Reanalysis of 24-Fujiwara

Audrey Yeo* Simon Schwab†

01/06/2020

Contents

Reference

Fujiwara, E. (2018). Looking at the eyes interferes with facial emotion recognition in alexithymia. Journal of Abnormal Psychology, 127(6), 571–577. https://doi.org/10.1037/abn0000361

Notes from reading methods section

This study assessed the two Alexithymic groups, high and low, with the individuals' ability to identify clear and ambiguous blends of emotions in faces and their underlying visual attention patterns. Using the Toronto Alexithymia Scale, students with high alexithymia (HA, n = 73) or low alexithymia (LA, n = 76) were enrolled in this study. * Dependant variable: deviance score * Independent variables: * 2 levels ambiguity (clear vs. ambiguous emotional blends in the target face) * 6 levels of emotion (anger, disgust, fear, happiness,

*University of Zurich, audrey.yeo@uzh.ch
†University of Zurich, simon.schwab@uzh.ch

sadness, surprise is dominant emotion) * 2 groups (HA, LA; high and low Alexithymia score) * Covariate: * DASS-21 (Depression, Anxiety and Stress total score) * Maybe log transformed response times were also used as covariate * Design: 2 (w) x 6 (w) x 2 (b) mixed ANCOVA (w within; b between)

Reading data

Data is loaded, reshaped into long form, and factors are specified.

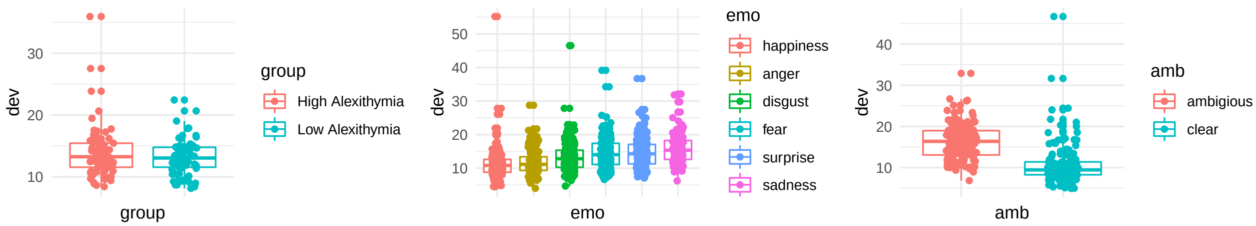
```
##        id            dev                  emo              amb          TAS_group
##  1      :  12   Min.   : 1.426   happiness:298   ambigious:894   Min.   :1.00
##  2      :  12   1st Qu.: 8.822   anger    :298   clear    :894   1st Qu.:1.00
##  3      :  12   Median :11.546   disgust  :298                   Median :1.00
##  4      :  12   Mean   :13.562   fear     :298                   Mean   :1.98
##  5      :  12   3rd Qu.:17.497   surprise :298                   3rd Qu.:3.00
##  6      :  12   Max.   :75.620   sadness  :298                   Max.   :3.00
##  (Other):1716
##     DASS_tot         log_lat                    group
##  Min.   :  2.00   Min.   :3.343   High Alexithymia:876
##  1st Qu.: 26.00   1st Qu.:3.626   Low Alexithymia :912
##  Median : 36.00   Median :3.735
##  Mean   : 44.95   Mean   :3.730
##  3rd Qu.: 62.00   3rd Qu.:3.845
##  Max.   :120.00   Max.   :4.143
##
```

