Data Analysis Report:

< Disability stereotypes and willingness for intergroup contact among undergraduate students without disabilities: A moderated mediation model grounded in Integrated Threat Theory >

Wendywy

2026-01-08

0/ Install Data Packages

```
    > rm(list=ls())  # Clear workspace
> gc()

           used (Mb) gc trigger (Mb) max used (Mb)
Ncells 466253 25.0    1001947 53.6   660408 35.3
Vcells 866523  6.7    8388608 64.0  1769584 13.6

    > if(!require("bruceR")) install.packages("bruceR", dep = TRUE);

    bruceR (v2024.6)
Broadly Useful Convenient and Efficient R functions

Packages also loaded:
✔ data.table    ✔ emmeans
✔ dplyr         ✔ lmerTest
✔ tidyr         ✔ effectsize
✔ stringr       ✔ performance
✔ ggplot2       ✔ interactions

Main functions of `bruceR`:
cc()            Describe()  TTEST()
add()           Freq()      MANOVA()
.mean()         Corr()      EMMEANS()
set.wd()        Alpha()     PROCESS()
import()        EFA()       model_summary()
print_table()   CFA()       lavaan_summary()

For full functionality, please install all dependencies:
install.packages("bruceR", dep=TRUE)

Online documentation:
https://psychbruce.github.io/bruceR

To use this package in publications, please cite:
```

```
Bao, H.-W.-S. (2024). bruceR: Broadly useful convenient and efficient R functions (Version 2
024.6) [Computer software]. https://CRAN.R-project.org/package=bruceR


NEWS: A new version of bruceR (2025.11) is available (2025-12-09)!

***** Please update *****
install.packages("bruceR", dep=TRUE)
```

```
    > library("bruceR")
> set.wd()  # Set working directory to current file path

    ✔ Set working directory to "D:/2-Manuscript_Submission_Keep_Moving/!-Under_Submission/2
0250806-Impact_of_Disability_Stereotypes_on_Intergroup_Interaction_Intention_of_General_Col
lege_Students-Questionnaire_Survey/2-Data_Analysis"
```

Add plotting fonts

```
    > if(!require("showtext")) install.packages("showtext"); library(showtext)

    > font_add('TNR', regular = 'C:/Windows/Fonts/Times New Roman/times.ttf')
> font_add('WRYH', regular = 'C:/Windows/Fonts/微软雅黑/msyh.ttc')
```

========== 01/ Participant Demographic Information ========

1.1-Data Import

```
    > df = import("Disability-Stereotypes-Intergroup-Contact-Data.xlsx",sheet="Stereo_Inter_
Data",as="data.table")
> #View(df)
> names(df)

    [1] "ID"                          "Age"
 [3] "Gender"                      "Grade"
 [5] "Residence"                   "Cont_Freq"
 [7] "Media_Internet"              "Encountered_daily_life"
 [9] "Classmates_with_disabilities"   "Friends_relatives_disabilities"
[11] "Dis_Stereo"                  "Inter_Anx"
[13] "Empathy"                     "Inter_Willingness"
[15] "Emp_1PT"                     "Emp_2FS"
[17] "Emp_3EC"                     "Emp_4PD"
[19] "B1"                          "B2"
[21] "B3"                          "B4"
[23] "B5"                          "B6"
[25] "B7"                          "B8"
```

```
[27] "B9"                          "B10"
[29] "B11"                         "B12"
[31] "B13"                         "B14"
[33] "B15"                         "B16"
[35] "B17"                         "B18"
[37] "B19"                         "B20"
[39] "B21"                         "B22"
[41] "B23"                         "C1"
[43] "C2"                          "C3"
[45] "C4"                          "C5"
[47] "C6"                          "C7"
[49] "C8"                          "C9"
[51] "C10"                         "D1"
[53] "D2"                          "D3"
[55] "D4"                          "D5"
[57] "D6"                          "D7"
[59] "D8"                          "D9"
[61] "D10"                         "D11"
[63] "D12"                         "D13"
[65] "D14"                         "D15"
[67] "D16"                         "D17"
[69] "D18"                         "D19"
[71] "D20"                         "D21"
[73] "D22"                         "F1"
[75] "F2"                          "F3"
[77] "F4"                          "F5"
```

```
> head(df)
```

```
   ID Age Gender Grade Residence Cont_Freq Media_Internet
1:  1  18      1     2         2         4              1
2:  1  18      2     1         2         3              0
3:  2  19      2     1         2         2              0
4:  3  23      2     4         1         3              0
5:  3  20      2     1         1         2              1
6:  4  21      1     4         1         1              1
   Encountered_daily_life Classmates_with_disabilities
1:                      0                           0
2:                      0                           0
3:                      1                           0
4:                      1                           0
5:                      1                           1
6:                      0                           0
   Friends_relatives_disabilities Dis_Stereo Inter_Anx  Empathy Inter_Willingness
1:                              0   4.260870       3.4 3.409091              3.8
```

```
2:                          1   2.782609       1.7 3.272727            4.4
3:                          0   3.260870       1.7 3.681818            3.6
4:                          0   4.304348       2.4 3.863636            2.8
5:                          1   2.391304       3.3 3.727273            4.4
6:                          0   3.391304       2.8 1.909091            1.6
   Emp_1PT Emp_2FS  Emp_3EC  Emp_4PD B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13
1:       4     3.0 3.500000 3.166667  6  6  6  3  5  3  4  5  5   1   4   5   4
2:       3     2.8 4.500000 2.666667  2  2  2  3  2  7  2  2  2   1   4   3   3
3:       4     3.6 3.500000 3.666667  2  2  2  3  2  7  2  2  2   1   2   2   2
4:       4     3.6 3.833333 4.000000  6  5  4  6  4  7  4  4  4   4   4   6   1
5:       4     3.2 3.500000 4.166667  1  1  1  6  1  7  1  2  1   2   2   2   1
6:       1     1.0 2.333333 3.000000  3  2  1  5  2  7  2  2  2   2   2   5   2
   B14 B15 B16 B17 B18 B19 B20 B21 B22 B23 C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 D1 D2
1:   7   2   2   7   5   1   5   6   1   5  3  3  6  4  5  2  3  4  2   2  2  3
2:   4   6   2   2   2   3   3   3   2   2  2  1  1  1  2  2  2  2  2   2  3  4
3:   7   6   6   2   5   3   5   6   2   2  2  1  1  1  2  2  2  2  2   2  4  3
4:   4   4   4   4   4   4   4   4   4   4  2  2  1  1  7  1  7  1  1   1  5  5
5:   6   6   2   4   1   1   1   4   1   1  1  1  1  1  6  7  7  3  3   3  5  5
6:   6   6   3   6   4   4   4   4   2   2  1  1  1  1  7  7  7  1  1   1  1  5
   D3 D4 D5 D6 D7 D8 D9 D10 D11 D12 D13 D14 D15 D16 D17 D18 D19 D20 D21 D22 F1
1:  5  4  2  3  4  1  3   2   4   5   4   3   5   3   3   3   4   4   3   5  3
2:  5  3  4  4  2  2  3   4   3   5   4   2   4   2   5   3   2   4   2   2  3
3:  4  4  3  4  4  3  4   2   4   4   4   4   4   3   4   4   4   4   3   4  3
4:  2  4  5  4  5  5  4   4   3   4   4   4   4   2   4   2   4   4   3   4  1
5:  5  5  5  5  5  4  4   2   3   1   2   4   5   3   5   4   3   3   1   3  3
6:  1  1  5  1  1  1  1   5   1   1   1   5   1   5   1   1   1   1   1   1  1
   F2 F3 F4 F5
1:  4  3  5  4
2:  4  5  5  5
3:  3  4  4  4
4:  2  4  3  4
5:  4  5  5  5
6:  2  1  3  1
```

1.2-Demographic characteristics of the participants

```
> Freq(df$Age)

 Frequency Statistics:
_____________

      N    %
_____________

16      1  0.1
17     14  0.8
18    179 10.8
```

```
19    312 18.8
20    381 22.9
21    357 21.5
22    230 13.8
23    127  7.6
24     41  2.5
25      7  0.4
26      2  0.1
27      1  0.1
28      4  0.2
31      1  0.1
(NA)    4  0.2
_____________

Total N = 1,661
Valid N = 1,657
```

```
> Freq(df$Gender, labels=c("male", "female"))

   Frequency Statistics:
_________________
          N    %
_________________
male     323 19.4
female  1338 80.6
_________________
Total N = 1,661
```

```
> Freq(df$Grade, labels=c("Freshman", "Sophomore", "Junior", "Senior") )

   Frequency Statistics:
____________________
           N    %
____________________
Freshman   462 27.8
Sophomore  468 28.2
Junior     435 26.2
Senior     296 17.8
____________________
Total N = 1,661
```

```
> Freq(df$Residence, labels=c("Rural", "Urban") )

   Frequency Statistics:
_______________
         N    %
_______________
```

```
Rural  1082 65.1
Urban   579 34.9
─────────────────

Total N = 1,661
```

```
> Freq(df$Cont_Freq, labels=c("Never", "Rarely", "Often", "Always") )

   Frequency Statistics:
──────────────────
         N    %
──────────────────
Never    166 10.0
Rarely  1173 70.6
Often    209 12.6
Always   113  6.8
──────────────────
Total N = 1,661
```

1.3-Contact Methods (Multiple Choice)

```
> Freq(df$Media_Internet)

   Frequency Statistics:
──────────────
       N    %
──────────────
0     739 44.5
1     921 55.4
(NA)    1  0.1
──────────────
Total N = 1,661
Valid N = 1,660
```

```
> Freq(df$Encountered_daily_life)

   Frequency Statistics:
─────────────────
        N    %
─────────────────
0     361 21.7
1    1299 78.2
(NA)    1  0.1
─────────────────
Total N = 1,661
Valid N = 1,660
```

```
> Freq(df$Classmates_with_disabilities)
```

```
   Frequency Statistics:
──────────────
        N    %
──────────────
0     1465 88.2
1      195 11.7
(NA)     1  0.1
──────────────
Total N = 1,661
Valid N = 1,660
```

```
   > Freq(df$Friends_relatives_disabilities)

   Frequency Statistics:
──────────────
        N    %
──────────────
0     1278 76.9
1      382 23.0
(NA)     1  0.1
──────────────
Total N = 1,661
Valid N = 1,660
```

======== 02/ Scale Reliability Analysis ========

2.1-Disability Stereotypes

```
   > df = import("Disability-Stereotypes-Intergroup-Contact-Data.xlsx",sheet="Stereo_Inter_
Data",as="data.table")
> #Alpha(df, "B", 1:23, rev=cc("B4, B6, B14, B15, B17, B18, B21"), digits = 3)
> Alpha(df, "B", 1:23, digits = 3)


Reliability Analysis

Summary:
Total Items: 23
Scale Range: 1 ~ 7
Total Cases: 1661
Valid Cases: 1661 (100.0%)

Scale Statistics:
Mean = 3.340
```

```
S.D. = 0.697
Cronbach’s α = 0.880
McDonald’s ω = 0.893

Items B6, B14, B15 correlate negatively with the scale and may be reversed.
You can specify this argument: rev=c("B6", "B14", "B15")

Item Statistics (Cronbach’s α If Item Deleted):
```

	Mean	S.D.	Item-Rest Cor.	Cronbach’s α
B1	3.176	(1.315)	0.491	0.874
B2	3.219	(1.307)	0.646	0.869
B3	2.673	(1.283)	0.603	0.871
B4	4.402	(1.430)	0.332	0.879
B5	2.477	(1.373)	0.596	0.871
B6	5.566	(1.225)	-0.272	0.893
B7	2.728	(1.384)	0.705	0.867
B8	2.299	(1.210)	0.614	0.871
B9	2.402	(1.246)	0.630	0.870
B10	2.690	(1.343)	0.661	0.869
B11	2.765	(1.304)	0.635	0.870
B12	2.958	(1.392)	0.548	0.872
B13	2.535	(1.169)	0.372	0.877
B14	4.617	(1.300)	0.132	0.884
B15	5.154	(1.357)	0.014	0.887
B16	3.405	(1.342)	0.489	0.874
B17	4.373	(1.253)	0.252	0.880
B18	3.829	(1.488)	0.392	0.877
B19	2.890	(1.441)	0.602	0.870
B20	2.686	(1.380)	0.632	0.870
B21	4.404	(1.340)	0.309	0.879
B22	2.978	(1.422)	0.599	0.871
B23	2.600	(1.278)	0.648	0.870

```
Item-Rest Cor. = Corrected Item-Total Correlation
```

2.2-Intergroup Anxiety

```
    > df = import("Disability-Stereotypes-Intergroup-Contact-Data.xlsx",sheet="Stereo_Inter_
Data",as="data.table")
> #Alpha(df, "C", 1:10, rev=cc("C5, C6, C7"), digits = 3)
>
> Alpha(df, "C", 1:10, digits = 3)
```

```
Reliability Analysis

Summary:
Total Items: 10
Scale Range: 1 ~ 7
Total Cases: 1661
Valid Cases: 1661 (100.0%)

Scale Statistics:
Mean = 3.064
S.D. = 0.970
Cronbach's α = 0.797
McDonald's ω = 0.832

Items C5, C6, C7 correlate negatively with the scale and may be reversed.
You can specify this argument: rev=c("C5", "C6", "C7")

Item Statistics (Cronbach's α If Item Deleted):
---------------------------------------------
     Mean    S.D. Item-Rest Cor. Cronbach's α
---------------------------------------------
C1   2.924 (1.641)         0.605       0.763
C2   2.983 (1.671)         0.632       0.759
C3   2.118 (1.542)         0.604       0.764
C4   2.306 (1.592)         0.644       0.759
C5   3.701 (1.596)         0.167       0.812
C6   3.415 (1.600)         0.226       0.806
C7   3.999 (1.693)         0.011       0.831
C8   3.049 (1.658)         0.617       0.761
C9   3.143 (1.645)         0.638       0.758
C10  2.998 (1.669)         0.646       0.757
---------------------------------------------
Item-Rest Cor. = Corrected Item-Total Correlation
```

