1.2_FactorAnalysis

MKappen

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R Markdown

This is an R Markdown document displaying the code and output for the cfa and glmm's ran for valence and arousal for two image sets.

This results in the following (clickable) structure

General code

Used to load and prepare dataframes

```r
##### Set environment #####
rm(list = ls()) # Clear environment
cat("\014") # Clear console
dev.off() # Clear plot window
options(contrasts=c("contr.sum", "contr.poly")) # Set contrast settings to effect coding

# Libraries
library(arrow)
library(lavaan)
library(lavaanPlot)
library(psych)
library(ltm)
library(car)
library(ggplot2)
library(ggstatsplot)
library(Polychrome)

#GLM specific
library(lme4)
library(lmerTest)
library(emmeans)
library(effects)
```

```r
##### Loading data #####
imageData <-as.data.frame(read_parquet("../loc_data/df_session_tot_cleaned.parquet"))

piscesData <- imageData[imageData$DB == 'PiSCES',]
radboudData <- imageData[imageData$DB == 'Radboud',]
marloesData <- imageData[imageData$DB == 'marloes',]
```

1.0. Pisces Dataset

1.1. Valence

```r
##### Valence #####
piscesDataClean = piscesData[c("ID", "pic_name","valence")]
piscesDataClean$pic_name = as.factor(piscesDataClean$pic_name)
piscesDataClean = reshape(piscesDataClean, idvar = "ID", timevar = "pic_name", direction = "wide")
piscesDataCronbachs = piscesDataClean[ ,2:16]
```

1.1.1. Cronbach's Alpha

```r
# Calculate Cronbach's alpha using alpha()
alphavar = psych::alpha(piscesDataCronbachs, check.keys = TRUE)
summary(alphavar)
```

```
##
## Reliability analysis
```

```
##  raw_alpha std.alpha G6(smc) average_r S/N   ase mean sd median_r
##       0.84      0.84    0.88      0.26 5.4 0.025   57  8     0.27
```

1.1.2. CFA

```
names(piscesDataClean)[2:16] = c("Picture_105", "Picture_82",  "Picture_118", "Picture_65", "Picture_88
                                 "Picture_110", "Picture_96",  "Picture_132", "Picture_80",  "Picture_9

HS.model <- 'pisces =~ Picture_105 + Picture_82 + Picture_118 + Picture_65 + Picture_88 + Picture_87 +
```

