

Emotional features to memory

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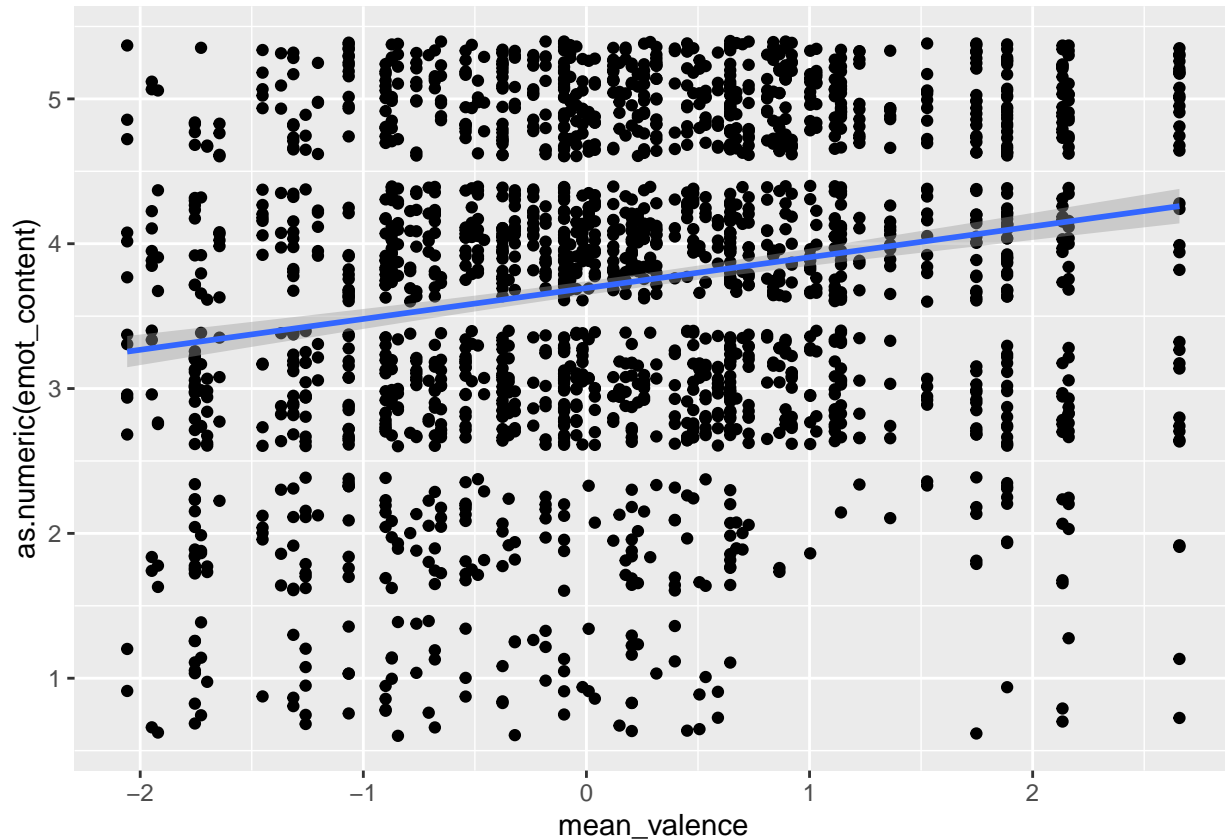
This notebook looks at the emotional ratings of memories as a function of the emotional valence and arousal of the songs they are evoked by.

Load the data.

Make the memory ratings factors.

