coAuthor-ENA

Zach

2023-08-30

Contents

Load packages

```
rm(list=ls()) #clear environment

library(rENA)
#library(ona)
#library(tma)
library(tidyverse) #for wrangling
library(lmerTest) #for hlms
library(ICC) #for testing clustering of observations
library(emmeans)  #for comparing subpopulations
library(performance) #for regression diagnostics
```

Prep data

Read data

```
# data1 <- read.csv('ena_all_with_groups.csv',stringsAsFactors = FALSE) #read data
#
# #read metadata
#
# meta_cr = read.csv("~/Rprojects/Yixin/CoAuthor - Metadata & Survey - Metadata (creative).csv",
#                    stringsAsFactors = FALSE)
#
# meta_arg = read.csv("~/Rprojects/Yixin/CoAuthor - Metadata & Survey - Metadata (argumentative).csv",
#                    stringsAsFactors = FALSE)
#
# meta_coauthor = bind_rows(meta_cr,meta_arg)


load("~/Rprojects/Yixin/accum-300823.Rdata")
```

Add metadata

```
#data1 = left_join(data1,meta_coauthor,by = c("worker_id","session_id"))
```

Prep for ENA model

```
# units = data1[,c("session_id",
#                  "worker_id")]
#
#
# conversation = data1[,c("session_id",
#                         "worker_id",
#                         "sentSeq")]
#
# codeCols = c(
#   'compose',
#   #'delete',
#   'relocate',
#   'reflect',
#   'seekSugg',
#   'acceptSugg',
#   'dismissSugg',
#   'lowModification',
#   'highModification',
#   'reviseSugg',
#   'reviseUser'
# )
#
# codes = data1[,codeCols]
#
# #mask =
#
# meta = data1[,c("genre",
#                 "highTemp",
```

```
#                   "ownershipMetadata",
#                   "prompt_code"
#                   )]
```

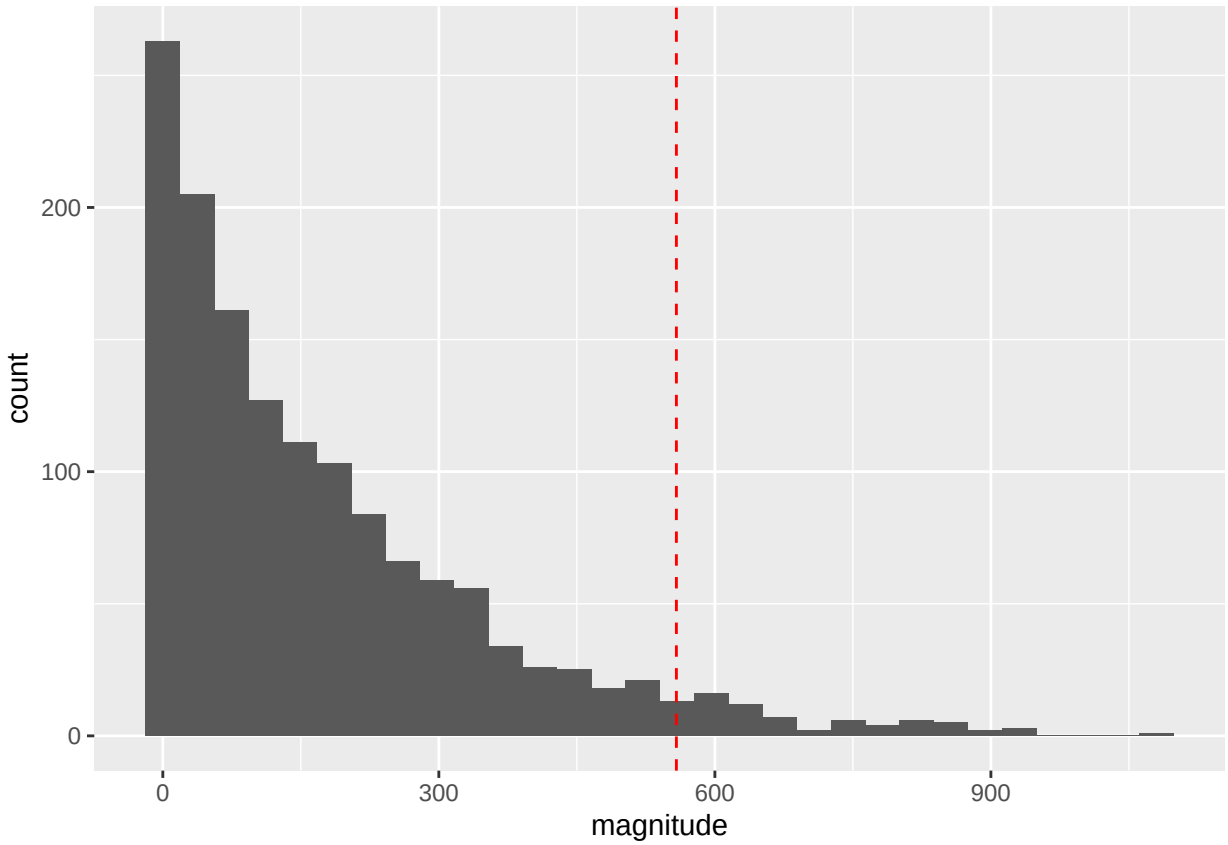
Run ENA accumulation

```
# accum =
#   ena.accumulate.data(
#   units = units,
#   conversation = conversation,
#   codes = codes,
#   metadata = meta,
#   #mask = mask,
#   window.size.back = "inf" # each line in the conversation can connect back to the first line--allows
# )

set = ena.make.set(accum)
```