Descriptives

Dependant variable

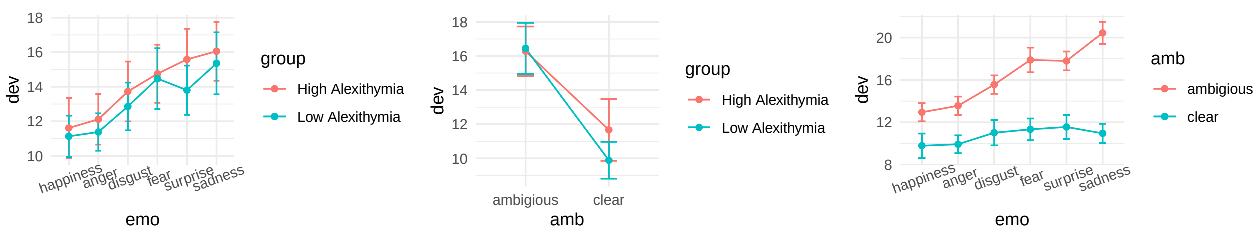
Number of samples and mean (SD) in levels of the independent variables. We reproduce Table 3 and Figure 2A of the study.

```
d.1 = aggregate(dev ~ DASS_tot + log_lat + id*group, data = data, FUN = mean)
d.2 = aggregate(dev ~ DASS_tot + log_lat + id*emo, data = data, FUN = mean)
d.3 = aggregate(dev ~ DASS_tot + log_lat + id*amb, data = data, FUN = mean)

p1 = ggplot(d.1, aes(y=dev, x=group, color=group)) +
  geom_boxplot() +
  geom_point(position = position_jitter(width = 0.15, height = 0)) +
  theme_minimal() + theme(axis.text.x = element_blank())

p2 = ggplot(d.2, aes(y=dev, x=emo, color=emo)) +
  geom_boxplot() +
  geom_point(position = position_jitter(width = 0.15, height = 0)) +
  theme_minimal() + theme(axis.text.x = element_blank())

p3 = ggplot(d.3, aes(y=dev, x=amb, color=amb)) +
  geom_boxplot() +
  geom_point(position = position_jitter(width = 0.15, height = 0)) +
 theme_minimal() + theme(axis.text.x = element_blank())

plot_grid(p1, p2, p3, nrow = 1, ncol = 3)
```



Averaging subjects across along the third factor to see the two-way interactions. Plots show means (95%-CI as error bar)

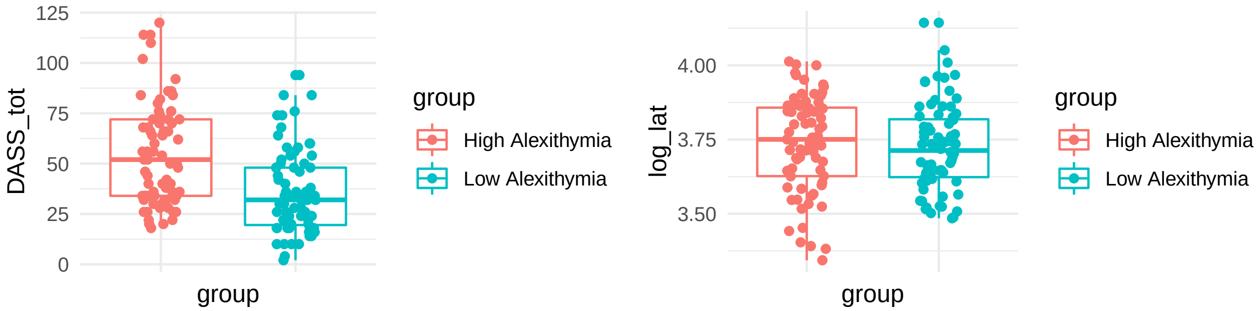
```
d.A = aggregate(dev ~ group*emo, data = data, FUN = mean)
d.B = aggregate(dev ~ group*amb, data = data, FUN = mean)
d.C = aggregate(dev ~ emo*amb, data = data, FUN = mean)

# get SD
d.A$sd = aggregate(dev ~ group*emo, data = data, FUN = sd)[,3]
d.A$se = d.A$sd/sqrt(rep(c(73, 76), 6))

d.B$sd = aggregate(dev ~ group*amb, data = data, FUN = sd)[,3]
d.B$se = d.B$sd/sqrt(rep(c(73, 76), 2))

d.C$sd = aggregate(dev ~ emo*amb, data = data, FUN = sd)[,3]
d.C$se = d.C$sd/sqrt(rep(N, 12))

pA = ggplot(d.A, aes(y=dev, x=emo, group=group, color=group)) +
  geom_errorbar(aes(ymin=dev-1.96*se, ymax=dev+1.96*se), width=.2) +
  geom_line() + geom_point() +
  theme_minimal() + theme(axis.text.x = element_text(angle = 20) )

pB = ggplot(d.B, aes(y=dev, x=amb, group=group, color=group)) +
  geom_errorbar(aes(ymin=dev-1.96*se, ymax=dev+1.96*se), width=.2) +
  geom_line() + geom_point() +
  theme_minimal()

pC = ggplot(d.C, aes(y=dev, x=emo, group=amb, color=amb)) +
  geom_errorbar(aes(ymin=dev-1.96*se, ymax=dev+1.96*se), width=.2) +
  geom_line() + geom_point() +
  theme_minimal() + theme(axis.text.x = element_text(angle = 20))

plot_grid(pA, pB, pC, nrow = 1, ncol = 3)
```



Covariate(s)