Fit and visualize

```
## lavaan 0.6-9 ended normally after 56 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of model parameters                        30
##
##                                                   Used       Total
##   Number of observations                            84          89
##
## Model Test User Model:
##
##   Test statistic                               188.181
##   Degrees of freedom                               90
##   P-value (Chi-square)                          0.000
##
## Model Test Baseline Model:
##
##   Test statistic                               466.939
##   Degrees of freedom                              105
##   P-value                                       0.000
##
## User Model versus Baseline Model:
##
##   Comparative Fit Index (CFI)                    0.729
##   Tucker-Lewis Index (TLI)                       0.684
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)              -4979.918
##   Loglikelihood unrestricted model (H1)      -4885.827
##
##   Akaike (AIC)                               10019.835
##   Bayesian (BIC)                             10092.760
##   Sample-size adjusted Bayesian (BIC)         9998.124
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.114
##   90 Percent confidence interval - lower         0.091
```

```
##   90 Percent confidence interval - upper         0.137
##   P-value RMSEA <= 0.05                          0.000
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.099
##
## Parameter Estimates:
##
##   Standard errors                             Standard
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   pisces =~
##     Picture_105       5.297    1.451    3.651    0.000    5.297    0.407
##     Picture_82        4.740    1.734    2.733    0.006    4.740    0.311
##     Picture_118       8.769    1.328    6.603    0.000    8.769    0.673
##     Picture_65        8.353    1.519    5.498    0.000    8.353    0.582
##     Picture_88        4.194    1.977    2.122    0.034    4.194    0.244
##     Picture_87       11.781    2.013    5.853    0.000   11.781    0.612
##     Picture_59        5.198    1.336    3.891    0.000    5.198    0.431
##     Picture_93        7.133    1.309    5.451    0.000    7.133    0.578
##     Picture_56        8.063    1.239    6.509    0.000    8.063    0.665
##     Picture_81        9.692    1.413    6.861    0.000    9.692    0.692
##     Picture_110       6.620    1.515    4.369    0.000    6.620    0.478
##     Picture_96        5.934    1.575    3.766    0.000    5.934    0.419
##     Picture_132       6.329    1.508    4.196    0.000    6.329    0.462
##     Picture_80        9.759    1.681    5.807    0.000    9.759    0.608
##     Picture_98        8.113    1.287    6.302    0.000    8.113    0.649
##
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .Picture_105     141.212   22.442    6.292    0.000  141.212    0.834
##    .Picture_82      209.994   32.918    6.379    0.000  209.994    0.903
##    .Picture_118      93.033   16.340    5.693    0.000   93.033    0.548
##    .Picture_65      136.514   22.772    5.995    0.000  136.514    0.662
##    .Picture_88      278.204   43.328    6.421    0.000  278.204    0.941
##    .Picture_87      231.777   39.210    5.911    0.000  231.777    0.625
##    .Picture_59      118.188   18.868    6.264    0.000  118.188    0.814
##    .Picture_93      101.667   16.930    6.005    0.000  101.667    0.666
##    .Picture_56       81.859   14.300    5.724    0.000   81.859    0.557
##    .Picture_81      101.959   18.198    5.603    0.000  101.959    0.520
##    .Picture_110     147.831   23.846    6.199    0.000  147.831    0.771
##    .Picture_96      165.490   26.356    6.279    0.000  165.490    0.825
##    .Picture_132     148.002   23.780    6.224    0.000  148.002    0.787
##    .Picture_80      162.325   27.408    5.923    0.000  162.325    0.630
##    .Picture_98       90.502   15.635    5.788    0.000   90.502    0.579
##     pisces            1.000                             1.000    1.000
```

