Feelings_initial

2025-04-13

```
feelings_initial <- load("feelings_initial.RData")
ls()
```

```
## [1] "dat"              "feelings_initial" "Iaro_wide"        "Ineg_wide"
## [5] "Ipos_wide"
```

```
summary(feelings_initial)
```

```
##    Length     Class      Mode
##         4 character character
```

```
str(dat)
```

```
## 'data.frame':    16380 obs. of  9 variables:
##  $ subj     : Factor w/ 156 levels "f001","f002",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ trial.num: int  1 2 3 4 5 6 7 8 9 10 ...
##  $ trial.val: Factor w/ 3 levels "neg","neu","pos": 3 1 1 3 3 2 2 1 1 3 ...
##  $ sex      : Factor w/ 3 levels "male","female",..: 2 2 2 2 2 2 2 2 2 2 ...
##  $ age      : int  19 19 19 19 19 19 19 19 19 19 ...
##  $ ethn     : Factor w/ 7 levels "Asian or Pacific Islander",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ Ineg     : num  1 4 2 1 1 1 1 3 5 1 ...
##  $ Ipos     : num  3.69 1 1 1 4 ...
##  $ Iaro     : num  2.86 3 2 2 3 ...
```

```
head(Iaro_wide)
```

```
##   subj        1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
## 1 f001 2.857143 3 2 2 3 1 1 2 5  2  2  2  6  3  4  3  1  5  4  4  4  3  3  4  2
## 2 f002 4.000000 2 1 4 2 4 1 3 5  4  4  4  4  4  4  3  1  2  3  5  2  3  2  2  3
## 3 f003 5.000000 3 1 3 4 6 4 4 4  3  1  5  2  3  3  2  3  2  1  4  3  1  1  4  5
## 4 f004 2.000000 2 2 3 2 2 1 2 2  2  3  2  2  3  1  2  3  3  2  2  2  2  2  2  2
## 5 f005 3.000000 1 3 6 5 7 5 4 5  2  5  4  1  7  1  4  6  5  2  4  7  2  4  5  8
## 6 f006 2.000000 2 1 2 1 1 2 2 1  3  1  2  1  2  3  3  3  1  1  2  2  1  1  2  2
##   26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45       46 47 48 49
## 1  5  2  1  6  3  3  3  2  2  3  5  2  2  5  1  5  3  4  5  1 3.000000  3  1  5
## 2  5  4  1  5  3  4  2  1  4  4  1  3  4  3  5  6  4  3  1  4 3.000000  3  3  3
## 3  3  2  1  4  3  2  1  3  5  3  5  5  2  3  3  4  1  2  1  5 2.000000  3  3  3
## 4  3  3  2  3  2  2  2  3  3  3  2  3  3  2  3  2  3  2  3  3 2.000000  2  2  2
## 5  6  4  7  1  8  7  6  8  1  9  3  3  7  7  5  5  1  5  4  7 5.857143  1  7  7
## 6  2  2  1  1  2  1  1  1  2  2  1  1  2  2  1  1  1  1  2  1 1.000000  1  2  1
##   50 51 52 53 54 55       56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73
## 1  3  4  3  1  4  4 3.000000  1  1  4  2  3  5  4  2  3  2  5  4  2  2  2  3  3
```

```
