Beyond Looks: A Study on Agent Movement and Audiovisual Spatial Coherence in Augmented Reality

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Statistical Analysis

Valence and Arousal

Boxplot of Valence and Arousal questions 1-2

```
## Using avatar, audio, animation as id variables
```

```
## Warning in geom_signif(inherit.aes = FALSE, data = annotation_df, aes(xmin =
## start, : Ignoring unknown aesthetics: xmin, xmax, annotations, and y_position
```

```
## Warning in geom_signif(inherit.aes = FALSE, data = annotation_df2, aes(xmin =
## start, : Ignoring unknown aesthetics: xmin, xmax, annotations, and y_position
```
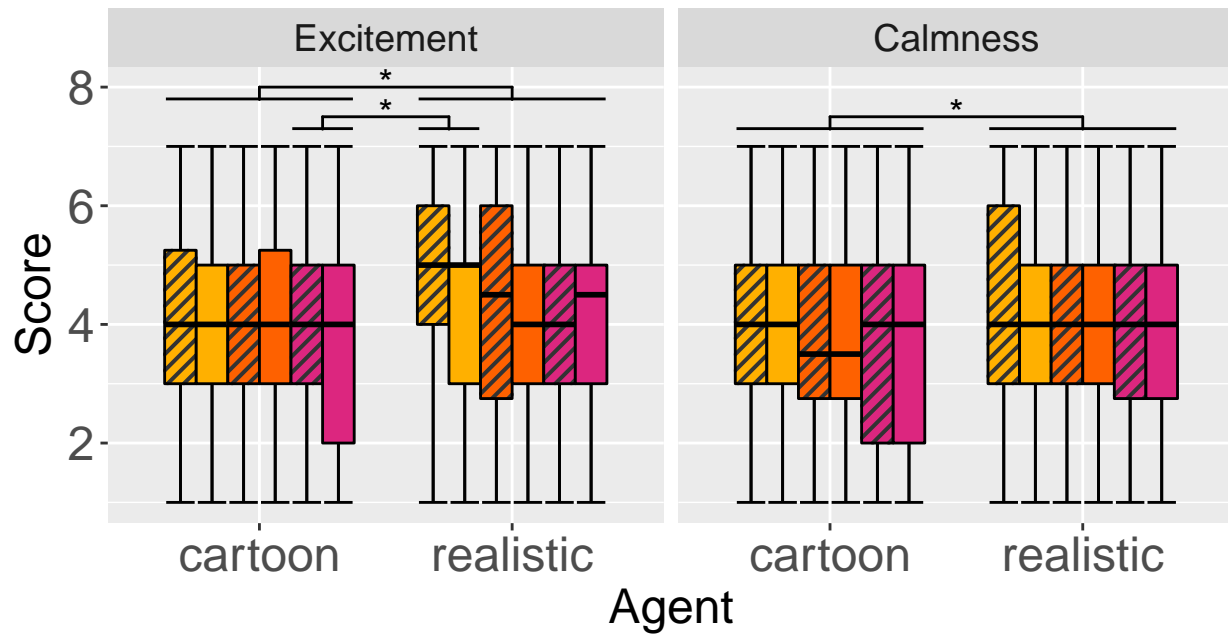
Analysis Excitement

descriptive analysis

```
## # A tibble: 12 x 7
##    avatar audio animation variable      n  mean    sd
##    <fct>  <fct> <fct>     <fct>     <dbl> <dbl> <dbl>
##  1 C      MA    PC        excitement   36  4.25  1.78
##  2 C      MA    PD        excitement   36  4.06  1.79
##  3 C      MA    PS        excitement   36  4.08  1.75
##  4 C      SA    PC        excitement   36  4.28  1.61
##  5 C      SA    PD        excitement   36  4.14  1.82
##  6 C      SA    PS        excitement   36  3.97  1.92
##  7 R      MA    PC        excitement   36  4.75  1.52
##  8 R      MA    PD        excitement   36  4.22  1.97
##  9 R      MA    PS        excitement   36  3.94  1.84
## 10 R      SA    PC        excitement   36  4.28  1.73
## 11 R      SA    PD        excitement   36  4.22  1.71
## 12 R      SA    PS        excitement   36  4.19  1.72
```

mean and SD values grouped by avatar

```
## # A tibble: 2 x 4
##   avatar count  mean    sd
##   <fct>  <int> <dbl> <dbl>
## 1 C        216  4.13  1.76
## 2 R        216  4.27  1.75
```

mean and SD values grouped by animation

```
## # A tibble: 3 x 4
##   animation count  mean    sd
##   <fct>     <int> <dbl> <dbl>
## 1 PC          144  4.39  1.66
## 2 PD          144  4.16  1.81
## 3 PS          144  4.05  1.79
```

mean and SD values grouped by avatar:animation

```
## `summarise()` has grouped output by 'avatar'. You can override using the
## `.groups` argument.
```

```
## # A tibble: 6 x 5
## # Groups:   avatar [2]
##   avatar animation count  mean    sd
##   <fct>  <fct>     <int> <dbl> <dbl>
## 1 C      PC           72  4.26  1.69
## 2 C      PD           72  4.10  1.79
## 3 C      PS           72  4.03  1.82
## 4 R      PC           72  4.51  1.64
## 5 R      PD           72  4.22  1.83
## 6 R      PS           72  4.07  1.77
```

Outliers

```
##  [1] avatar          audio           animation        v_ID
##  [5] OrderCondition  Condition       excitement       calmness
##  [9] externalization auvicoherence   auplausibility   distance
## [13] ABP1_BehPl      ABP2_AppPl      ABP3_BehAppMatch ABP4_coherence
```

```
## [17] ABP5_BehExp       ABP6_predict      SP1                 SP2
## [21] SP3               SP4               SP5                 avgabp
## [25] avgsp             avgaudio          is.outlier          is.extreme
## <0 Zeilen> (oder row.names mit Länge 0)
```

Normality assumptions (Shapiro-Wilk test and QQ-plot)

```
## # A tibble: 12 x 6
##    avatar audio animation variable   statistic      p
##    <fct>  <fct> <fct>     <chr>          <dbl>  <dbl>
##  1 C      MA    PC        excitement     0.942 0.0585
##  2 C      MA    PD        excitement     0.946 0.0797
##  3 C      MA    PS        excitement     0.944 0.0654
##  4 C      SA    PC        excitement     0.949 0.0945
##  5 C      SA    PD        excitement     0.935 0.0345
##  6 C      SA    PS        excitement     0.932 0.0281
##  7 R      MA    PC        excitement     0.942 0.0577
##  8 R      MA    PD        excitement     0.922 0.0149
##  9 R      MA    PS        excitement     0.930 0.0254
## 10 R      SA    PC        excitement     0.922 0.0148
## 11 R      SA    PD        excitement     0.944 0.0701
## 12 R      SA    PS        excitement     0.936 0.0393
```
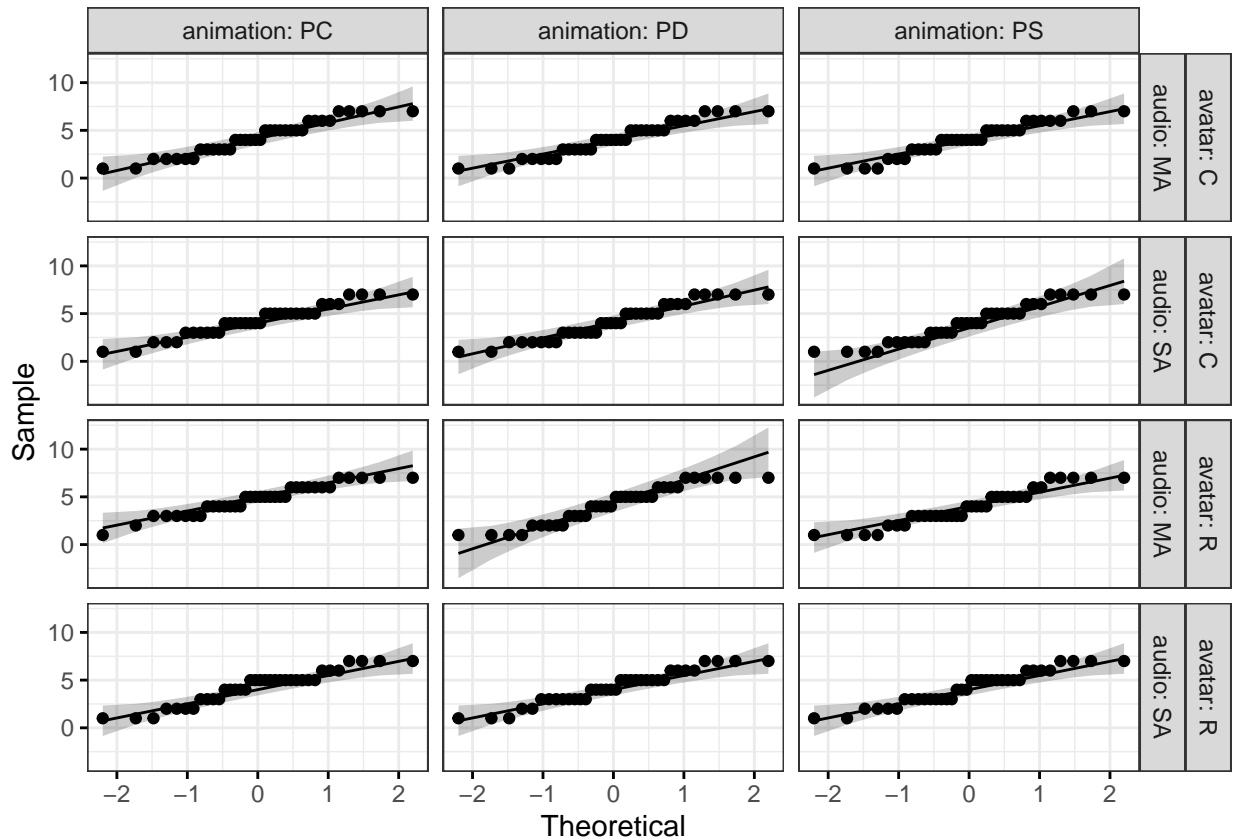

