.09
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
library(effectsize)

# For trust model
eta_squared(trust_model, partial = TRUE)
```

```
# Effect Size for ANOVA (Type I)

Parameter                     | Eta2 (partial) |       95% CI
-------------------------------------------------------------
ideology                      |           0.12 | [0.08, 1.00]
intervention_factor           |           0.03 | [0.01, 1.00]
group_factor                  |       3.64e-03 | [0.00, 1.00]
intervention_factor:group_factor |       2.10e-03 | [0.00, 1.00]

- One-sided CIs: upper bound fixed at [1.00].
```

```
# For threat model
eta_squared(threat_model, partial = TRUE)
```

```
# Effect Size for ANOVA (Type I)

Parameter                     | Eta2 (partial) |       95% CI
-------------------------------------------------------------
ideology                      |           0.15 | [0.11, 1.00]
intervention_factor           |           0.04 | [0.02, 1.00]
group_factor                  |       8.01e-03 | [0.00, 1.00]
intervention_factor:group_factor |       1.44e-03 | [0.00, 1.00]

- One-sided CIs: upper bound fixed at [1.00].
```
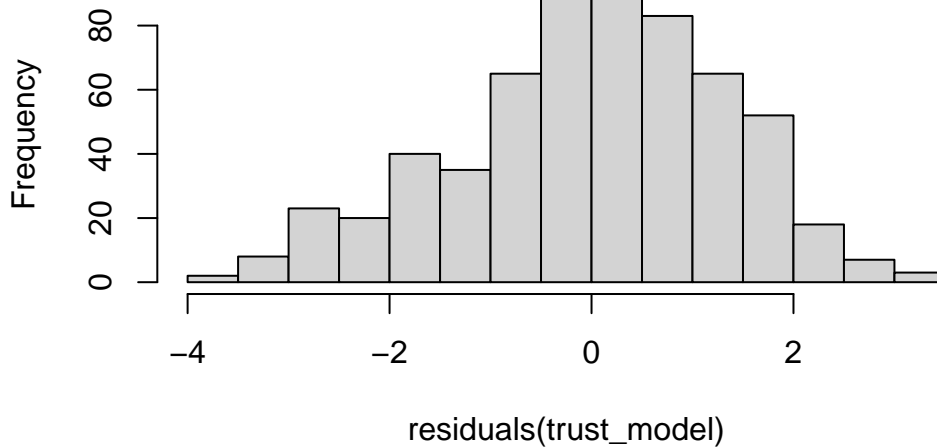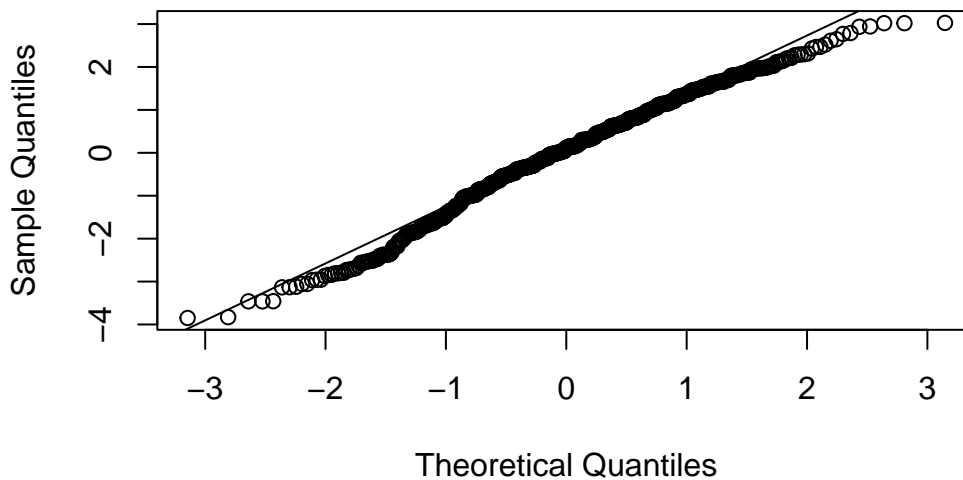
Check Model Assumptions