## 2  2  2  1  2  5  4 5.000000  1  2  3  2  4  3  5  3  3  3  1  4  3  1  2  2  4
## 3  1  2  3  5  3  3 3.071429  1  6  6  4  2  3  3  2  2  3  3  3  7  3  1  3  2
## 4  3  3  2  2  3  1 2.000000  2  2  2  3  1  3  3  3  2  1  3  2  2  2  3  2  3
## 5  3  8  1  9  7  6 3.000000  6  7  5  3  1  5  5  4  4  7  8  7  5  8  5  1  5
## 6  1  1  1  2  1  1 1.000000  1  1  1  1  1  3  5  3  1  1  1  3  1  1  1  2  2
##   74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99
## 1  3  2  3  3  1  2  5  2  3  3  1  1  2  5  1  3  2  5  5  1  4  4  4  4  2  4
## 2  2  3  5  3  4  4  3  3  5  3  1  4  4  4  4  2  5  5  5  5  3  1  3  3  4  3
## 3  2  3  1  4  2  4  2  3  5  2  4  1  2  1  2  2  4  2  3  2  3  3  2  3  1  2
## 4  4  3  2  3  4  2  2  3  3  5  2  2  2  3  2  1  2  2  3  2  2  2  2  2  4  2
## 5  2  4  5  6  8  7  4  6  8  5  1  7  4  3  5  1  7  5  7  7  6  5  6  8  7  1
## 6  2  1  1  1  1  1  3  1  1  3  1  2  2  1  1  2  1  3  1  3  1  1  1  1  1  1
##   100 101 102 103 104 105
## 1   4   3   3   5   3   3
## 2   2   2   5   5   2   3
## 3   3   1   5   3   7   2
## 4   3   3   2   1   3   3
## 5   1   7   4   6   5   3
## 6   1   1   1   1   1   1
```

```
head(Ineg_wide)
```

```
##   subj 1 2 3 4        5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
## 1 f001 1 4 2 1 1.000000 1 1 3 5  1  3  1  6  3  1  1  1  5  1  4  4  4  1  1  1
## 2 f002 5 1 1 1 4.000000 5 1 5 1  1  5  4  1  1  1  1  1  1  1  1  4  4  4  1  5
## 3 f003 4 4 2 4 6.000000 1 1 1 1  4  1  9  1  3  1  4  2  1  1  1  4  1  3  7  1
## 4 f004 1 3 1 3 1.000000 1 2 3 1  1  2  1  1  4  1  1  2  3  4  2  3  3  1  1  2
## 5 f005 6 1 2 7 7.285714 6 5 1 1  1  5  2  1  1  1  1  1  7  2  3  3  1  4  1  9
## 6 f006 1 3 1 1 1.000000 2 4 1 3  6  1  1  1  1  9  4  4  1  1  1  5  3  1  1  4
##   26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51
## 1  4  1  1  5  4  3  3  1  1  1  5  1  1  4  1  1  3  1  5  1  1  3  1  5  1  1
## 2  5  5  1  1  3  5  1  1  5  1  1  1  1  1  1  6  5  1  2  3  1  1  4  1  3  1
## 3  3  3  3  7  2  1  1  1  9  5  1  2  1  6  1  1  2  4  1  9  3  2  2  5  1  4
## 4  4  3  1  2  1  3  2  1  5  2  1  4  1  1  1  1  5  1  5  6  1  1  2  3  4  1
## 5  1  6  8  1  8  1  7  7  1  8  4  1  1  7  4  1  1  1  5  3  3  1  6  1  2  9
## 6  4  1  1  3  1  1  1  1  6  1  1  1  1  5  2  3  1  1  1  2  1  3  4  1  2  3
##   52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77
## 1  1  1  4  3  4  1  1  3  1  1  4  3  1  3  1  1  3  1  1  1  1  3  4  1  4  3
## 2  1  4  5  1  5  2  1  1  1  1  4  5  4  1  1  1  1  1  1  1  4  1  3  3  1  1
## 3  3  6  5  1  1  1  9  1  5  5  5  7  4  5  1  1  2  1  4  1  1  1  6  5  1  6
## 4  1  2  3  1  2  3  1  1  5  1  3  2  3  1  1  5  1  2  3  5  1  1  1  1  1  4
## 5  1  9  9  1  1  1  7  6  3  1  4  7  3  1  7  1  8  1  1  2  1  5  1  6  5  1
## 6  1  1  1  1  2  1  1  3  1  5  6  9  7  