3-way repeated meassure Anova

```
## ANOVA Table (type III tests)
##
##              Effect  DFn   DFd      F     p p<.05      ges
## 1           avatar 1.00 35.00 1.427 0.240       0.002000
```

```
## 2                   audio 1.00 35.00 0.210 0.650        0.000113
## 3               animation 1.43 50.14 2.942 0.078        0.007000
## 4            avatar:audio 1.00 35.00 0.185 0.670        0.000113
## 5        avatar:animation 2.00 70.00 0.577 0.564        0.000603
## 6         audio:animation 2.00 70.00 1.352 0.265        0.001000
## 7 avatar:audio:animation 2.00 70.00 1.757 0.180        0.003000
```

ART Test

```
## Aligned Rank Transform of Factorial Model
##
## Call:
## art(formula = excitement ~ avatar * audio * animation + (1 |
##     v_ID), data = data_long)
##
## Column sums of aligned responses (should all be ~0):
##                 avatar                    audio               animation
##                      0                        0                        0
##           avatar:audio         avatar:animation          audio:animation
##                      0                        0                        0
## avatar:audio:animation
##                      0
##
## F values of ANOVAs on aligned responses not of interest (should all be ~0):
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##       0       0       0       0       0       0
##
## Analysis of Variance of Aligned Rank Transformed Data
##
## Table Type: Analysis of Deviance Table (Type III Wald F tests with Kenward-Roger df)
## Model: Mixed Effects (lmer)
## Response: art(excitement)
##
##                           F Df Df.res      Pr(>F)
## 1 avatar                4.4142  1    385   0.036290   *
## 2 audio                 3.1626  1    385   0.076132   .
## 3 animation            14.1477  2    385 1.1777e-06 ***
## 4 avatar:audio          1.8578  1    385   0.173676
## 5 avatar:animation      4.1190  2    385   0.016982   *
## 6 audio:animation       1.3444  2    385   0.261906
## 7 avatar:audio:animation 2.4376  2    385   0.088717   .
## ---
## Signif. codes:   0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

ART.Con Avatar:Animation

```
## NOTE: Results may be misleading due to involvement in interactions
##
##   contrast     estimate    SE  df t.ratio p.value
##   C,PC - C,PD     11.58 11.8 385   0.984  1.0000
##   C,PC - C,PS     15.28 11.8 385   1.298  1.0000
##   C,PC - R,PC    -19.75 11.8 385  -1.678  1.0000
##   C,PC - R,PD      1.18 11.8 385   0.100  1.0000
##   C,PC - R,PS     14.04 11.8 385   1.193  1.0000
##   C,PD - C,PS      3.69 11.8 385   0.314  1.0000
##   C,PD - R,PC    -31.33 11.8 385  -2.663  0.1212
##   C,PD - R,PD    -10.40 11.8 385  -0.884  1.0000
```

```
##  C,PD - R,PS     2.46 11.8 385    0.209  1.0000
##  C,PS - R,PC    -35.03 11.8 385   -2.977  0.0465
##  C,PS - R,PD    -14.10 11.8 385   -1.198  1.0000
##  C,PS - R,PS     -1.24 11.8 385   -0.105  1.0000
##  R,PC - R,PD     20.93 11.8 385    1.779  1.0000
##  R,PC - R,PS     33.79 11.8 385    2.872  0.0647
##  R,PD - R,PS     12.86 11.8 385    1.093  1.0000
##
## Results are averaged over the levels of: audio
## Degrees-of-freedom method: kenward-roger
## P value adjustment: bonferroni method for 15 tests
```

ART.Con Animation

```
## NOTE: Results may be misleading due to involvement in interactions

##   contrast estimate   SE  df t.ratio p.value
##   PC - PD     34.31 8.27 385   4.150  0.0001
##   PC - PS     40.98 8.27 385   4.957  <.0001
##   PD - PS      6.67 8.27 385   0.807  1.0000
##
## Results are averaged over the levels of: avatar, audio
## Degrees-of-freedom method: kenward-roger
## P value adjustment: bonferroni method for 3 tests
```

Analysis Calmness

descriptive analysis

```
## # A tibble: 12 x 7
##    avatar audio animation variable     n  mean    sd
##    <fct>  <fct> <fct>     <fct>    <dbl> <dbl> <dbl>
## 1  C      MA    PC        calmness    36  3.83  1.63
## 2  C      MA    PD        calmness    36  3.81  1.67
## 3  C      MA    PS        calmness    36  3.81  1.70
## 4  C      SA    PC        calmness    36  3.97  1.70
## 5  C      SA    PD        calmness    36  3.89  1.74
## 6  C      SA    PS        calmness    36  3.92  1.83
## 7  R      MA    PC        calmness    36  4.19  1.79
## 8  R      MA    PD        calmness    36  4.03  1.73
## 9  R      MA    PS        calmness    36  3.89  1.67
## 10 R      SA    PC        calmness    36  3.81  1.65
## 11 R      SA    PD        calmness    36  3.92  1.66
## 12 R      SA    PS        calmness    36  3.94  1.64
```

mean and SD values grouped by avatar

```
## # A tibble: 2 x 4
##   avatar count  mean    sd
##   <fct>  <int> <dbl> <dbl>
## 1 C        216  3.87  1.69
## 2 R        216  3.96  1.68
```

Outliers

```
##  [1] avatar          audio           animation        v_ID
##  [5] OrderCondition  Condition       excitement       calmness
##  [9] externalization auvicoherence   auplausibility   distance
## [13] ABP1_BehPl      ABP2_AppPl      ABP3_BehAppMatch ABP4_coherence
## [17] ABP5_BehExp     ABP6_predict    SP1              SP2
## [21] SP3             SP4             SP5              avgabp
## [25] avgsp           avgaudio        is.outlier       is.extreme
## <0 Zeilen> (oder row.names mit Länge 0)
```

Normality assumptions (Shapiro-Wilk test and QQ-plot)

```
## # A tibble: 12 x 6
##    avatar audio animation variable statistic      p
##    <fct>  <fct> <fct>     <chr>        <dbl>  <dbl>
## 1  C      MA    PC        calmness     0.946 0.0764
## 2  C      MA    PD        calmness     0.938 0.0433
## 3  C      MA    PS        calmness     0.944 0.0691
## 4  C      SA    PC        calmness     0.952 0.121
## 5  C      SA    PD        calmness     0.930 0.0250
## 6  C      SA    PS        calmness     0.925 0.0173
## 7  R      MA    PC        calmness     0.938 0.0430
## 8  R      MA    PD        calmness     0.949 0.0966
## 9  R      MA    PS        calmness     0.944 0.0700
## 10 R      SA    PC        calmness     0.949 0.0986
## 11 R      SA    PD        calmness     0.934 0.0328
## 12 R      SA    PS        calmness     0.941 0.0535
```
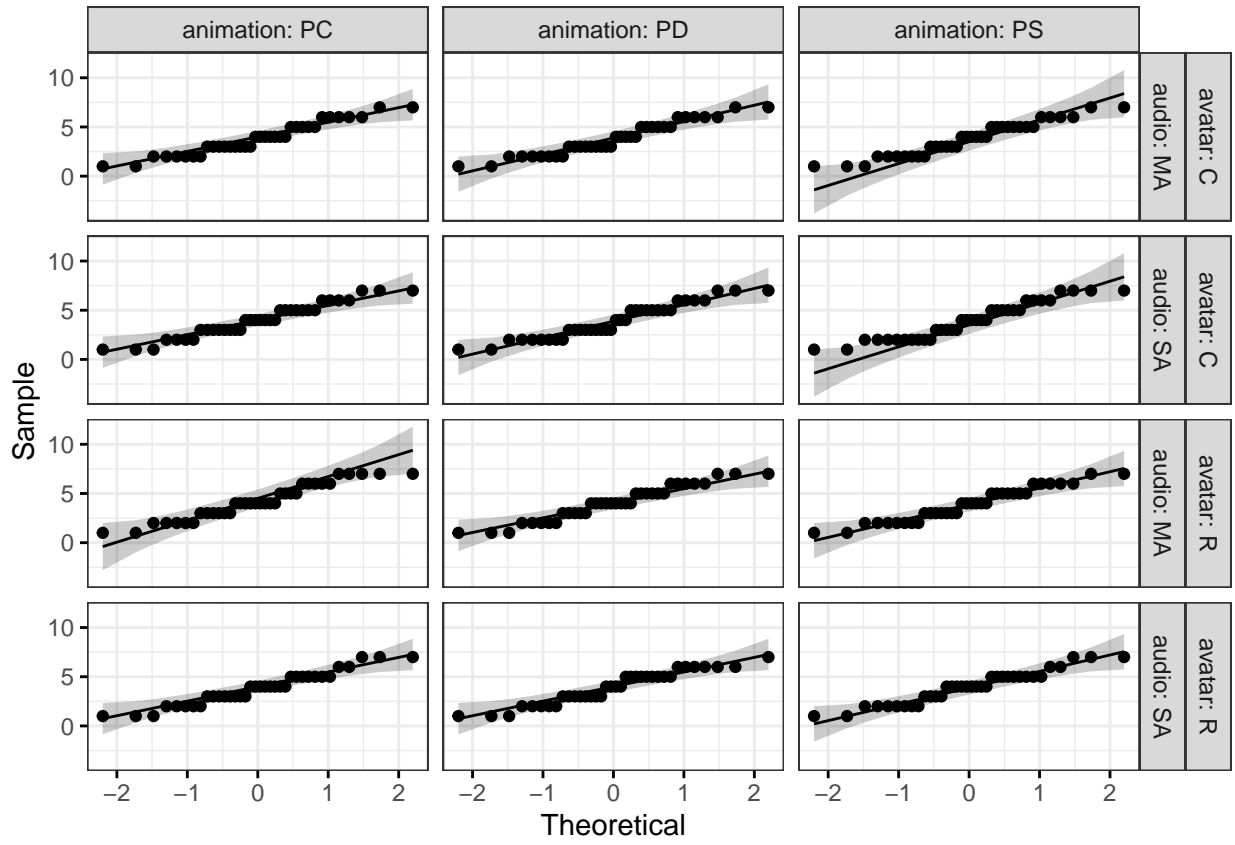
3-way repeated meassure Anova