checking networks

```
sparse.nets = accum$connection.counts %>% rowwise(ENA_UNIT) %>% mutate(magnitude = norm(c_across(contai
```

```
x = quantile(sparse.nets$magnitude,0.95)

ggplot(sparse.nets, aes(x = magnitude)) + geom_histogram() + geom_vline(xintercept = x, linetype = "das
#> `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



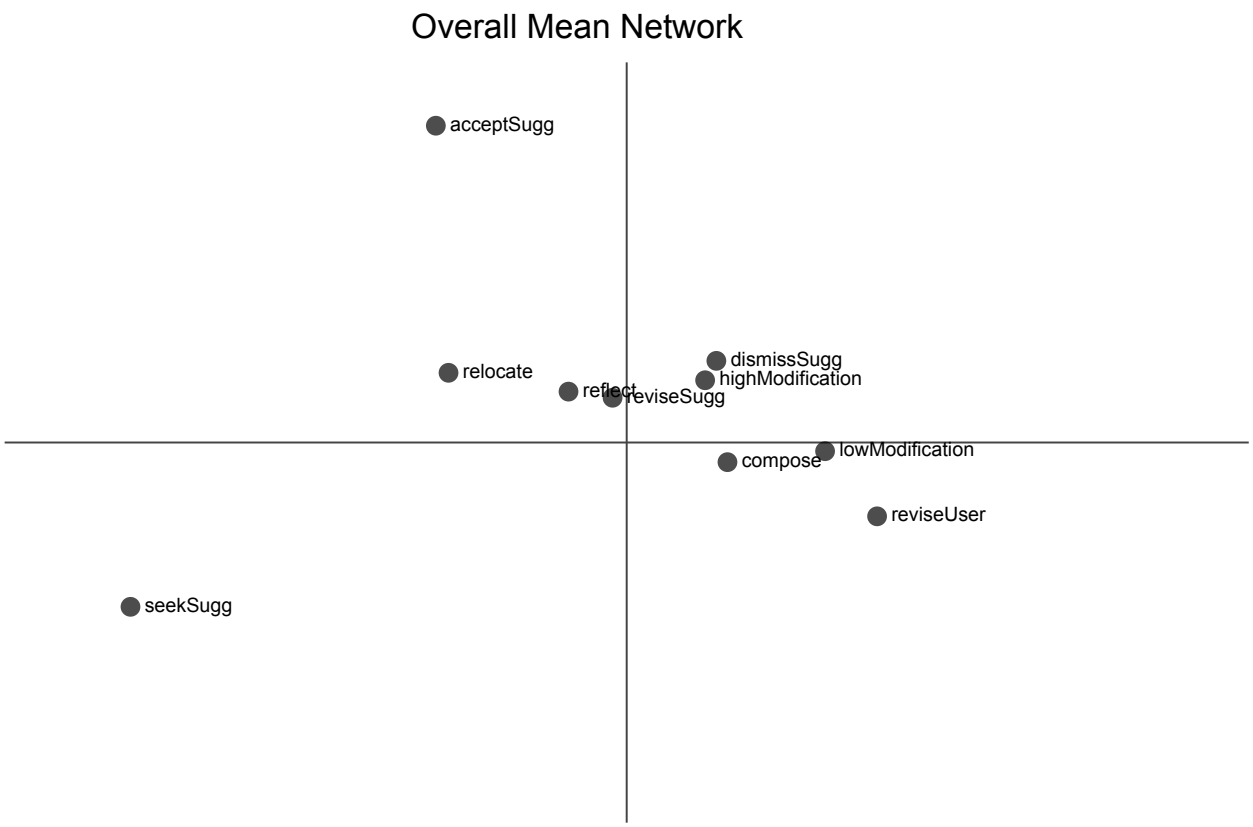