1.1.3. CFA Visualization

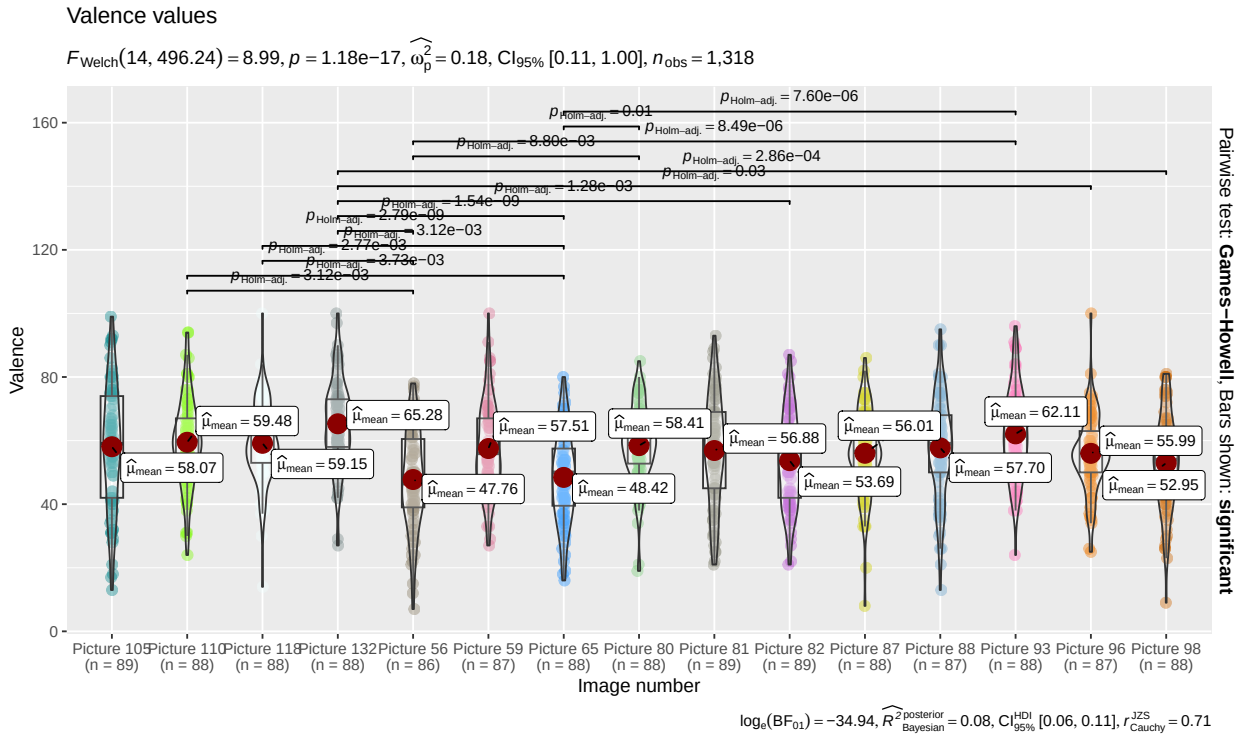
Pisces dataset - Valence

1.1.4. Distributions

```
# Re-prep data
piscesDataClean = piscesData[c("ID","pic_name","valence")]
piscesDataClean$pic_name = as.factor(piscesDataClean$pic_name)
piscesDataClean$ID = as.factor(piscesDataClean$ID)
```

Visualizations

Pisces - Valence



1.2. Arousal

```
##### Arousal #####
piscesDataClean = piscesData[c("ID", "pic_name","arousal")]
piscesDataClean$pic_name = as.factor(piscesDataClean$pic_name)
piscesDataClean = reshape(piscesDataClean, idvar = "ID", timevar = "pic_name", direction = "wide")
piscesDataCronbachs = piscesDataClean[ ,2:16]
```

1.2.1. Cronbach's Alpha

```
# Calculate Cronbach's alpha using alpha()
alphavar = psych::alpha(piscesDataCronbachs, check.keys = TRUE)
summary(alphavar)
```

```
##
## Reliability analysis
##  raw_alpha std.alpha G6(smc) average_r S/N  ase mean sd median_r
##       0.94      0.94    0.95      0.49  14 0.01   48 14     0.51
```

1.2.2. CFA

```
names(piscesDataClean)[2:16] = c("Picture_105", "Picture_82",  "Picture_118", "Picture_65", "Picture_88
                                 "Picture_110", "Picture_96",  "Picture_132", "Picture_80",  "Picture_9

HS.model <- 'pisces =~ Picture_105 + Picture_82 + Picture_118 + Picture_65 + Picture_88 + Picture_87 +
```