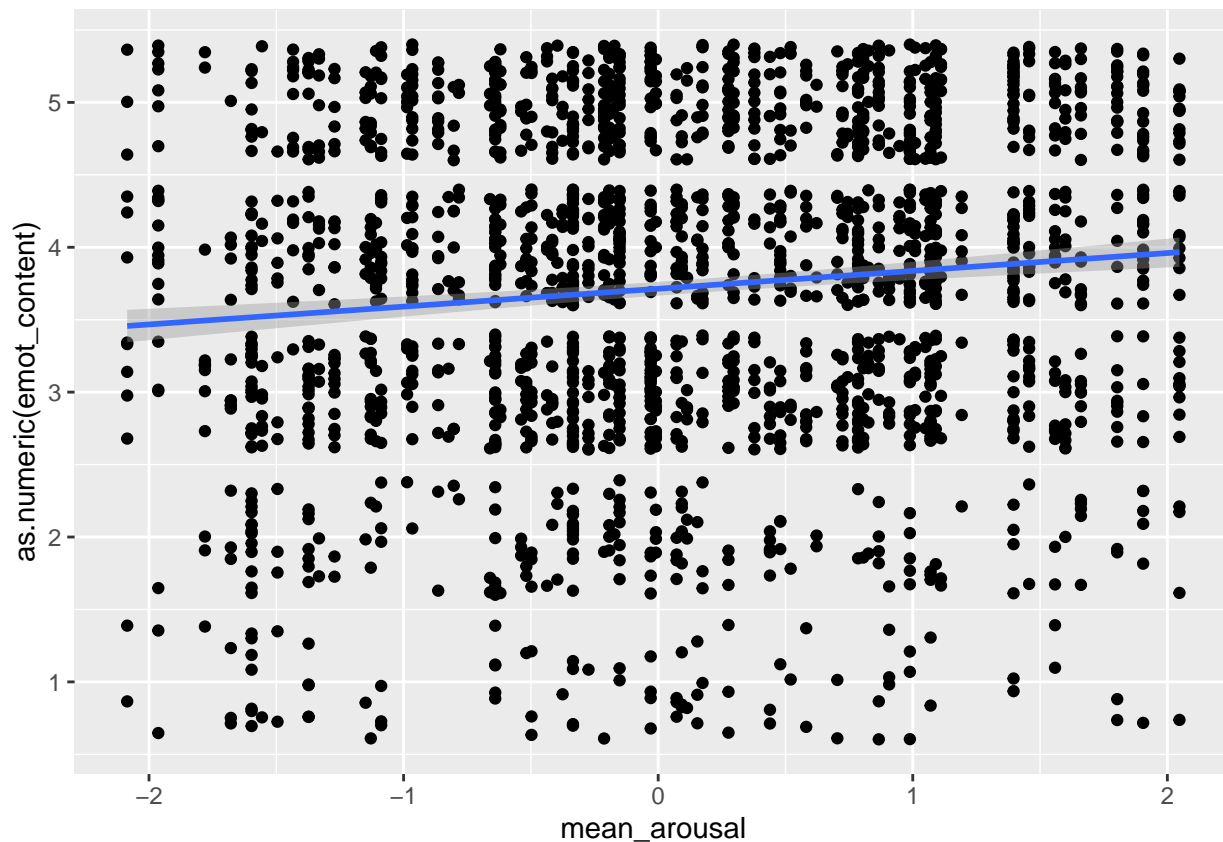
Predict emotional valence of the memories using emotional valence and arousal of the clips.

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [  
## lmerModLmerTest]  
## Formula: as.numeric(emot_content) ~ mean_valence + (1 | internal_id) +  
##      (1 | song_id)  
##      Data: data_factor  
##  
## REML criterion at convergence: 6049.2  
##  
## Scaled residuals:  
##      Min      1Q  Median      3Q      Max  
## -3.4784 -0.6137  0.1462  0.7250  2.0955  
##  
## Random effects:  
##      Groups      Name      Variance Std.Dev.  
## internal_id (Intercept) 0.15936  0.3992  
## song_id      (Intercept) 0.05428  0.2330  
## Residual                0.96932  0.9845  
## Number of obs: 2088, groups: internal_id, 89; song_id, 50  
##  
## Fixed effects:  
##      Estimate Std. Error      df t value Pr(>|t|)  
## (Intercept)   3.68498    0.06077 102.90815  60.634 < 2e-16 ***  
## mean_valence  0.17044    0.03451 108.00369   4.939 2.88e-06 ***  
## ---  
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1  
##  
## Correlation of Fixed Effects:  
##      (Intr)  
## mean_valenc -0.050
```