2.3-Empathy

```
> df = import("Disability-Stereotypes-Intergroup-Contact-Data.xlsx",sheet="Stereo_Inter_Data",as="data.table")
> Alpha(df, "D", 1:22, digits = 3)


Reliability Analysis

Summary:
```

```
Total Items: 22
Scale Range: 1 ~ 22
Total Cases: 1661
Valid Cases: 1661 (100.0%)

Scale Statistics:
Mean = 3.563
S.D. = 0.408
Cronbach's α = 0.750
McDonald's ω = 0.783

Items D5, D10, D14 correlate negatively with the scale and may be reversed.
You can specify this argument: rev=c("D5", "D10", "D14")

Item Statistics (Cronbach's α If Item Deleted):
```

	Mean	S.D.	Item-Rest Cor.	Cronbach's α
D1	4.238	(0.859)	0.417	0.734
D2	3.930	(1.109)	0.095	0.757
D3	3.638	(1.132)	0.368	0.736
D4	3.608	(1.171)	0.349	0.737
D5	3.707	(1.087)	0.026	0.761
D6	3.530	(0.968)	0.332	0.739
D7	3.905	(0.876)	0.487	0.730
D8	3.426	(1.052)	0.365	0.736
D9	3.727	(0.896)	0.435	0.733
D10	3.445	(1.170)	-0.063	0.769
D11	2.793	(1.016)	0.028	0.760
D12	3.185	(1.100)	0.394	0.734
D13	3.553	(1.004)	0.454	0.730
D14	3.564	(1.213)	0.032	0.763
D15	3.888	(0.864)	0.425	0.734
D16	3.945	(0.940)	0.475	0.730
D17	3.850	(0.898)	0.566	0.724
D18	2.950	(1.081)	0.272	0.743
D19	3.413	(0.965)	0.310	0.741
D20	3.715	(0.911)	0.528	0.727
D21	2.750	(1.058)	0.216	0.747
D22	3.625	(0.920)	0.443	0.732

```
Item-Rest Cor. = Corrected Item-Total Correlation
```

2.4-Intergroup Interaction Intention

```
    > df = import("Disability-Stereotypes-Intergroup-Contact-Data.xlsx",sheet="Stereo_Inter_
Data",as="data.table")
> Alpha(df, "F", 1:5, digits = 3)


Reliability Analysis

Summary:
Total Items: 5
Scale Range: 1 ~ 5
Total Cases: 1661
Valid Cases: 1661 (100.0%)

Scale Statistics:
Mean = 3.819
S.D. = 0.661
Cronbach's α = 0.826
McDonald's ω = 0.846

Item Statistics (Cronbach's α If Item Deleted):
---------------------------------------------
    Mean    S.D. Item-Rest Cor. Cronbach's α
---------------------------------------------
F1  2.818 (0.874)         0.344       0.868
F2  3.668 (0.953)         0.615       0.796
F3  4.215 (0.805)         0.749       0.757
F4  4.112 (0.858)         0.752       0.753
F5  4.281 (0.800)         0.703       0.771
---------------------------------------------
Item-Rest Cor. = Corrected Item-Total Correlation
```

========= 03/ Common Method Bias Test =========

```
    > df = import("Disability-Stereotypes-Intergroup-Contact-Data.xlsx",sheet="Stereo_Inter_
Data",as="data.table")
> # Install and load required packages
> if(!require("psych")) install.packages("psych"); library(psych)

    > if(!require("GPArotation")) install.packages("GPArotation"); library(GPArotation)

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

    equamax, varimin
```

```
    > # Step 1: Extract data for all items
> all_items <- df[, c(paste0("B", 1:23),
+                     paste0("C", 1:10),
+                     paste0("D", 1:22),
+                     paste0("F", 1:5))]
>
> # Step 2: Check data suitability for factor analysis
> # Bartlett's Test of Sphericity
> bartlett_result <- cortest.bartlett(cor(all_items), n = nrow(all_items))
> cat("Results of Bartlett's Test of Sphericity:\n")

    Results of Bartlett's Test of Sphericity:

    > cat("Chi-square =", round(bartlett_result$chisq, 2), "\n")

    Chi-square = 41373.37

    > cat("p-value =", format.pval(bartlett_result$p.value, digits = 3), "\n")

    p-value = <2e-16

    > if(bartlett_result$p.value < 0.05) {
+   message("Bartlett's test was significant (p<0.05), indicating suitability for factor ana
lysis")
+ } else {
+   warning("Bartlett's test was not significant; factor analysis results may be unreliable")
+ }

    Bartlett's test was significant (p<0.05), indicating suitability for factor analysis

    > # Kaiser-Meyer-Olkin (KMO) Test
> kmo_result <- KMO(all_items)
> cat("\nKaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy:\n")


Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy:

    > print(kmo_result$MSA)

    [1] 0.90612

    > if(kmo_result$MSA > 0.8) {
+   message("KMO > 0.8: Very suitable for factor analysis")
+ } else if(kmo_result$MSA > 0.6) {
+   message("KMO > 0.6: Marginally suitable for factor analysis")
+ } else {
+   warning("KMO < 0.6: Not suitable for factor analysis; recheck data")
+ }
```

```
   KMO > 0.8: Very suitable for factor analysis

   > # Step 3: Single-factor factor analysis (Harman's single-factor test)
> # Principal Component Analysis (PCA)
> harman_test <- principal(all_items,
+                          nfactors = 1,
+                          rotate = "none",
+                          scores = FALSE)
> # Step 5: Extract eigenvalues for all factors (complete factor analysis)
> fa_all <- principal(all_items, nfactors = ncol(all_items), rotate = "none")
>
> # Number of factors with eigenvalues greater than 1
> eigenvalues <- fa_all$values
> n_factors_above_1 <- sum(eigenvalues > 1)
>
> # Calculate total explained variance
> total_variance_explained <- sum(eigenvalues[eigenvalues > 1]) / sum(eigenvalues) * 100
>
> # Variance explained by the first factor
> variance_first_factor <- harman_test$Vaccounted[2] * 100
>
> # Professional report output
> cat("\n=== Results of Common Method Bias Test ===\n")


=== Results of Common Method Bias Test ===

   > cat("Bartlett's Test of Sphericity: χ² =",
+     format(round(bartlett_result$chisq, 1), big.mark = ","),
+     ", p < .001\n")

   Bartlett's Test of Sphericity: χ² = 41,373.4 , p < .001

   > cat("Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy:", round(kmo_result$MSA, 3),

+     " (>0.9, very suitable for factor analysis)\n\n")

   Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy: 0.906  (>0.9, very suitable for fa
ctor analysis)

   > cat("Results of Exploratory Factor Analysis (Unrotated):\n")

   Results of Exploratory Factor Analysis (Unrotated):

   > cat("1. Number of factors with eigenvalues > 1:", n_factors_above_1, "\n")

   1. Number of factors with eigenvalues > 1: 11
```

```
   > cat("2. Variance explained by the first factor:", round(variance_first_factor, 2), "%\
n")

   2. Variance explained by the first factor: 16.14 %

   > cat("3. Total variance explained by all factors:", round(total_variance_explained, 2),
 "%\n\n")

   3. Total variance explained by all factors: 56.2 %
```

========= 04 Descriptive Statistics and Correlation Analysis =========

4.1-Descriptive Statistics

```
   > df = import("Disability-Stereotypes-Intergroup-Contact-Data.xlsx",sheet="Stereo_Inter_
Data",as="data.table")
>
> # Set data types
> # Several variables are not numeric
> df$Dis_Stereo = as.numeric(df$Dis_Stereo)
> df$Inter_Anx = as.numeric(df$Inter_Anx)
> df$Inter_Willingness = as.numeric(df$Inter_Willingness)
> df$Empathy = as.numeric(df$Empathy)
> df$Emp_1PT = as.numeric(df$Emp_1PT)   # Perspective Taking (PT: Items 6, 9, 15, 19, 22)
> df$Emp_2FS = as.numeric(df$Emp_2FS)   # Fantasy(FS: Items 3, 5, 10, 12, 17, 20)
> df$Emp_3EC = as.numeric(df$Emp_3EC)   # Empathic Concern (EC: Items 1, 2, 7, 11, 14, 16)
> df$Emp_4PD = as.numeric(df$Emp_4PD)   # Personal Distress(PD: Items 4, 8, 13, 18, 21)

   > ## Calculate M-1SD and M+1SD for the above variables, and output directly.
> # Create results data table
> results <- data.table(
+   Variable = character(),
+   Mean = numeric(),
+   SD = numeric(),
+   M_minus_1SD = numeric(),
+   M_plus_1SD = numeric(),
+   Description = character()
+ )
>
> # Add auxiliary function to calculate statistics
> add_stats <- function(df, var_name, description) {
+   mean_val <- mean(df[[var_name]], na.rm = TRUE)
+   sd_val <- sd(df[[var_name]], na.rm = TRUE)
+
```

```
+   results <<- rbind(results, list(
+     Variable = var_name,
+     Mean = mean_val,
+     SD = sd_val,
+     M_minus_1SD = mean_val - sd_val,
+     M_plus_1SD = mean_val + sd_val,
+     Description = description
+   ))
+ }
>
> # Calculate statistics for all variables
> add_stats(df, "Dis_Stereo", "Disability Stereotypes")
> add_stats(df, "Inter_Anx", "Intergroup Anxiety")
> add_stats(df, "Inter_Willingness", "Intergroup Interaction Intention")
> add_stats(df, "Empathy", "Total Empathy")
> add_stats(df, "Emp_1PT", "Perspective Taking")
> add_stats(df, "Emp_2FS", "Fantasy")
> add_stats(df, "Emp_3EC", "Empathic Concern")
> add_stats(df, "Emp_4PD", "Personal Distress")
>
> # Format and beautify output
> library(flextable)
>
> # Create professional table
> stats_table <- flextable(results) %>%
+   set_header_labels(
+     Variable = "Variable",
+     Mean = "Mean (M)",
+     SD = "Standard Deviation (SD)",
+     M_minus_1SD = "M-1SD",
+     M_plus_1SD = "M+1SD",
+     Description = "Description"
+   ) %>%
+   theme_zebra(odd_header = "#2c7fb8", even_body = "#f7fcfd") %>%
+   align(align = "center", part = "all") %>%
+   fontsize(size = 11, part = "all") %>%
+   colformat_num(col_keys = c("Mean", "SD", "M_minus_1SD", "M_plus_1SD"),
+                 digits = 3) %>%
+   autofit() %>%
+   set_caption(caption = "Table 1: Mean and Standard Deviation of Core Variables")
>
> # Print table
> print(stats_table)

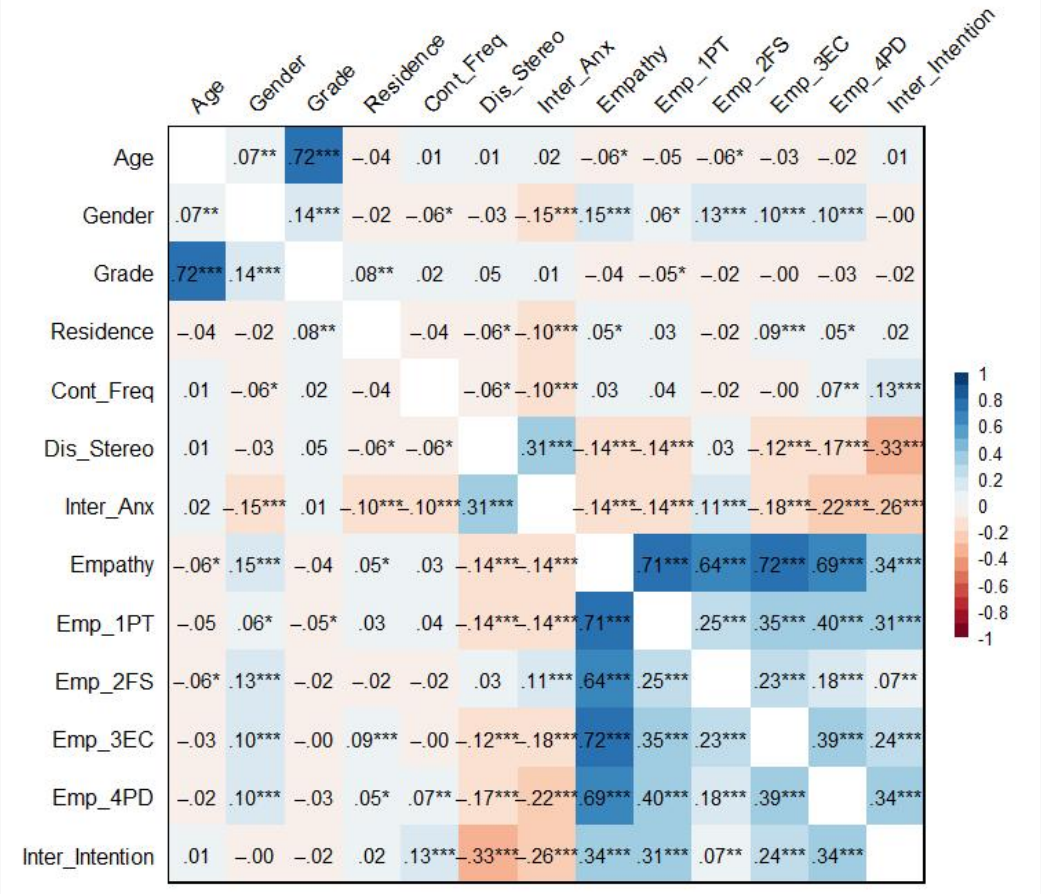
   a flextable object.
```

```
col_keys: `Variable`, `Mean`, `SD`, `M_minus_1SD`, `M_plus_1SD`, `Description`
header has 1 row(s)
body has 8 row(s)
original dataset sample:
        Variable     Mean       SD M_minus_1SD M_plus_1SD
1     Dis_Stereo 3.340265 0.6972628    2.643003   4.037528
2      Inter_Anx 3.063633 0.9699535    2.093680   4.033587
3 Inter_Willingness 3.818543 0.6607721    3.157771   4.479315
4        Empathy 3.562996 0.4076103    3.155386   3.970607
5        Emp_1PT 3.636692 0.6167677    3.019924   4.253460
                    Description
1          Disability Stereotypes
2              Intergroup Anxiety
3 Intergroup Interaction Intention
4                  Total Empathy
5              Perspective Taking
```

4.2-Correlation Analysis

```
   > Corr(df[, .(Age,Gender,Grade,Residence,Cont_Freq,
+               Dis_Stereo,Inter_Anx,Empathy,
+               Emp_1PT,Emp_2FS,Emp_3EC,Emp_4PD,
+              Inter_Willingness
+               )], file="Correlation_Matrix.doc")

   Descriptive Statistics and Correlation Matrix:
✔ Table saved to "D:/2-Manuscript_Submission_Keep_Moving/!-Under_Submission/20250806-Impact
_of_Disability_Stereotypes_on_Intergroup_Interaction_Intention_of_General_College_Students-
Questionnaire_Survey/2-Data_Analysis/Correlation_Matrix.doc"
```



Correlation matrix is displayed in the RStudio `Plots` Pane.