```
zeros = which(sparse.nets$magnitude == 0)
length(zeros)
#> [1] 24
```

#Run ENA dimensional reduction

```
set = ena.make.set(enadata = accum)
```

View space

```
network = as.matrix(set$line.weights)
mean_network = colMeans(network)

network_mult = 0

p = ena.plot(set,title = "Overall Mean Network") %>%
  ena.plot.network(mean_network * network_mult,colors = "black")

p$plot
```



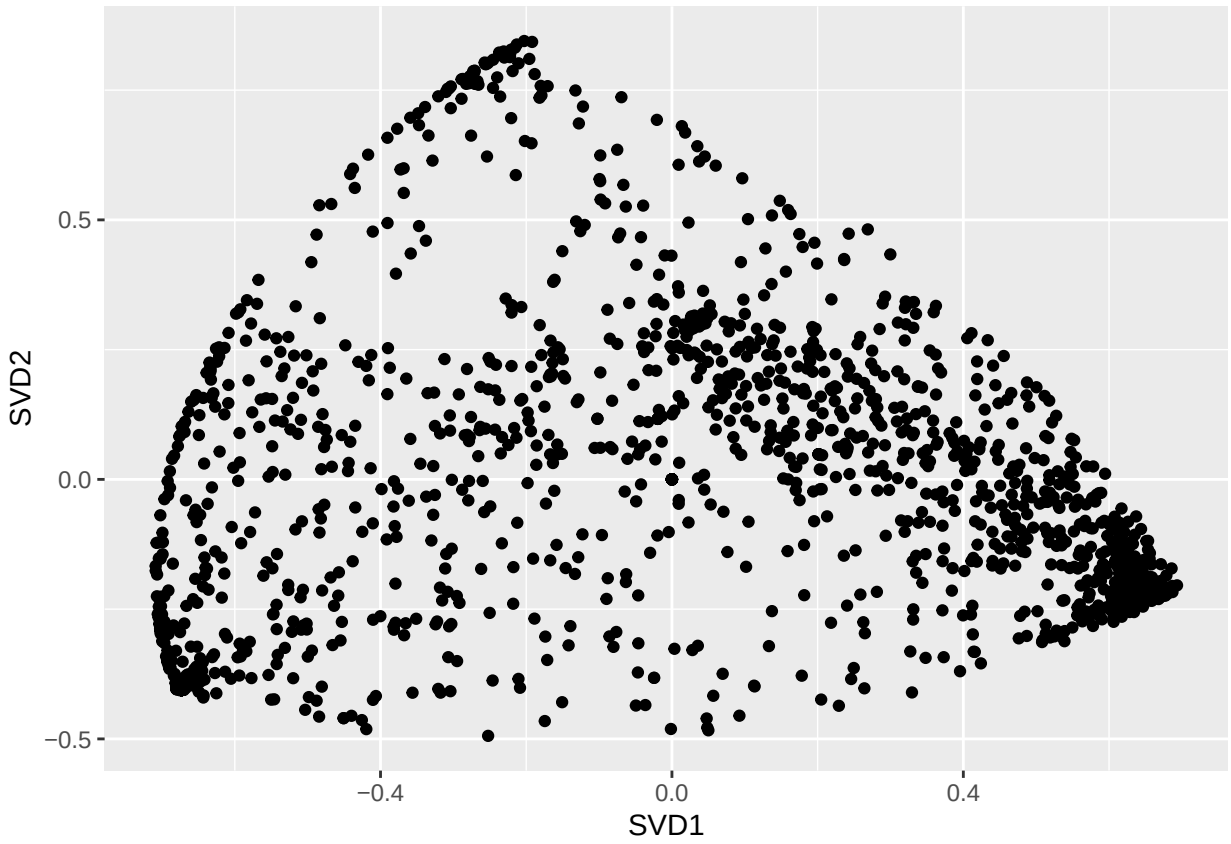
Statistical tests

Set up data and check data