```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: as.numeric(emot_content) ~ mean_arousal + (1 | internal_id) +
##          (1 | song_id)
## Data: data_factor
##
## REML criterion at convergence: 6063.4
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.4382 -0.6209  0.1593  0.7262  2.0891
##
## Random effects:
##  Groups      Name      Variance Std.Dev.
## internal_id (Intercept) 0.15963  0.3995
## song_id      (Intercept) 0.08751  0.2958
## Residual                0.96794  0.9838
## Number of obs: 2088, groups:  internal_id, 89; song_id, 50
##
## Fixed effects:
##              Estimate Std. Error    df t value Pr(>|t|)
## (Intercept)   3.69488   0.06608 104.28222  55.913  <2e-16 ***
## mean_arousal   0.07506   0.03314 405.69977   2.265   0.0241 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
```

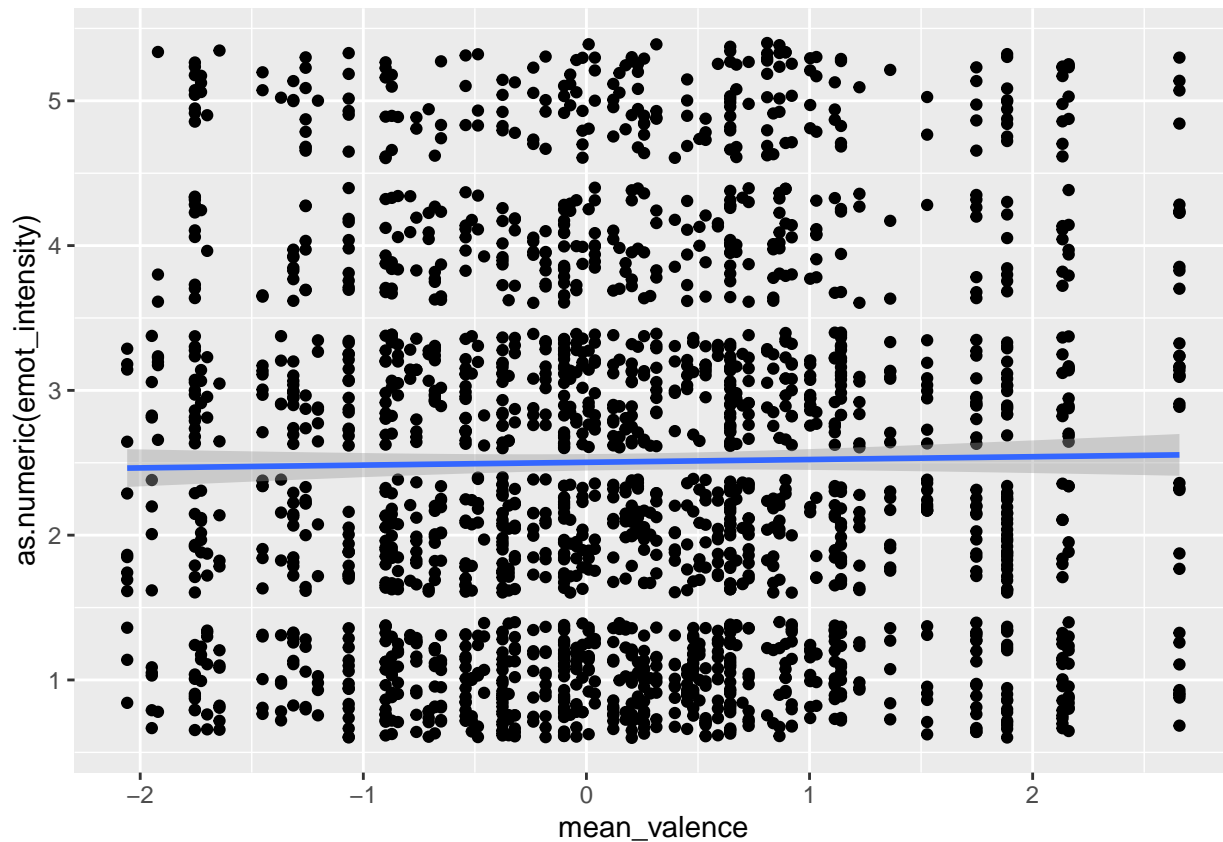
```
## (Intr)
## mean_rousl -0.035
```



Predict emotional intensity of the memories using emotional valence and arousal of the clips.

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: as.numeric(emot_intensity) ~ mean_valence + (1 | internal_id) +
## (1 | song_id)
## Data: data_factor
##
## REML criterion at convergence: 6327.5
##
## Scaled residuals:
##   Min      1Q  Median      3Q      Max
## -3.0226 -0.6967 -0.0824  0.6975  3.3010
##
## Random effects:
##   Groups      Name      Variance Std.Dev.
##   internal_id (Intercept) 0.57845  0.7606
##   song_id      (Intercept) 0.05152  0.2270
##   Residual                1.06667  1.0328
## Number of obs: 2088, groups:  internal_id, 89; song_id, 50
##
## Fixed effects:
##              Estimate Std. Error    df t value Pr(>|t|)
## (Intercept)   2.41407    0.09269 105.10735  26.045 <2e-16 ***
## mean_valence   0.05562    0.03508  99.54597   1.586  0.116
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##          (Intr)
## mean_valenc -0.035
```



```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: as.numeric(emot_intensity) ~ mean_arousal + (1 | internal_id) +
##          (1 | song_id)
## Data: data_factor
##
## REML criterion at convergence: 6329.5
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.0130 -0.6995 -0.0839  0.6972  3.3178
##
## Random effects:
## Groups      Name                Variance Std.Dev.
## internal_id (Intercept) 0.57894  0.7609
## song_id      (Intercept) 0.05274  0.2296
## Residual                    1.06720  1.0331
## Number of obs: 2088, groups:  internal_id, 89; song_id, 50
##
## Fixed effects:
```

```
##               Estimate Std. Error      df t value Pr(>|t|)
## (Intercept)    2.41673    0.09283 104.62181  26.033  <2e-16 ***
## mean_arousal    0.02797    0.03208 219.85280   0.872    0.384
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##              (Intr)
## mean_arousl -0.028
```