```
## ANOVA Table (type III tests)
##
##                     Effect DFn DFd     F     p p<.05      ges
## 1                   avatar   1  35 1.844 0.183       7.61e-04
## 2                    audio   1  35 0.094 0.761       3.05e-05
## 3                animation   2  70 0.188 0.829       2.40e-04
## 4              avatar:audio   1  35 4.138 0.050     * 1.00e-03
## 5          avatar:animation   2  70 0.057 0.945       7.23e-05
## 6           audio:animation   2  70 0.733 0.484       6.43e-04
## 7 avatar:audio:animation   2  70 0.848 0.433       8.71e-04
```

ART Test

```
## Aligned Rank Transform of Factorial Model
##
## Call:
## art(formula = calmness ~ avatar * audio * animation + (1 | v_ID),
##     data = data_long)
##
## Column sums of aligned responses (should all be ~0):
##              avatar                 audio            animation
##                   0                     0                    0
##        avatar:audio      avatar:animation      audio:animation
##                   0                     0                    0
## avatar:audio:animation
##                   0
```

```
##
## F values of ANOVAs on aligned responses not of interest (should all be ~0):
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##       0       0       0       0       0       0

## Analysis of Variance of Aligned Rank Transformed Data
##
## Table Type: Analysis of Deviance Table (Type III Wald F tests with Kenward-Roger df)
## Model: Mixed Effects (lmer)
## Response: art(calmness)
##
##                            F Df Df.res    Pr(>F)
## 1 avatar                4.2561  1    385 0.0397786  *
## 2 audio                 2.7575  1    385 0.0976126  .
## 3 animation             1.7924  2    385 0.1679462
## 4 avatar:audio          8.3626  1    385 0.0040476 **
## 5 avatar:animation      2.9233  2    385 0.0549493  .
## 6 audio:animation       0.6867  2    385 0.5038512
## 7 avatar:audio:animation 1.8971  2    385 0.1514082
## ---
## Signif. codes:   0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

ART.Con Avatar:Audio

```
## NOTE: Results may be misleading due to involvement in interactions

##   contrast      estimate    SE  df t.ratio p.value
##   C,MA - C,SA    -8.306 8.18 385  -1.016  1.0000
##   C,MA - R,MA   -17.736 8.18 385  -2.169  0.1839
##   C,MA - R,SA    -0.458 8.18 385  -0.056  1.0000
##   C,SA - R,MA    -9.431 8.18 385  -1.154  1.0000
##   C,SA - R,SA     7.847 8.18 385   0.960  1.0000
##   R,MA - R,SA    17.278 8.18 385   2.113  0.2113
##
## Results are averaged over the levels of: animation
## Degrees-of-freedom method: kenward-roger
## P value adjustment: bonferroni method for 6 tests
```
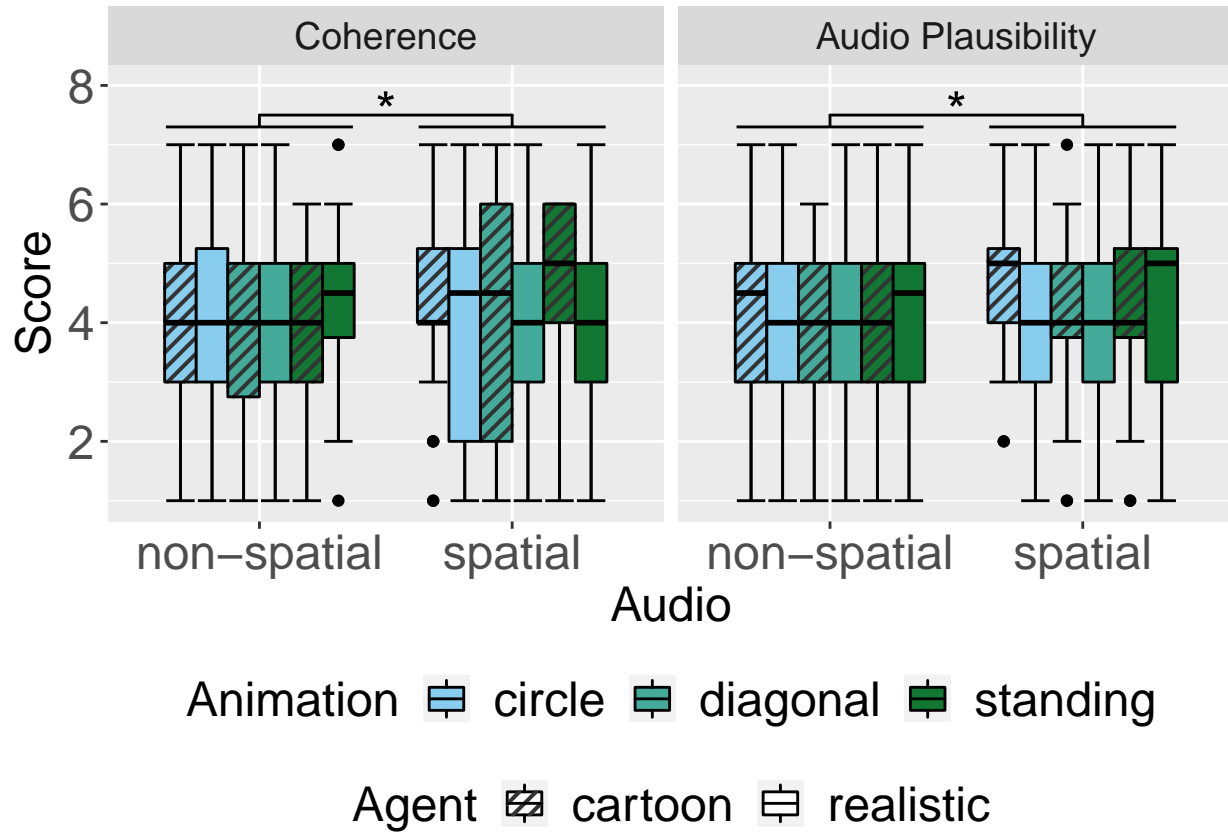
Audio Related Questions

Boxplot Audio related questions 1-4

```
## Using avatar, audio, animation as id variables
```

```
## Warning in geom_signif(inherit.aes = FALSE, data = annotation_df, aes(xmin =
## start, : Ignoring unknown aesthetics: xmin, xmax, annotations, and y_position
```

