# Prolife Analysis

### Load the data

```
library(readxl)

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

data <- read_excel(file_path)
```

### Pepare the data

```
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
```

```r
# 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

```r
# 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   45.3   45.33  24.161 1.15e-06 ***
intervention_factor              2   35.2   17.61   9.389 9.67e-05 ***
group_factor                     1    1.6    1.59   0.846    0.358
intervention_factor:group_factor 2    3.3    1.64   0.872    0.419
Residuals                      593 1112.4    1.88
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

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

```
                                Df Sum Sq Mean Sq F value   Pr(>F)
ideology                         1   73.1   73.05  37.288 1.84e-09 ***
intervention_factor              2   33.2   16.58   8.464 0.000238 ***
group_factor                     1    3.3    3.26   1.662 0.197870
intervention_factor:group_factor 2    4.9    2.47   1.259 0.284571
Residuals                      593 1161.8    1.96
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
library(effectsize)

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

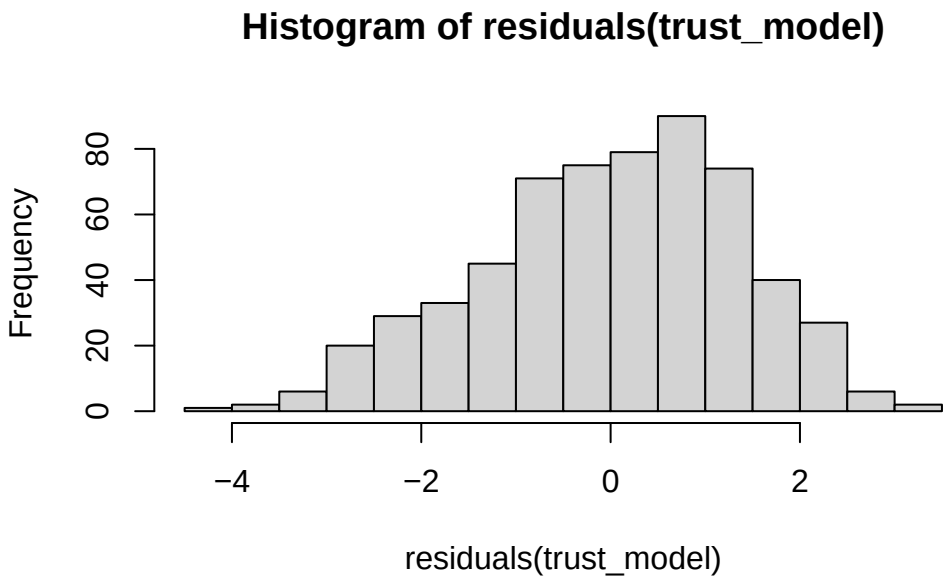
```
# Effect Size for ANOVA (Type I)

Parameter                      | Eta2 (partial) |       95% CI
-------------------------------------------------------------
ideology                       |           0.04 | [0.02, 1.00]
intervention_factor            |           0.03 | [0.01, 1.00]
group_factor                   |       1.42e-03 | [0.00, 1.00]
intervention_factor:group_factor |       2.93e-03 | [0.00, 1.00]