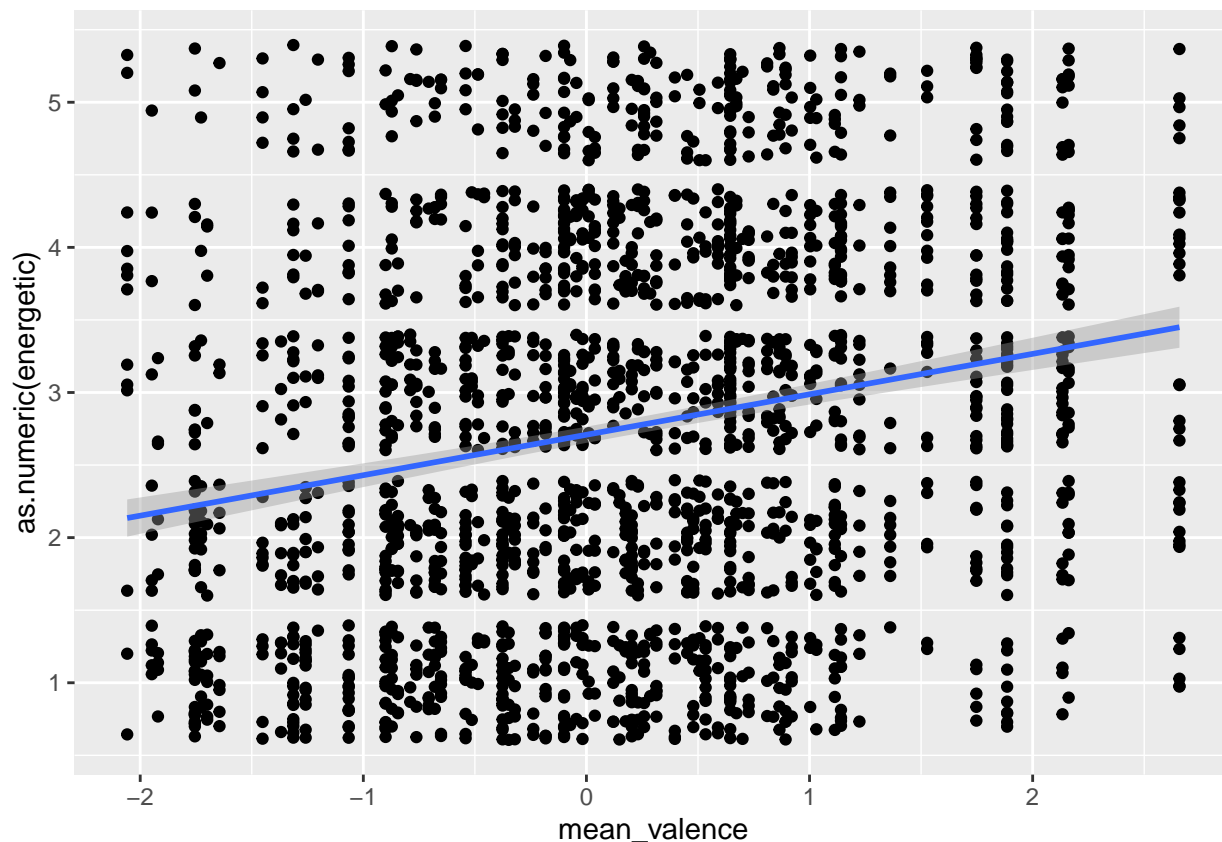
Predict energy of the memories using emotional valence and arousal of the clips.