The two covariates are DASS_tot scores and log of time.

```r
p1 = ggplot(d.1, aes(y=DASS_tot, x=group, color=group)) +
  geom_boxplot() +
  geom_point(position = position_jitter(width = 0.15, height = 0)) +
 theme_minimal() + theme(axis.text.x = element_blank())

p2 = ggplot(d.1, aes(y=log_lat, x=group, color=group)) +
  geom_boxplot() +
  geom_point(position = position_jitter(width = 0.15, height = 0)) +
 theme_minimal() + theme(axis.text.x = element_blank())

plot_grid(p1, p2, nrow = 1, ncol = 2)
```



Main analysis ANCOVA

Independent variable: TAS_group (Between Group)

```r
# Orthogonal contrasts
contrasts(data$group) = contr.helmert(2)
contrasts(data$amb) = contr.helmert(2)
contrasts(data$emo) = contr.helmert(6)

fit.ancova = aov(dev ~ log_lat + DASS_tot + (group*emo*amb) + Error(id/(emo*amb)) + group,
                 data = data)
result = summary(fit.ancova) # Type I
print(result)
```

```
##
## Error: id
##            Df Sum Sq Mean Sq F value Pr(>F)
## log_lat     1      2     1.5   0.010 0.9201
## DASS_tot    1    437   437.0   2.852 0.0934 .
## group       1     94    93.9   0.613 0.4349
## Residuals 145  22213   153.2
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Error: id:emo
##            Df Sum Sq Mean Sq F value Pr(>F)
## emo         5   4506   901.3  45.282 <2e-16 ***
## group:emo   5    101    20.3   1.019  0.405
## Residuals 735  14629    19.9
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Error: id:amb
##             Df Sum Sq Mean Sq F value Pr(>F)
## amb          1  14048   14048 130.571 <2e-16 ***
## group:amb    1    424     424   3.936 0.0491 *
## Residuals 147  15816     108
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Error: id:emo:amb
##                 Df Sum Sq Mean Sq F value Pr(>F)
## emo:amb          5   2042   408.3  18.863 <2e-16 ***
## group:emo:amb    5     29     5.7   0.265  0.932
## Residuals      735  15911    21.6
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
fit2.ancova = ezANOVA(dv = .(dev), wid = .(id), between = .(group), within = .(emo, amb),
                      within_covariates = .(DASS_tot, log_lat), type=3, detailed=TRUE,  data = data)
```

```
## Warning: Data is unbalanced (unequal N per group). Make sure you specified a
## well-considered value for the type argument to ezANOVA().

## Warning: Implementation of ANCOVA in this version of ez is experimental and
## not yet fully validated. Also, note that ANCOVA is intended purely as a tool
## to increase statistical power; ANCOVA can not eliminate confounds in the data.
## Specifically, covariates should: (1) be uncorrelated with other predictors and
## (2) should have effects on the DV that are independent of other predictors.
## Failure to meet these conditions may dramatically increase the rate of false-
## positives.

## Warning: Covariate"DASS_tot" is numeric and will therefore be fit to a linear
## effect.

## Warning: Covariate"log_lat" is numeric and will therefore be fit to a linear
## effect.
```

```
print(fit2.ancova)
```

```
## $ANOVA
##          Effect DFn DFd          SSn      SSd           F            p p<.05
## 1   (Intercept)   1 147 329109.61359 22453.25 2154.659410 1.045880e-89     *
## 2         group   1 147    291.72820 22453.25    1.909926 1.690680e-01
## 3           emo   5 735   4511.33271 14629.06   45.332085 7.777113e-41     *
## 5           amb   1 147  13944.48409 15815.77  129.607304 6.306088e-22     *
## 4     group:emo   5 735    101.37071 14629.06    1.018623 4.054881e-01
## 6     group:amb   1 147    423.50614 15815.77    3.936287 4.911711e-02     *
## 7       emo:amb   5 735   2035.47814 15910.78   18.805826 1.283640e-17     *
## 8 group:emo:amb   5 735     28.65974 15910.78    0.264788 9.322917e-01
##           ges
## 1 0.827077994
## 2 0.004221790
## 3 0.061529198
## 5 0.168506591
## 4 0.001471055
## 6 0.006117170
```

```
## 7 0.028731698
## 8 0.000416339
##
## $`Mauchly's Test for Sphericity`
##          Effect         W            p p<.05
## 3           emo 0.8032470 4.294652e-03     *
## 4     group:emo 0.8032470 4.294652e-03     *
## 7       emo:amb 0.5848216 7.154692e-11     *
## 8 group:emo:amb 0.5848216 7.154692e-11     *
##
## $`Sphericity Corrections`
##          Effect       GGe        p[GG] p[GG]<.05       HFe        p[HF]
## 3           emo 0.9180654 1.042569e-37         * 0.9512955 5.618448e-39
## 4     group:emo 0.9180654 4.023647e-01           0.9512955 4.036846e-01
## 7       emo:amb 0.8399564 3.577157e-15         * 0.8677406 1.344884e-15
## 8 group:emo:amb 0.8399564 9.080457e-01           0.8677406 9.128726e-01
##   p[HF]<.05
## 3         *
## 4
## 7         *
## 8
```