Fit and visualize

```
## lavaan 0.6-9 ended normally after 19 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of model parameters                        30
##
##                                                   Used       Total
##   Number of observations                            84          89
##
## Model Test User Model:
##
##   Test statistic                               193.015
##   Degrees of freedom                               90
##   P-value (Chi-square)                          0.000
##
## Model Test Baseline Model:
##
##   Test statistic                               858.041
##   Degrees of freedom                               105
##   P-value                                       0.000
##
## User Model versus Baseline Model:
##
##   Comparative Fit Index (CFI)                    0.863
##   Tucker-Lewis Index (TLI)                       0.840
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)              -5201.631
##   Loglikelihood unrestricted model (H1)      -5105.123
```

```
##
##   Akaike (AIC)                               10463.261
##   Bayesian (BIC)                             10536.186
##   Sample-size adjusted Bayesian (BIC)        10441.550
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.117
##   90 Percent confidence interval - lower         0.094
##   90 Percent confidence interval - upper         0.139
##   P-value RMSEA <= 0.05                          0.000
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.070
##
## Parameter Estimates:
##
##   Standard errors                             Standard
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   pisces =~
##     Picture_105      11.707    2.013    5.816    0.000   11.707    0.591
##     Picture_82       16.310    1.828    8.923    0.000   16.310    0.812
##     Picture_118      15.903    2.012    7.904    0.000   15.903    0.747
##     Picture_65       13.560    1.953    6.944    0.000   13.560    0.680
##     Picture_88       14.346    1.846    7.771    0.000   14.346    0.738
##     Picture_87       13.571    1.747    7.770    0.000   13.571    0.738
##     Picture_59       16.185    1.898    8.528    0.000   16.185    0.788
##     Picture_93       14.186    1.891    7.502    0.000   14.186    0.720
##     Picture_56       15.444    1.835    8.415    0.000   15.444    0.781
##     Picture_81       12.237    1.831    6.682    0.000   12.237    0.660
##     Picture_110       7.739    1.935    4.000    0.000    7.739    0.427
##     Picture_96       13.904    1.818    7.648    0.000   13.904    0.730
##     Picture_132      13.627    1.914    7.121    0.000   13.627    0.693
##     Picture_80       13.176    1.872    7.039    0.000   13.176    0.687
##     Picture_98       14.812    1.906    7.772    0.000   14.812    0.738
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .Picture_105     255.417   40.745    6.269    0.000  255.417    0.651
##    .Picture_82      137.429   24.055    5.713    0.000  137.429    0.341
##    .Picture_118     199.787   33.412    5.979    0.000  199.787    0.441
##    .Picture_65      214.218   34.882    6.141    0.000  214.218    0.538
##    .Picture_88      171.575   28.568    6.006    0.000  171.575    0.455
##    .Picture_87      153.637   25.580    6.006    0.000  153.637    0.455
##    .Picture_59      160.072   27.447    5.832    0.000  160.072    0.379
##    .Picture_93      187.074   30.896    6.055    0.000  187.074    0.482
##    .Picture_56      152.821   26.069    5.862    0.000  152.821    0.391
##    .Picture_81      194.121   31.433    6.176    0.000  194.121    0.565
##    .Picture_110     267.851   41.901    6.392    0.000  267.851    0.817
```

```
##     .Picture_96      169.447   28.105    6.029    0.000  169.447    0.467
##     .Picture_132     201.360   32.925    6.116    0.000  201.360    0.520
##     .Picture_80      194.607   31.758    6.128    0.000  194.607    0.529
##     .Picture_98      182.901   30.454    6.006    0.000  182.901    0.455
##      pisces            1.000                              1.000    1.000
```