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: as.numeric(energetic) ~ mean_valence + (1 | internal_id) + (1 |
## song_id)
## Data: data_factor
##
## REML criterion at convergence: 6614.8
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.59466 -0.73759 -0.00468  0.71873  3.06981
##
## Random effects:
## Groups      Name      Variance Std.Dev.
## internal_id (Intercept) 0.3588   0.5990
## song_id      (Intercept) 0.1006   0.3171
```

```
## Residual          1.2431    1.1149
## Number of obs: 2087, groups:  internal_id, 89; song_id, 50
##
## Fixed effects:
##              Estimate Std. Error      df t value Pr(>|t|)
## (Intercept)   2.73391    0.08481 105.37675  32.234 < 2e-16 ***
## mean_valence   0.18984    0.04251 125.54886   4.466 1.76e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##              (Intr)
## mean_valenc -0.040

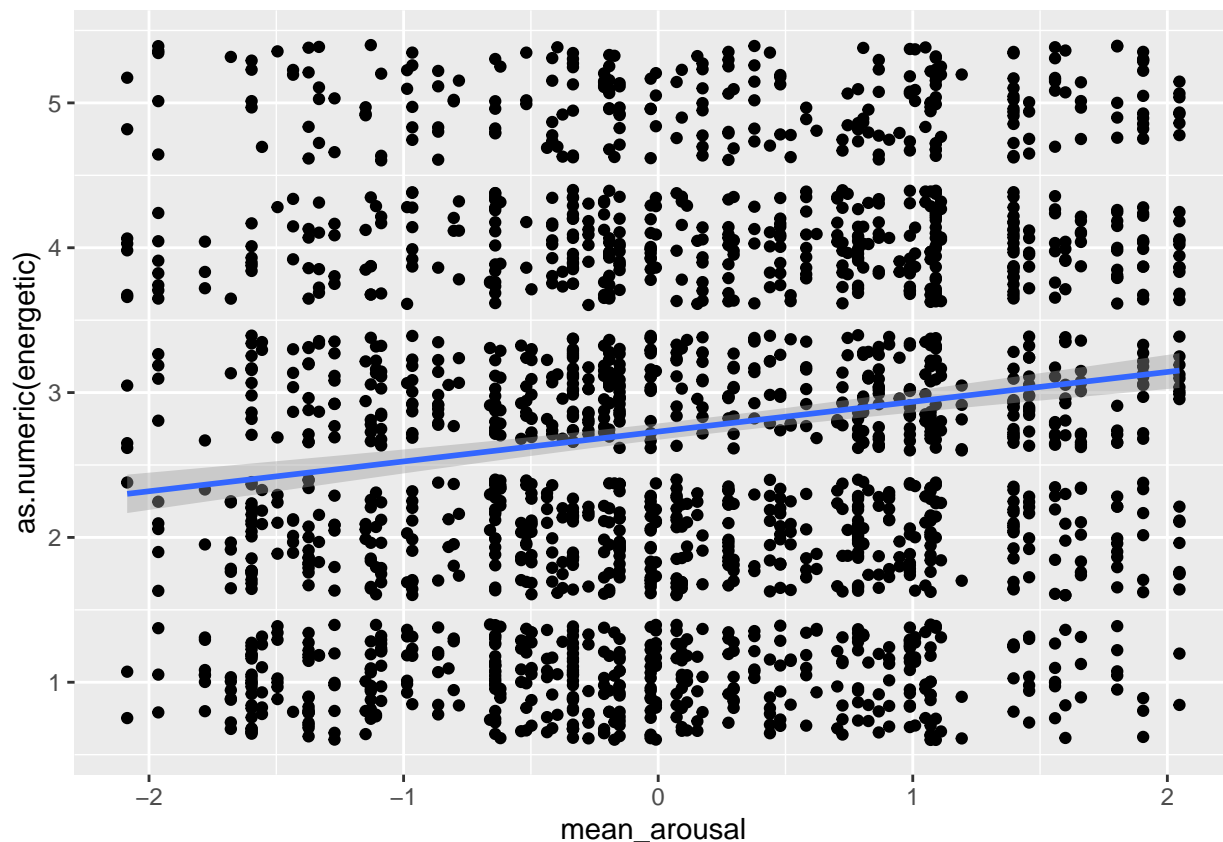
## Warning: Removed 1 row containing non-finite outside the scale range
## (`stat_smooth()`).

## Warning: Removed 1 row containing missing values or values outside the scale range
## (`geom_point()`).
```



```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: as.numeric(energetic) ~ mean_arousal + (1 | internal_id) + (1 |
## song_id)
## Data: data_factor
##
## REML criterion at convergence: 6623.4
##
```