Comparing ANCOVA in original study with reanalysis

Independant variable

Main effect ambiguity

```
tab.IV = rbind(stats.orig.IV.amb, stats.rep.IV.amb, stats.rep2.IV.amb)
rownames(tab.IV) = c("original Study", "reanalysis type I SS", "reanalysis type II SS")
print(t(tab.IV))
```

```
##        original Study reanalysis type I SS reanalysis type II SS
## Fvalue "4.67"         "130.57"             "129.61"
## df1    "1"            "1"                  "1"
## df2    "145"          "147"                "147"
## pvalue "0.03"         "< 0.0001"           "< 0.0001"
```

Interaction ambiguity x emotion

```
tab.IV = rbind(stats.orig.IV.emoXamb, stats.rep.IV.emoXamb, stats.rep2.IV.emoXamb)
rownames(tab.IV) = c("original Study", "reanalysis type I SS", "reanalysis type II SS")
print(t(tab.IV))
```

```
##        original Study reanalysis type I SS reanalysis type II SS
## Fvalue "2.61"         "18.86"              "18.81"
## df1    "4.21"         "5.00"               "5.00"
## df2    "610.65"       "735.00"             "735.00"
## pvalue "0.03"         "< 0.0001"           "< 0.0001"
```

Assumptions

1. Homogeneity of variance

- ANOVA/ANCOVA is fairly robust in terms of the error rate when sample sizes are equal.
- When groups with larger sample sizes have larger variances than the groups with smaller sample sizes, the resulting F-ratio tends to be conservative. That is, it's more likely to produce a non-significant result when a genuine difference does exist in the population.
- Conversely, when the groups with larger sample sizes have smaller variances than the groups with smaller samples sizes, the resulting F-ratio tends to be liberal and can inflate the false positive rate.

```
tapply(d.1$dev, d.1$group, sd)
```

```
## High Alexithymia  Low Alexithymia
##         4.218945         2.803665
```

```
leveneTest(dev ~ group, data = d.1)
```

```
## Levene's Test for Homogeneity of Variance (center = median)
##        Df F value Pr(>F)
## group   1  1.5935 0.2088
##       147
```

2. Independence between covariate and IV.

When the covariate and the experimental effect (independent variable) are not independent the treatment effect is obscured, spurious treatment effects can arise and the interpretation of the ANCOVA is seriously compromised.

We test whether our groups differ on the CV. If the groups do not significantly differ then is appropriate to use the covariate.

```
fit.cv1 = aov(DASS_tot ~ group, data = d.1)
summary(fit.cv1)
```

```
##              Df Sum Sq Mean Sq F value   Pr(>F)
## group         1  14094   14094   27.13 6.31e-07 ***
## Residuals   147  76366     519
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
fit.cv2 = aov(log_lat ~ group, data = d.1)
summary(fit.cv2)
```

```
##              Df Sum Sq  Mean Sq F value Pr(>F)
## group         1  0.007 0.007117   0.303  0.583
## Residuals   147  3.454 0.023496
```