========= 05/ Regression Analysis =========

5.1-Model 0: Control Variable

```
> # Model 0: Control Variable
> model <- lm(Inter_Willingness ~ Cont_Freq, data = df)
> GLM_summary(model)


General Linear Model (OLS Regression)

Model Fit:
F(1, 1659) = 26.46, p = 3e-07 ***
R² = 0.01570 (Adjusted R² = 0.01510)

Unstandardized Coefficients:
Outcome Variable: Inter_Willingness
N = 1661
_____________________________________________________________
```

```
                b    S.E.      t     p      [95% CI of b] VIF
──────────────────────────────────────────────────────────────
(Intercept)  3.558 (0.053) 66.948 <.001 *** [3.454, 3.662]
Cont_Freq    0.121 (0.023)  5.144 <.001 *** [0.075, 0.166]
──────────────────────────────────────────────────────────────

Standardized Coefficients (β):
Outcome Variable: Inter_Willingness
N = 1661
──────────────────────────────────────────────────────────────────────────────
              β    S.E.     t     p      [95% CI of β] r(partial) r(part)
──────────────────────────────────────────────────────────────────────────────
Cont_Freq  0.125 (0.024) 5.144 <.001 *** [0.078, 0.173]     0.125   0.125
──────────────────────────────────────────────────────────────────────────────
```

5.2-Model 1: Direct Effect

```
    > # Model 1: Direct Effect
> model_direct <- lm(Inter_Willingness ~ Dis_Stereo + Cont_Freq, data = df)
> GLM_summary(model_direct)


General Linear Model (OLS Regression)

Model Fit:
F(2, 1658) = 112.34, p = 2e-46 ***
R² = 0.11934 (Adjusted R² = 0.11827)

Unstandardized Coefficients:
Outcome Variable: Inter_Willingness
N = 1661
──────────────────────────────────────────────────────────────────────
                b    S.E.      t     p       [95% CI of b]   VIF
──────────────────────────────────────────────────────────────────────
(Intercept)   4.620 (0.091)  50.689 <.001 *** [ 4.441,  4.799]
Dis_Stereo   -0.306 (0.022) -13.969 <.001 *** [-0.349, -0.263] 1.004
Cont_Freq     0.102 (0.022)   4.576 <.001 *** [ 0.058,  0.145] 1.004
──────────────────────────────────────────────────────────────────────

Standardized Coefficients (β):
Outcome Variable: Inter_Willingness
N = 1661
──────────────────────────────────────────────────────────────────────────────
              β    S.E.      t     p       [95% CI of β] r(partial) r(part)
──────────────────────────────────────────────────────────────────────────────
```

```
Dis_Stereo  -0.323 (0.023) -13.969 <.001 *** [-0.368, -0.277]     -0.324  -0.322
Cont_Freq    0.106 (0.023)   4.576 <.001 *** [ 0.060,  0.151]      0.112   0.105
-------------------------------------------------------------------------------
```

5.3-Model 2: Add Mediating and Moderating Variables

```
    > # Model 2: Add Mediating and Moderating Variables
> model_med <- lm(Inter_Willingness ~ Dis_Stereo + Inter_Anx + Empathy + Cont_Freq, data = d
f)
> GLM_summary(model_med)


General Linear Model (OLS Regression)

Model Fit:
F(4, 1656) = 119.09, p = 2e-89 ***
R² = 0.22340 (Adjusted R² = 0.22153)

Unstandardized Coefficients:
Outcome Variable: Inter_Willingness
N = 1661
-------------------------------------------------------------------------
                b    S.E.       t     p        [95% CI of b]   VIF
-------------------------------------------------------------------------
(Intercept)   3.049 (0.166)  18.418 <.001 *** [ 2.725,  3.374]
Dis_Stereo   -0.228 (0.022) -10.499 <.001 *** [-0.271, -0.185] 1.120
Inter_Anx    -0.095 (0.016)  -6.081 <.001 *** [-0.126, -0.065] 1.128
Empathy       0.460 (0.036)  12.905 <.001 *** [ 0.390,  0.530] 1.031
Cont_Freq     0.085 (0.021)   4.062 <.001 *** [ 0.044,  0.126] 1.011
-------------------------------------------------------------------------

Standardized Coefficients (β):
Outcome Variable: Inter_Willingness
N = 1661
-------------------------------------------------------------------------------
                β    S.E.       t     p        [95% CI of β] r(partial) r(part)
-------------------------------------------------------------------------------
Dis_Stereo  -0.241 (0.023) -10.499 <.001 *** [-0.286, -0.196]     -0.250  -0.227
Inter_Anx   -0.140 (0.023)  -6.081 <.001 *** [-0.185, -0.095]     -0.148  -0.132
Empathy      0.284 (0.022)  12.905 <.001 *** [ 0.241,  0.327]      0.302   0.279
Cont_Freq    0.088 (0.022)   4.062 <.001 *** [ 0.046,  0.131]      0.099   0.088
-------------------------------------------------------------------------------
```

5.4-Model 3: Add Dimensions of Empathy

```
    > # Model 3: Add Dimensions of Empathy
> model_full <- lm(Inter_Willingness ~ Dis_Stereo + Inter_Anx + Emp_1PT + Emp_2FS + Emp_3EC
+ Emp_4PD + Cont_Freq, data = df)
> GLM_summary(model_full)


General Linear Model (OLS Regression)

Model Fit:
F(7, 1653) = 76.21, p = 7e-96 ***
R² = 0.24400 (Adjusted R² = 0.24080)

Unstandardized Coefficients:
Outcome Variable: Inter_Willingness
N = 1661
```

	b	S.E.	t	p		[95% CI of b]	VIF
(Intercept)	2.767	(0.171)	16.147	<.001	***	[2.431, 3.103]	
Dis_Stereo	-0.215	(0.022)	-10.001	<.001	***	[-0.258, -0.173]	1.129
Inter_Anx	-0.076	(0.016)	-4.781	<.001	***	[-0.107, -0.045]	1.190
Emp_1PT	0.179	(0.026)	6.862	<.001	***	[0.128, 0.230]	1.297
Emp_2FS	-0.000	(0.021)	-0.006	.995		[-0.041, 0.040]	1.133
Emp_3EC	0.079	(0.028)	2.774	.006	**	[0.023, 0.135]	1.290
Emp_4PD	0.242	(0.033)	7.246	<.001	***	[0.176, 0.307]	1.345
Cont_Freq	0.078	(0.021)	3.754	<.001	***	[0.037, 0.118]	1.016

```
Standardized Coefficients (β):
Outcome Variable: Inter_Willingness
N = 1661
```

	β	S.E.	t	p		[95% CI of β]	r(partial)	r(part)
Dis_Stereo	-0.227	(0.023)	-10.001	<.001	***	[-0.272, -0.183]	-0.239	-0.214
Inter_Anx	-0.112	(0.023)	-4.781	<.001	***	[-0.157, -0.066]	-0.117	-0.102
Emp_1PT	0.167	(0.024)	6.862	<.001	***	[0.119, 0.215]	0.166	0.147
Emp_2FS	-0.000	(0.023)	-0.006	.995		[-0.045, 0.045]	-0.000	-0.000
Emp_3EC	0.067	(0.024)	2.774	.006	**	[0.020, 0.115]	0.068	0.059
Emp_4PD	0.180	(0.025)	7.246	<.001	***	[0.131, 0.228]	0.175	0.155
Cont_Freq	0.081	(0.022)	3.754	<.001	***	[0.039, 0.123]	0.092	0.080

======== 06/ Moderated Mediation Effect ========

-Intergroup anxiety is the mediating variable, and empathy (including four dimensions) may be the moderating variable.

6.1-Mediation of Intergroup Anxiety

```
    > PROCESS(df, y = "Inter_Willingness",       # Dependent variable: Intergroup Interactio
n Intention
+            x = "Dis_Stereo",            # Independent variable: Disability Stereotypes
+            meds = "Inter_Anx",          # Mediating variable: Intergroup Anxiety
+            covs = "Cont_Freq",    # Control variable
+            std = TRUE,
+            ci = "boot",nsim = 5000,seed = 1)


***************** PART 1. Regression Model Summary *****************

PROCESS Model Code : 4 (Hayes, 2018; www.guilford.com/p/hayes3)
PROCESS Model Type : Simple Mediation
-    Outcome (Y) : Inter_Willingness
-  Predictor (X) : Dis_Stereo
-  Mediators (M) : Inter_Anx
- Moderators (W) : -
- Covariates (C) : Cont_Freq
-   HLM Clusters : -

All numeric predictors have been standardized.
(For details, please see the help page of PROCESS.)

Formula of Mediator:
-    Inter_Anx ~ Cont_Freq + Dis_Stereo
Formula of Outcome:
-    Inter_Willingness ~ Cont_Freq + Dis_Stereo + Inter_Anx

CAUTION:
  Fixed effect (coef.) of a predictor involved in an interaction
  denotes its "simple effect/slope" at the other predictor = 0.
  Only when all predictors in an interaction are mean-centered
  can the fixed effect denote the "main effect"!

Model Summary

_____________________________________________________________________

           (1) Inter_Willingness  (2) Inter_Anx  (3) Inter_Willingness
```

```
──────────────────────────────────────────────────────────────────
Cont_Freq       .106 ***           -.081 ***       .092 ***
               (.023)             (.023)          (.023)
Dis_Stereo     -.323 ***           .307 ***       -.270 ***
               (.023)             (.023)          (.024)
Inter_Anx                                         -.170 ***
                                                  (.024)
──────────────────────────────────────────────────────────────────
R^2             .119               .104            .145
Adj. R^2        .118               .103            .144
Num. obs.   1661               1661            1661
──────────────────────────────────────────────────────────────────
Note. * p < .05, ** p < .01, *** p < .001.

************ PART 2. Mediation/Moderation Effect Estimate ************

Package Use : ‘mediation’ (v4.5.0)
Effect Type : Simple Mediation (Model 4)
Sample Size : 1661
Random Seed : set.seed(1)
Simulations : 5000 (Bootstrap)

Running 5000 simulations...
Indirect Path: "Dis_Stereo" (X) ==> "Inter_Anx" (M) ==> "Inter_Willingness" (Y)
──────────────────────────────────────────────────────────────────
              Effect    S.E.       z     p        [Boot 95% CI]
──────────────────────────────────────────────────────────────────
Indirect (ab)  -0.052 (0.009)  -5.950 <.001 *** [-0.070, -0.036]
Direct (c')    -0.270 (0.025) -11.024 <.001 *** [-0.318, -0.223]
Total (c)      -0.323 (0.024) -13.653 <.001 *** [-0.368, -0.277]
──────────────────────────────────────────────────────────────────
Percentile Bootstrap Confidence Interval
(SE and CI are estimated based on 5000 Bootstrap samples.)

Note. The results based on bootstrapping or other random processes
are unlikely identical to other statistical software (e.g., SPSS).
To make results reproducible, you need to set a seed (any number).
Please see the help page for details: help(PROCESS)
Ignore this note if you have already set a seed. :)
```