```
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.53079 -0.74630  0.00567  0.71764  3.06996
##
## Random effects:
##   Groups       Name             Variance Std.Dev.
##   internal_id (Intercept) 0.3616    0.6014
##   song_id      (Intercept) 0.1346    0.3669
##   Residual                1.2411    1.1140
## Number of obs: 2087, groups:  internal_id, 89; song_id, 50
##
## Fixed effects:
##              Estimate Std. Error      df t value Pr(>|t|)
## (Intercept)   2.74007   0.08894 109.85452  30.808 < 2e-16 ***
## mean_arousal   0.10963   0.03845 461.45297   2.852  0.00454 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##              (Intr)
## mean_arousl -0.030
##
## Warning: Removed 1 row containing non-finite outside the scale range
## (`stat_smooth()`).
##
## Warning: Removed 1 row containing missing values or values outside the scale range
## (`geom_point()`).
```



Valence and arousal together

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: as.numeric(emot_content) ~ mean_valence * mean_arousal + (1 |
##   internal_id) + (1 | song_id)
##   Data: data_factor
##
## REML criterion at convergence: 6054.2
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.4121 -0.6114  0.1508  0.7215  2.1031
##
## Random effects:
##   Groups      Name      Variance Std.Dev.
##   internal_id (Intercept) 0.15867  0.3983
##   song_id      (Intercept) 0.04415  0.2101
##   Residual                0.97098  0.9854
## Number of obs: 2088, groups:  internal_id, 89; song_id, 50
##
## Fixed effects:
##              Estimate Std. Error      df t value Pr(>|t|)
## (Intercept)      3.713955   0.060325 104.676949  61.566 < 2e-16 ***
## mean_valence      0.204922   0.040997  85.678638   4.998 3.03e-06 ***
## mean_arousal     -0.001562   0.036325 190.962260  -0.043  0.9657
## mean_valence:mean_arousal -0.059906   0.024941 193.356986  -2.402  0.0173 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##              (Intr) mn_vln mn_rsl
## mean_valenc  0.019
## mean_arousl -0.001 -0.523
## mn_vlnc:mn_ -0.209 -0.255 -0.055
##
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: as.numeric(emot_intensity) ~ mean_valence * mean_arousal + (1 |