1  1  1  7  1  1  1  3  3  1  1  1  1
##   78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102
## 1  1  1  4  2  3  1  1  1  1  4  1  1  1  1  5  1  1  3  3  1  1  3   1   3   1
## 2  1  1  3  3  5  4  1  1  5  1  6  1  7  5  6  1  3  1  3  1  1  1   3   1   5
## 3  1  8  1  5  1  4  1  3  2  3  1  4  1  2  1  3  1  1  1  1  2  3   5   1   1
## 4  6  1  1  1  4  8  2  1  1  3  3  1  1  1  4  4  2  1  4  1  6  1   1   4   1
## 5  1  8  6  2  1  1  1  2  1  6  1  1  9  1  2  2  1  1  7  9  2  1   1   7   7
## 6  1  1  4  1  1  3  2  4  3  2  2  5  1  4  1  4  3  1  1  1  3  2   1   1   1
##   103 104 105
## 1   5   3   1
## 2   1   1   1
## 3   4   9   1
```

```
## 4   1   1   4
## 5   1   7   4
## 6   1   4   1
```

```
head(Ipos_wide)
```

```
##   subj        1 2 3 4 5 6 7 8 9 10 11 12 13 14       15 16 17 18 19 20 21 22 23
## 1 f001 3.692308 1 1 1 4 1 1 1 1  3  1  1  1  1 3.083333  4  1  1  5  1  1  1  4
## 2 f002 1.000000 2 1 5 1 1 1 1 5  5  1  1  5  5 6.000000  5  5  1  5  6  1  1  2
## 3 f003 3.000000 2 4 1 1 7 6 9 6  1  3  1  5  3 6.000000  4  4  7  1  6  1  4  3
## 4 f004 1.000000 1 2 1 3 3 2 1 3  3  1  3  2  1 1.000000  3  1  1  1  3  1  1  2
## 5 f005 1.000000 1 5 1 1 1 1 7 6  3  1  6  1  9 1.000000  7  7  1  3  1  6  3  1
## 6 f006 3.285714 1 3 5 1 1 1 5 1  1  4  5  1  5 1.000000  2  1  3  3  4  1  1  1
##   24 25 26       27 28 29 30 31 32 33       34 35 36 37 38 39 40 41 42 43 44 45
## 1  5  2  1 3.083333  1  1  2  1  1  3 3.692308  4  1  3  3  1  1  4  1  5  1  1
## 2  3  1  1 1.000000  1  3  1  1  4  1 1.000000  4  1  5  6  4  6  1  1  4  1  1
## 3  1  9  2 4.000000  1  1  6  6  1  7 1.000000  1  8  7  6  1  8  7  1  1  5  1
## 4  4  2  1 3.000000  3  1  2  2  2  4 1.000000  5  2  1  4  3  4  2  1  2  1  1
## 5  6  1  7 1.000000  1  1  1  8  1  1 1.000000  1  1  4  6  1  1  5  1  8  1  6
## 6  5  1  1 6.000000  3  2  6  5  3  1 1.000000  5  3  1  6  1  1  1  4  1  4  3
##   46 47 48 49 50 51 52 53       54 55 56 57 58 59 60 61       62 63 64 65 66 67
## 1  4  1  2  1  4  5  4  1 1.000000  1  1  2  1  1  1  3 1.000000  1  1  1  1  5
## 2  5  6  1  6  1  5  1  1 1.000000  6  1  1  3  1  5  6 1.000000  1  1  1  4  1
## 3  1  5  6  1  3  1  3  1 1.000000  7  9  5  1  7  1  1 1.285714  1  2  1  6  6
## 4  3  3  3  1  2  5  2  1 1.000000  1  1  1  2  5  1  2 1.000000  3  1  2  1  1
## 5  8  1  1  7  4  1  1  1 6.571429  7  6  8  1  2  1  1 1.000000  1  1  6  1  7
## 6  1  1  1  2  3  1  5  3 1.000000  6  1  2  4  1  3  1 1.000000  1  1  1  3  3
##   68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87       88 89 90 91
## 1  1  2  1  1  