```
# Check normality of residuals
hist(residuals(trust_model))
```

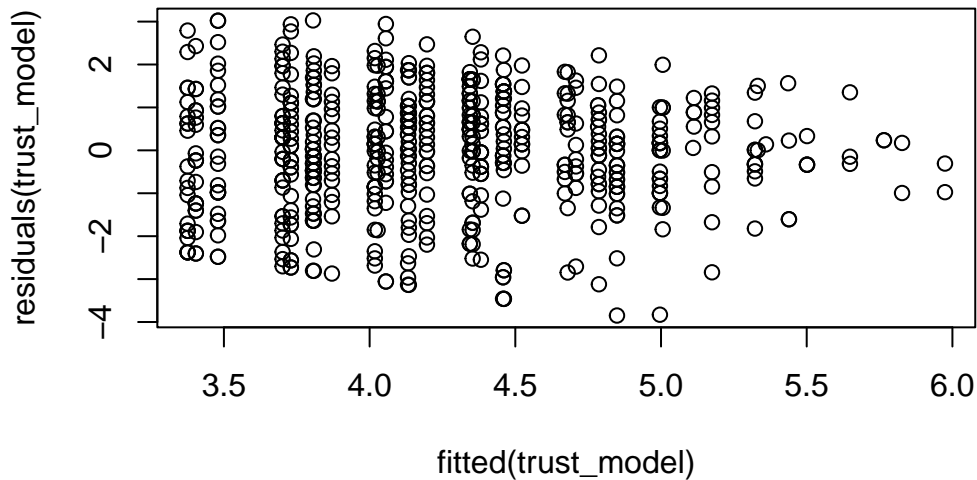## Histogram of residuals(trust_model)


```
qqnorm(residuals(trust_model))
qqline(residuals(trust_model))
```

Normal Q–Q Plot

```
# Check homogeneity of variance
plot(fitted(trust_model), residuals(trust_model))
```



```
# Repeat for threat model
```

Calculate EMMs at Different Levels of Perspective Taking

```
library(emmeans)
```

```
Welcome to emmeans.
Caution: You lose important information if you filter this package's results.
See '? untidy'
```

```
# For trust model - Examine the interaction effect
trust_emms <- emmeans(trust_model,
                      specs = ~ intervention_factor | group_factor,
                      covariates = list(ideology = mean(data$ideology, na.rm = TRUE)))

# For threat model
threat_emms <- emmeans(threat_model,
                       specs = ~ intervention_factor | group_factor,
                       covariates = list(ideology = mean(data$ideology, na.rm = TRUE)))

# Alternative: Get the full grid of means
trust_emms_grid <- emmeans(trust_model,
```

```
                          specs = ~ intervention_factor * group_factor,
                          covariates = list(ideology = mean(data$ideology, na.rm = TRUE)))

threat_emms_grid <- emmeans(threat_model,
                            specs = ~ intervention_factor * group_factor,
                            covariates = list(ideology = mean(data$ideology, na.rm = TRUE)))
```

Examine Pairwise Comparisons

```
# Compare intervention conditions within each moral condition
trust_pairs <- pairs(trust_emms, adjust = "tukey")
summary(trust_pairs)
```

```
group_factor = Individualizing:
 contrast          estimate    SE  df t.ratio p.value
 Better - Worse       0.495 0.185 597   2.678  0.0208
 Better - Control     0.391 0.193 597   2.030  0.1060
 Worse - Control     -0.104 0.189 597  -0.550  0.8463

group_factor = Binding:
 contrast          estimate    SE  df t.ratio p.value
 Better - Worse       0.614 0.191 597   3.213  0.0040
 Better - Control     0.209 0.196 597   1.071  0.5326
 Worse - Control     -0.405 0.192 597  -2.112  0.0883

P value adjustment: tukey method for comparing a family of 3 estimates
```

```
threat_pairs <- pairs(threat_emms, adjust = "tukey")
summary(threat_pairs)
```

```
group_factor = Individualizing:
 contrast          estimate    SE  df t.ratio p.value
 Better - Worse      -0.607 0.198 597  -3.065  0.0064
 Better - Control    -0.231 0.206 597  -1.121  0.5017
 Worse - Control      0.376 0.203 597   1.852  0.1537

group_factor = Binding:
 contrast          estimate    SE  df t.ratio p.value
 Better - Worse      -0.851 0.205 597  -4.156  0.0001
```

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```
 Better - Control    -0.449 0.209 597  -2.145  0.0819
 Worse - Control      0.402 0.205 597   1.957  0.1240


P value adjustment: tukey method for comparing a family of 3 estimates
```