```
#names(set$points)
reg_data = set$points[,c(1:9)]
#glimpse(reg_data)
#table(reg_data$genre)
#t(table(reg_data$genre,reg_data$worker_id))
#summary(reg_data)
```

Checking points

```
ggplot(reg_data,aes(x = SVD1, y = SVD2)) + geom_point()
```

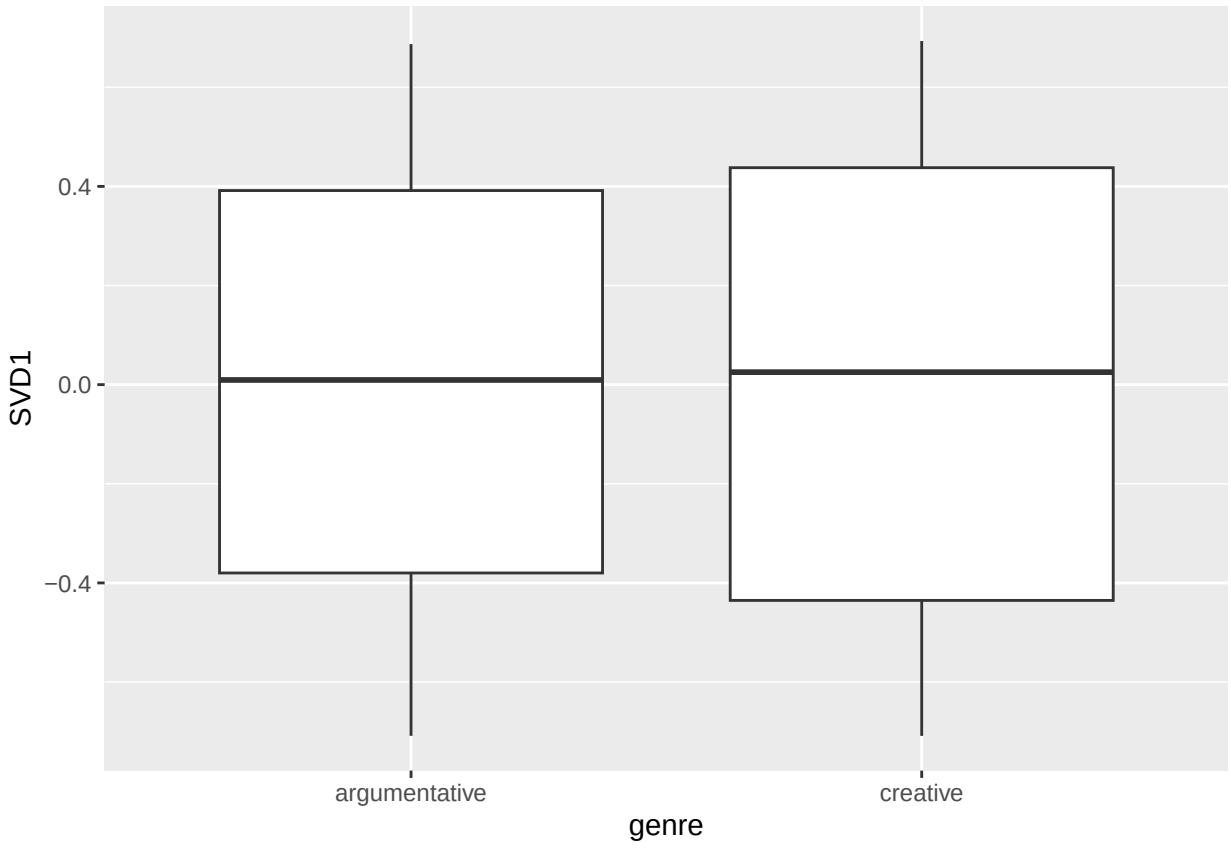


Fanning shape is strange to me

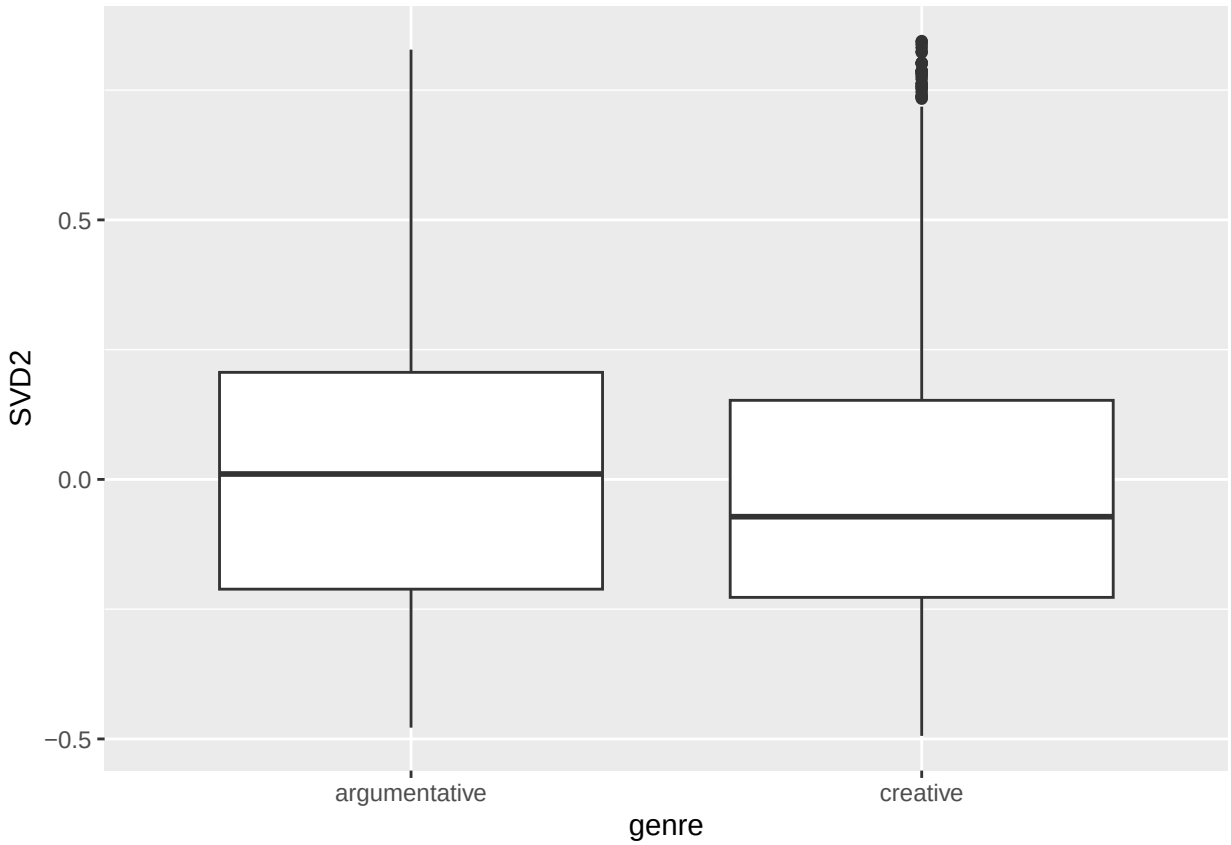
Checking other groups

genre