3  1  1  3  1  1  1  2  1  1  1  4  1  1  3  1 1.000000  3  2  5
## 2  5  4  1  4  1  6  1  1  5  5  5  6  1  1  1  1  1  4  1  7 1.000000  1  1  1
## 3  8  9  1  2  5  5  1  3  1  1  6  1  5  1  9  1  8  1  6  3 5.000000  1  7  4
## 4  3  1  1  1  3  4  6  4  4  1  1  3  3  4  1  1  1  1  3  1 1.000000  2  3  3
## 5  1  8  7  6  1  1  4  1  1  7  9  1  1  7  9  7  1  7  3  2 8.000000  1  1  6
## 6  1  5  5  1  1  1  3  3  2  1  4  2  1  2  1  1  1  1  1  1 3.571429  1  2  1
##   92 93 94 95 96 97       98 99 100 101 102 103 104      105
## 1  1  1  4  1  1  5 3.083333  1   5   1   3   1   1 3.000000
## 2  1  6  1  1  1  1 7.000000  5   1   3   1   6   4 6.000000
## 3  7  2  7  6  4  6 2.000000  2   2   1   8   1   1 1.928571
## 4  1  1  3  3  1  3 1.000000  3   4   1   3   1   3 1.000000
## 5  7  6  4  6  1  1 8.000000  1   1   1   2   8   1 1.000000
## 6  2  1  1  1  2  2 2.000000  1   1   2   2   3   1 3.000000
```

Descriptive statistics

```
summary(dat[, c("Ineg", "Ipos", "Iaro")])
```

```
##       Ineg            Ipos            Iaro
##  Min.   :1.000   Min.   :1.000   Min.   :1.000
##  1st Qu.:1.000   1st Qu.:1.000   1st Qu.:1.000
##  Median :2.000   Median :2.000   Median :3.000
##  Mean   :3.075   Mean   :3.066   Mean   :3.265
```

```
##  3rd Qu.:5.000   3rd Qu.:5.000   3rd Qu.:5.000
##  Max.   :9.000   Max.   :9.000   Max.   :9.000
```

```
# identify NAs
colSums(is.na(dat))
```

```
##      subj trial.num trial.val       sex       age      ethn      Ineg      Ipos
##         0         0         0         0         0         0         0         0
##      Iaro
##         0
```

There are no NAs in the dataset.

```
# identify outliers using z-score

# Calculate Z-scores for Ineg, Ipos, and Iaro
dat$z_Ineg <- scale(dat$Ineg)
dat$z_Ipos <- scale(dat$Ipos)
dat$z_Iaro <- scale(dat$Iaro)

# Identify outliers (Z-score > 3 or < -3)
outliers_Ineg <- dat[abs(dat$z_Ineg) > 3, ]
outliers_Ineg
```

```
##  [1] subj      trial.num trial.val sex       age       ethn      Ineg
##  [8] Ipos      Iaro      z_Ineg    z_Ipos    z_Iaro
## <0 rows> (or 0-length row.names)
```

```
outliers_Ipos <- dat[abs(dat$z_Ipos) > 3, ]
outliers_Ipos
```

```
##  [1] subj      trial.num trial.val sex       age       ethn      Ineg
##  [8] Ipos      Iaro      z_Ineg    z_Ipos    z_Iaro
## <0 rows> (or 0-length row.names)
```

```
outliers_Iaro <- dat[abs(dat$z_Iaro) > 3, ]
outliers_Iaro
```

```
##  [1] subj      trial.num trial.val sex       age       ethn      Ineg
##  [8] Ipos      Iaro      z_Ineg    z_Ipos    z_Iaro
## <0 rows> (or 0-length row.names)
```

There are no outliers.