Moderating role of empathy

```
# Run full model with perspective taking as a continuous moderator
trust_model_full <- lm(trust_score ~ ideology + intervention_factor * group_factor * perspect
                       data = data)
summary(trust_model_full)
```

```
Call:
lm(formula = trust_score ~ ideology + intervention_factor * group_factor *
    perspective_taking, data = data)

Residuals:
    Min      1Q  Median      3Q     Max
-4.0744 -0.7989  0.1667  0.9513  3.0863

Coefficients:
                                                                     Estimate
(Intercept)                                                           2.72107
ideology                                                              0.33885
intervention_factorWorse                                            -1.00770
intervention_factorControl                                          -1.77086
group_factorBinding                                                 -0.01290
perspective_taking                                                   0.19958
intervention_factorWorse:group_factorBinding                         0.97693
intervention_factorControl:group_factorBinding                       1.45818
intervention_factorWorse:perspective_taking                          0.12620
intervention_factorControl:perspective_taking                        0.34026
group_factorBinding:perspective_taking                               0.03745
intervention_factorWorse:group_factorBinding:perspective_taking     -0.27313
intervention_factorControl:group_factorBinding:perspective_taking   -0.31056
                                                                     Std. Error
(Intercept)                                                           0.76970
ideology                                                              0.03753
intervention_factorWorse                                             1.18822
```

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```
intervention_factorControl                                               1.20669
group_factorBinding                                                      1.12512
perspective_taking                                                       0.19108
intervention_factorWorse:group_factorBinding                             1.67720
intervention_factorControl:group_factorBinding                           1.68986
intervention_factorWorse:perspective_taking                              0.29615
intervention_factorControl:perspective_taking                            0.29922
group_factorBinding:perspective_taking                                   0.27965
intervention_factorWorse:group_factorBinding:perspective_taking          0.41470
intervention_factorControl:group_factorBinding:perspective_taking        0.41933
                                                                        t value
(Intercept)                                                               3.535
ideology                                                                  9.028
intervention_factorWorse                                                 -0.848
intervention_factorControl                                               -1.468
group_factorBinding                                                      -0.011
perspective_taking                                                        1.045
intervention_factorWorse:group_factorBinding                             0.582
intervention_factorControl:group_factorBinding                           0.863
intervention_factorWorse:perspective_taking                              0.426
intervention_factorControl:perspective_taking                            1.137
group_factorBinding:perspective_taking                                   0.134
intervention_factorWorse:group_factorBinding:perspective_taking         -0.659
intervention_factorControl:group_factorBinding:perspective_taking       -0.741
                                                                        Pr(>|t|)
(Intercept)                                                             0.000439 ***
ideology                                                                 < 2e-16 ***
intervention_factorWorse                                               0.396737
intervention_factorControl                                             0.142765
group_factorBinding                                                    0.990856
perspective_taking                                                     0.296673
intervention_factorWorse:group_factorBinding                           0.560469
intervention_factorControl:group_factorBinding                         0.388543
intervention_factorWorse:perspective_taking                            0.670156
intervention_factorControl:perspective_taking                          0.255930
group_factorBinding:perspective_taking                                 0.893524
intervention_factorWorse:group_factorBinding:perspective_taking        0.510396
intervention_factorControl:group_factorBinding:perspective_taking 0.459228
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.344 on 591 degrees of freedom
Multiple R-squared:  0.1602,    Adjusted R-squared:  0.1431
```

```
F-statistic: 9.395 on 12 and 591 DF,  p-value: < 2.2e-16
```

```
threat_model_full <- lm(threat_score ~ ideology + intervention_factor * group_factor * perspe
                        data = data)
summary(threat_model_full)
```

```
Call:
lm(formula = threat_score ~ ideology + intervention_factor *
    group_factor * perspective_taking, data = data)

Residuals:
    Min      1Q  Median      3Q     Max
-3.8102 -0.8405  0.1004  1.0142  3.8858

Coefficients:
```

	Estimate
(Intercept)	5.65738
ideology	-0.41266
intervention_factorWorse	0.23850
intervention_factorControl	-0.67775
group_factorBinding	-1.26407
perspective_taking	-0.17852
intervention_factorWorse:group_factorBinding	0.56382
intervention_factorControl:group_factorBinding	1.35014
intervention_factorWorse:perspective_taking	0.09505
intervention_factorControl:perspective_taking	0.23012
group_factorBinding:perspective_taking	0.21565
intervention_factorWorse:group_factorBinding:perspective_taking	-0.08352
intervention_factorControl:group_factorBinding:perspective_taking	-0.28616

	Std. Error
(Intercept)	0.83175
ideology	0.04056
intervention_factorWorse	1.28400
intervention_factorControl	1.30397
group_factorBinding	1.21582
perspective_taking	0.20648
intervention_factorWorse:group_factorBinding	1.81240
intervention_factorControl:group_factorBinding	1.82609
intervention_factorWorse:perspective_taking	0.32002
intervention_factorControl:perspective_taking	0.32334
group_factorBinding:perspective_taking	0.30219