1.2.3. CFA Visualization

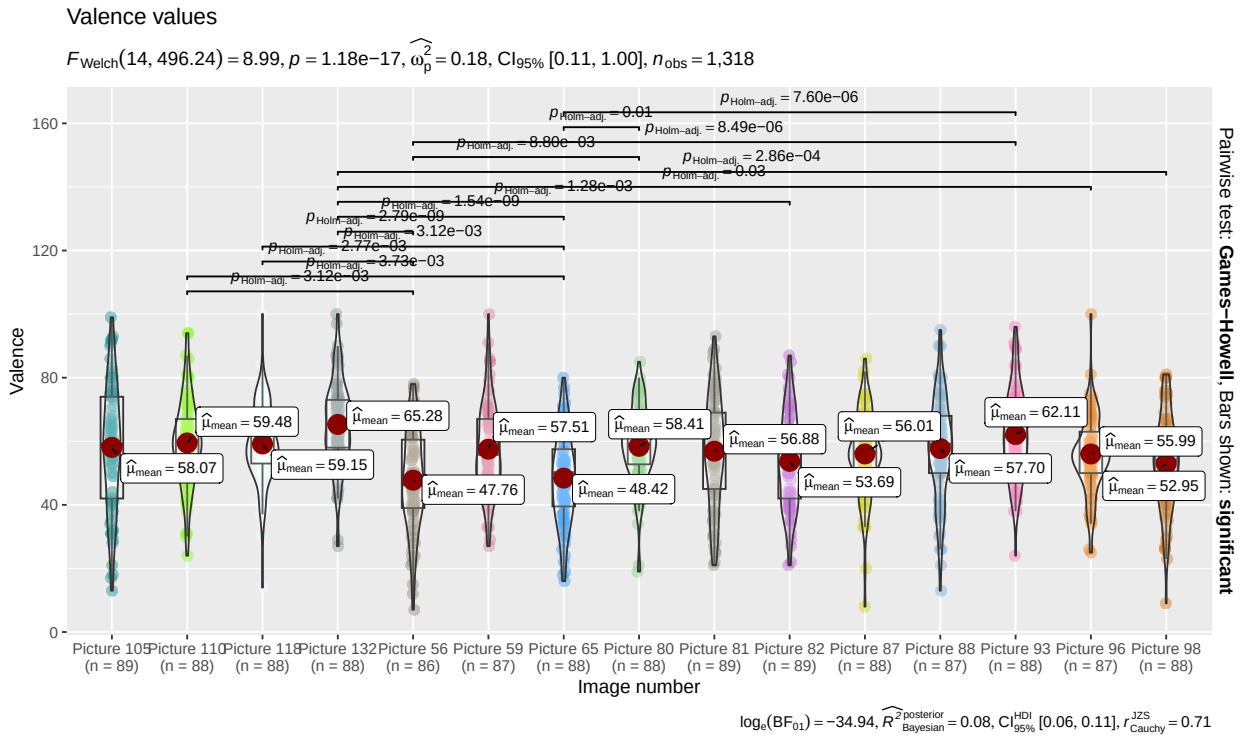
Pisces dataset - Arousal

1.2.4. Distributions

```
# Re-prep data
piscesDataClean = piscesData[c("ID","pic_name","valence")]
piscesDataClean$pic_name = as.factor(piscesDataClean$pic_name)
piscesDataClean$ID = as.factor(piscesDataClean$ID)
```

Visualizations

Pisces - Arousal



2.0. Radboud faces ## 2.1. Valence

```
##### Valence #####
radboudDataClean = radboudData[c("ID", "pic_name","valence")]
radboudDataClean$pic_name = as.factor(radboudDataClean$pic_name)
radboudDataClean = reshape(radboudDataClean, idvar = "ID", timevar = "pic_name", direction = "wide")
radboudDataCronbachs = radboudDataClean[ ,2:16]
```

2.1.1. Cronbach's Alpha

```
# Calculate Cronbach's alpha using alpha()
alphavar = psych::alpha(radboudDataCronbachs, check.keys = TRUE)
summary(alphavar)
```

```
##
## Reliability analysis
##  raw_alpha std.alpha G6(smc) average_r S/N   ase mean  sd median_r
##       0.89      0.89    0.91      0.36 8.3 0.017   51 8.6     0.35
```

2.1.2. CFA

```
names(radboudDataClean)[2:16] = c('Face_01', 'Face_36', 'Face_32', 'Face_61', 'Face_04', 'Face_24', 'Fa

HS.model <- 'radboud =~ Face_01 + Face_36 + Face_32 + Face_61 + Face_04 + Face_24 + Face_02 + Face_49 +
```