```
ggplot(reg_data, aes(x = genre, y = SVD1)) + geom_boxplot()
```

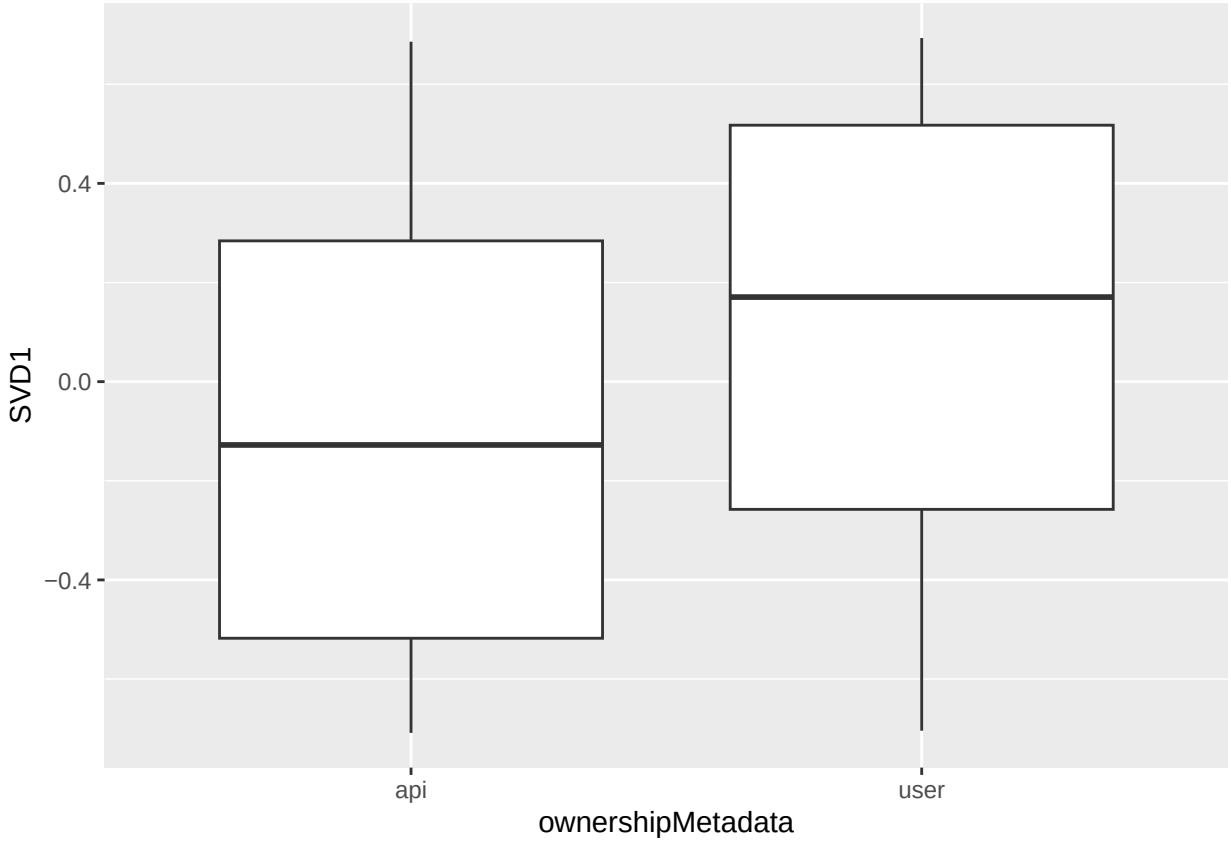