```
intervention_factorWorse:group_factorBinding:perspective_taking      0.44813
intervention_factorControl:group_factorBinding:perspective_taking    0.45313
                                                                    t value
(Intercept)                                                           6.802
ideology                                                            -10.174
intervention_factorWorse                                              0.186
intervention_factorControl                                           -0.520
group_factorBinding                                                  -1.040
perspective_taking                                                   -0.865
intervention_factorWorse:group_factorBinding                          0.311
intervention_factorControl:group_factorBinding                       0.739
intervention_factorWorse:perspective_taking                          0.297
intervention_factorControl:perspective_taking                        0.712
group_factorBinding:perspective_taking                               0.714
intervention_factorWorse:group_factorBinding:perspective_taking     -0.186
intervention_factorControl:group_factorBinding:perspective_taking   -0.632
                                                                    Pr(>|t|)
(Intercept)                                                         2.54e-11 ***
ideology                                                             < 2e-16 ***
intervention_factorWorse                                              0.853
intervention_factorControl                                           0.603
group_factorBinding                                                  0.299
perspective_taking                                                   0.388
intervention_factorWorse:group_factorBinding                         0.756
intervention_factorControl:group_factorBinding                       0.460
intervention_factorWorse:perspective_taking                          0.767
intervention_factorControl:perspective_taking                        0.477
group_factorBinding:perspective_taking                               0.476
intervention_factorWorse:group_factorBinding:perspective_taking      0.852
intervention_factorControl:group_factorBinding:perspective_taking    0.528
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.453 on 591 degrees of freedom
Multiple R-squared:  0.1914,    Adjusted R-squared:  0.175
F-statistic: 11.66 on 12 and 591 DF,  p-value: < 2.2e-16
```

```r
# Calculate EMMs at specific levels of perspective taking
pt_mean <- mean(data$perspective_taking, na.rm = TRUE)
pt_sd <- sd(data$perspective_taking, na.rm = TRUE)

trust_emms_pt <- emmeans(trust_model_full,
```

```
                            specs = ~ intervention_factor | group_factor,
                            at = list(perspective_taking = c(pt_mean - pt_sd, pt_mean, pt_mean +
                            covariates = list(ideology = mean(data$ideology, na.rm = TRUE)))
```

NOTE: Results may be misleading due to involvement in interactions

Graph

```
library(ggplot2)
library(dplyr)
library(gridExtra)
```

Attaching package: 'gridExtra'

The following object is masked from 'package:dplyr':

    combine

```
# First, prepare your data with EMMs
trust_emms_df <- as.data.frame(trust_emms)
threat_emms_df <- as.data.frame(threat_emms)

# Violin plot for Trust
trust_plot <- ggplot() +
  # Add violin plot of raw data
  geom_violin(data = data, aes(x = intervention_factor, y = trust_score,
                               fill = group_factor),
              alpha = 0.5, position = position_dodge(0.8), width = 0.7) +
  # Add EMM points and error bars
  geom_point(data = trust_emms_df, aes(x = intervention_factor, y = emmean,
                                       group = group_factor, shape = group_factor),
             position = position_dodge(0.8), size = 3) +
  geom_errorbar(data = trust_emms_df,
                aes(x = intervention_factor, y = emmean,
                    group = group_factor,
                    ymin = lower.CL, ymax = upper.CL),
                position = position_dodge(0.8), width = 0.2, linewidth = 1) +
```

```
  # Custom aesthetics
  scale_fill_manual(values = c("skyblue", "coral")) +
  # Set fixed y-axis range from 1 to 7
  scale_y_continuous(limits = c(1, 7), breaks = 1:7) +
  labs(title = "Trust Toward Outgroup",
       x = "Feedback Condition",
       y = "Trust Score",
       fill = "Moral Foundation",
       shape = "Moral Foundation") +
  scale_x_discrete(labels = c("Better\nthan expected", "Worse\nthan expected", "Control")) +
  theme_minimal(base_size = 12) +
  theme(
    plot.title = element_text(hjust = 0.5, face = "bold"),
    axis.title = element_text(face = "bold"),
    legend.position = "bottom",
    legend.title = element_text(face = "bold"),
    panel.grid.major = element_line(color = "gray90"),
    panel.grid.minor = element_line(color = "gray95")
  )