Fit and visualize

```
## lavaan 0.6-9 ended normally after 20 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of model parameters                        30
##
##                                                   Used       Total
##   Number of observations                            85          89
##
## Model Test User Model:
##
##   Test statistic                               174.182
##   Degrees of freedom                               90
##   P-value (Chi-square)                          0.000
##
## Model Test Baseline Model:
##
##   Test statistic                               571.377
##   Degrees of freedom                              105
##   P-value                                       0.000
##
## User Model versus Baseline Model:
##
##   Comparative Fit Index (CFI)                    0.819
##   Tucker-Lewis Index (TLI)                       0.789
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)              -4927.772
##   Loglikelihood unrestricted model (H1)      -4840.681
##
```

```
##   Akaike (AIC)                                9915.544
##   Bayesian (BIC)                              9988.824
##   Sample-size adjusted Bayesian (BIC)         9894.180
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.105
##   90 Percent confidence interval - lower         0.081
##   90 Percent confidence interval - upper         0.128
##   P-value RMSEA <= 0.05                          0.000
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.078
##
## Parameter Estimates:
##
##   Standard errors                             Standard
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   radboud =~
##     Face_01          7.066    1.485    4.757    0.000    7.066    0.505
##     Face_36          7.284    1.263    5.767    0.000    7.284    0.594
##     Face_32          8.577    1.308    6.556    0.000    8.577    0.658
##     Face_61          7.407    1.319    5.617    0.000    7.407    0.581
##     Face_04          8.736    1.527    5.723    0.000    8.736    0.590
##     Face_24          7.528    1.344    5.600    0.000    7.528    0.580
##     Face_02         10.139    1.364    7.433    0.000   10.139    0.723
##     Face_49          9.735    1.498    6.499    0.000    9.735    0.653
##     Face_58          8.523    1.404    6.070    0.000    8.523    0.619
##     Face_46          7.598    1.506    5.045    0.000    7.598    0.531
##     Face_05          7.625    1.377    5.537    0.000    7.625    0.575
##     Face_33          9.031    1.364    6.620    0.000    9.031    0.663
##     Face_57          6.207    1.432    4.334    0.000    6.207    0.466
##     Face_47          9.368    1.350    6.941    0.000    9.368    0.687
##     Face_27          7.324    1.228    5.962    0.000    7.324    0.610
##
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .Face_01        145.570   23.206    6.273    0.000  145.570    0.745
##    .Face_36         97.307   15.881    6.127    0.000   97.307    0.647
##    .Face_32         96.528   16.166    5.971    0.000   96.528    0.568
##    .Face_61        107.425   17.461    6.152    0.000  107.425    0.662
##    .Face_04        142.697   23.260    6.135    0.000  142.697    0.652
##    .Face_24        111.813   18.166    6.155    0.000  111.813    0.664
##    .Face_02         94.130   16.420    5.733    0.000   94.130    0.478
##    .Face_49        127.330   21.279    5.984    0.000  127.330    0.573
##    .Face_58        116.898   19.251    6.072    0.000  116.898    0.617
##    .Face_46        146.669   23.518    6.237    0.000  146.669    0.718
##    .Face_05        117.988   19.138    6.165    0.000  117.988    0.670
##    .Face_33        104.206   17.496    5.956    0.000  104.206    0.561
```

```
##     .Face_57          139.054    22.001     6.320     0.000   139.054     0.783
##     .Face_47           98.264    16.722     5.876     0.000    98.264     0.528
##     .Face_27           90.419    14.840     6.093     0.000    90.419     0.628
##      radboud            1.000                                  1.000     1.000
```