Analysis Audio Visual Coherence

descriptive analysis

```
## # A tibble: 12 x 7
##    avatar audio animation variable          n  mean    sd
##    <fct>  <fct> <fct>     <fct>         <dbl> <dbl> <dbl>
##  1 C      MA    PC        auvicoherence    36  3.94  1.77
##  2 C      MA    PD        auvicoherence    36  3.72  1.75
##  3 C      MA    PS        auvicoherence    36  4.11  1.56
##  4 C      SA    PC        auvicoherence    36  4.39  1.57
##  5 C      SA    PD        auvicoherence    36  4.08  1.89
##  6 C      SA    PS        auvicoherence    36  4.67  1.39
##  7 R      MA    PC        auvicoherence    36  4.06  1.82
##  8 R      MA    PD        auvicoherence    36  3.92  1.64
##  9 R      MA    PS        auvicoherence    36  4.33  1.45
## 10 R      SA    PC        auvicoherence    36  4     1.91
## 11 R      SA    PD        auvicoherence    36  3.94  1.64
## 12 R      SA    PS        auvicoherence    36  4.25  1.38
```

mean and SD values grouped by audio

```
## # A tibble: 2 x 4
##   audio count  mean    sd
##   <fct> <int> <dbl> <dbl>
## 1 MA      216  4.01  1.66
## 2 SA      216  4.22  1.64
```

mean and SD values grouped by animation

```
## # A tibble: 3 x 4
##   animation count  mean    sd
##   <fct>     <int> <dbl> <dbl>
## 1 PC          144  4.10  1.76
## 2 PD          144  3.92  1.72
## 3 PS          144  4.34  1.45
```

mean and SD values grouped by avatar:audio

```
## `summarise()` has grouped output by 'avatar'. You can override using the
## `.groups` argument.
```

```
## # A tibble: 4 x 5
## # Groups:   avatar [2]
##   avatar audio count  mean    sd
##   <fct>  <fct> <int> <dbl> <dbl>
## 1 C      MA      108  3.93  1.69
## 2 C      SA      108  4.38  1.63
## 3 R      MA      108  4.10  1.64
## 4 R      SA      108  4.06  1.65
```

Outliers

```
## # A tibble: 8 x 28
##   avatar audio animation v_ID  OrderCondition Condition excitement calmness
##   <fct>  <fct> <fct>     <chr>          <int> <chr>          <int>    <int>
## 1 C      SA    PC        p8                10 C_SA_PC            3        3
## 2 C      SA    PC        p10                6 C_SA_PC            1        4
## 3 C      SA    PC        p11                4 C_SA_PC            4        3
```

```
## 4 C      SA     PC        p23                4 C_SA_PC            2        2
## 5 C      SA     PC        p25                1 C_SA_PC            4        3
## 6 R      MA     PS        p10                3 R_MA_PS            1        4
## 7 R      MA     PS        P19                4 R_MA_PS            7        5
## 8 R      MA     PS        p24                7 R_MA_PS            1        7
## # i 20 more variables: externalization <int>, auvicoherence <int>,
## #   auplausibility <int>, distance <int>, ABP1_BehPl <int>, ABP2_AppPl <int>,
## #   ABP3_BehAppMatch <int>, ABP4_coherence <int>, ABP5_BehExp <int>,
## #   ABP6_predict <dbl>, SP1 <dbl>, SP2 <dbl>, SP3 <dbl>, SP4 <dbl>, SP5 <dbl>,
## #   avgabp <dbl>, avgsp <dbl>, avgaudio <dbl>, is.outlier <lgl>,
## #   is.extreme <lgl>
```

Normality assumptions (Shapiro-Wilk test and QQ-plot)

```
## # A tibble: 12 x 6
##    avatar audio animation variable      statistic         p
##    <fct>  <fct> <fct>     <chr>             <dbl>     <dbl>
## 1 C      MA     PC        auvicoherence    0.936 0.0375
## 2 C      MA     PD        auvicoherence    0.933 0.0305
## 3 C      MA     PS        auvicoherence    0.896 0.00261
## 4 C      SA     PC        auvicoherence    0.941 0.0554
## 5 C      SA     PD        auvicoherence    0.896 0.00263
## 6 C      SA     PS        auvicoherence    0.821 0.0000434
## 7 R      MA     PC        auvicoherence    0.935 0.0347
## 8 R      MA     PD        auvicoherence    0.954 0.138
## 9 R      MA     PS        auvicoherence    0.945 0.0737
## 10 R     SA     PC        auvicoherence    0.903 0.00408
## 11 R     SA     PD        auvicoherence    0.929 0.0241
## 12 R     SA     PS        auvicoherence    0.951 0.109
```
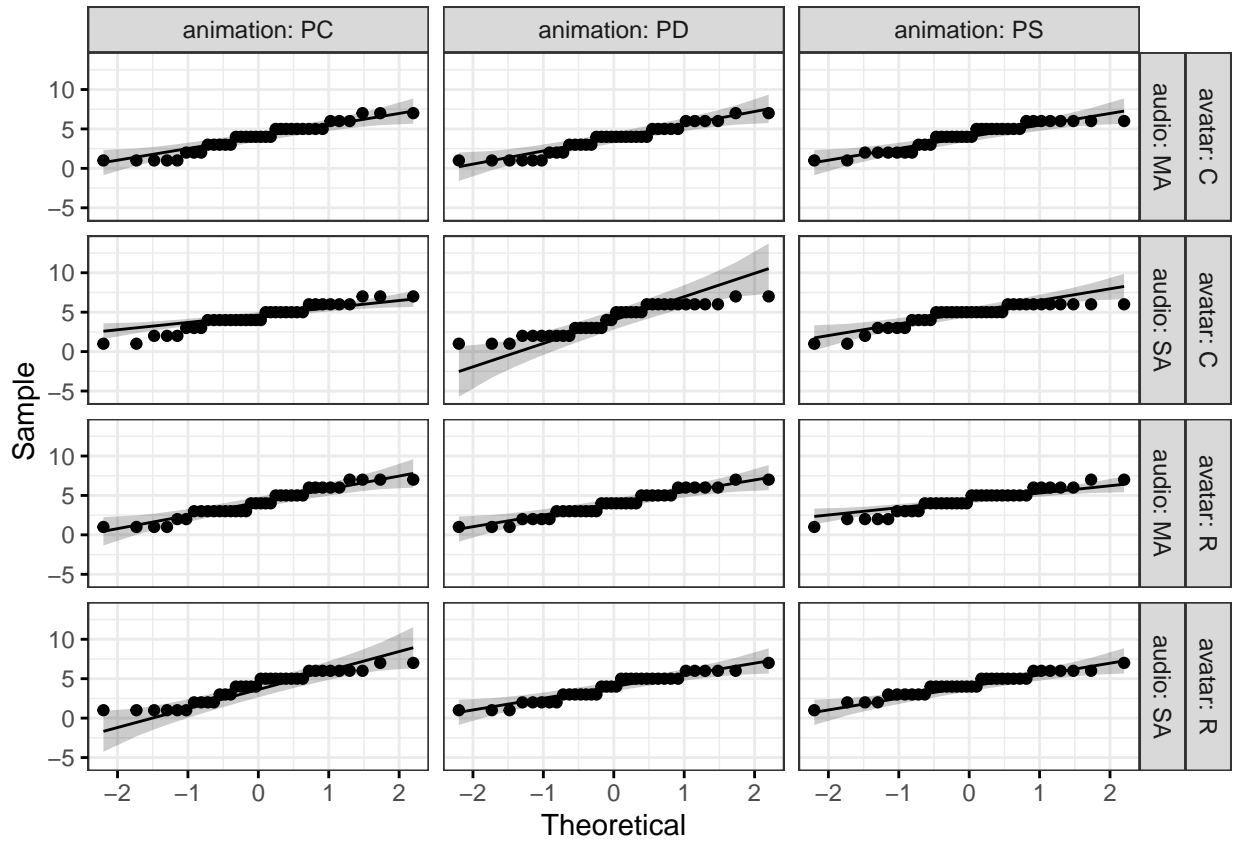
3-way repeated meassure Anova

```
## ANOVA Table (type III tests)
##
##                      Effect DFn DFd     F     p p<.05      ges
## 1                    avatar   1  35 0.477 0.494       4.51e-04
## 2                     audio   1  35 2.747 0.106       4.00e-03
## 3                 animation   2  70 3.564 0.034     * 1.10e-02
## 4              avatar:audio   1  35 4.957 0.033     * 6.00e-03
## 5          avatar:animation   2  70 0.279 0.757       4.69e-04
## 6           audio:animation   2  70 0.015 0.985       3.61e-05
## 7 avatar:audio:animation     2  70 0.212 0.809       3.65e-04
```

ART Test

```
## Aligned Rank Transform of Factorial Model
##
## Call:
## art(formula = auvicoherence ~ avatar * audio * animation + (1 |
##     v_ID), data = data_long)
##
## Column sums of aligned responses (should all be ~0):
##             avatar                audio            animation
##                  0                    0                    0
##       avatar:audio     avatar:animation      audio:animation
##                  0                    0                    0
## avatar:audio:animation
##                  0
```

```
##
## F values of ANOVAs on aligned responses not of interest (should all be ~0):
##    Min. 1st Qu. Median    Mean 3rd Qu.    Max.
##      0       0      0       0       0       0

## Analysis of Variance of Aligned Rank Transformed Data
##
## Table Type: Analysis of Deviance Table (Type III Wald F tests with Kenward-Roger df)
## Model: Mixed Effects (lmer)
## Response: art(auvicoherence)
##
##                           F Df Df.res    Pr(>F) eta.sq.part
## 1 avatar              0.89880  1    385 0.3436971  0.00232912
## 2 audio               5.30259  1    385 0.0218263  0.01358584  *
## 3 animation           6.22375  2    385 0.0021869  0.03131861 **
## 4 avatar:audio        4.70078  1    385 0.0307609  0.01206254  *
## 5 avatar:animation    0.67594  2    385 0.5092794  0.00349910
## 6 audio:animation     0.16187  2    385 0.8506133  0.00084015
## 7 avatar:audio:animation 0.57103 2   385 0.5654192  0.00295763
## ---
## Signif. codes:   0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

ART.Con avatar:audio