Mixed-effects model: analyze data with repeated measures

- Each participant has multiple trials, so the trials within a participant are likely correlated
- Data is nested
- Each participant may have their own baseline level of emotional responses

- fixed effects (trial.val, sex, age, ethn) explain the variation between individuals
- random effects (1|subj) explain the correlation of repeated measures within individuals

```
library(lme4)
```

```
## Loading required package: Matrix
```

```
# Mixed-effects model for predicting Ineg
model_ineg <- lmer(Ineg ~ trial.val + sex + age + ethn + (1|subj), data = dat)
summary(model_ineg)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: Ineg ~ trial.val + sex + age + ethn + (1 | subj)
##    Data: dat
##
## REML criterion at convergence: 58969.5
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.9915 -0.5714 -0.0487  0.5031  5.6660
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  subj     (Intercept) 0.5259   0.7252
##  Residual             2.0745   1.4403
## Number of obs: 16380, groups:  subj, 156
##
## Fixed effects:
##                                                    Estimate Std. Error
## (Intercept)                                        5.218934   0.443816
## trial.valneu                                      -4.076439   0.034381
## trial.valpos                                      -4.086175   0.024311
## sexfemale                                          0.317543   0.121858
## sexother                                          -0.031652   0.747300
## age                                                0.001809   0.021086
## ethnBlack/African American                        -0.060943   0.237892
## ethnLatino/Hispanic                               -0.317652   0.232008
## ethnOther                                          0.138570   0.290750
## ethnWhite/Caucasian                                0.070420   0.155354
## ethnAmerican Indian/Native American or Alaskan Native -0.692261   0.393608
## ethnDecline to state                              -0.275510   0.543413
##                                                    t value
## (Intercept)                                         11.759
## trial.valneu                                      -118.566
## trial.valpos                                      -168.079
## sexfemale                                            2.606
## sexother                                            -0.042
## age                                                  0.086
## ethnBlack/African American                          -0.256
## ethnLatino/Hispanic                                 -1.369
## ethnOther                                            0.477
## ethnWhite/Caucasian                                  0.453
```

```
## ethnAmerican Indian/Native American or Alaskan Native   -1.759
## ethnDecline to state                                     -0.507
##
## Correlation of Fixed Effects:
##             (Intr) trl.vln trl.vlp sexfml sexthr age    etB/AA ethL/H ethnOt
## trial.valne -0.019
## trial.valps -0.027  0.354
## sexfemale   -0.197  0.000   0.000
## sexother    -0.070  0.000   0.000   0.084
## age         -0.941  0.000   0.000   0.021  0.059
## ethnBlck/AA -0.026  0.000   0.000   0.072 -0.002 -0.149
## ethnLtn/Hsp  0.065  0.000   0.000   0.072 -0.008 -0.250  0.334
## ethnOther   -0.081  0.000   0.000  -0.044 -0.006 -0.038  0.234  0.244
## ethnWht/Ccs -0.091  0.000   0.000   0.107 -0.062 -0.171  0.468  0.496  0.357
## ethAI/NAoAN -0.141  0.000   0.000   0.123  0.012  0.029  0.176  0.178  0.134
## ethnDclntst -0.067  0.000   0.000   0.144  0.010 -0.027  0.139  0.145  0.096
##             ethW/C eIAoAN
## trial.valne
## trial.valps
## sexfemale
## sexother
## age
## ethnBlck/AA
## ethnLtn/Hsp
## ethnOther
## ethnWht/Ccs
## ethAI/NAoAN  0.271
## ethnDclntst  0.211  0.092
```

- Random effects: each participant has a different baseline emotional response
  - `(1|subj)`: represents the random effect
    - each participant (subj) has a different baseline deviation (intercept).
    - This accounts for the correlation between multiple trial results from the same participant
- `REML score` (residual maximum likelihood estimate): assess the model fit
- Fixed Effects:
  - Intercept: Negative trial
  - `trial.valneu` (Neutral trial): Estimate = -4.08, t = -118.57, a very significant negative value.
    - Compared to the baseline (negative trial), the neutral trial significantly decreases negative emotions (Ineg)
  - `trial.valpos` (Positive trial): Estimate = -4.09, t = -168.08, also significant.
    - the positive trial also significantly decreases negative emotions compared to the negative trial
  - sexfemale: Estimate = 0.317543, t = 2.606.