6.2-Moderated Mediation of Empathy

-Moderated Mediation

```
> process_result <- PROCESS(
+   df,
+   y = "Inter_Willingness",              # Dependent variable: Intergroup Interaction Inten
tion
+   x = "Dis_Stereo",               # Independent variable: Disability Stereotypes
+   meds = "Inter_Anx",            # Mediating variable: Intergroup Anxiety
+   mods = "Empathy",              # Moderating variable: Empathy
+   covs = "Cont_Freq",     # Control variable
+   mod.type = "2-way",        # Two-way interaction
+   mod.path = "all",          # All paths
+   cov.path = "both",         # Covariate acts on all paths
+   std = TRUE,               # Use standardized coefficients
+   ci = "boot",              # Bootstrap confidence interval
+   nsim = 5000,              # 5000 resamplings
+   seed = 1                  # Random seed
+ )


****************** PART 1. Regression Model Summary ******************

PROCESS Model Code : 59 (Hayes, 2018; www.guilford.com/p/hayes3)
PROCESS Model Type : Moderated Mediation
-    Outcome (Y) : Inter_Willingness
-  Predictor (X) : Dis_Stereo
-  Mediators (M) : Inter_Anx
- Moderators (W) : Empathy
- Covariates (C) : Cont_Freq
-   HLM Clusters : -

All numeric predictors have been standardized.
(For details, please see the help page of PROCESS.)

Formula of Mediator:
-    Inter_Anx ~ Cont_Freq + Dis_Stereo*Empathy
Formula of Outcome:
-    Inter_Willingness ~ Cont_Freq + Dis_Stereo*Empathy + Inter_Anx*Empathy

Model Summary

                  (1) Inter_Willingness  (2) Inter_Anx  (3) Inter_Willingness
Cont_Freq               .106 ***           -.080 ***       .088 ***
                       (.023)             (.023)          (.022)
Dis_Stereo             -.323 ***            .294 ***      -.240 ***
```

```
                     (.023)             (.023)        (.023)
Empathy                                 -.098 ***      .280 ***
                                        (.023)        (.022)
Dis_Stereo:Empathy                        .006          .019
                                        (.023)        (.024)
Inter_Anx                                             -.148 ***
                                                      (.023)
Empathy:Inter_Anx                                      .069 **
                                                      (.024)
_____________________________________________________________________________
R^2                    .119               .113          .230
Adj. R^2               .118               .111          .227
Num. obs.          1661               1661          1661
_____________________________________________________________________________
Note. * p < .05, ** p < .01, *** p < .001.

************ PART 2. Mediation/Moderation Effect Estimate ************

Package Use : ‘mediation’ (v4.5.0), ‘interactions’ (v1.1.5)
Effect Type : Moderated Mediation (Model 59)
Sample Size : 1661
Random Seed : set.seed(1)
Simulations : 5000 (Bootstrap)

Interaction Effect on "Inter_Willingness" (Y)
_____________________________________________
                       F df1  df2     p
_____________________________________________
Dis_Stereo * Empathy  0.65   1 1654  .422
Empathy * Inter_Anx   8.25   1 1654  .004 **
(All Interactions)    6.61   2 1654  .001 **
_____________________________________________

Simple Slopes: "Dis_Stereo" (X) ==> "Inter_Willingness" (Y)
(Conditional Direct Effects [c'] of X on Y)
_____________________________________________________________________
 "Empathy"     Effect    S.E.       t     p            [95% CI]
_____________________________________________________________________
 -1.000 (- SD) -0.260 (0.034)  -7.580 <.001 *** [-0.327, -0.193]
 -0.000 (Mean) -0.240 (0.023) -10.508 <.001 *** [-0.285, -0.195]
 1.000 (+ SD)  -0.221 (0.033)  -6.760 <.001 *** [-0.285, -0.157]
_____________________________________________________________________

Interaction Effect on "Inter_Anx" (M)
```

```
_____________________________________________
                       F df1  df2     p
_____________________________________________
Dis_Stereo * Empathy  0.07   1 1656  .792
_____________________________________________

Simple Slopes: "Dis_Stereo" (X) ==> "Inter_Anx" (M)
(Conditional Effects [a] of X on M)
_____________________________________________________________________
 "Empathy"     Effect    S.E.      t     p          [95% CI]
_____________________________________________________________________
 -1.000 (- SD)  0.287 (0.034)  8.434 <.001 *** [0.220, 0.354]
 -0.000 (Mean)  0.294 (0.023) 12.533 <.001 *** [0.248, 0.339]
 1.000 (+ SD)   0.300 (0.033)  9.184 <.001 *** [0.236, 0.364]
_____________________________________________________________________

Interaction Effect on "Inter_Willingness" (Y)
_____________________________________________
                       F df1  df2     p
_____________________________________________
Dis_Stereo * Empathy  0.65   1 1654  .422
Empathy * Inter_Anx   8.25   1 1654  .004 **
(All Interactions)    6.61   2 1654  .001 **
_____________________________________________

Simple Slopes: "Inter_Anx" (M) ==> "Inter_Willingness" (Y)
(Conditional Effects [b] of M on Y)
_____________________________________________________________________
 "Empathy"     Effect    S.E.      t     p            [95% CI]
_____________________________________________________________________
 -1.000 (- SD) -0.219 (0.036) -6.129 <.001 *** [-0.289, -0.149]
 -0.000 (Mean) -0.148 (0.023) -6.426 <.001 *** [-0.194, -0.103]
 1.000 (+ SD)  -0.078 (0.032) -2.477  .013 *   [-0.140, -0.016]
_____________________________________________________________________

Running 5000 * 3 simulations...
Indirect Path: "Dis_Stereo" (X) ==> "Inter_Anx" (M) ==> "Inter_Willingness" (Y)
(Conditional Indirect Effects [ab] of X through M on Y)
_____________________________________________________________________
 "Empathy"     Effect    S.E.      z     p       [Boot 95% CI]
_____________________________________________________________________
 -1.000 (- SD) -0.063 (0.014) -4.389 <.001 *** [-0.093, -0.037]
 -0.000 (Mean) -0.044 (0.008) -5.427 <.001 *** [-0.060, -0.029]
 1.000 (+ SD)  -0.023 (0.010) -2.271  .023 *   [-0.045, -0.004]
```

```
_____________________________________________________________

Percentile Bootstrap Confidence Interval
(SE and CI are estimated based on 5000 Bootstrap samples.)

Note. The results based on bootstrapping or other random processes
are unlikely identical to other statistical software (e.g., SPSS).
To make results reproducible, you need to set a seed (any number).
Please see the help page for details: help(PROCESS)
Ignore this note if you have already set a seed. :)

    > # Extract results of the intergroup anxiety model
> model_m <- process_result$model.m[[1]]
> model_m_summary <- model_summary(model_m, std = TRUE)


Model Summary

___________________________________
                  (1) Inter_Anx
___________________________________
Cont_Freq             -.080 ***
                     (.023)
Dis_Stereo             .294 ***
                     (.023)
Empathy               -.098 ***
                     (.023)
Dis_Stereo:Empathy     .006
                     (.023)
___________________________________
R^2                    .113
Adj. R^2               .111
Num. obs.          1661
___________________________________
Note. * p < .05, ** p < .01, *** p < .001.

# Check for Multicollinearity

Low Correlation

              Term  VIF      VIF 95% CI adj. VIF Tolerance Tolerance 95% CI
         Cont_Freq 1.00 [1.00,   424.99]     1.00      1.00     [0.00, 1.00]
        Dis_Stereo 1.02 [1.00,     1.19]     1.01      0.98     [0.84, 1.00]
           Empathy 1.02 [1.00,     1.23]     1.01      0.98     [0.81, 1.00]
 Dis_Stereo:Empathy 1.00 [1.00, 1.65e+07]     1.00      1.00     [0.00, 1.00]
```

```
> # Extract results of the interaction intention model
> model_y <- process_result$model.y
> model_y_summary <- model_summary(model_y, std = TRUE)


Model Summary

──────────────────────────────────────────
                  (1) Inter_Willingness
──────────────────────────────────────────
Cont_Freq              .088 ***
                      (.022)
Dis_Stereo            -.240 ***
                      (.023)
Empathy                .280 ***
                      (.022)
Inter_Anx             -.148 ***
                      (.023)
Dis_Stereo:Empathy     .019
                      (.024)
Empathy:Inter_Anx      .069 **
                      (.024)
──────────────────────────────────────────
R^2                    .230
Adj. R^2               .227
Num. obs.          1661
──────────────────────────────────────────
Note. * p < .05, ** p < .01, *** p < .001.

# Check for Multicollinearity

Low Correlation

                Term  VIF   VIF 95% CI adj. VIF Tolerance Tolerance 95% CI
           Cont_Freq 1.01 [1.00, 1.84]     1.01      0.99     [0.54, 1.00]
          Dis_Stereo 1.12 [1.08, 1.20]     1.06      0.89     [0.83, 0.93]
             Empathy 1.03 [1.01, 1.15]     1.02      0.97     [0.87, 0.99]
           Inter_Anx 1.15 [1.10, 1.22]     1.07      0.87     [0.82, 0.91]
 Dis_Stereo:Empathy 1.22 [1.16, 1.30]     1.10      0.82     [0.77, 0.86]
  Empathy:Inter_Anx 1.24 [1.18, 1.32]     1.11      0.81     [0.76, 0.85]
```

6.3-Plotting

6.3.1 Histogram

```
> library(ggplot2)
```

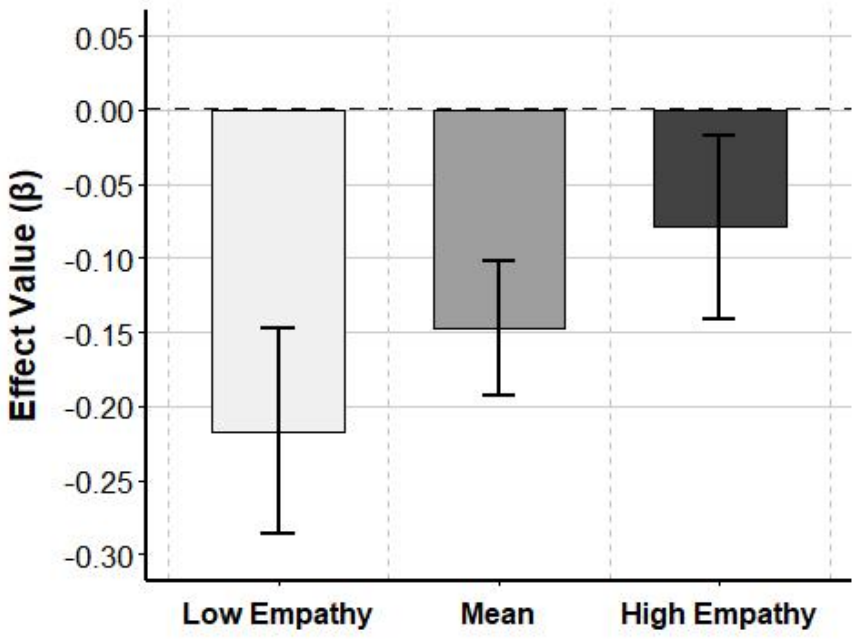
```
>
> # Create data frame - Precisely use the 95% confidence interval values from the image
> contact_data <- data.frame(
+   Level = factor(c("Low Empathy", "Mean", "High Empathy"),
+                  levels = c("Low Empathy", "Mean", "High Empathy")),
+   Effect = c(-0.217, -0.148, -0.079),       # Updated effect values
+   Lower_CI = c(-0.286, -0.193, -0.141),      # Updated 95%CI lower bound
+   Upper_CI = c(-0.147, -0.102, -0.017),      # Updated 95%CI upper bound
+   Significance = c("***", "***", "*")       # Updated significance markers
+ )
>
>
> # Create black-white-gray gradient colors
> grey_palette <- c("#f0f0f0", "#9E9E9E", "#424242")  # Light gray -> Medium gray -> Dark gra
y
>
> # Plot the chart
> p1 <- ggplot(contact_data, aes(x = Level, y = Effect)) +
+   # Reference lines and axes
+   geom_hline(yintercept = 0, size = 0.8, color = "black", linetype = "dashed") +
+   geom_hline(yintercept = seq(-0.20, 0.05, by = 0.05),
+              size = 0.3, color = "gray80") +
+   geom_vline(xintercept = c(0.5, 1.5, 2.5, 3.5),
+              size = 0.3, linetype = "dashed", color = "gray80") +
+
+   # Bar chart (black-white-gray gradient)
+   geom_col(aes(fill = Level), width = 0.6, color = "black", size = 0.7) +
+   scale_fill_manual(values = grey_palette) +
+
+   # Error bars (95% confidence interval) - Use CI values from the image directly
+   geom_errorbar(aes(ymin = Lower_CI, ymax = Upper_CI),
+                 width = 0.15, size = 0.8, color = "black") +
+
+   # Effect value labels
+   #geom_text(aes(label = sprintf("%.3f", Effect)),
+             #vjust = -0.8, size = 5.5, fontface = "bold") +
+
+   # Significance markers (asterisks)
+   #geom_text(aes(label = Significance),
+             #vjust = 8, size = 7, fontface = "bold") +
+
+    # Axes and theme
+   scale_y_continuous(
+     limits = c(-0.30, 0.05),
```

```
+     breaks = seq(-0.30, 0.05, by = 0.05),
+     labels = function(x) sprintf("%.2f", x),  # Key modification: Ensure two decimal places
+     name = "Effect Value (β)",
+     expand = expansion(mult = c(0.05, 0.05))
+   )  +
+
+   labs(x = " ",
+        y = NULL) +
+   theme_classic() +
+   theme(
+     legend.position = "none",
+     panel.grid.major.y = element_blank(),
+     panel.grid.minor.y = element_blank(),
+     panel.background = element_rect(fill = "white"),
+     plot.background = element_rect(fill = "white"),
+     axis.text.x = element_text(size = 12, face = "bold", color = "black",
+                                margin = margin(t=5)),
+     axis.text.y = element_text(size = 13, color = "black"),
+     axis.title.x = element_text(size = 12, face = "bold", margin = margin(t=10)),
+     axis.title.y = element_text(size = 14, face = "bold", margin = margin(r=10)),
+     axis.line = element_line(size = 0.8, color = "black"),
+     axis.ticks = element_line(color = "black", size = 0.6)
+   )

    Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
ℹ  Please use `linewidth` instead.
This warning is displayed once every 8 hours.
Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
generated.

    Warning: The `size` argument of `element_line()` is deprecated as of ggplot2 3.4.0.
ℹ  Please use the `linewidth` argument instead.
This warning is displayed once every 8 hours.
Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
generated.

    > # Display the plot
> print(p1)
```



6.3.2 Slope Plot

(1) Calculate High and Low Simple Effect Values

```
   > # Extract regression coefficients from PROCESS results
> # Intercept (not directly given, but theoretically 0 for standardized variables)
> # Main effect of Intergroup Anxiety (Inter_Anx): -0.148
> # Main effect of Empathy (Empathy): 0.278
> # Interaction term of Intergroup Anxiety and Empathy (Inter_Anx:Empathy): 0.067
> # Plot data points should be predicted values when Inter_Anx (Intergroup Anxiety) and Empa
thy take ±1SD (i.e., -1 and 1) respectively.
> # Therefore, the formula for calculating predicted values is:
>
> coefs <- c(
+   intercept = 0,  # Intercept of standardized model is 0
+   Cont_Freq = 0.278,
+   Inter_Anx = -0.148,
+   interaction = 0.067
+ )
>
> # Calculate predicted values for different combinations
> calculate_value <- function(Inter_Anx_val, contact_val) {
+   coefs["intercept"] +
+   coefs["Cont_Freq"] * contact_val +
+   coefs["Inter_Anx"] * Inter_Anx_val +
+   coefs["interaction"] * contact_val * Inter_Anx_val
+ }
>
```

```
> # Create precise data frame
> plot_data <- data.frame(
+   Group = rep(c("Low Intergroup Anxiety", "High Intergroup Anxiety"), each = 2),
+   Empathy = factor(rep(c("Low Empathy", "High Empathy"), 2),
+                    levels = c("Low Empathy", "High Empathy")),
+   Value = c(
+     calculate_value(-1, -1),  # Low Anxiety - Low Empathy
+     calculate_value(-1, 1),   # Low Anxiety - High Empathy
+     calculate_value(1, -1),   # High Anxiety - Low Empathy
+     calculate_value(1, 1)     # High Anxiety - High Empathy
+   )
+ )
>
> # Print calculation results
> cat("Precise Calculated Values:\n")

   Precise Calculated Values:

   > print(plot_data)    # c(-0.063, 0.359, 0.197, -0.093)

                     Group      Empathy  Value
1  Low Intergroup Anxiety  Low Empathy -0.063
2  Low Intergroup Anxiety High Empathy  0.359
3 High Intergroup Anxiety  Low Empathy -0.493
4 High Intergroup Anxiety High Empathy  0.197
```