2.1.3. CFA Visualization

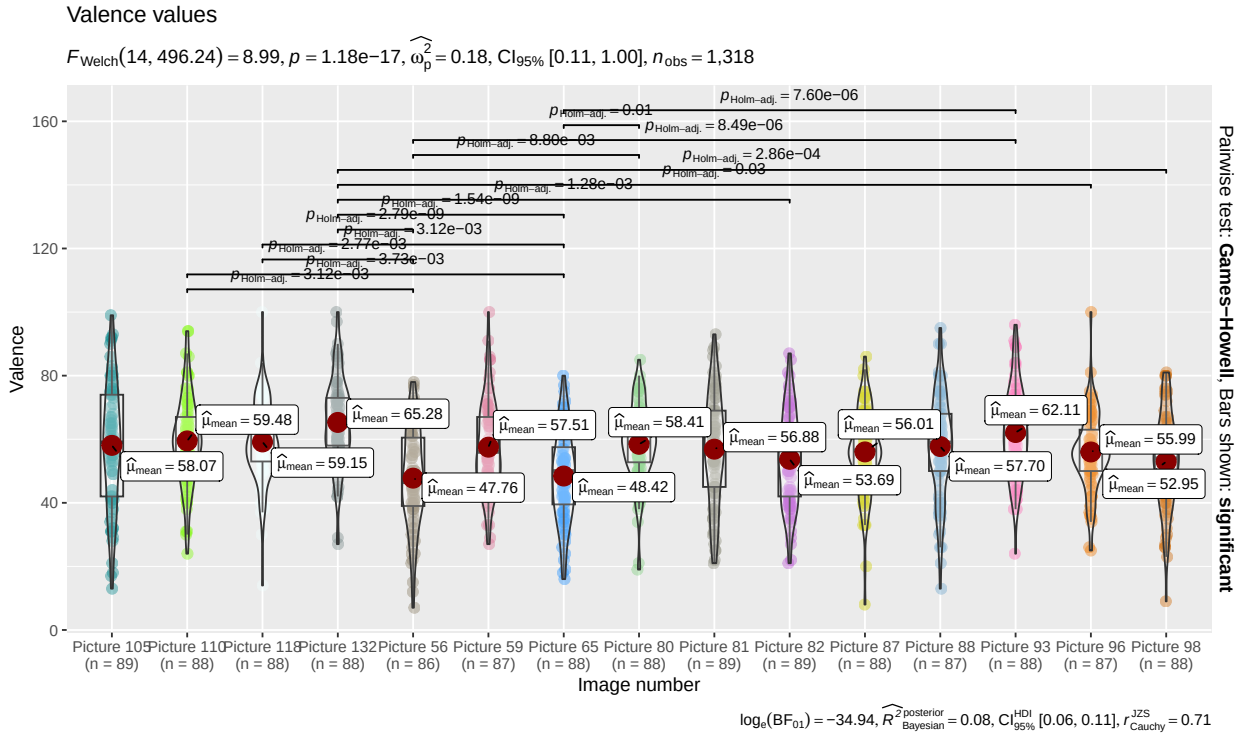
Radboud dataset - Valence

2.1.4. Distributions

```
# Re-prep data
piscesDataClean = piscesData[c("ID","pic_name","valence")]
piscesDataClean$pic_name = as.factor(piscesDataClean$pic_name)
piscesDataClean$ID = as.factor(piscesDataClean$ID)
```

Visualizations

Pisces - Valence



2.2. Arousal

```
##### Valence #####
radboudDataClean = radboudData[c("ID", "pic_name","arousal")]
radboudDataClean$pic_name = as.factor(radboudDataClean$pic_name)
radboudDataClean = reshape(radboudDataClean, idvar = "ID", timevar = "pic_name", direction = "wide")
radboudDataCronbachs = radboudDataClean[ ,2:16]
```

2.2.1. Cronbach's Alpha

```
# Calculate Cronbach's alpha using alpha()
alphavar = psych::alpha(radboudDataCronbachs, check.keys = TRUE)
summary(alphavar)
```

```
##
## Reliability analysis
##  raw_alpha std.alpha G6(smc) average_r S/N    ase mean sd median_r
##       0.95      0.95    0.96      0.57  20 0.0075   36 14     0.56
```

2.2.2. CFA

```
names(radboudDataClean)[2:16] = c('Face_01', 'Face_36', 'Face_32', 'Face_61', 'Face_04', 'Face_24', 'Fa

HS.model <- 'radboud =~ Face_01 + Face_36 + Face_32 + Face_61 + Face_04 + Face_24 + Face_02 + Face_49 +
```