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

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

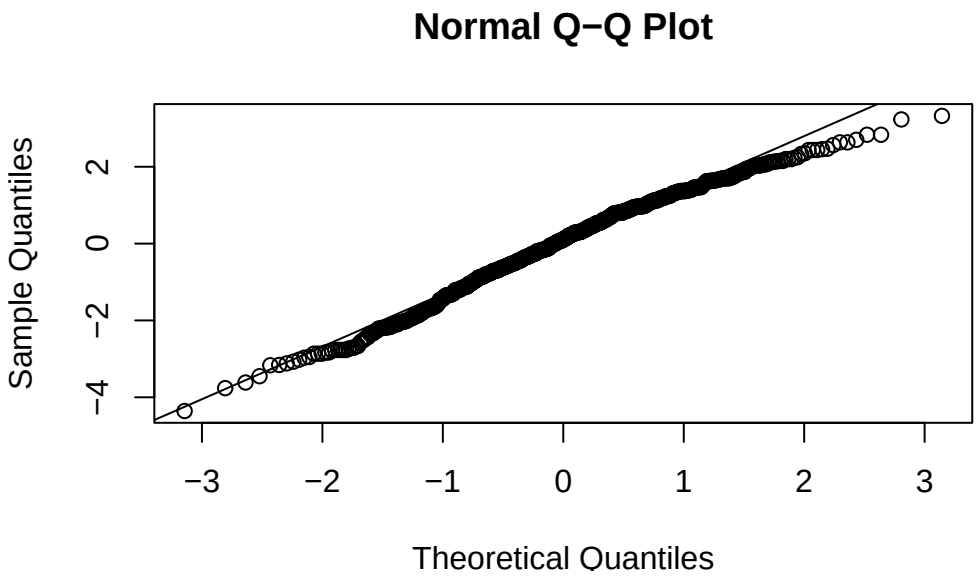
```
# Effect Size for ANOVA (Type I)

Parameter                      | Eta2 (partial) |       95% CI
-------------------------------------------------------------
ideology                       |           0.06 | [0.03, 1.00]
intervention_factor            |           0.03 | [0.01, 1.00]
group_factor                   |       2.79e-03 | [0.00, 1.00]
intervention_factor:group_factor |       4.23e-03 | [0.00, 1.00]

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

### Check Model Assumptions

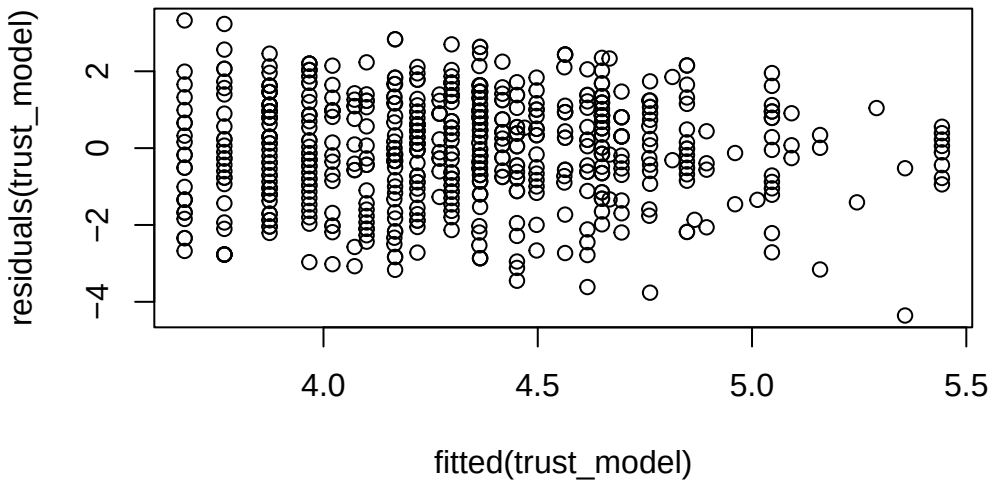
```
# Check normality of residuals
hist(residuals(trust_model))
```




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



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




```r
# Repeat for threat model
```

### Calculate EMMs at Different Levels of Perspective Taking

```r
library(emmeans)
```

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

```r
# 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     0.6828 0.192 593   3.549  0.0012
 Better - Control   0.4306 0.196 593   2.193  0.0732
 Worse - Control   -0.2522 0.196 593  -1.288  0.4027

group_factor = Binding:
 contrast         estimate    SE  df t.ratio p.value
 Better - Worse     0.4911 0.191 593   2.572  0.0279
 Better - Control   0.0665 0.194 593   0.343  0.9373
 Worse - Control   -0.4247 0.194 593  -2.186  0.0743

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    -0.7271 0.197 593  -3.698  0.0007
 Better - Control  -0.4972 0.201 593  -2.478  0.0359
 Worse - Control    0.2299 0.200 593   1.149  0.4846

group_factor = Binding:
 contrast         estimate    SE  df t.ratio p.value
 Better - Worse    -0.4176 0.195 593  -2.140  0.0827
```

```
 Better - Control  -0.0653 0.198 593  -0.329  0.9420
 Worse - Control    0.3523 0.198 593   1.775  0.1789