(2) Draw Slope Plot of Empathy

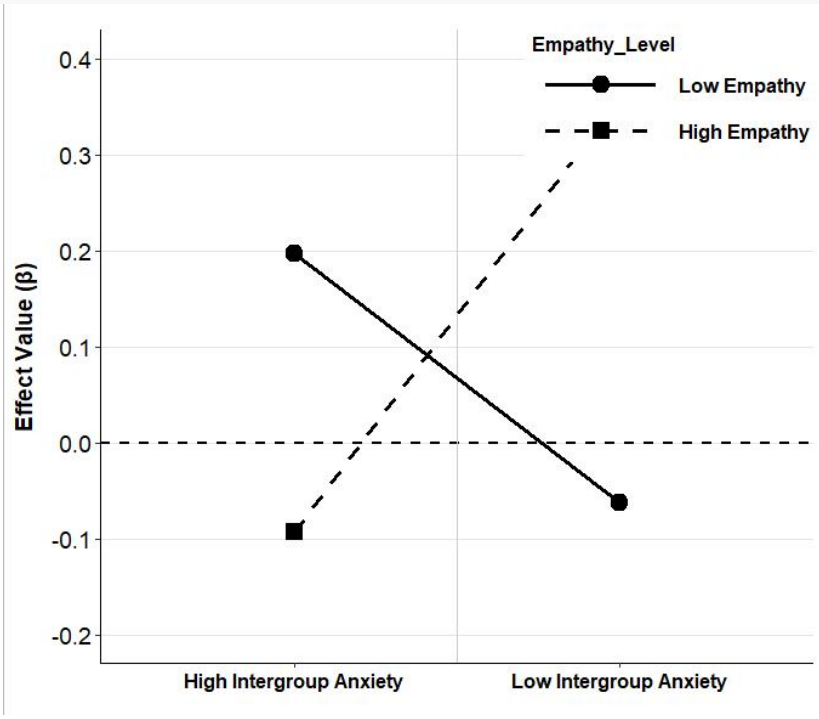
```
   > # Moderation effect plot of empathy between intergroup anxiety and interaction intentio
n
>
> # Assume this is data extracted from your model
> plot_data <- data.frame(
+   Group = c("Low Intergroup Anxiety", "Low Intergroup Anxiety", "High Intergroup Anxiety",
 "High Intergroup Anxiety"),
+   Empathy_Level = factor(rep(c("Low Empathy", "High Empathy"), 2),
+                    levels = c("Low Empathy", "High Empathy")),
+   Value = c(-0.063, 0.359, 0.197, -0.093)
+       # Low Anxiety-Low Empathy, Low Anxiety-High Empathy, High Anxiety-Low Empathy, High
Anxiety-High Empathy
+ )
>
>  # Low Anxiety-Low Empathy, Low Anxiety-High Empathy, High Anxiety-Low Empathy, High Anxie
ty-High Empathy
>
>
> # Create professional moderation effect plot
```

```
> p2 <- ggplot(plot_data, aes(x = Group, y = Value, group = Empathy_Level)) +
+   # Grid lines and reference lines
+   geom_hline(yintercept = 0, size = 0.8, color = "black", linetype = "dashed") +
+   geom_vline(xintercept = c(1.5), size = 0.5, color = "gray80") +
+
+   # Lines and points
+   geom_line(aes(linetype = Empathy_Level), size = 1.2) +
+   geom_point(aes(shape = Empathy_Level), size = 4, stroke = 1.5) +
+
+   # Style settings
+   scale_linetype_manual(values = c("solid", "dashed")) +
+   scale_shape_manual(values = c(19, 15)) +  # Solid circle and square
+   scale_y_continuous(limits = c(-0.2, 0.4),
+                      breaks = seq(-0.5, 0.5, by = 0.1),
+                      name = "Effect Value (β)") +
+
+   # Labels and title
+   labs(x = " ",
+        title = " ") +
+
+   # Theme settings
+   theme_classic() +
+   theme(
+     panel.grid.major.y = element_line(color = "gray90", size = 0.3),
+    # panel.grid.minor.y = element_blank(),
+     panel.background = element_rect(fill = "white"),
+     plot.background = element_rect(fill = "white"),
+    # legend.background = element_rect(fill = "white", color = "black"),
+     axis.text.x = element_text(size = 12, face = "bold", color = "black"),
+     axis.text.y = element_text(size = 14, color = "black"),
+     axis.title.x = element_text(size = 126, face = "bold", margin = margin(t=10)),
+     axis.title.y = element_text(size = 14, face = "bold", margin = margin(r=10)),
+     plot.title = element_text(size = 14, face = "bold", hjust = 0.5),
+     legend.position = c(0.8, 0.9),    # Legend position (top right)
+     legend.title = element_text(size = 12, face = "bold", color = "black"),
+     legend.text = element_text(size = 12, face = "bold", color = "black"),
+     #legend.background = element_rect(fill = "white", color = "black", size = 0.8),
+     #legend.key = element_rect(fill = "white", color = "black"),
+     legend.key.width = unit(3, "cm"),  # Increase legend key width
+     legend.key.height = unit(1, "cm") ) # Increase legend key height

   Warning: A numeric `legend.position` argument in `theme()` was deprecated in ggplot2
3.5.0.
ℹ Please use the `legend.position.inside` argument of `theme()` instead.
This warning is displayed once every 8 hours.
```

```
Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
generated.

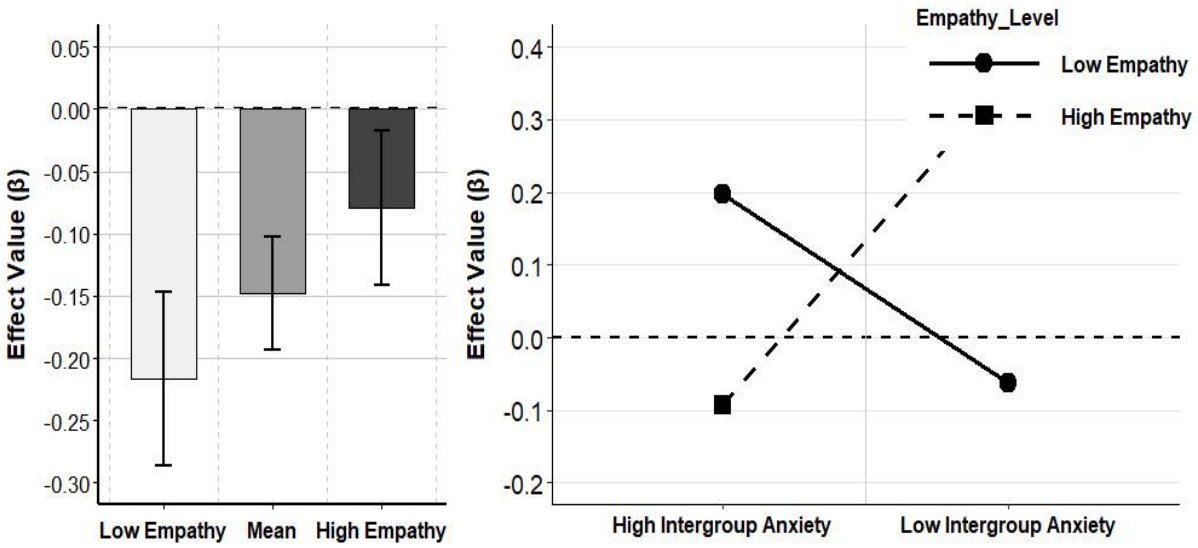
    > # Display the plot
> print(p2)
```



6.3.3 Combine Plots

```
    > library(patchwork)

    > # Assume plots p1 and p2 have been created
>
> # Combine plots using patchwork
> combined_plot <- (p1 + p2) +
+                 plot_layout(ncol = 2, widths = c(1, 1.8))
> # Display combined plot
> combined_plot
```



6.4-Moderated Mediation of the Four Dimensions of Empathy

6.4.1 Analyze Dimension:Emp_1PT

```
    >   PROCESS(df, y = "Inter_Willingness",       # Dependent variable: Intergroup Interact
ion Intention
+              x = "Dis_Stereo",         # Independent variable: Disability Stereotypes
+              meds = "Inter_Anx",       # Mediating variable: Intergroup Anxiety
+              mods = "Emp_1PT",         # Moderating variable: Perspective Taking
+              covs = "Cont_Freq", # Control variables
+              mod.type = c("2-way"),
+              mod.path = "all",    # All paths
+              std = TRUE,
+              ci = "boot",nsim = 5000,seed = 1)


****************** PART 1. Regression Model Summary ******************

PROCESS Model Code : 59 (Hayes, 2018; www.guilford.com/p/hayes3)
PROCESS Model Type : Moderated Mediation
-    Outcome (Y) : Inter_Willingness
-  Predictor (X) : Dis_Stereo
-  Mediators (M) : Inter_Anx
- Moderators (W) : Emp_1PT
- Covariates (C) : Cont_Freq
-   HLM Clusters : -

All numeric predictors have been standardized.
(For details, please see the help page of PROCESS.)
```

```
Formula of Mediator:
-    Inter_Anx ~ Cont_Freq + Dis_Stereo*Emp_1PT
Formula of Outcome:
-    Inter_Willingness ~ Cont_Freq + Dis_Stereo*Emp_1PT + Inter_Anx*Emp_1PT

CAUTION:
  Fixed effect (coef.) of a predictor involved in an interaction
  denotes its "simple effect/slope" at the other predictor = 0.
  Only when all predictors in an interaction are mean-centered
  can the fixed effect denote the "main effect"!

Model Summary

──────────────────────────────────────────────────────────────────────────
                  (1) Inter_Willingness  (2) Inter_Anx  (3) Inter_Willingness
──────────────────────────────────────────────────────────────────────────
Cont_Freq              .106 ***           -.078 ***       .085 ***
                      (.023)             (.023)          (.022)
Dis_Stereo            -.323 ***            .294 ***      -.241 ***
                      (.023)             (.023)          (.023)
Emp_1PT                                  -.093 ***        .256 ***
                                         (.023)          (.022)
Dis_Stereo:Emp_1PT                        -.017           .065 **
                                         (.023)          (.023)
Inter_Anx                                                -.148 ***
                                                        (.023)
Emp_1PT:Inter_Anx                                          .032
                                                        (.023)
──────────────────────────────────────────────────────────────────────────
R^2                    .119               .113            .215
Adj. R^2               .118               .111            .212
Num. obs.          1661               1661            1661
──────────────────────────────────────────────────────────────────────────
Note. * p < .05, ** p < .01, *** p < .001.

************ PART 2. Mediation/Moderation Effect Estimate ************

Package Use : ‘mediation’ (v4.5.0), ‘interactions’ (v1.1.5)
Effect Type : Moderated Mediation (Model 59)
Sample Size : 1661
Random Seed : set.seed(1)
Simulations : 5000 (Bootstrap)

Interaction Effect on "Inter_Willingness" (Y)
```

```
_____________________________________________
                       F df1  df2     p
_____________________________________________
Dis_Stereo * Emp_1PT  7.85   1 1654  .005 **
Emp_1PT * Inter_Anx   1.89   1 1654  .169
(All Interactions)    6.89   2 1654  .001 **
_____________________________________________

Simple Slopes: "Dis_Stereo" (X) ==> "Inter_Willingness" (Y)
(Conditional Direct Effects [c'] of X on Y)
_____________________________________________________________________
 "Emp_1PT"     Effect    S.E.       t     p            [95% CI]
_____________________________________________________________________
 -1.000 (- SD) -0.305 (0.033)  -9.389 <.001 *** [-0.369, -0.242]
 -0.000 (Mean) -0.241 (0.023) -10.454 <.001 *** [-0.287, -0.196]
 1.000 (+ SD)  -0.177 (0.032)  -5.475 <.001 *** [-0.241, -0.114]
_____________________________________________________________________

Interaction Effect on "Inter_Anx" (M)
_____________________________________________
                       F df1  df2     p
_____________________________________________
Dis_Stereo * Emp_1PT  0.55   1 1656  .457
_____________________________________________

Simple Slopes: "Dis_Stereo" (X) ==> "Inter_Anx" (M)
(Conditional Effects [a] of X on M)
_____________________________________________________________________
 "Emp_1PT"     Effect    S.E.      t     p          [95% CI]
_____________________________________________________________________
 -1.000 (- SD)  0.312 (0.032)  9.613 <.001 *** [0.248, 0.375]
 -0.000 (Mean)  0.294 (0.023) 12.583 <.001 *** [0.249, 0.340]
 1.000 (+ SD)   0.277 (0.033)  8.393 <.001 *** [0.213, 0.342]
_____________________________________________________________________

Interaction Effect on "Inter_Willingness" (Y)
_____________________________________________
                       F df1  df2     p
_____________________________________________
Dis_Stereo * Emp_1PT  7.85   1 1654  .005 **
Emp_1PT * Inter_Anx   1.89   1 1654  .169
(All Interactions)    6.89   2 1654  .001 **
_____________________________________________
```

```
Simple Slopes: "Inter_Anx" (M) ==> "Inter_Willingness" (Y)
(Conditional Effects [b] of M on Y)
_____________________________________________________________________

 "Emp_1PT"     Effect    S.E.      t     p            [95% CI]
_____________________________________________________________________

 -1.000 (- SD) -0.180 (0.035) -5.094 <.001 *** [-0.249, -0.110]
 -0.000 (Mean) -0.148 (0.023) -6.317 <.001 *** [-0.194, -0.102]
 1.000 (+ SD)  -0.116 (0.030) -3.802 <.001 *** [-0.175, -0.056]
_____________________________________________________________________


Running 5000 * 3 simulations...
Indirect Path: "Dis_Stereo" (X) ==> "Inter_Anx" (M) ==> "Inter_Willingness" (Y)
(Conditional Indirect Effects [ab] of X through M on Y)
_____________________________________________________________________

 "Emp_1PT"     Effect    S.E.      z     p        [Boot 95% CI]
_____________________________________________________________________

 -1.000 (- SD) -0.056 (0.015) -3.674 <.001 *** [-0.088, -0.029]
 -0.000 (Mean) -0.043 (0.008) -5.279 <.001 *** [-0.060, -0.028]
 1.000 (+ SD)  -0.032 (0.010) -3.251  .001 **  [-0.053, -0.014]
_____________________________________________________________________

Percentile Bootstrap Confidence Interval
(SE and CI are estimated based on 5000 Bootstrap samples.)

Note. The results based on bootstrapping or other random processes
are unlikely identical to other statistical software (e.g., SPSS).
To make results reproducible, you need to set a seed (any number).
Please see the help page for details: help(PROCESS)
Ignore this note if you have already set a seed. :)
```