##   internal_id) + (1 | song_id)
##   Data: data_factor
##
## REML criterion at convergence: 6337.6
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.0240 -0.7002 -0.0815  0.6941  3.2946
##
## Random effects:
##   Groups      Name      Variance Std.Dev.
##   internal_id (Intercept) 0.57835  0.7605
##   song_id      (Intercept) 0.05342  0.2311
##   Residual                1.06713  1.0330
## Number of obs: 2088, groups:  internal_id, 89; song_id, 50
##
```



```

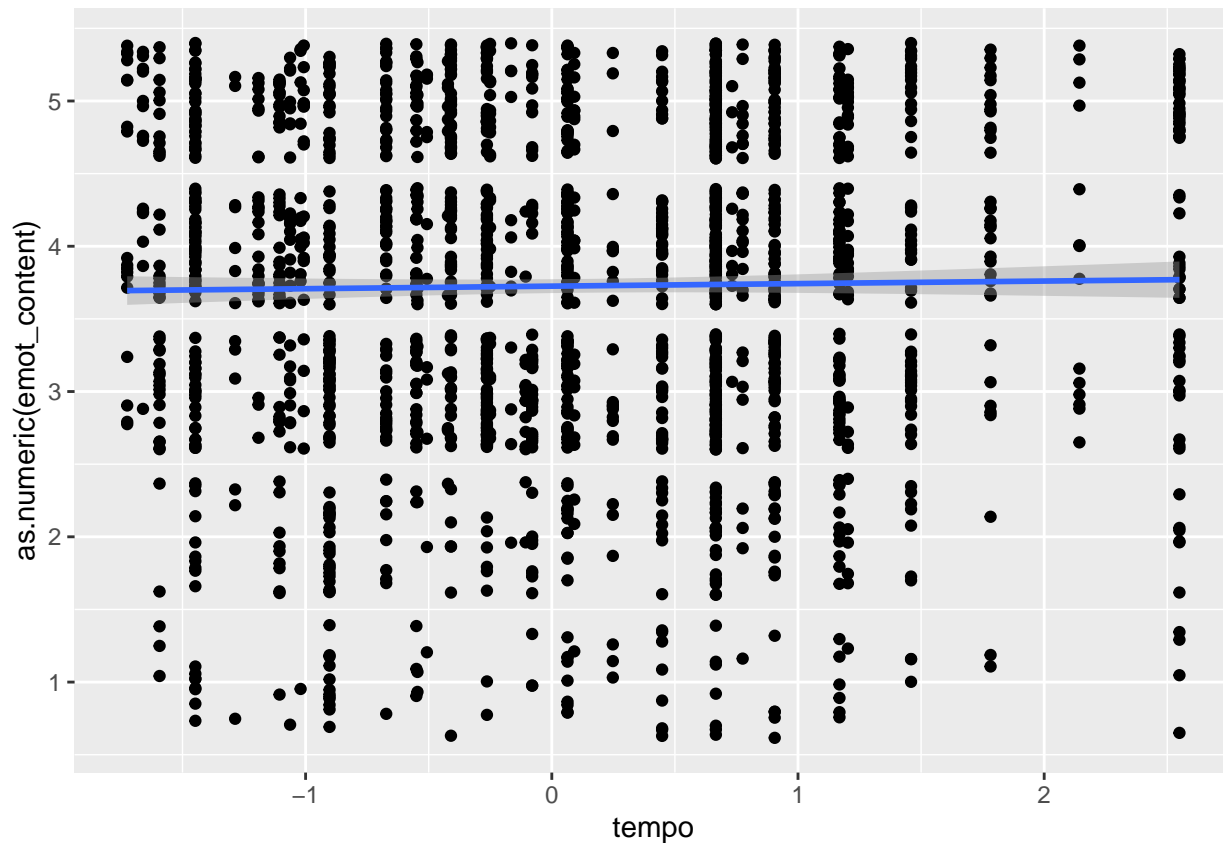
## Fixed effects:
##               Estimate Std. Error      df t value Pr(>|t|)
## (Intercept)      2.417e+00  9.388e-02 1.086e+02  25.742   <2e-16 ***
## mean_valence      5.886e-02  4.401e-02  8.932e+01   1.337    0.185
## mean_arousal      2.621e-04  3.872e-02  2.027e+02   0.007    0.995
## mean_valence:mean_arousal -5.540e-03  2.656e-02  2.095e+02  -0.209    0.835
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##           (Intr) mn_vln mn_rsl
## mean_valenc  0.015
## mean_arousl -0.002 -0.523
## mn_vlnc:mn_ -0.144 -0.255 -0.054

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## as.numeric(energetic) ~ mean_valence * mean_arousal + (1 | internal_id) +
##   (1 | song_id)
##   Data: data_factor
##
## REML criterion at convergence: 6623.6
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.58175 -0.74068 -0.00231  0.71229  3.05691
##
## Random effects:
##   Groups      Name      Variance Std.Dev.
## internal_id (Intercept) 0.3591   0.5993
## song_id      (Intercept) 0.1005   0.3171
## Residual                1.2438   1.1153
## Number of obs: 2087, groups: internal_id, 89; song_id, 50
##
## Fixed effects:
##               Estimate Std. Error      df t value Pr(>|t|)
## (Intercept)      2.734119   0.086165 109.861822  31.731   < 2e-16 ***
## mean_valence      0.166523   0.053159 107.396257   3.133   0.00223 **
## mean_arousal      0.037779   0.044888 266.954612   0.842   0.40074
## mean_valence:mean_arousal -0.002027   0.030706 304.710066  -0.066   0.94742
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##           (Intr) mn_vln mn_rsl
## mean_valenc  0.019
## mean_arousl -0.002 -0.529
## mn_vlnc:mn_ -0.175 -0.255 -0.053