```
ggplot(reg_data, aes(x = genre, y = SVD2)) + geom_boxplot()
```

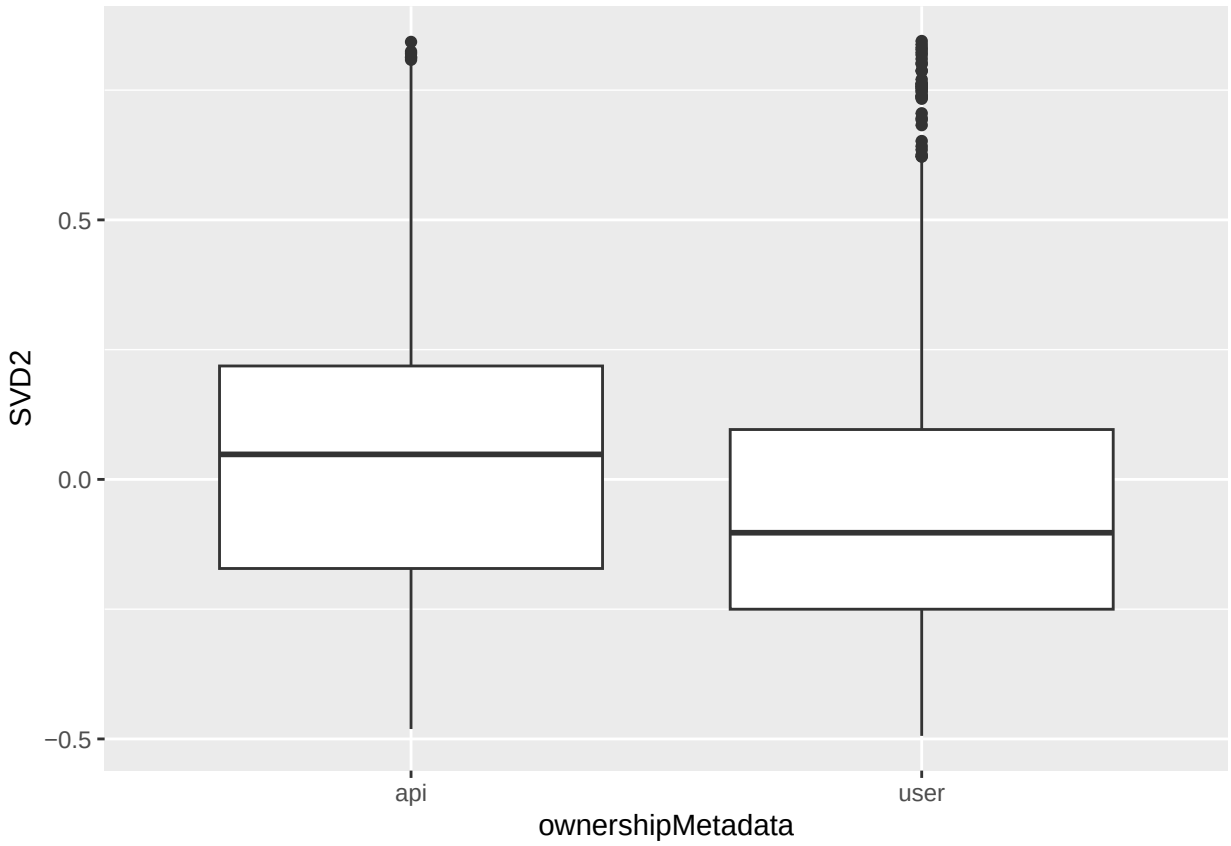


ownership