6.4.2 Analyze Dimension:Emp_2FS

```
> PROCESS(df, y = "Inter_Willingness",     # Dependent variable: Intergroup Interaction
 Intention
+              x = "Dis_Stereo",          # Independent variable: Disability Stereotypes
+              meds = "Inter_Anx",        # Mediating variable: Intergroup Anxiety
+              mods = "Emp_2FS",          # Moderating variable: Personal Distress
+              covs = "Cont_Freq", # Control variables
+              mod.type = c("2-way"),
+              mod.path = "all",    # All paths
+              std = TRUE,
+              ci = "boot",nsim = 5000,seed = 1)


****************** PART 1. Regression Model Summary ******************

PROCESS Model Code : 59 (Hayes, 2018; www.guilford.com/p/hayes3)
```

```
PROCESS Model Type : Moderated Mediation
-    Outcome (Y) : Inter_Willingness
-  Predictor (X) : Dis_Stereo
-  Mediators (M) : Inter_Anx
- Moderators (W) : Emp_2FS
- Covariates (C) : Cont_Freq
-   HLM Clusters : -

All numeric predictors have been standardized.
(For details, please see the help page of PROCESS.)

Formula of Mediator:
-    Inter_Anx ~ Cont_Freq + Dis_Stereo*Emp_2FS
Formula of Outcome:
-    Inter_Willingness ~ Cont_Freq + Dis_Stereo*Emp_2FS + Inter_Anx*Emp_2FS

CAUTION:
  Fixed effect (coef.) of a predictor involved in an interaction
  denotes its "simple effect/slope" at the other predictor = 0.
  Only when all predictors in an interaction are mean-centered
  can the fixed effect denote the "main effect"!

Model Summary

                                                                                
                  (1) Inter_Willingness  (2) Inter_Anx  (3) Inter_Willingness
                                                                                
Cont_Freq              .106 ***           -.079 ***       .093 ***
                      (.023)             (.023)          (.023)
Dis_Stereo            -.323 ***            .305 ***      -.268 ***
                      (.023)             (.023)          (.024)
Emp_2FS                                   .092 ***        .104 ***
                                         (.023)          (.023)
Dis_Stereo:Emp_2FS                        -.041            .029
                                         (.023)          (.024)
Inter_Anx                                                -.180 ***
                                                        (.024)
Emp_2FS:Inter_Anx                                          .057 *
                                                        (.024)
                                                                                
R^2                    .119               .115            .160
Adj. R^2               .118               .113            .157
Num. obs.          1661               1661            1661
                                                                                
```

```
Note. * p < .05, ** p < .01, *** p < .001.

********** PART 2. Mediation/Moderation Effect Estimate **********

Package Use : ‘mediation’ (v4.5.0), ‘interactions’ (v1.1.5)
Effect Type : Moderated Mediation (Model 59)
Sample Size : 1661
Random Seed : set.seed(1)
Simulations : 5000 (Bootstrap)

Interaction Effect on "Inter_Willingness" (Y)
_____________________________________________
                        F df1  df2     p
_____________________________________________
Dis_Stereo * Emp_2FS  1.42   1 1654  .233
Emp_2FS * Inter_Anx   5.63   1 1654  .018 *
(All Interactions)    4.94   2 1654  .007 **
_____________________________________________

Simple Slopes: "Dis_Stereo" (X) ==> "Inter_Willingness" (Y)
(Conditional Direct Effects [c'] of X on Y)
_____________________________________________________________________
 "Emp_2FS"     Effect    S.E.       t     p            [95% CI]
_____________________________________________________________________
 -1.000 (- SD) -0.296 (0.034)  -8.664 <.001 *** [-0.363, -0.229]
 -0.000 (Mean) -0.268 (0.024) -11.260 <.001 *** [-0.314, -0.221]
 1.000 (+ SD)  -0.240 (0.033)  -7.332 <.001 *** [-0.304, -0.176]
_____________________________________________________________________

Interaction Effect on "Inter_Anx" (M)
_____________________________________________
                        F df1  df2     p
_____________________________________________
Dis_Stereo * Emp_2FS  3.14   1 1656  .076 .
_____________________________________________

Simple Slopes: "Dis_Stereo" (X) ==> "Inter_Anx" (M)
(Conditional Effects [a] of X on M)
_____________________________________________________________
 "Emp_2FS"     Effect    S.E.      t     p          [95% CI]
_____________________________________________________________
 -1.000 (- SD)  0.346 (0.033) 10.559 <.001 *** [0.282, 0.410]
 -0.000 (Mean)  0.305 (0.023) 13.178 <.001 *** [0.260, 0.351]
 1.000 (+ SD)   0.265 (0.032)  8.207 <.001 *** [0.202, 0.328]
```

```
──────────────────────────────────────────────────────────────

Interaction Effect on "Inter_Willingness" (Y)
──────────────────────────────────────────────
                        F df1  df2     p
──────────────────────────────────────────────
Dis_Stereo * Emp_2FS  1.42   1 1654  .233
Emp_2FS * Inter_Anx   5.63   1 1654  .018 *
(All Interactions)    4.94   2 1654  .007 **
──────────────────────────────────────────────

Simple Slopes: "Inter_Anx" (M) ==> "Inter_Willingness" (Y)
(Conditional Effects [b] of M on Y)
──────────────────────────────────────────────────────────────────
 "Emp_2FS"     Effect    S.E.      t     p            [95% CI]
──────────────────────────────────────────────────────────────────
 -1.000 (- SD) -0.234 (0.033) -7.003 <.001 *** [-0.299, -0.168]
 -0.000 (Mean) -0.180 (0.024) -7.497 <.001 *** [-0.227, -0.133]
 1.000 (+ SD)  -0.126 (0.033) -3.837 <.001 *** [-0.190, -0.061]
──────────────────────────────────────────────────────────────────

Running 5000 * 3 simulations...
Indirect Path: "Dis_Stereo" (X) ==> "Inter_Anx" (M) ==> "Inter_Willingness" (Y)
(Conditional Indirect Effects [ab] of X through M on Y)
──────────────────────────────────────────────────────────────────
 "Emp_2FS"     Effect    S.E.      z     p        [Boot 95% CI]
──────────────────────────────────────────────────────────────────
 -1.000 (- SD) -0.081 (0.016) -4.951 <.001 *** [-0.116, -0.052]
 -0.000 (Mean) -0.055 (0.009) -6.085 <.001 *** [-0.073, -0.038]
 1.000 (+ SD)  -0.033 (0.009) -3.511 <.001 *** [-0.053, -0.016]
──────────────────────────────────────────────────────────────────

Percentile Bootstrap Confidence Interval
(SE and CI are estimated based on 5000 Bootstrap samples.)

Note. The results based on bootstrapping or other random processes
are unlikely identical to other statistical software (e.g., SPSS).
To make results reproducible, you need to set a seed (any number).
Please see the help page for details: help(PROCESS)
Ignore this note if you have already set a seed. :)
```

6.4.3 Analyze Dimension:Emp_3EC

```
> PROCESS(df, y = "Inter_Willingness",     # Dependent variable: Intergroup Interaction
 Intention
+             x = "Dis_Stereo",          # Independent variable: Disability Stereotypes
+             meds = "Inter_Anx",        # Mediating variable: Intergroup Anxiety
```

```
+              mods = "Emp_3EC",          # Moderating variable: Personal Distress
+              covs = "Cont_Freq", # Control variables
+              mod.type = c("2-way"),
+              mod.path = "all",    # All paths
+              std = TRUE,
+              ci = "boot",nsim = 5000,seed = 1)


****************** PART 1. Regression Model Summary ******************

PROCESS Model Code : 59 (Hayes, 2018; www.guilford.com/p/hayes3)
PROCESS Model Type : Moderated Mediation
-    Outcome (Y) : Inter_Willingness
-  Predictor (X) : Dis_Stereo
-  Mediators (M) : Inter_Anx
- Moderators (W) : Emp_3EC
- Covariates (C) : Cont_Freq
-   HLM Clusters : -

All numeric predictors have been standardized.
(For details, please see the help page of PROCESS.)

Formula of Mediator:
-    Inter_Anx ~ Cont_Freq + Dis_Stereo*Emp_3EC
Formula of Outcome:
-    Inter_Willingness ~ Cont_Freq + Dis_Stereo*Emp_3EC + Inter_Anx*Emp_3EC

CAUTION:
  Fixed effect (coef.) of a predictor involved in an interaction
  denotes its "simple effect/slope" at the other predictor = 0.
  Only when all predictors in an interaction are mean-centered
  can the fixed effect denote the "main effect"!

Model Summary

                    (1) Inter_Willingness  (2) Inter_Anx  (3) Inter_Willingness
Cont_Freq                        .106 ***          -.083 ***       .095 ***
                                (.023)            (.023)          (.022)
Dis_Stereo                       -.323 ***          .290 ***       -.258 ***
                                (.023)            (.023)          (.023)
Emp_3EC                                           -.140 ***        .191 ***
                                                  (.023)          (.023)
Dis_Stereo:Emp_3EC                                 .049 *          .000
```

```
                                        (.023)        (.024)
Inter_Anx                                              -.145 ***
                                                       (.024)
Emp_3EC:Inter_Anx                                        .054 *
                                                       (.024)
──────────────────────────────────────────────────────────────────────────
R^2                    .119               .126          .182
Adj. R^2               .118               .124          .179
Num. obs.          1661               1661          1661
──────────────────────────────────────────────────────────────────────────
Note. * p < .05, ** p < .01, *** p < .001.

************ PART 2. Mediation/Moderation Effect Estimate ************

Package Use : ‘mediation’ (v4.5.0), ‘interactions’ (v1.1.5)
Effect Type : Moderated Mediation (Model 59)
Sample Size : 1661
Random Seed : set.seed(1)
Simulations : 5000 (Bootstrap)

Interaction Effect on "Inter_Willingness" (Y)
──────────────────────────────────────────────
                       F df1  df2     p
──────────────────────────────────────────────
Dis_Stereo * Emp_3EC  0.00   1 1654  .991
Emp_3EC * Inter_Anx   5.14   1 1654  .024 *
(All Interactions)    2.88   2 1654  .057 .
──────────────────────────────────────────────

Simple Slopes: "Dis_Stereo" (X) ==> "Inter_Willingness" (Y)
(Conditional Direct Effects [c'] of X on Y)
──────────────────────────────────────────────────────────────────────
 "Emp_3EC"     Effect    S.E.       t     p            [95% CI]
──────────────────────────────────────────────────────────────────────
 -1.000 (- SD) -0.258 (0.032)  -8.005 <.001 *** [-0.321, -0.195]
 -0.000 (Mean) -0.258 (0.023) -10.965 <.001 *** [-0.304, -0.212]
 1.000 (+ SD)  -0.257 (0.033)  -7.786 <.001 *** [-0.322, -0.193]
──────────────────────────────────────────────────────────────────────

Interaction Effect on "Inter_Anx" (M)
──────────────────────────────────────────────
                       F df1  df2     p
──────────────────────────────────────────────
Dis_Stereo * Emp_3EC  4.56   1 1656  .033 *
```

```
──────────────────────────────────────────

Simple Slopes: "Dis_Stereo" (X) ==> "Inter_Anx" (M)
(Conditional Effects [a] of X on M)
──────────────────────────────────────────────────────────────
 "Emp_3EC"     Effect    S.E.      t     p           [95% CI]
──────────────────────────────────────────────────────────────
 -1.000 (- SD)  0.243 (0.032)  7.590 <.001 *** [0.180, 0.306]
 -0.000 (Mean)  0.290 (0.023) 12.514 <.001 *** [0.245, 0.336]
 1.000 (+ SD)   0.337 (0.032) 10.519 <.001 *** [0.274, 0.400]
──────────────────────────────────────────────────────────────

Interaction Effect on "Inter_Willingness" (Y)
──────────────────────────────────────────
                       F df1  df2     p
──────────────────────────────────────────
Dis_Stereo * Emp_3EC  0.00   1 1654  .991
Emp_3EC * Inter_Anx   5.14   1 1654  .024 *
(All Interactions)    2.88   2 1654  .057 .
──────────────────────────────────────────

Simple Slopes: "Inter_Anx" (M) ==> "Inter_Willingness" (Y)
(Conditional Effects [b] of M on Y)
──────────────────────────────────────────────────────────────
 "Emp_3EC"     Effect    S.E.      t     p            [95% CI]
──────────────────────────────────────────────────────────────
 -1.000 (- SD) -0.198 (0.034) -5.787 <.001 *** [-0.265, -0.131]
 -0.000 (Mean) -0.145 (0.024) -6.087 <.001 *** [-0.192, -0.098]
 1.000 (+ SD)  -0.092 (0.032) -2.845  .004 **  [-0.156, -0.029]
──────────────────────────────────────────────────────────────

Running 5000 * 3 simulations...
Indirect Path: "Dis_Stereo" (X) ==> "Inter_Anx" (M) ==> "Inter_Willingness" (Y)
(Conditional Indirect Effects [ab] of X through M on Y)
──────────────────────────────────────────────────────────────
 "Emp_3EC"     Effect    S.E.      z     p        [Boot 95% CI]
──────────────────────────────────────────────────────────────
 -1.000 (- SD) -0.048 (0.012) -4.128 <.001 *** [-0.073, -0.028]
 -0.000 (Mean) -0.042 (0.008) -5.266 <.001 *** [-0.059, -0.028]
 1.000 (+ SD)  -0.031 (0.011) -2.733  .006 **  [-0.055, -0.009]
──────────────────────────────────────────────────────────────

Percentile Bootstrap Confidence Interval
(SE and CI are estimated based on 5000 Bootstrap samples.)
```

```
Note. The results based on bootstrapping or other random processes
are unlikely identical to other statistical software (e.g., SPSS).
To make results reproducible, you need to set a seed (any number).
Please see the help page for details: help(PROCESS)
Ignore this note if you have already set a seed. :)
```