```
## NOTE: Results may be misleading due to involvement in interactions

##   contrast    estimate   SE  df t.ratio p.value
##   C,MA - C,SA   -32.27 11.9 385  -2.713  0.0418
##   C,MA - R,MA    -8.38 11.9 385  -0.704  1.0000
##   C,MA - R,SA   -12.96 11.9 385  -1.090  1.0000
##   C,SA - R,MA    23.90 11.9 385   2.009  0.2715
##   C,SA - R,SA    19.31 11.9 385   1.623  0.6322
##   R,MA - R,SA    -4.59 11.9 385  -0.386  1.0000
##
## Results are averaged over the levels of: animation
## Degrees-of-freedom method: kenward-roger
## P value adjustment: bonferroni method for 6 tests
```

ART.Con audio

```
## NOTE: Results may be misleading due to involvement in interactions

##   contrast estimate   SE  df t.ratio p.value
##   MA - SA     -19.4 8.44 385  -2.303  0.0218
##
## Results are averaged over the levels of: avatar, animation
## Degrees-of-freedom method: kenward-roger
```

ART.Con animation

```
## NOTE: Results may be misleading due to involvement in interactions

##   contrast estimate   SE  df t.ratio p.value
##   PC - PD     20.3 10.3 385   1.971  0.1482
##   PC - PS    -15.9 10.3 385  -1.548  0.3672
##   PD - PS    -36.2 10.3 385  -3.520  0.0015
##
## Results are averaged over the levels of: avatar, audio
## Degrees-of-freedom method: kenward-roger
```

```
## P value adjustment: bonferroni method for 3 tests
```

Analysis Audio Plausibility

descriptive analysis

```
## # A tibble: 12 x 7
##    avatar audio animation variable         n  mean    sd
##    <fct>  <fct> <fct>     <fct>         <dbl> <dbl> <dbl>
##  1 C      MA    PC        auplausibility   36  4.22  1.55
##  2 C      MA    PD        auplausibility   36  3.92  1.52
##  3 C      MA    PS        auplausibility   36  4.08  1.44
##  4 C      SA    PC        auplausibility   36  4.58  1.30
##  5 C      SA    PD        auplausibility   36  4.19  1.49
##  6 C      SA    PS        auplausibility   36  4.33  1.59
##  7 R      MA    PC        auplausibility   36  4.22  1.62
##  8 R      MA    PD        auplausibility   36  3.94  1.62
##  9 R      MA    PS        auplausibility   36  4.19  1.53
## 10 R      SA    PC        auplausibility   36  4.11  1.74
## 11 R      SA    PD        auplausibility   36  4     1.57
## 12 R      SA    PS        auplausibility   36  4.25  1.61
```

mean and SD values grouped by audio

```
## # A tibble: 2 x 4
##   audio count  mean    sd
##   <fct> <int> <dbl> <dbl>
## 1 MA      216  4.10  1.54
## 2 SA      216  4.25  1.55
```

Outliers

```
## # A tibble: 7 x 28
##    avatar audio animation v_ID  OrderCondition Condition excitement calmness
##    <fct>  <fct> <fct>     <chr>          <int> <chr>          <int>    <int>
## 1 C       SA    PC        p15                5 C_SA_PC            4        6
## 2 C       SA    PC        P36                2 C_SA_PC            3        2
## 3 C       SA    PD        p8                12 C_SA_PD            3        3
## 4 C       SA    PD        p24                4 C_SA_PD            7        7
## 5 C       SA    PD        p25                2 C_SA_PD            4        2
## 6 C       SA    PS        p10               12 C_SA_PS            1        4
## 7 C       SA    PS        p25                6 C_SA_PS            6        6
## # i 20 more variables: externalization <int>, auvicoherence <int>,
## #   auplausibility <int>, distance <int>, ABP1_BehPl <int>, ABP2_AppPl <int>,
## #   ABP3_BehAppMatch <int>, ABP4_coherence <int>, ABP5_BehExp <int>,
## #   ABP6_predict <dbl>, SP1 <dbl>, SP2 <dbl>, SP3 <dbl>, SP4 <dbl>, SP5 <dbl>,
## #   avgabp <dbl>, avgsp <dbl>, avgaudio <dbl>, is.outlier <lgl>,
## #   is.extreme <lgl>
```

Normality assumptions (Shapiro-Wilk test and QQ-plot)

```
## # A tibble: 12 x 6
##   avatar audio animation variable       statistic       p
##   <fct>  <fct> <fct>     <chr>              <dbl>   <dbl>
## 1 C      MA    PC        auplausibility     0.933 0.0311
## 2 C      MA    PD        auplausibility     0.920 0.0122
## 3 C      MA    PS        auplausibility     0.952 0.119
## 4 C      SA    PC        auplausibility     0.940 0.0513
## 5 C      SA    PD        auplausibility     0.933 0.0305
## 6 C      SA    PS        auplausibility     0.947 0.0832
```
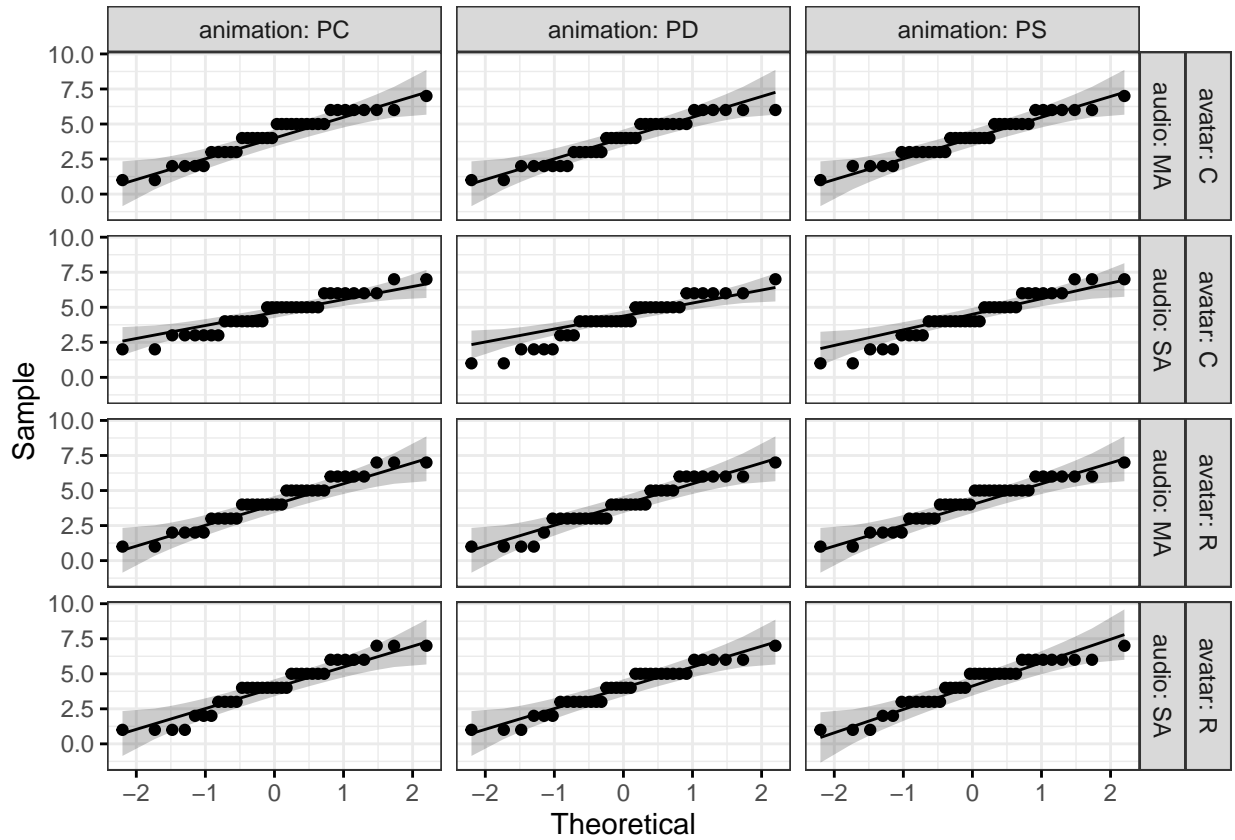
```
## 7 R      MA    PC       auplausibility   0.953 0.131
## 8 R      MA    PD       auplausibility   0.930 0.0256
## 9 R      MA    PS       auplausibility   0.934 0.0320
## 10 R     SA    PC       auplausibility   0.939 0.0486
## 11 R     SA    PD       auplausibility   0.941 0.0549
## 12 R     SA    PS       auplausibility   0.919 0.0116
```


3-way repeated meassure Anova

```
## ANOVA Table (type III tests)
##
##                      Effect DFn DFd     F      p p<.05      ges
## 1                    avatar   1  35 1.163 0.288        1.00e-03
## 2                     audio   1  35 1.724 0.198        2.00e-03
## 3                 animation   2  70 1.912 0.155        6.00e-03
## 4              avatar:audio   1  35 2.067 0.159        2.00e-03
## 5          avatar:animation   2  70 0.672 0.514        1.00e-03
## 6           audio:animation   2  70 0.022 0.978        3.21e-05
## 7 avatar:audio:animation     2  70 0.212 0.810        4.17e-04
```

ART Test