```
ggplot(reg_data, aes(x = ownershipMetadata, y = SVD1)) + geom_boxplot()
```

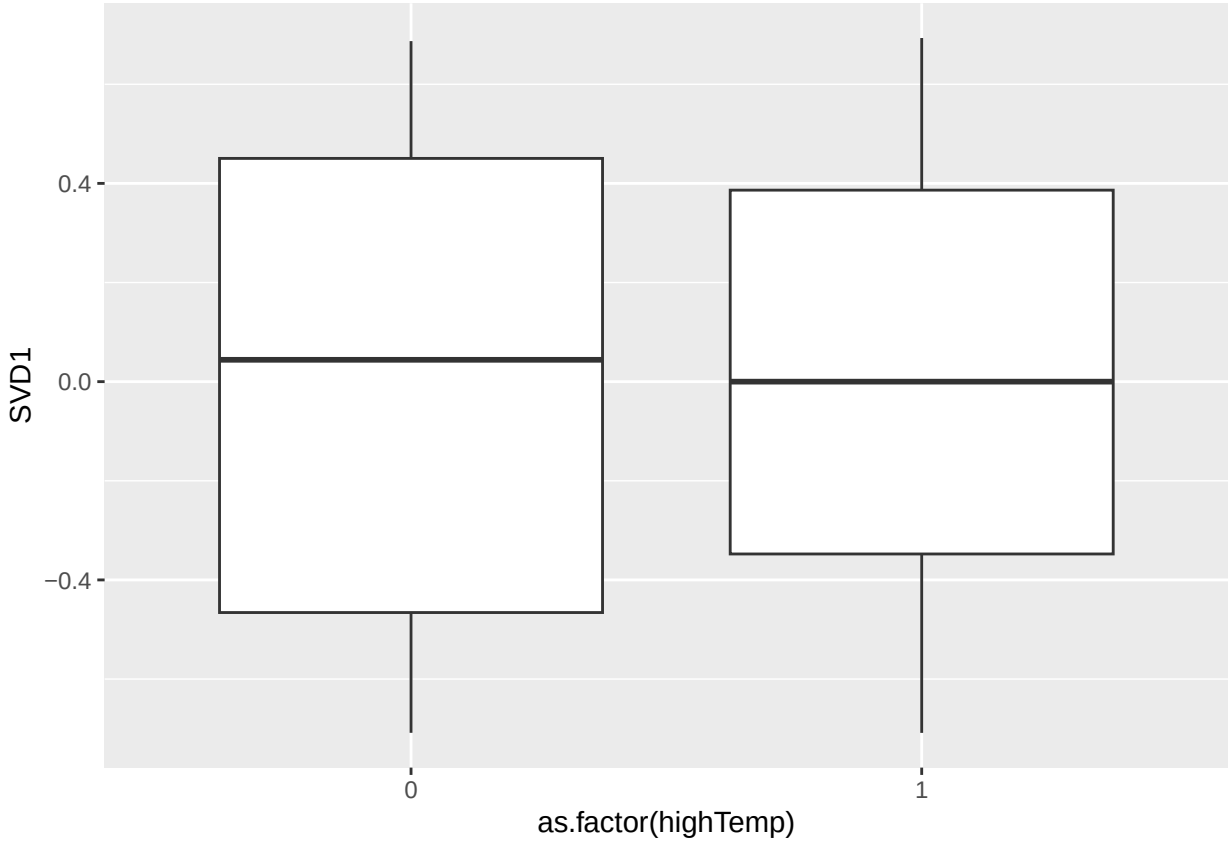