6.4.4 Analyze Dimension:Emp_4PD

```
    > PROCESS(df, y = "Inter_Willingness",
+             x = "Dis_Stereo",
+             meds = "Inter_Anx",
+             mods = "Emp_4PD",
+             covs = "Cont_Freq",
+             mod.type = c("2-way"),
+             mod.path = "all",
+             std = TRUE,
+             ci = "boot",nsim = 5000,seed = 1)


****************** PART 1. Regression Model Summary ******************

PROCESS Model Code : 59 (Hayes, 2018; www.guilford.com/p/hayes3)
PROCESS Model Type : Moderated Mediation
-    Outcome (Y) : Inter_Willingness
-  Predictor (X) : Dis_Stereo
-  Mediators (M) : Inter_Anx
- Moderators (W) : Emp_4PD
- Covariates (C) : Cont_Freq
-   HLM Clusters : -

All numeric predictors have been standardized.
(For details, please see the help page of PROCESS.)

Formula of Mediator:
-    Inter_Anx ~ Cont_Freq + Dis_Stereo*Emp_4PD
Formula of Outcome:
-    Inter_Willingness ~ Cont_Freq + Dis_Stereo*Emp_4PD + Inter_Anx*Emp_4PD

CAUTION:
  Fixed effect (coef.) of a predictor involved in an interaction
  denotes its "simple effect/slope" at the other predictor = 0.
  Only when all predictors in an interaction are mean-centered
  can the fixed effect denote the "main effect"!

Model Summary
```

```
                  (1) Inter_Willingness  (2) Inter_Anx  (3) Inter_Willingness
Cont_Freq               .106 ***           -.071 **        .080 ***
                       (.023)             (.023)          (.022)
Dis_Stereo              -.323 ***           .276 ***       -.241 ***
                       (.023)             (.023)          (.023)
Emp_4PD                                   -.162 ***        .264 ***
                                          (.023)          (.023)
Dis_Stereo:Emp_4PD                          .029            .002
                                          (.023)          (.023)
Inter_Anx                                                  -.131 ***
                                                          (.024)
Emp_4PD:Inter_Anx                                           .057 *
                                                          (.023)
R^2                     .119               .130            .216
Adj. R^2                .118               .128            .213
Num. obs.           1661               1661            1661
Note. * p < .05, ** p < .01, *** p < .001.

********** PART 2. Mediation/Moderation Effect Estimate **********

Package Use : 'mediation' (v4.5.0), 'interactions' (v1.1.5)
Effect Type : Moderated Mediation (Model 59)
Sample Size : 1661
Random Seed : set.seed(1)
Simulations : 5000 (Bootstrap)

Interaction Effect on "Inter_Willingness" (Y)
                          F df1  df2     p
Dis_Stereo * Emp_4PD   0.01   1 1654  .931
Emp_4PD * Inter_Anx    5.88   1 1654  .015 *
(All Interactions)     3.42   2 1654  .033 *

Simple Slopes: "Dis_Stereo" (X) ==> "Inter_Willingness" (Y)
(Conditional Direct Effects [c'] of X on Y)
 "Emp_4PD"     Effect    S.E.       t     p            [95% CI]
```

```
 -1.000 (- SD) -0.243 (0.034)  -7.139 <.001 *** [-0.310, -0.177]
 -0.000 (Mean) -0.241 (0.023) -10.405 <.001 *** [-0.287, -0.196]
 1.000 (+ SD)  -0.239 (0.031)  -7.748 <.001 *** [-0.300, -0.179]
_____________________________________________________________________


Interaction Effect on "Inter_Anx" (M)
_____________________________________________
                       F df1  df2     p
_____________________________________________
Dis_Stereo * Emp_4PD  1.59   1 1656  .207
_____________________________________________

Simple Slopes: "Dis_Stereo" (X) ==> "Inter_Anx" (M)
(Conditional Effects [a] of X on M)
_____________________________________________________________________
 "Emp_4PD"     Effect    S.E.      t     p           [95% CI]
_____________________________________________________________________
 -1.000 (- SD)  0.248 (0.034)  7.218 <.001 *** [0.181, 0.315]
 -0.000 (Mean)  0.276 (0.023) 11.784 <.001 *** [0.230, 0.322]
 1.000 (+ SD)   0.305 (0.031)  9.970 <.001 *** [0.245, 0.365]
_____________________________________________________________________

Interaction Effect on "Inter_Willingness" (Y)
_____________________________________________
                       F df1  df2     p
_____________________________________________
Dis_Stereo * Emp_4PD  0.01   1 1654  .931
Emp_4PD * Inter_Anx   5.88   1 1654  .015 *
(All Interactions)    3.42   2 1654  .033 *
_____________________________________________

Simple Slopes: "Inter_Anx" (M) ==> "Inter_Willingness" (Y)
(Conditional Effects [b] of M on Y)
_____________________________________________________________________
 "Emp_4PD"     Effect    S.E.      t     p            [95% CI]
_____________________________________________________________________
 -1.000 (- SD) -0.188 (0.035) -5.354 <.001 *** [-0.257, -0.119]
 -0.000 (Mean) -0.131 (0.024) -5.570 <.001 *** [-0.177, -0.085]
 1.000 (+ SD)  -0.074 (0.031) -2.375  .018 *   [-0.135, -0.013]
_____________________________________________________________________

Running 5000 * 3 simulations...
Indirect Path: "Dis_Stereo" (X) ==> "Inter_Anx" (M) ==> "Inter_Willingness" (Y)
(Conditional Indirect Effects [ab] of X through M on Y)
```

```
------------------------------------------------------------------
 "Emp_4PD"     Effect    S.E.      z     p        [Boot 95% CI]
------------------------------------------------------------------
 -1.000 (- SD) -0.047 (0.012) -3.747 <.001 *** [-0.073, -0.025]
 -0.000 (Mean) -0.036 (0.008) -4.759 <.001 *** [-0.052, -0.022]
 1.000 (+ SD)  -0.023 (0.009) -2.575  .010 *   [-0.041, -0.007]
------------------------------------------------------------------
Percentile Bootstrap Confidence Interval
(SE and CI are estimated based on 5000 Bootstrap samples.)

Note. The results based on bootstrapping or other random processes
are unlikely identical to other statistical software (e.g., SPSS).
To make results reproducible, you need to set a seed (any number).
Please see the help page for details: help(PROCESS)
Ignore this note if you have already set a seed. :)
```

======== 07-Contact Frequency ========

7.1-Contact_Frequency - Moderating Effect

```
   > # Test the moderating effect of Contact_Frequency
> PROCESS(df, y="Inter_Willingness", x="Dis_Stereo",
+         meds = c("Inter_Anx"),
+         mods = "Cont_Freq",      # Continuous moderating variable  "region"
+         mod.path = "all",       # Test all paths
+         std = TRUE,
+         ci = "boot", nsim = 5000, seed = 1)


****************** PART 1. Regression Model Summary ******************

PROCESS Model Code : 59 (Hayes, 2018; www.guilford.com/p/hayes3)
PROCESS Model Type : Moderated Mediation
-    Outcome (Y) : Inter_Willingness
-  Predictor (X) : Dis_Stereo
-  Mediators (M) : Inter_Anx
- Moderators (W) : Cont_Freq
- Covariates (C) : -
-   HLM Clusters : -

All numeric predictors have been standardized.
(For details, please see the help page of PROCESS.)
```

```
Formula of Mediator:
-    Inter_Anx ~ Dis_Stereo*Cont_Freq
Formula of Outcome:
-    Inter_Willingness ~ Dis_Stereo*Cont_Freq + Inter_Anx*Cont_Freq

CAUTION:
  Fixed effect (coef.) of a predictor involved in an interaction
  denotes its "simple effect/slope" at the other predictor = 0.
  Only when all predictors in an interaction are mean-centered
  can the fixed effect denote the "main effect"!

Model Summary

                                                                                
                    (1) Inter_Willingness  (2) Inter_Anx  (3) Inter_Willingness
                                                                                
Dis_Stereo               -.329 ***            .309 ***      -.273 ***
                        (.023)              (.023)         (.024)
Cont_Freq                                    -.082 ***       .101 ***
                                            (.023)         (.023)
Dis_Stereo:Cont_Freq                          -.013           .034
                                            (.023)         (.024)
Inter_Anx                                                   -.176 ***
                                                           (.024)
Cont_Freq:Inter_Anx                                           .052 *
                                                           (.024)
                                                                                
R^2                      .108                .104           .150
Adj. R^2                 .108                .103           .148
Num. obs.             1661                1661           1661
                                                                                
Note. * p < .05, ** p < .01, *** p < .001.

************ PART 2. Mediation/Moderation Effect Estimate ************

Package Use : ‘mediation’ (v4.5.0), ‘interactions’ (v1.1.5)
Effect Type : Moderated Mediation (Model 59)
Sample Size : 1661
Random Seed : set.seed(1)
Simulations : 5000 (Bootstrap)

Interaction Effect on "Inter_Willingness" (Y)
                                                
                          F df1  df2     p
```

```
──────────────────────────────────────────────
Dis_Stereo * Cont_Freq  2.00   1 1655  .157
Cont_Freq * Inter_Anx   4.44   1 1655  .035 *
(All Interactions)      4.75   2 1655  .009 **
──────────────────────────────────────────────

Simple Slopes: "Dis_Stereo" (X) ==> "Inter_Willingness" (Y)
(Conditional Direct Effects [c'] of X on Y)
──────────────────────────────────────────────────────────────────────
 "Cont_Freq"   Effect    S.E.       t     p            [95% CI]
──────────────────────────────────────────────────────────────────────
 -1.000 (- SD) -0.302 (0.033)  -9.096 <.001 *** [-0.367, -0.237]
 0.000 (Mean)  -0.273 (0.024) -11.367 <.001 *** [-0.320, -0.226]
 1.000 (+ SD)  -0.244 (0.030)  -8.228 <.001 *** [-0.302, -0.186]
──────────────────────────────────────────────────────────────────────

Interaction Effect on "Inter_Anx" (M)
──────────────────────────────────────────────
                        F df1  df2     p
──────────────────────────────────────────────
Dis_Stereo * Cont_Freq  0.30   1 1657  .585
──────────────────────────────────────────────

Simple Slopes: "Dis_Stereo" (X) ==> "Inter_Anx" (M)
(Conditional Effects [a] of X on M)
──────────────────────────────────────────────────────────────────
 "Cont_Freq"   Effect    S.E.      t     p          [95% CI]
──────────────────────────────────────────────────────────────────
 -1.000 (- SD)  0.319 (0.032)  9.952 <.001 *** [0.256, 0.382]
 0.000 (Mean)   0.309 (0.023) 13.176 <.001 *** [0.263, 0.354]
 1.000 (+ SD)   0.298 (0.029) 10.265 <.001 *** [0.241, 0.355]
──────────────────────────────────────────────────────────────────

Interaction Effect on "Inter_Willingness" (Y)
──────────────────────────────────────────────
                        F df1  df2     p
──────────────────────────────────────────────
Dis_Stereo * Cont_Freq  2.00   1 1655  .157
Cont_Freq * Inter_Anx   4.44   1 1655  .035 *
(All Interactions)      4.75   2 1655  .009 **
──────────────────────────────────────────────

Simple Slopes: "Inter_Anx" (M) ==> "Inter_Willingness" (Y)
(Conditional Effects [b] of M on Y)
```

```
_____________________________________________________________________
 "Cont_Freq"   Effect    S.E.      t     p            [95% CI]
_____________________________________________________________________
 -1.000 (- SD) -0.223 (0.035) -6.383 <.001 *** [-0.292, -0.155]
 0.000 (Mean)  -0.176 (0.024) -7.291 <.001 *** [-0.223, -0.129]
 1.000 (+ SD)  -0.129 (0.031) -4.188 <.001 *** [-0.189, -0.068]
_____________________________________________________________________

Running 5000 * 3 simulations...
Indirect Path: "Dis_Stereo" (X) ==> "Inter_Anx" (M) ==> "Inter_Willingness" (Y)
(Conditional Indirect Effects [ab] of X through M on Y)
_____________________________________________________________________
 "Cont_Freq"   Effect    S.E.      z     p        [Boot 95% CI]
_____________________________________________________________________
 -1.000 (- SD) -0.071 (0.014) -5.171 <.001 *** [-0.100, -0.046]
 0.000 (Mean)  -0.054 (0.009) -6.081 <.001 *** [-0.073, -0.038]
 1.000 (+ SD)  -0.038 (0.010) -3.792 <.001 *** [-0.060, -0.020]
_____________________________________________________________________
Percentile Bootstrap Confidence Interval
(SE and CI are estimated based on 5000 Bootstrap samples.)

Note. The results based on bootstrapping or other random processes
are unlikely identical to other statistical software (e.g., SPSS).
To make results reproducible, you need to set a seed (any number).
Please see the help page for details: help(PROCESS)
Ignore this note if you have already set a seed. :)

    > # Extract results of the intergroup anxiety model
> model_m <- process_result$model.m[[1]]
> model_m_summary <- model_summary(model_m, std = TRUE)


Model Summary

_____________________________________
                  (1) Inter_Anx
_____________________________________
Cont_Freq             -.080 ***
                     (.023)
Dis_Stereo             .294 ***
                     (.023)
Empathy               -.098 ***
                     (.023)
Dis_Stereo:Empathy     .006
                     (.023)
```

```
──────────────────────────────────
R^2                    .113
Adj. R^2               .111
Num. obs.           1661
──────────────────────────────────
Note. * p < .05, ** p < .01, *** p < .001.

# Check for Multicollinearity

Low Correlation

                Term  VIF      VIF 95% CI adj. VIF Tolerance Tolerance 95% CI
           Cont_Freq 1.00 [1.00,   424.99]     1.00      1.00     [0.00, 1.00]
          Dis_Stereo 1.02 [1.00,     1.19]     1.01      0.98     [0.84, 1.00]
             Empathy 1.02 [1.00,     1.23]     1.01      0.98     [0.81, 1.00]
 Dis_Stereo:Empathy 1.00 [1.00, 1.65e+07]     1.00      1.00     [0.00, 1.00]

   > # Extract results of the interaction intention model
> model_y <- process_result$model.y
> model_y_summary <- model_summary(model_y, std = TRUE)


Model Summary

──────────────────────────────────────────
                   (1) Inter_Willingness
──────────────────────────────────────────
Cont_Freq               .088 ***
                       (.022)
Dis_Stereo             -.240 ***
                       (.023)
Empathy                 .280 ***
                       (.022)
Inter_Anx              -.148 ***
                       (.023)
Dis_Stereo:Empathy      .019
                       (.024)
Empathy:Inter_Anx       .069 **
                       (.024)
──────────────────────────────────────────
R^2                    .230
Adj. R^2               .227
Num. obs.           1661
──────────────────────────────────────────
Note. * p < .05, ** p < .01, *** p < .001.
```

```
# Check for Multicollinearity

Low Correlation

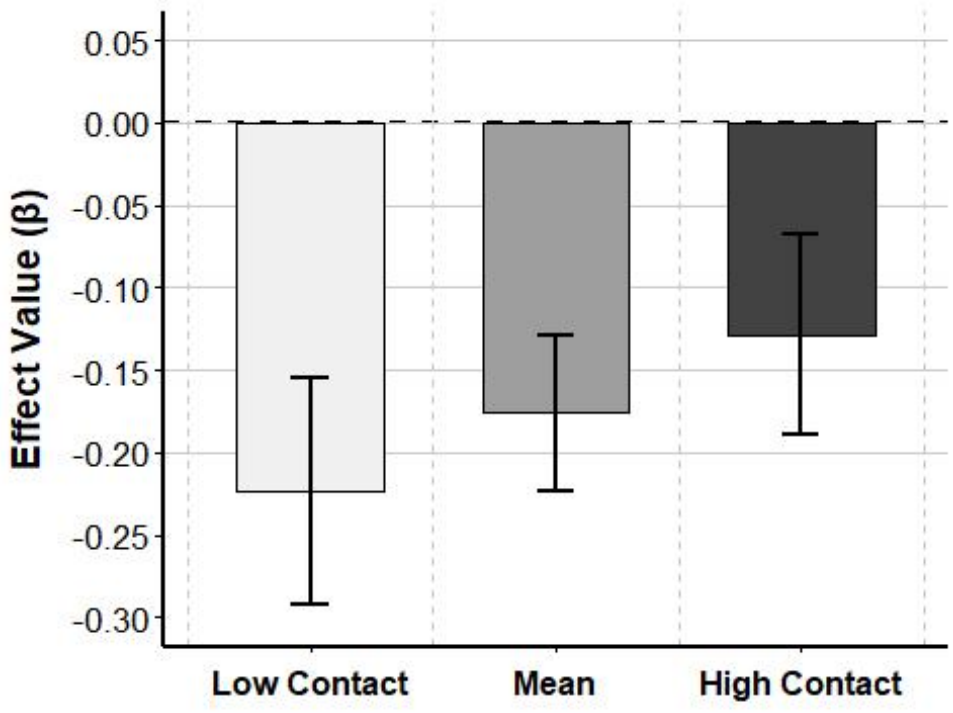
                Term  VIF   VIF 95% CI adj. VIF Tolerance Tolerance 95% CI
           Cont_Freq 1.01 [1.00, 1.84]     1.01      0.99     [0.54, 1.00]
          Dis_Stereo 1.12 [1.08, 1.20]     1.06      0.89     [0.83, 0.93]
             Empathy 1.03 [1.01, 1.15]     1.02      0.97     [0.87, 0.99]
           Inter_Anx 1.15 [1.10, 1.22]     1.07      0.87     [0.82, 0.91]
 Dis_Stereo:Empathy 1.22 [1.16, 1.30]     1.10      0.82     [0.77, 0.86]
  Empathy:Inter_Anx 1.24 [1.18, 1.32]     1.11      0.81     [0.76, 0.85]
```