```
## Aligned Rank Transform of Factorial Model
##
## Call:
## art(formula = auplausibility ~ avatar * audio * animation + (1 |
##     v_ID), data = data_long)
##
```

```
## Column sums of aligned responses (should all be ~0):
##                avatar                   audio              animation
##                     0                       0                      0
##           avatar:audio        avatar:animation       audio:animation
##                     0                       0                      0
## avatar:audio:animation
##                     0
##
## F values of ANOVAs on aligned responses not of interest (should all be ~0):
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##       0       0       0       0       0       0
##
## Analysis of Variance of Aligned Rank Transformed Data
##
## Table Type: Analysis of Deviance Table (Type III Wald F tests with Kenward-Roger df)
## Model: Mixed Effects (lmer)
## Response: art(auplausibility)
##
##                          F Df Df.res   Pr(>F) eta.sq.part
## 1 avatar              1.14959  1    385 0.284307   0.0029770
## 2 audio               4.02665  1    385 0.045486   0.0103506 *
## 3 animation           2.79865  2    385 0.062131   0.0143301 .
## 4 avatar:audio        3.03533  1    385 0.082268   0.0078223 .
## 5 avatar:animation    1.31849  2    385 0.268744   0.0068027
## 6 audio:animation     0.85019  2    385 0.428133   0.0043972
## 7 avatar:audio:animation 0.36162  2    385 0.696782   0.0018750
## ---
## Signif. codes:   0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

ART.Con audio

```
## NOTE: Results may be misleading due to involvement in interactions

##  contrast estimate   SE  df t.ratio p.value
##  MA - SA      -16.2 8.09 385  -2.007  0.0455
##
## Results are averaged over the levels of: avatar, animation
## Degrees-of-freedom method: kenward-roger
```

Appearance and Behavior Plausibility

Boxplot appearance and behavior plausibility shows mean values of related questions 1-6

```
## Using avatar, audio, animation as id variables
```

```
## Warning in geom_signif(inherit.aes = FALSE, data = annotation_df, aes(xmin =
## start, : Ignoring unknown aesthetics: xmin, xmax, annotations, and y_position
```

```
## Warning: Removed 7 rows containing non-finite values (`stat_boxplot()`).
## Removed 7 rows containing non-finite values (`stat_boxplot()`).
```
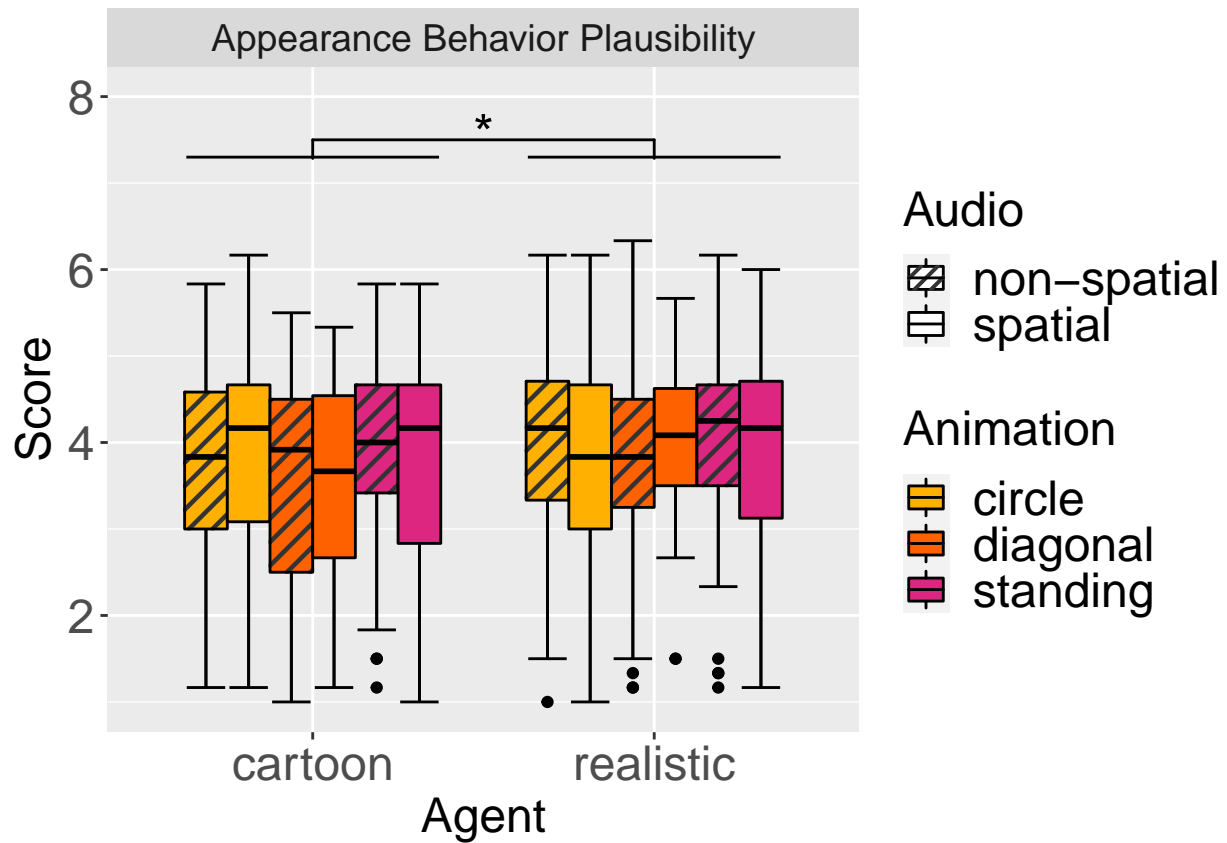
Analysis Appearance Behavior Mean

descriptive analysis

```
## # A tibble: 12 x 7
##    avatar audio animation variable     n  mean    sd
##    <fct>  <fct> <fct>     <fct>    <dbl> <dbl> <dbl>
## 1 C      MA    PC        avgabp      36  3.61  1.34
## 2 C      MA    PD        avgabp      36  3.52  1.32
## 3 C      MA    PS        avgabp      36  3.72  1.30
## 4 C      SA    PC        avgabp      36  3.74  1.37
## 5 C      SA    PD        avgabp      36  3.52  1.20
## 6 C      SA    PS        avgabp      36  3.75  1.27
## 7 R      MA    PC        avgabp      36  3.99  1.23
## 8 R      MA    PD        avgabp      36  3.69  1.35
## 9 R      MA    PS        avgabp      36  3.91  1.26
## 10 R     SA    PC        avgabp      36  3.71  1.24
## 11 R     SA    PD        avgabp      36  3.81  1.23
## 12 R     SA    PS        avgabp      36  3.91  1.25
```

mean and SD values grouped by animation

```
## # A tibble: 3 x 4
##   animation count  mean    sd
##   <fct>     <int> <dbl> <dbl>
## 1 PC          144  3.76  1.29
## 2 PD          144  3.64  1.27
## 3 PS          144  3.82  1.26
```

mean and SD values grouped by avatar

```
## # A tibble: 2 x 4
##   avatar count  mean    sd
##   <fct>  <int> <dbl> <dbl>
## 1 C        216  3.64  1.29
## 2 R        216  3.84  1.25
```

Outliers

```
## # A tibble: 11 x 7
##    avatar audio animation avgabp v_ID  is.outlier is.extreme
##    <fct>  <fct> <fct>      <dbl> <chr> <lgl>      <lgl>
## 1 C      MA    PS         0.667 p11   TRUE       FALSE
## 2 R      MA    PC         1     p8    TRUE       FALSE
## 3 R      MA    PD         0.333 p11   TRUE       FALSE
## 4 R      MA    PS         1.33  p8    TRUE       FALSE
## 5 R      MA    PS         1.17  p11   TRUE       FALSE
## 6 R      MA    PS         1.33  P20   TRUE       FALSE
## 7 R      MA    PS         1.5   P6    TRUE       FALSE
## 8 R      SA    PD         0.833 p8    TRUE       FALSE
## 9 R      SA    PD         1.5   p10   TRUE       FALSE
## 10 R     SA    PD         0.5   p11   TRUE       FALSE
## 11 R     SA    PD         1.5   P6    TRUE       FALSE
```