# Violin plot for Threat
threat_plot <- ggplot() +
  # Add violin plot of raw data
  geom_violin(data = data, aes(x = intervention_factor, y = threat_score,
                               fill = group_factor),
              alpha = 0.5, position = position_dodge(0.8), width = 0.7) +
  # Add EMM points and error bars
  geom_point(data = threat_emms_df, aes(x = intervention_factor, y = emmean,
                                        group = group_factor, shape = group_factor),
             position = position_dodge(0.8), size = 3) +
  geom_errorbar(data = threat_emms_df,
                aes(x = intervention_factor, y = emmean,
                    group = group_factor,
                    ymin = lower.CL, ymax = upper.CL),
                position = position_dodge(0.8), width = 0.2, linewidth = 1) +
  # Custom aesthetics
  scale_fill_manual(values = c("skyblue", "coral")) +
  # Set fixed y-axis range from 1 to 7
  scale_y_continuous(limits = c(1, 7), breaks = 1:7) +
  labs(title = "Perceived Threat from Outgroup",
       x = "Feedback Condition",
       y = "Threat Score",
```

```
      fill = "Moral Foundation",
      shape = "Moral Foundation") +
  scale_x_discrete(labels = c("Better\nthan expected", "Worse\nthan expected", "Control")) +
  theme_minimal(base_size = 12) +
  theme(
    plot.title = element_text(hjust = 0.5, face = "bold"),
    axis.title = element_text(face = "bold"),
    legend.position = "bottom",
    legend.title = element_text(face = "bold"),
    panel.grid.major = element_line(color = "gray90"),
    panel.grid.minor = element_line(color = "gray95")
  )