    - Females have significantly higher negative emotional responses (Ineg) compared to males
  - The effects of age and ethnicity are small and not significant

```r
# Mixed-effects model for predicting Ipos
model_ipos <- lmer(Ipos ~ trial.val + sex + age + ethn + (1|subj), data = dat)
summary(model_ipos)
```

```
## Linear mixed model fit by REML ['lmerMod']
```

```
## Formula: Ipos ~ trial.val + sex + age + ethn + (1 | subj)
##    Data: dat
##
## REML criterion at convergence: 60034.7
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.8302 -0.5834 -0.0294  0.5335  5.4659
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  subj     (Intercept) 0.5687   0.7541
##  Residual             2.2138   1.4879
## Number of obs: 16380, groups:  subj, 156
##
## Fixed effects:
##                                                          Estimate Std. Error
## (Intercept)                                               0.71768    0.46141
## trial.valneu                                              0.33658    0.03552
## trial.valpos                                              4.03432    0.02511
## sexfemale                                                 0.20020    0.12669
## sexother                                                 -1.13135    0.77693
## age                                                       0.02213    0.02192
## ethnBlack/African American                                0.08731    0.24732
## ethnLatino/Hispanic                                      -0.33718    0.24121
## ethnOther                                                -0.01740    0.30228
## ethnWhite/Caucasian                                       0.13375    0.16151
## ethnAmerican Indian/Native American or Alaskan Native -0.93997    0.40921
## ethnDecline to state                                     -0.33289    0.56496
##                                                          t value
## (Intercept)                                                1.555
## trial.valneu                                               9.477
## trial.valpos                                             160.642
## sexfemale                                                  1.580
## sexother                                                  -1.456
## age                                                        1.010
## ethnBlack/African American                                 0.353
## ethnLatino/Hispanic                                       -1.398
## ethnOther                                                 -0.058
## ethnWhite/Caucasian                                        0.828
## ethnAmerican Indian/Native American or Alaskan Native   -2.297
## ethnDecline to state                                      -0.589
##
## Correlation of Fixed Effects:
##             (Intr) trl.vln trl.vlp sexfml sexthr age    etB/AA ethL/H ethnOt
## trial.valne -0.019
## trial.valps -0.027  0.354
## sexfemale   -0.197  0.000   0.000
## sexother    -0.070  0.000   0.000   0.084
## age         -0.941  0.000   0.000   0.021  0.059
## ethnBlck/AA -0.026  0.000   0.000   0.072 -0.002 -0.149
## ethnLtn/Hsp  0.065  0.000   0.000   0.072 -0.008 -0.250  0.334
## ethnOther   -0.081  0.000   0.000  -0.044 -0.006 -0.038  0.234  0.244
## ethnWht/Ccs -0.091  0.000   0.000   0.107 -0.062 -0.171  0.468  0.496  0.357
```

```
## ethAI/NAoAN -0.141  0.000   0.000   0.123  0.012  0.029  0.176  0.178  0.134
## ethnDclntst -0.067  0.000   0.000   0.144  0.010 -0.027  0.139  0.145  0.096
##             ethW/C eIAoAN
## trial.valne
## trial.valps
## sexfemale
## sexother
## age
## ethnBlck/AA
## ethnLtn/Hsp
## ethnOther
## ethnWht/Ccs
## ethAI/NAoAN  0.271
## ethnDclntst  0.211  0.092
```

- Intercept (negative trial): estimate = 0.72, t-value = 1.56. The effect of negative trial on positive emotions (Ipos) is small.
- `trial.valneu`: estimate = 0.34, t-value = 9.48. Compared to valneg, the neutral trial significantly increases positive emotions (Ipos).
- `trial.valpos`: estimate = 4.03, t-value = 160.64. Compared to valneg, the positive trial largely increases positive emotions (Ipos), and the effect is extremely significant.
- `sexfemale`: estimate = 0.20, t = 1.58. Females tend to have slightly higher positive emotional responses than males.