Normality assumptions (Shapiro-Wilk test and QQ-plot)

```
## # A tibble: 12 x 6
##    avatar audio animation variable statistic     p
##    <fct>  <fct> <fct>     <chr>        <dbl> <dbl>
```

```
##  1 C      MA    PC         avgabp      0.948 0.0913
##  2 C      MA    PD         avgabp      0.942 0.0581
##  3 C      MA    PS         avgabp      0.933 0.0307
##  4 C      SA    PC         avgabp      0.943 0.0615
##  5 C      SA    PD         avgabp      0.950 0.105
##  6 C      SA    PS         avgabp      0.954 0.138
##  7 R      MA    PC         avgabp      0.968 0.378
##  8 R      MA    PD         avgabp      0.946 0.0797
##  9 R      MA    PS         avgabp      0.922 0.0139
## 10 R      SA    PC         avgabp      0.969 0.401
## 11 R      SA    PD         avgabp      0.913 0.00786
## 12 R      SA    PS         avgabp      0.949 0.0996
```
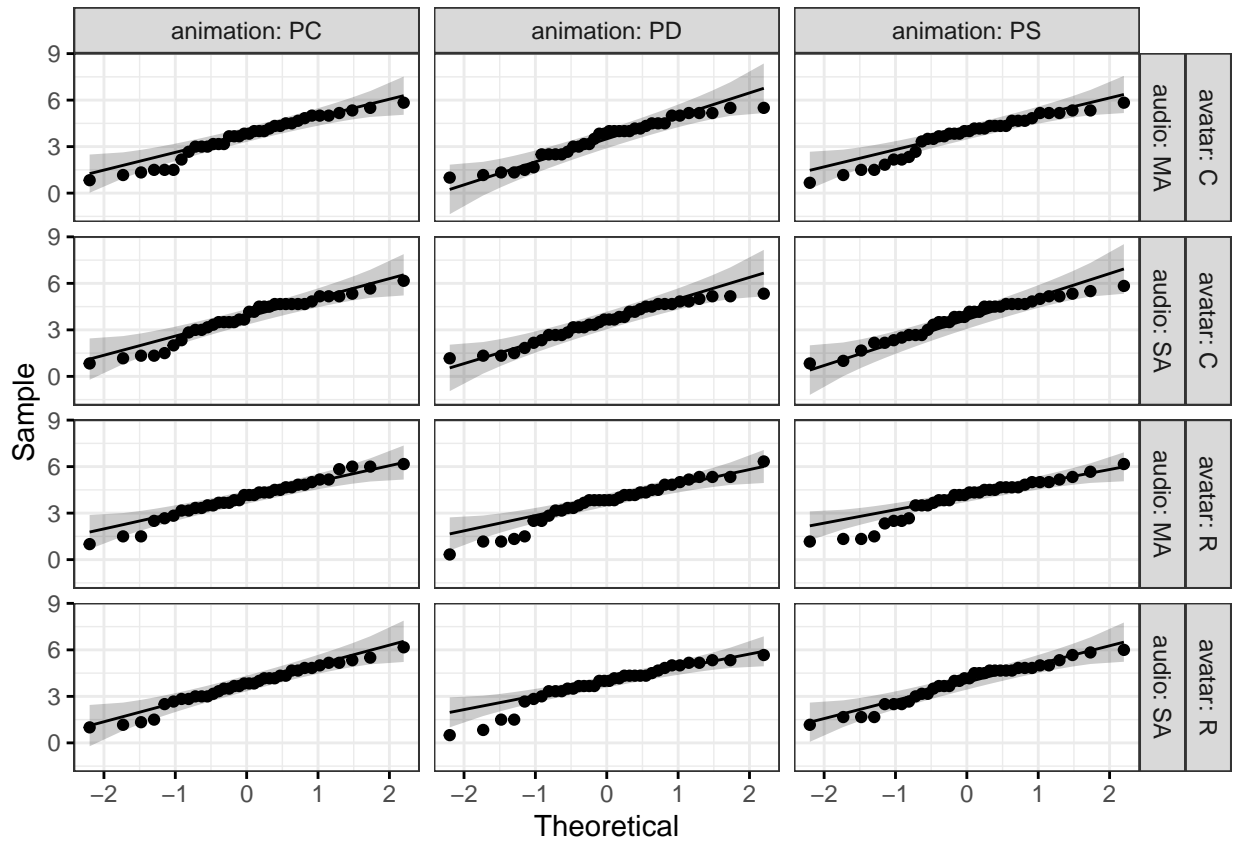

3-way repeated meassure Anova

```
## ANOVA Table (type III tests)
##
##                         Effect  DFn    DFd         F      p p<.05      ges
## 1                       avatar 1.00  35.00 5.354e+00  0.027     * 6.00e-03
## 2                        audio 1.00  35.00 5.590e-30  1.000       3.43e-33
## 3                    animation 1.66  57.93 9.250e-01  0.386       4.00e-03
## 4                 avatar:audio 1.00  35.00 1.225e+00  0.276       4.31e-04
## 5             avatar:animation 2.00  70.00 8.000e-02  0.923       9.03e-05
## 6              audio:animation 2.00  70.00 4.660e-01  0.629       4.86e-04
## 7 avatar:audio:animation 2.00  70.00 2.070e+00  0.134       2.00e-03
```

ART Test

```
## Aligned Rank Transform of Factorial Model
##
## Call:
## art(formula = avgabp ~ avatar * audio * animation + (1 | v_ID),
##     data = data_B)
##
## Column sums of aligned responses (should all be ~0):
##                avatar                   audio              animation
##                     0                       0                      0
##          avatar:audio         avatar:animation        audio:animation
##                     0                       0                      0
## avatar:audio:animation
##                     0
##
## F values of ANOVAs on aligned responses not of interest (should all be ~0):
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##       0       0       0       0       0       0
##
## Analysis of Variance of Aligned Rank Transformed Data
##
## Table Type: Analysis of Deviance Table (Type III Wald F tests with Kenward-Roger df)
## Model: Mixed Effects (lmer)
## Response: art(avgabp)
##
##                               F Df Df.res    Pr(>F)
## 1 avatar                 5.2724e+00  1    385 0.022203 *
## 2 audio                  3.9788e-07  1    385 0.999497
## 3 animation              1.9153e+00  2    385 0.148692
## 4 avatar:audio           6.4457e-01  1    385 0.422555
## 5 avatar:animation       1.1071e-01  2    385 0.895224
## 6 audio:animation        6.8216e-02  2    385 0.934070
## 7 avatar:audio:animation 1.2251e+00  2    385 0.294879
## ---
## Signif. codes:   0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

ART.Con Animation

```
## NOTE: Results may be misleading due to involvement in interactions
##
##  contrast estimate   SE  df t.ratio p.value
##  PC - PD      9.43 8.97 385   1.051  0.8820
##  PC - PS     -8.12 8.97 385  -0.905  1.0000
##  PD - PS    -17.55 8.97 385  -1.955  0.1538
##
## Results are averaged over the levels of: avatar, audio
## Degrees-of-freedom method: kenward-roger
## P value adjustment: bonferroni method for 3 tests
```
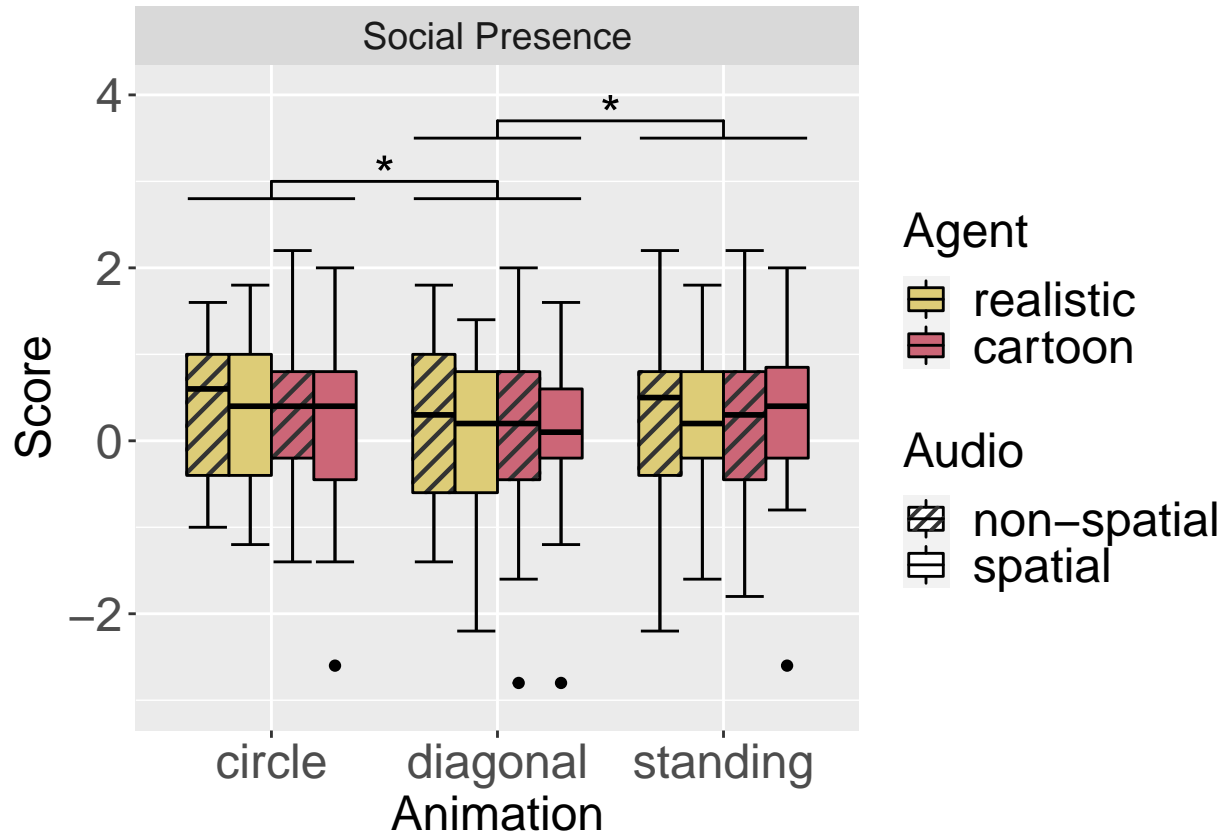
Social Presence

Boxplot social presence shows mean values of related questions 1-5