# Display both plots
trust_plot
```
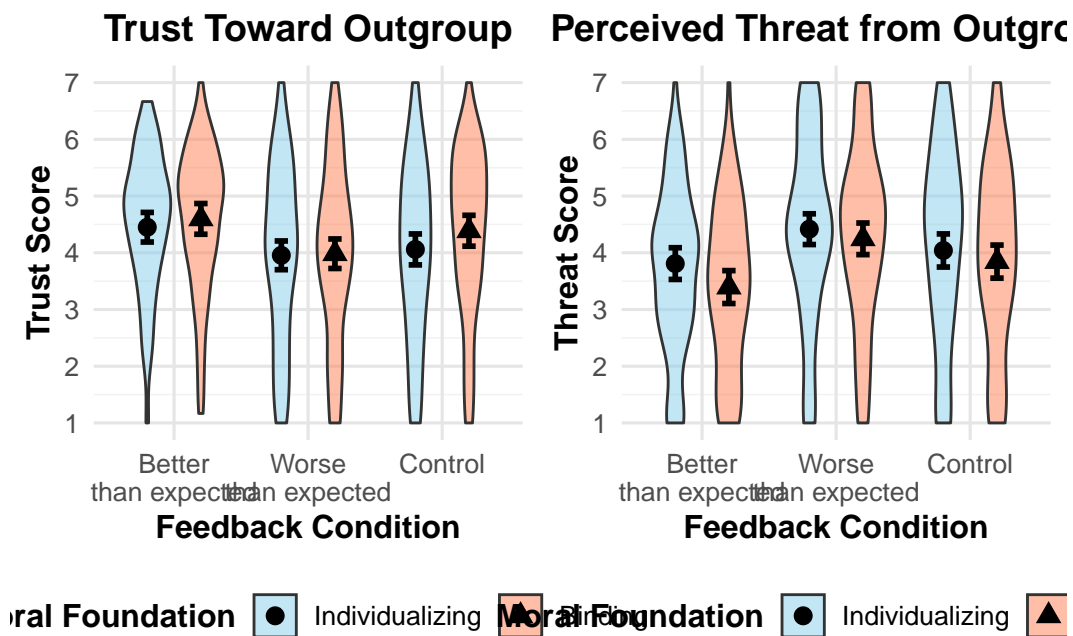


```
threat_plot
```

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Perceived Threat from Outgroup
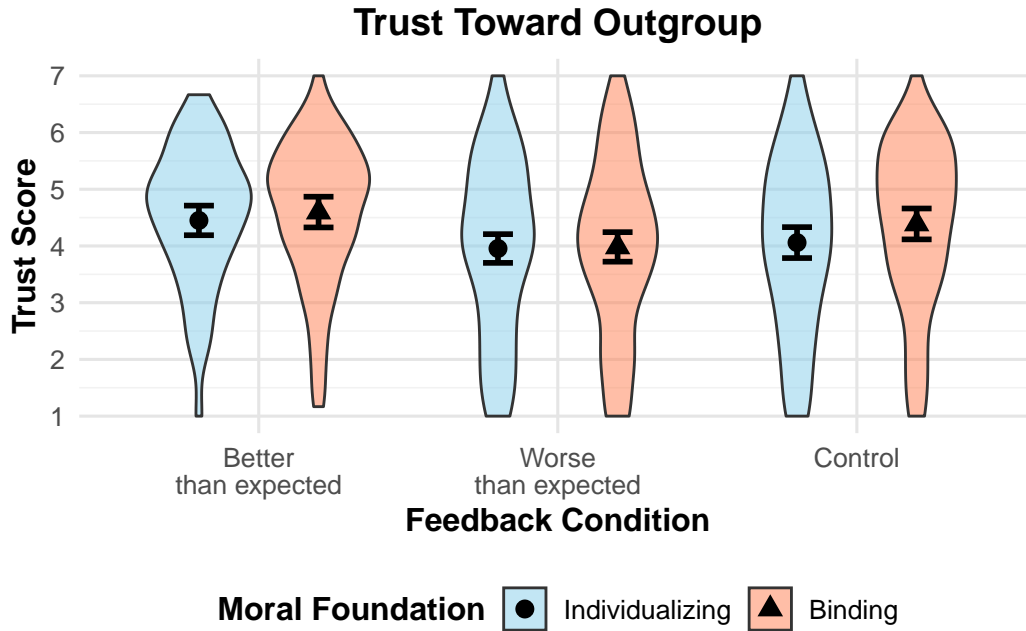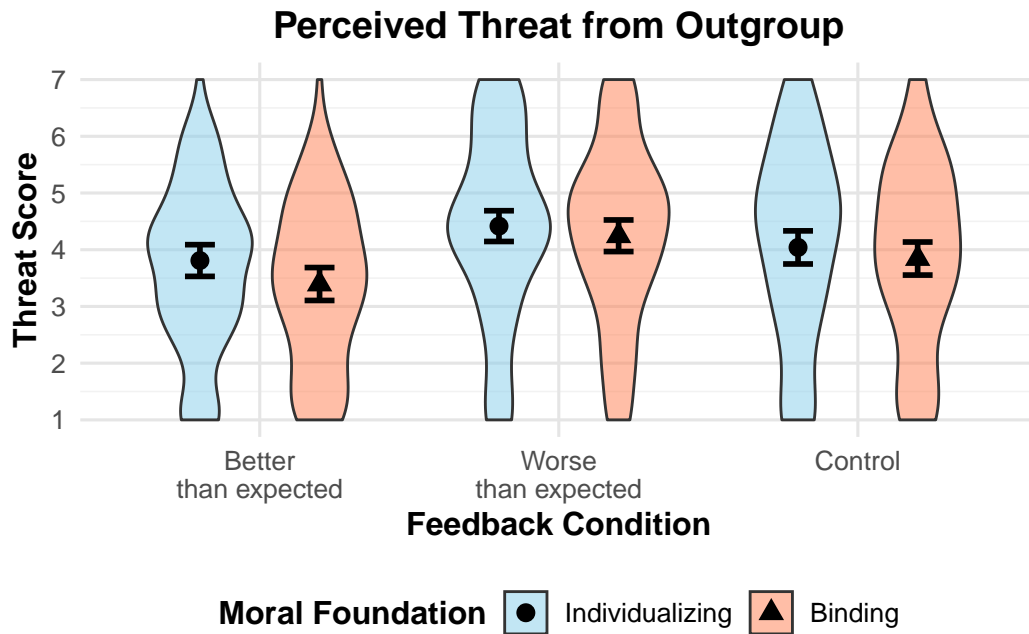

```
# To save the plots to files:
ggsave("/Users/daryani/Desktop/trust_violin_plot.jpg", trust_plot, width = 10, height = 7, d
ggsave("/Users/daryani/Desktop/threat_violin_plot.jpg", threat_plot, width = 10, height = 7,

# To display both plots side by side in a single figure:
combined_plot <- grid.arrange(trust_plot, threat_plot, ncol = 2)
```

```
ggsave("/Users/daryani/Desktop/combined_violin_plots.jpg", combined_plot, width = 14, height
```