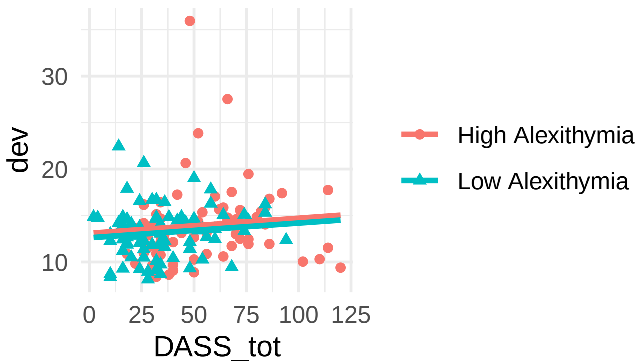
3. Homogeneity of regression slopes

```
fit.hrs = aov(dev ~ DASS_tot*group, data = d.1)
Anova(fit.hrs, type = "III")
```

```
## Anova Table (Type III tests)
##
```

```
## Response: dev
##                  Sum Sq  Df  F value Pr(>F)
## (Intercept)    2149.18   1 168.3272 <2e-16 ***
## DASS_tot         12.05   1   0.9438 0.3329
## group             1.71   1   0.1339 0.7149
## DASS_tot:group    0.00   1   0.0002 0.9881
## Residuals      1851.34 145
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

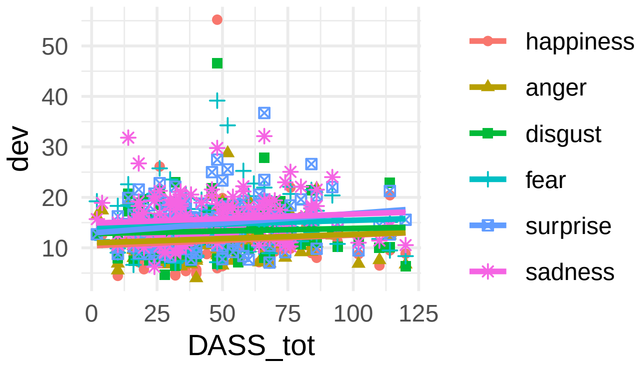
```
ggplot(d.1, aes(y=dev, x=DASS_tot, color=group, shape=group)) +
  geom_point() +
  geom_smooth(formula = y ~ x,method=lm, se=FALSE, fullrange=TRUE) +
  theme_minimal() +
  theme(legend.title = element_blank())
```




```
fit.hrs = aov(dev ~ DASS_tot*emo + Error(id/emo), data = d.2)
summary(fit.hrs)
```

```
##
## Error: id
##            Df Sum Sq Mean Sq F value Pr(>F)
## DASS_tot    1    218  218.20   2.876 0.0921 .
## Residuals 147  11154   75.88
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Error: id:emo
##               Df Sum Sq Mean Sq F value Pr(>F)
## emo            5   2253   450.6  45.235 <2e-16 ***
## DASS_tot:emo   5     43     8.6   0.864  0.505
## Residuals    735   7322    10.0
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

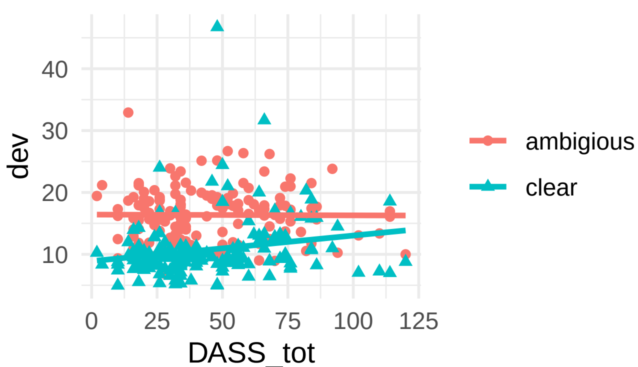
```
ggplot(d.2, aes(y=dev, x=DASS_tot, color=emo, shape=emo)) +
  geom_point() +
  geom_smooth(formula = y ~ x,method=lm, se=FALSE, fullrange=TRUE) +
  theme_minimal() +
  theme(legend.title = element_blank())
```




```
fit.hrs = aov(dev ~ DASS_tot*amb + Error(id/amb), data = d.3)
summary(fit.hrs)
```

```
##
## Error: id
##              Df Sum Sq Mean Sq F value Pr(>F)
## DASS_tot      1     73   72.73   2.876 0.0921 .
## Residuals 147   3718   25.29
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Error: id:amb
##                 Df Sum Sq Mean Sq F value Pr(>F)
## amb              1 2341.4  2341.4 131.132 <2e-16 ***
## DASS_tot:amb     1   81.8    81.8   4.584 0.0339 *
## Residuals      147 2624.7    17.9
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
ggplot(d.3, aes(y=dev, x=DASS_tot, color=amb, shape=amb)) +
  geom_point() +
  geom_smooth(formula = y ~ x,method=lm, se=FALSE, fullrange=TRUE) +
  theme_minimal() +
  theme(legend.title = element_blank())
```



Notes

- Log transform of outcome could have been considered.
- Not all main effects and interactions were reported.

- Could not numerically reproduce the two reported results, but conclusions remain the same.
- Homogeneity of variances was met for groups.
- Independence between covariate DASS_tot and the IV group was not met.
- Homogeneity of regression slopes was met for group and emotion, but not across levels of ambiguity.

Data was analyzed according to recommendations by Field, Miles, & Field (2012).