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

### Moderating role of empathy

```r
# 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
-4.1761 -0.8749  0.0976  1.0480  3.1399

Coefficients:
                                                                 Estimate
(Intercept)                                                      3.490528
ideology                                                        -0.197085
intervention_factorWorse                                         2.794464
intervention_factorControl                                       2.400520
group_factorBinding                                             -0.254472
perspective_taking                                               0.601041
intervention_factorWorse:group_factorBinding                    -2.632439
intervention_factorControl:group_factorBinding                  -1.779140
intervention_factorWorse:perspective_taking                     -0.885466
intervention_factorControl:perspective_taking                   -0.724089
group_factorBinding:perspective_taking                          -0.004214
intervention_factorWorse:group_factorBinding:perspective_taking  0.721021
intervention_factorControl:group_factorBinding:perspective_taking 0.547292
                                                                Std. Error
(Intercept)                                                       0.850834
ideology                                                          0.042303
intervention_factorWorse                                          1.244865
```

```
intervention_factorControl                                            1.259194
group_factorBinding                                                   1.084140
perspective_taking                                                    0.208712
intervention_factorWorse:group_factorBinding                          1.644541
intervention_factorControl:group_factorBinding                        1.641750
intervention_factorWorse:perspective_taking                           0.311537
intervention_factorControl:perspective_taking                         0.315836
group_factorBinding:perspective_taking                                0.274596
intervention_factorWorse:group_factorBinding:perspective_taking       0.415384
intervention_factorControl:group_factorBinding:perspective_taking     0.414014
                                                                     t value
(Intercept)                                                            4.102
ideology                                                              -4.659
intervention_factorWorse                                               2.245
intervention_factorControl                                             1.906
group_factorBinding                                                   -0.235
perspective_taking                                                     2.880
intervention_factorWorse:group_factorBinding                          -1.601
intervention_factorControl:group_factorBinding                        -1.084
intervention_factorWorse:perspective_taking                           -2.842
intervention_factorControl:perspective_taking                         -2.293
group_factorBinding:perspective_taking                                -0.015
intervention_factorWorse:group_factorBinding:perspective_taking        1.736
intervention_factorControl:group_factorBinding:perspective_taking      1.322
                                                                    Pr(>|t|)
(Intercept)                                                        4.67e-05 ***
ideology                                                           3.94e-06 ***
intervention_factorWorse                                            0.02515 *
intervention_factorControl                                          0.05709 .
group_factorBinding                                                 0.81451
perspective_taking                                                  0.00412 **
intervention_factorWorse:group_factorBinding                        0.10998
intervention_factorControl:group_factorBinding                      0.27895
intervention_factorWorse:perspective_taking                         0.00464 **
intervention_factorControl:perspective_taking                       0.02222 *
group_factorBinding:perspective_taking                              0.98776
intervention_factorWorse:group_factorBinding:perspective_taking     0.08312 .
intervention_factorControl:group_factorBinding:perspective_taking   0.18671
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.343 on 587 degrees of freedom
Multiple R-squared:  0.1164,    Adjusted R-squared:  0.09834
```

```
F-statistic: 6.444 on 12 and 587 DF,  p-value: 7.843e-11
```

```r
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
-3.7480 -0.8800  0.0889  0.9545  3.2966

Coefficients:
                                                                  Estimate
(Intercept)                                                         4.9154
ideology                                                            0.2596
intervention_factorWorse                                           -4.4310
intervention_factorControl                                         -3.6516
group_factorBinding                                                -1.1721
perspective_taking                                                 -0.6985
intervention_factorWorse:group_factorBinding                        4.0186
intervention_factorControl:group_factorBinding                      4.4264
intervention_factorWorse:perspective_taking                         1.3088
intervention_factorControl:perspective_taking                       1.0575
group_factorBinding:perspective_taking                              0.3991
intervention_factorWorse:group_factorBinding:perspective_taking    -1.0955
intervention_factorControl:group_factorBinding:perspective_taking  -1.2412
                                                                  Std. Error
(Intercept)                                                           0.8709
ideology                                                              0.0433
intervention_factorWorse                                              1.2742
intervention_factorControl                                            1.2889
group_factorBinding                                                   1.1097
perspective_taking                                                    0.2136
intervention_factorWorse:group_factorBinding                          1.6833
intervention_factorControl:group_factorBinding                        1.6805
intervention_factorWorse:perspective_taking                           0.3189
intervention_factorControl:perspective_taking                         0.3233
group_factorBinding:perspective_taking                                0.2811
```

```
intervention_factorWorse:group_factorBinding:perspective_taking       0.4252
intervention_factorControl:group_factorBinding:perspective_taking     0.4238
                                                                    t value
(Intercept)                                                           5.644
ideology                                                              5.996
intervention_factorWorse                                             -3.477
intervention_factorControl                                           -2.833
group_factorBinding                                                  -1.056
perspective_taking                                                   -3.270
intervention_factorWorse:group_factorBinding                          2.387
intervention_factorControl:group_factorBinding                        2.634
intervention_factorWorse:perspective_taking                           4.104
intervention_factorControl:perspective_taking                         3.271
group_factorBinding:perspective_taking                                1.420
intervention_factorWorse:group_factorBinding:perspective_taking      -2.577
intervention_factorControl:group_factorBinding:perspective_taking    -2.929
                                                                    Pr(>|t|)
(Intercept)                                                         2.59e-08 ***
ideology                                                            3.54e-09 ***
intervention_factorWorse                                            0.000544 ***
intervention_factorControl                                          0.004767 **
group_factorBinding                                                 0.291288
perspective_taking                                                  0.001140 **
intervention_factorWorse:group_factorBinding                        0.017287 *
intervention_factorControl:group_factorBinding                      0.008661 **
intervention_factorWorse:perspective_taking                         4.63e-05 ***
intervention_factorControl:perspective_taking                       0.001134 **
group_factorBinding:perspective_taking                              0.156200
intervention_factorWorse:group_factorBinding:perspective_taking     0.010221 *
intervention_factorControl:group_factorBinding:perspective_taking   0.003533 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.374 on 587 degrees of freedom
Multiple R-squared:  0.1311,    Adjusted R-squared:  0.1133
F-statistic: 7.378 on 12 and 587 DF,  p-value: 1.028e-12
```

```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)
```