Fit and visualize

```
## lavaan 0.6-9 ended normally after 17 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of model parameters                        30
##
##                                                   Used       Total
##   Number of observations                            85          89
##
## Model Test User Model:
##
##   Test statistic                               222.273
##   Degrees of freedom                               90
##   P-value (Chi-square)                          0.000
##
## Model Test Baseline Model:
##
##   Test statistic                              1087.748
##   Degrees of freedom                              105
##   P-value                                       0.000
##
## User Model versus Baseline Model:
##
##   Comparative Fit Index (CFI)                    0.865
##   Tucker-Lewis Index (TLI)                       0.843
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)              -5070.572
##   Loglikelihood unrestricted model (H1)      -4959.436
##
```

```
##   Akaike (AIC)                               10201.145
##   Bayesian (BIC)                             10274.424
##   Sample-size adjusted Bayesian (BIC)        10179.780
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.131
##   90 Percent confidence interval - lower         0.110
##   90 Percent confidence interval - upper         0.153
##   P-value RMSEA <= 0.05                          0.000
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.062
##
## Parameter Estimates:
##
##   Standard errors                             Standard
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   radboud =~
##     Face_01          13.568    1.776    7.640    0.000   13.568    0.723
##     Face_36          13.139    1.701    7.724    0.000   13.139    0.729
##     Face_32          14.518    1.659    8.753    0.000   14.518    0.796
##     Face_61          14.030    1.776    7.901    0.000   14.030    0.741
##     Face_04          13.858    1.790    7.743    0.000   13.858    0.730
##     Face_24          13.351    1.706    7.827    0.000   13.351    0.736
##     Face_02          13.987    1.668    8.387    0.000   13.987    0.773
##     Face_49          12.272    1.577    7.780    0.000   12.272    0.733
##     Face_58          13.383    1.589    8.420    0.000   13.383    0.775
##     Face_46          13.872    1.852    7.490    0.000   13.872    0.713
##     Face_05          13.171    1.561    8.435    0.000   13.171    0.776
##     Face_33          15.258    1.575    9.687    0.000   15.258    0.850
##     Face_57          13.971    1.773    7.882    0.000   13.971    0.740
##     Face_47          14.586    1.535    9.504    0.000   14.586    0.840
##     Face_27          14.357    1.677    8.559    0.000   14.357    0.784
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .Face_01         167.812   27.096    6.193    0.000  167.812    0.477
##    .Face_36         152.107   24.605    6.182    0.000  152.107    0.468
##    .Face_32         122.170   20.341    6.006    0.000  122.170    0.367
##    .Face_61         161.597   26.245    6.157    0.000  161.597    0.451
##    .Face_04         167.974   27.182    6.179    0.000  167.974    0.467
##    .Face_24         150.716   24.436    6.168    0.000  150.716    0.458
##    .Face_02         131.867   21.695    6.078    0.000  131.867    0.403
##    .Face_49         129.747   21.014    6.174    0.000  129.747    0.463
##    .Face_58         119.136   19.620    6.072    0.000  119.136    0.399
##    .Face_46         186.223   29.977    6.212    0.000  186.223    0.492
##    .Face_05         114.656   18.891    6.069    0.000  114.656    0.398
##    .Face_33          89.525   15.584    5.745    0.000   89.525    0.278
```

```
##     .Face_57          161.447   26.209     6.160     0.000   161.447     0.453
##     .Face_47           88.986   15.323     5.807     0.000    88.986     0.295
##     .Face_27          129.495   21.419     6.046     0.000   129.495     0.386
##      radboud            1.000                                 1.000     1.000
```

2.2.3. CFA Visualization

Radboud dataset - Arousal

2.2.4. Distributions

```
# Re-prep data
piscesDataClean = piscesData[c("ID","pic_name","valence")]
piscesDataClean$pic_name = as.factor(piscesDataClean$pic_name)
piscesDataClean$ID = as.factor(piscesDataClean$ID)
```

Visualizations

Pisces - Valence