```

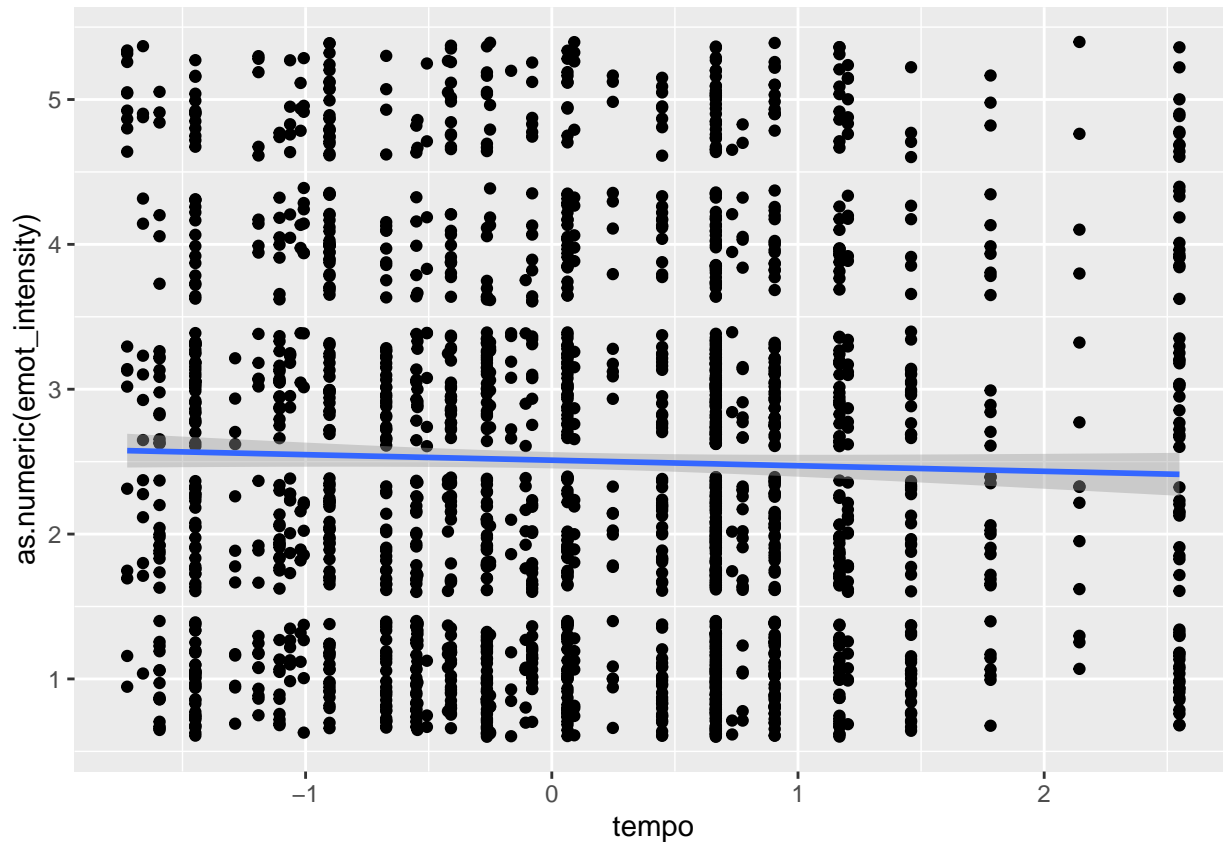
Tempo?

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: as.numeric(emot_content) ~ tempo + (1 | internal_id) + (1 | song_id)
## Data: data_factor
##
## REML criterion at convergence: 6067.5
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.3373 -0.6197  0.1504  0.7245  2.1321
##
## Random effects:
## Groups      Name                Variance Std.Dev.
## internal_id (Intercept) 0.16014  0.4002
## song_id      (Intercept) 0.09851  0.3139
## Residual                    0.96794  0.9838
## Number of obs: 2088, groups: internal_id, 89; song_id, 50
##
## Fixed effects:
##              Estimate Std. Error      df t value Pr(>|t|)
## (Intercept)   3.69955    0.06776 102.97357  54.600  <2e-16 ***
## tempo         0.02552    0.04659  73.59403   0.548   0.586
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##      (Intr)
## tempo -0.014
```



```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: as.numeric(emot_intensity) ~ tempo + (1 | internal_id) + (1 |
##   song_id)
##   Data: data_factor
##
## REML criterion at convergence: 6329.6
##
## Scaled residuals:
##   Min      1Q  Median      3Q      Max
## -3.0022 -0.6974 -0.0879  0.6945  3.3234
##
## Random effects:
##   Groups      Name      Variance Std.Dev.
##   internal_id (Intercept) 0.57760  0.7600
##   song_id      (Intercept) 0.04833  0.2198
##   Residual                1.06898  1.0339
## Number of obs: 2088, groups:  internal_id, 89; song_id, 50
##
## Fixed effects:
##              Estimate Std. Error      df t value Pr(>|t|)
## (Intercept)   2.42062    0.09224 103.95258  26.241  <2e-16 ***
## tempo        -0.02042    0.03824  61.51353  -0.534    0.595
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
```

```
##      (Intr)
## tempo -0.016
```



```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: as.numeric(energetic) ~ tempo + (1 | internal_id) + (1 | song_id)
## Data: data_factor
##
## REML criterion at convergence: 6628.6
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.58663 -0.73644  0.00957  0.71775  3.11660
##
## Random effects:
## Groups      Name                Variance Std.Dev.
## internal_id (Intercept) 0.3619     0.6015
## song_id      (Intercept) 0.1625     0.4031
## Residual                    1.2401     1.1136
## Number of obs: 2087, groups:  internal_id, 89; song_id, 50
##
## Fixed effects:
##              Estimate Std. Error    df t value Pr(>|t|)
## (Intercept)   2.74570    0.09202 110.64169  29.839  <2e-16 ***
## tempo         0.07287    0.05731  76.96890   1.271   0.207
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## Correlation of Fixed Effects:
##      (Intr)
## tempo -0.010

## Warning: Removed 1 row containing non-finite outside the scale range
## (`stat_smooth()`).

## Warning: Removed 1 row containing missing values or values outside the scale range
## (`geom_point()`).
```