- `ethnAmerican Indian/Native American or Alaskan Native`: estimate = -0.94, t = -2.30. This ethnicity tends to have significantly lower positive emotional responses compared to the reference group.
- `trial.valneu` and `trial.valpos` have a correlation of 0.354, showing that the effects of neutral and positive trials are somewhat related.

```r
# Mixed-effects model for predicting Iaro
model_aro <- lmer(Iaro ~ trial.val + sex + age + ethn + (1|subj), data = dat)
summary(model_aro)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: Iaro ~ trial.val + sex + age + ethn + (1 | subj)
##    Data: dat
##
## REML criterion at convergence: 59841.3
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.4843 -0.6288 -0.1072  0.5760  4.8022
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  subj     (Intercept) 1.593    1.262
##  Residual             2.168    1.472
## Number of obs: 16380, groups:  subj, 156
##
## Fixed effects:
##                                                    Estimate Std. Error
## (Intercept)                                         2.92802    0.76311
## trial.valneu                                       -2.25913    0.03515
```

```
## trial.valpos                                            -0.30058    0.02485
## sexfemale                                                0.22642    0.20959
## sexother                                                -1.53358    1.28529
## age                                                      0.02904    0.03627
## ethnBlack/African American                               0.22313    0.40915
## ethnLatino/Hispanic                                      0.12385    0.39903
## ethnOther                                                0.52839    0.50007
## ethnWhite/Caucasian                                      0.06932    0.26720
## ethnAmerican Indian/Native American or Alaskan Native -0.85245    0.67697
## ethnDecline to state                                     0.07313    0.93462
##                                                         t value
## (Intercept)                                               3.837
## trial.valneu                                            -64.279
## trial.valpos                                            -12.095
## sexfemale                                                 1.080
## sexother                                                 -1.193
## age                                                       0.801
## ethnBlack/African American                                0.545
## ethnLatino/Hispanic                                       0.310
## ethnOther                                                 1.057
## ethnWhite/Caucasian                                       0.259
## ethnAmerican Indian/Native American or Alaskan Native  -1.259
## ethnDecline to state                                      0.078
##
## Correlation of Fixed Effects:
##             (Intr) trl.vln trl.vlp sexfml sexthr age    etB/AA ethL/H ethnOt
## trial.valne -0.012
## trial.valps -0.016  0.354
## sexfemale   -0.197  0.000   0.000
## sexother    -0.070  0.000   0.000   0.084
## age         -0.942  0.000   0.000   0.021  0.059
## ethnBlck/AA -0.026  0.000   0.000   0.072 -0.002 -0.149
## ethnLtn/Hsp  0.065  0.000   0.000   0.072 -0.008 -0.250  0.334
## ethnOther   -0.081  0.000   0.000  -0.044 -0.006 -0.038  0.234  0.244
## ethnWht/Ccs -0.091  0.000   0.000   0.107 -0.062 -0.171  0.468  0.496  0.357
## ethAI/NAoAN -0.141  0.000   0.000   0.123  0.012  0.029  0.176  0.178  0.134
## ethnDclntst -0.067  0.000   0.000   0.144  0.010 -0.027  0.139  0.145  0.096
##             ethW/C eIAoAN
## trial.valne
## trial.valps
## sexfemale
## sexother
## age
## ethnBlck/AA
## ethnLtn/Hsp
## ethnOther
## ethnWht/Ccs
## ethAI/NAoAN  0.271
## ethnDclntst  0.211  0.092
```

- Intercept (negative trial): estimate = 2.93, t-value = 3.84. The effect of negative trial on arousal (Iaro) is moderate.
- `trial.valneu`: estimate -2.26, t-value = -64.28. Compared to `valneg`, the neutral trial significantly decreases arousal (Iaro), which can be expected.

- `trial.valpos`: estimate = -0.30, t-value = -12.10. Compared to `valneg`, the positive trial also significantly decreases arousal (Iaro), but the effect is small.
- Other fixed effects are not significant.