```
## Using avatar, audio, animation as id variables
```

```
## Warning in geom_signif(inherit.aes = FALSE, data = annotation_df, aes(xmin =
## start, : Ignoring unknown aesthetics: xmin, xmax, annotations, and y_position
```

Analysis Social Pressence Mean

descriptive analysis

```
## # A tibble: 12 x 7
##    avatar audio animation variable     n  mean    sd
##    <fct>  <fct> <fct>     <fct>    <dbl> <dbl> <dbl>
##  1 C      MA    PC        avgsp       36 0.372 0.753
##  2 C      MA    PD        avgsp       36 0.183 0.934
##  3 C      MA    PS        avgsp       36 0.289 1
##  4 C      SA    PC        avgsp       36 0.311 0.848
##  5 C      SA    PD        avgsp       36 0.056 0.936
##  6 C      SA    PS        avgsp       36 0.261 0.822
##  7 R      MA    PC        avgsp       36 0.361 0.775
##  8 R      MA    PD        avgsp       36 0.067 0.96
##  9 R      MA    PS        avgsp       36 0.2   0.885
## 10 R      SA    PC        avgsp       36 0.139 0.96
## 11 R      SA    PD        avgsp       36 0.133 0.887
## 12 R      SA    PS        avgsp       36 0.35  0.913
```

mean and SD values grouped by animation

```
## # A tibble: 3 x 4
##   animation count  mean    sd
##   <fct>     <int> <dbl> <dbl>
## 1 PC          144 0.296 0.834
## 2 PD          144 0.110 0.921
## 3 PS          144 0.275 0.899
```

Outliers

```
## # A tibble: 4 x 7
##   avatar audio animation avgsp v_ID  is.outlier is.extreme
##   <fct>  <fct> <fct>     <dbl> <chr> <lgl>      <lgl>
## 1 R      MA    PD         -2.8 p11   TRUE       FALSE
## 2 R      SA    PC         -2.6 p11   TRUE       FALSE
## 3 R      SA    PD         -2.8 p11   TRUE       TRUE
## 4 R      SA    PS         -2.6 p11   TRUE       FALSE
```

Normality assumptions (Shapiro-Wilk test and QQ-plot)

```
## # A tibble: 12 x 6
##    avatar audio animation variable statistic      p
##    <fct>  <fct> <fct>     <chr>        <dbl>  <dbl>
##  1 C      MA    PC        avgsp        0.945 0.0731
##  2 C      MA    PD        avgsp        0.950 0.103
##  3 C      MA    PS        avgsp        0.969 0.388
##  4 C      SA    PC        avgsp        0.952 0.120
##  5 C      SA    PD        avgsp        0.950 0.105
##  6 C      SA    PS        avgsp        0.981 0.787
##  7 R      MA    PC        avgsp        0.987 0.944
##  8 R      MA    PD        avgsp        0.965 0.304
##  9 R      MA    PS        avgsp        0.975 0.593
## 10 R      SA    PC        avgsp        0.971 0.459
## 11 R      SA    PD        avgsp        0.935 0.0346
## 12 R      SA    PS        avgsp        0.950 0.105
```
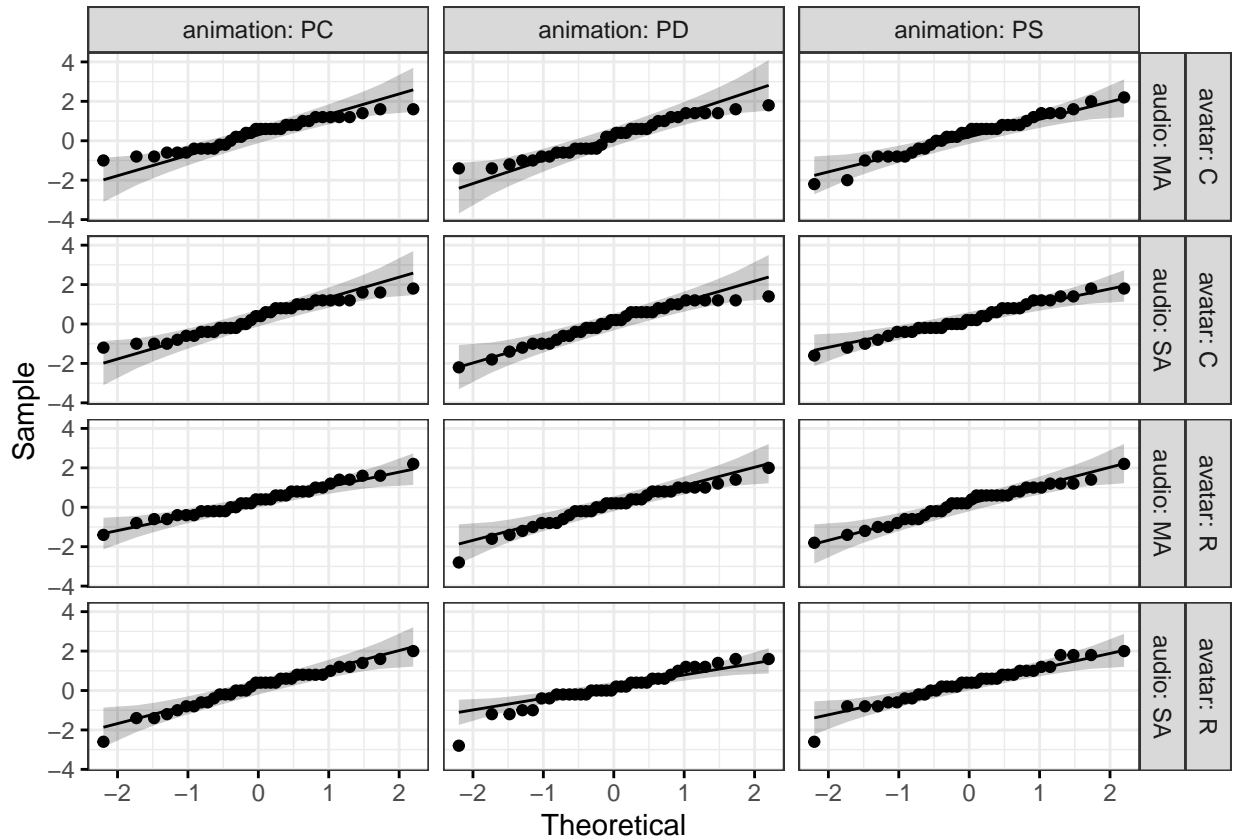
3-way repeated meassure Anova

```
## ANOVA Table (type III tests)
##
##                      Effect  DFn   DFd     F      p p<.05      ges
## 1                    avatar 1.00 35.00 0.358 0.553       0.000443
## 2                     audio 1.00 35.00 0.490 0.489       0.000443
## 3                 animation 1.54 53.86 4.473 0.024     * 0.009000
## 4              avatar:audio 1.00 35.00 0.504 0.482       0.000400
## 5          avatar:animation 2.00 70.00 0.398 0.673       0.000502
## 6           audio:animation 2.00 70.00 2.255 0.112       0.002000
## 7 avatar:audio:animation 2.00 70.00 1.306 0.277       0.002000
```

ART Test

```
## Aligned Rank Transform of Factorial Model
##
## Call:
## art(formula = avgsp ~ avatar * audio * animation + (1 | v_ID),
##     data = data_SP)
##
## Column sums of aligned responses (should all be ~0):
##              avatar                audio            animation
##                   0                    0                    0
##        avatar:audio     avatar:animation      audio:animation
##                   0                    0                    0
## avatar:audio:animation
##                   0
```

25

```
##
## F values of ANOVAs on aligned responses not of interest (should all be ~0):
##    Min. 1st Qu. Median   Mean 3rd Qu.   Max.
##       0       0      0      0      0      0

## Analysis of Variance of Aligned Rank Transformed Data
##
## Table Type: Analysis of Deviance Table (Type III Wald F tests with Kenward-Roger df)
## Model: Mixed Effects (lmer)
## Response: art(avgsp)
##
##                              F Df Df.res   Pr(>F)
## 1 avatar                0.45895  1    385 0.498523
## 2 audio                 0.25724  1    385 0.612314
## 3 animation             4.15512  2    385 0.016393 *
## 4 avatar:audio          0.56053  1    385 0.454506
## 5 avatar:animation      0.33329  2    385 0.716772
## 6 audio:animation       0.88595  2    385 0.413163
## 7 avatar:audio:animation 0.47093  2    385 0.624778
## ---
## Signif. codes:   0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

ART.Con Animation

```
## NOTE: Results may be misleading due to involvement in interactions

##  contrast estimate   SE  df t.ratio p.value
##  PC - PD    21.632 8.59 385   2.518  0.0367
##  PC - PS     0.368 8.59 385   0.043  1.0000
##  PD - PS   -21.264 8.59 385  -2.475  0.0413
##
## Results are averaged over the levels of: avatar, audio
## Degrees-of-freedom method: kenward-roger
## P value adjustment: bonferroni method for 3 tests
```