7.2-Plotting

7.2.1 Histogram

```
   > # Create data frame with data exactly matching the image
> contact_data <- data.frame(
+   Level = factor(c("Low Contact", "Mean", "High Contact"),
+                  levels = c("Low Contact", "Mean", "High Contact")),
+   Effect = c(-0.223, -0.176, -0.129),
+   Lower_CI = c(-0.292, -0.223, -0.189),
+   Upper_CI = c(-0.155, -0.129, -0.068),
+   Significance = c("***", "***", "***")
+ )
>
> # Create black-white-gray gradient colors
> grey_palette <- c("#f0f0f0", "#9E9E9E", "#424242")  # Light gray -> Medium gray -> Dark gra
y
>
> # Plot the chart
> p3 <- ggplot(contact_data, aes(x = Level, y = Effect)) +
+   # Reference lines and axes
+   geom_hline(yintercept = 0, size = 0.8, color = "black", linetype = "dashed") +
+   geom_hline(yintercept = seq(-0.20, 0.05, by = 0.05),
+              size = 0.3, color = "gray80") +
+   geom_vline(xintercept = c(0.5, 1.5, 2.5, 3.5),
+              size = 0.3, linetype = "dashed", color = "gray80") +
+
+   # Bar chart (black-white-gray gradient)
+   geom_col(aes(fill = Level), width = 0.6, color = "black", size = 0.7) +
+   scale_fill_manual(values = grey_palette) +
+
+   # Error bars (95% confidence interval) - Use CI values from the image directly
```

```
+   geom_errorbar(aes(ymin = Lower_CI, ymax = Upper_CI),
+                 width = 0.15, size = 0.8, color = "black") +
+
+   # Effect value labels
+   #geom_text(aes(label = sprintf("%.3f", Effect)),
+             #vjust = -0.8, size = 5.5, fontface = "bold") +
+
+   # Significance markers (asterisks)
+   #geom_text(aes(label = Significance),
+             #vjust = 8, size = 7, fontface = "bold") +
+
+    # Axes and theme
+   scale_y_continuous(
+     limits = c(-0.30, 0.05),
+     breaks = seq(-0.30, 0.05, by = 0.05),
+     labels = function(x) sprintf("%.2f", x),  # Key modification: Ensure two decimal places
+     name = "Effect Value (β)",
+     expand = expansion(mult = c(0.05, 0.05))
+   ) +
+
+   labs(x = " ",
+        y = NULL) +
+   theme_classic() +
+   theme(
+     legend.position = "none",
+     panel.grid.major.y = element_blank(),
+     panel.grid.minor.y = element_blank(),
+     panel.background = element_rect(fill = "white"),
+     plot.background = element_rect(fill = "white"),
+     axis.text.x = element_text(size = 12, face = "bold", color = "black",
+                                margin = margin(t=5)),
+     axis.text.y = element_text(size = 13, color = "black"),
+     axis.title.x = element_text(size = 12, face = "bold", margin = margin(t=10)),
+     axis.title.y = element_text(size = 14, face = "bold", margin = margin(r=10)),
+     axis.line = element_line(size = 0.8, color = "black"),
+     axis.ticks = element_line(color = "black", size = 0.6)
+   )
>
> # Display the plot
> print(p3)
```



7.2.2 Line Plot

(1) Calculate High and Low Simple Effect Values

```
   > # Extract regression coefficients from PROCESS results
> coefs <- c(
+   intercept = 0,  # Intercept of standardized model is 0
+   Cont_Freq = 0.101,
+   Inter_Anx = -0.148,
+   interaction = 0.052
+ )
>
> # Calculate predicted values for different combinations
> calculate_value <- function(Inter_Anx_val, contact_val) {
+   coefs["intercept"] +
+   coefs["Cont_Freq"] * contact_val +
+   coefs["Inter_Anx"] * Inter_Anx_val +
+   coefs["interaction"] * contact_val * Inter_Anx_val
+ }
>
> # Create precise data frame
> plot_data <- data.frame(
+   Group = rep(c("Low Intergroup Anxiety", "High Intergroup Anxiety"), each = 2),
+   Contact_Frequency = factor(rep(c("Low Contact", "High Contact"), 2),
+                              levels = c("Low Contact", "High Contact")),
+   Value = c(
+     calculate_value(-1, -1),  # Low Anxiety - Low Contact
```

```
+     calculate_value(-1, 1),   # Low Anxiety - High Contact
+     calculate_value(1, -1),   # High Anxiety - Low Contact
+     calculate_value(1, 1)     # High Anxiety - High Contact
+   )
+ )
>
> # Print calculation results
> cat("Precise Calculated Values:\n")

   Precise Calculated Values:

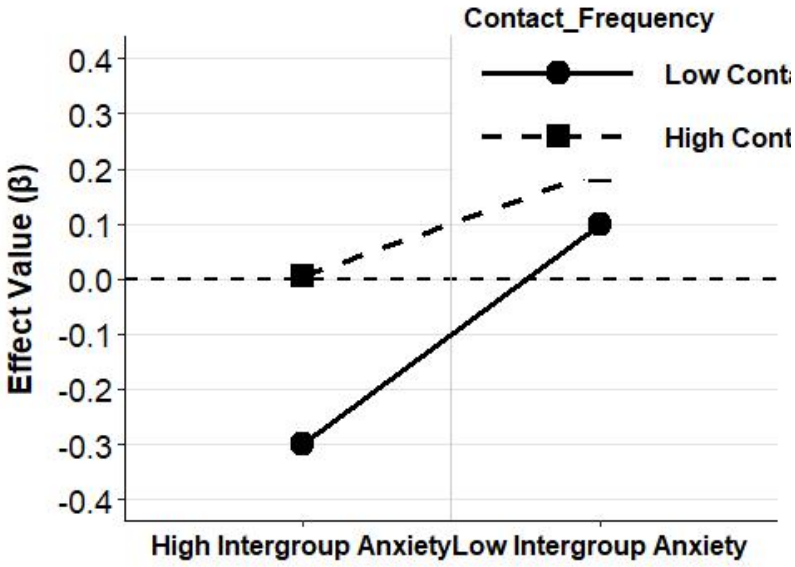
   > print(plot_data)    #c(0.099, 0.197, -0.301, 0.005)

                     Group Contact_Frequency  Value
1  Low Intergroup Anxiety       Low Contact  0.099
2  Low Intergroup Anxiety      High Contact  0.197
3 High Intergroup Anxiety       Low Contact -0.301
4 High Intergroup Anxiety      High Contact  0.005
```

(2) Plotting

```
   > # Moderation effect plot of contact frequency between intergroup anxiety and interactio
n intention
>
> # Assume this is data extracted from your model
> plot_data <- data.frame(
+   Group = c("Low Intergroup Anxiety", "Low Intergroup Anxiety", "High Intergroup Anxiety",
 "High Intergroup Anxiety"),
+   Contact_Frequency= factor(rep(c("Low Contact", "High Contact"), 2),
+                  levels = c("Low Contact", "High Contact")),
+   Value = c(0.099, 0.197, -0.301, 0.005)
+         # Low Anxiety-Low Contact, Low Anxiety-High Contact, High Anxiety-Low Contact, Hig
h Anxiety-High Contact
+ )
>
> # Create professional moderation effect plot
> p4 <- ggplot(plot_data, aes(x = Group, y = Value, group = Contact_Frequency)) +
+   # Grid lines and reference lines
+   geom_hline(yintercept = 0, size = 0.8, color = "black", linetype = "dashed") +
+   geom_vline(xintercept = c(1.5), size = 0.5, color = "gray80") +
+
+   # Lines and points
+   geom_line(aes(linetype = Contact_Frequency), size = 1.2) +
+   geom_point(aes(shape = Contact_Frequency), size = 4, stroke = 1.5) +
+
+   # Style settings
+   scale_linetype_manual(values = c("solid", "dashed")) +
```

```
+   scale_shape_manual(values = c(19, 15)) +  # Solid circle and square
+   scale_y_continuous(limits = c(-0.4, 0.4),
+                      breaks = seq(-0.4, 0.5, by = 0.1),
+                      name = "Effect Value (β)") +
+
+   # Labels and title
+   labs(x = " ",
+        title = " ") +
+
+   # Theme settings
+  theme_classic() +
+   theme(
+     panel.grid.major.y = element_line(color = "gray90", size = 0.3),
+    # panel.grid.minor.y = element_blank(),
+     panel.background = element_rect(fill = "white"),
+     plot.background = element_rect(fill = "white"),
+    # legend.background = element_rect(fill = "white", color = "black"),
+     axis.text.x = element_text(size = 12, face = "bold", color = "black"),
+     axis.text.y = element_text(size = 14, color = "black"),
+     axis.title.x = element_text(size = 12, face = "bold", margin = margin(t=10)),
+     axis.title.y = element_text(size = 14, face = "bold", margin = margin(r=10)),
+     plot.title = element_text(size = 14, face = "bold", hjust = 0.5),
+     legend.position = c(0.8, 0.9),    # Legend position (top right)
+     legend.title = element_text(size = 12, face = "bold", color = "black"),
+     legend.text = element_text(size = 12, face = "bold", color = "black"),
+     #legend.background = element_rect(fill = "white", color = "black", size = 0.8),
+     #legend.key = element_rect(fill = "white", color = "black"),
+     legend.key.width = unit(3, "cm"),  # Increase legend key width
+     legend.key.height = unit(1, "cm") ) # Increase legend key height
>
> # Display the plot
> print(p4)
```



7.2.3 Combine Plots

```
    > library(patchwork)
> # Assume plots p1 and p2 have been created
>
> # Combine plots using patchwork
> combined_plot <- (p3 + p4) +
+                 plot_layout(ncol = 2, widths = c(1, 1.8))
> # Display combined plot
> combined_plot
```