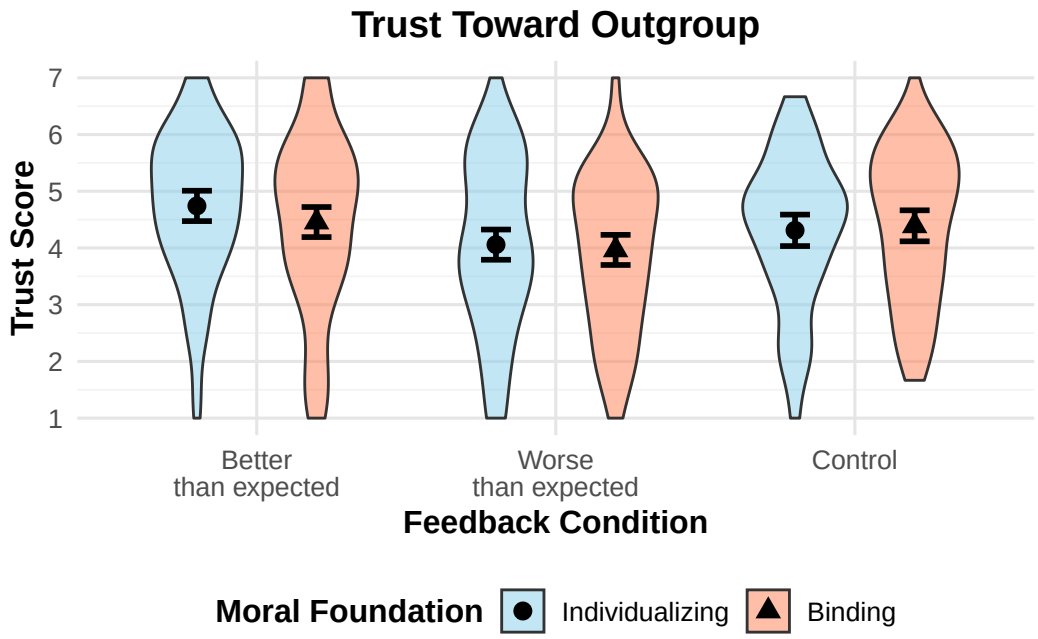
```
Attaching package: 'gridExtra'
```

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

    combine
```

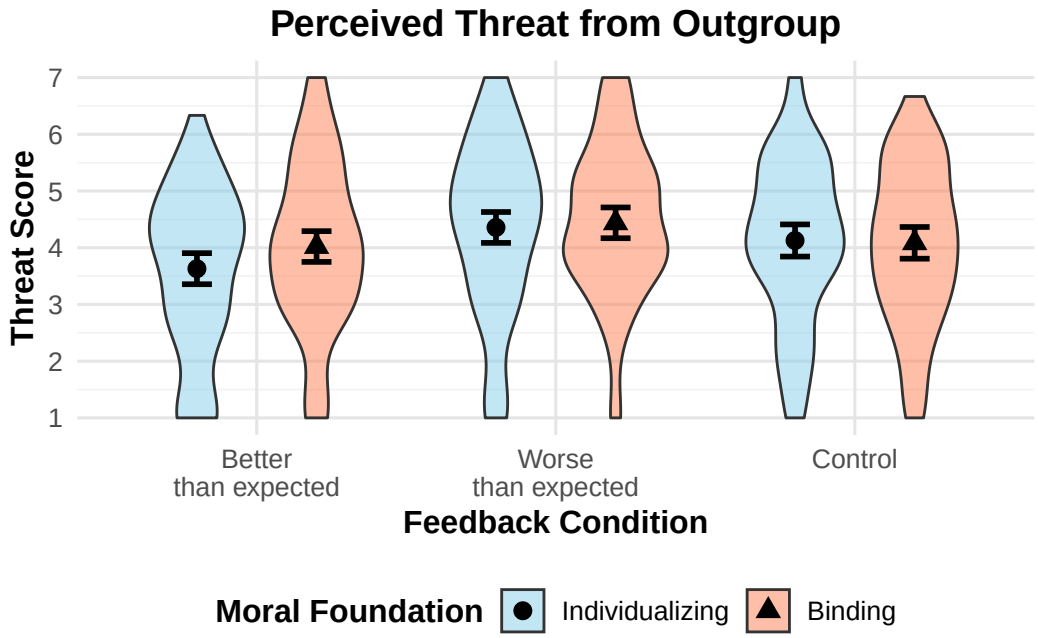
```
# First, prepare your data with EMMs
trust_emms_df <- as.data.frame(trust_emms)
threat_emms_df <- as.data.frame(threat_emms)

# 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",
```

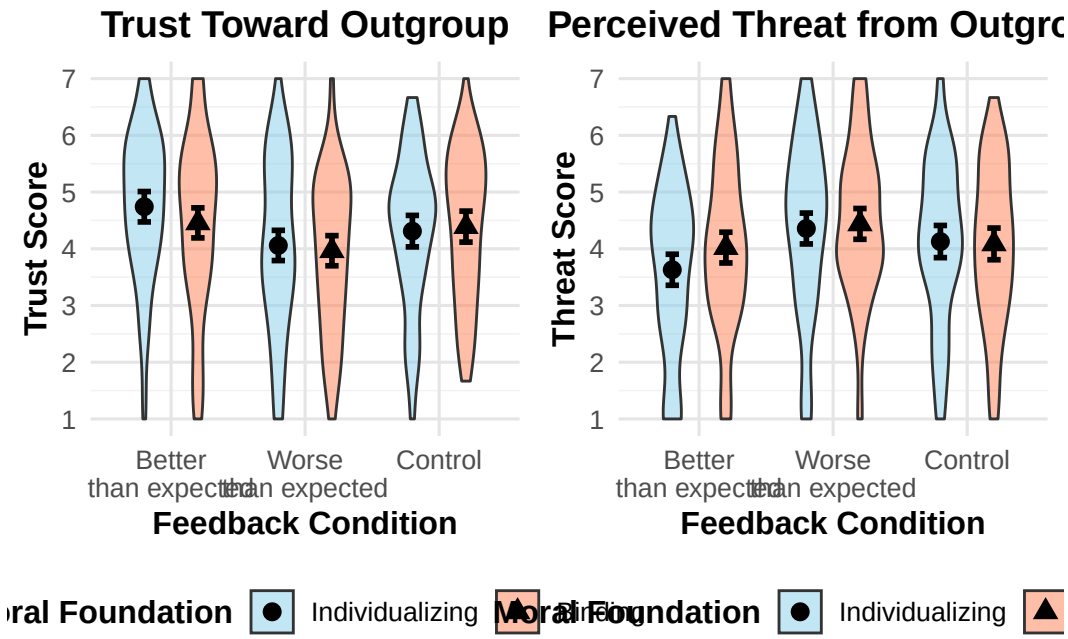
```
       fill = "Moral Foundation",
       shape = "Moral Foundation") +
  scale_x_discrete(labels = c("Better\nthan expected", "Worse\nthan expected", "Control")) +
  theme_minimal(base_size = 12) +
  theme(
    plot.title = element_text(hjust = 0.5, face = "bold"),
    axis.title = element_text(face = "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
```




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