```
ggplot(reg_data, aes(x = ownershipMetadata, y = SVD2)) + geom_boxplot()
```

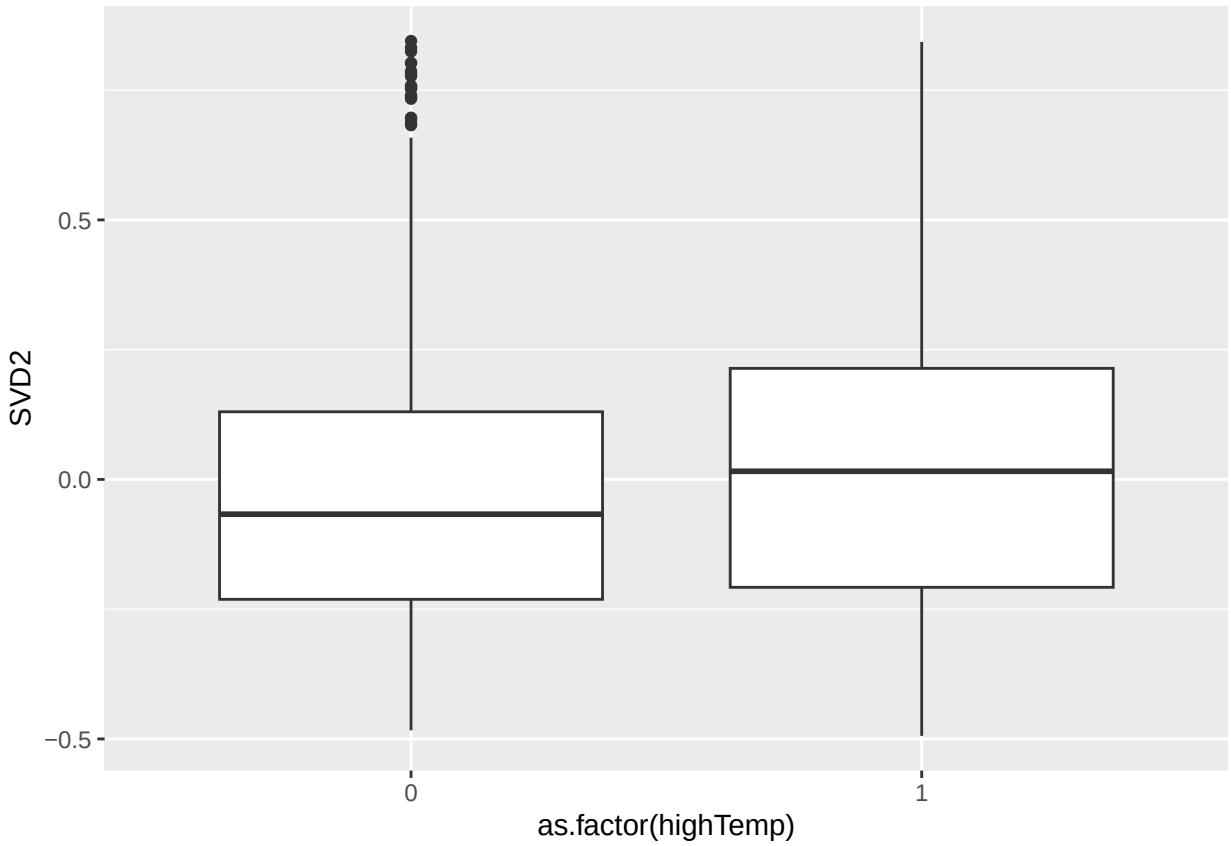


temperature

```
ggplot(reg_data, aes(x = as.factor(highTemp), y = SVD1)) + geom_boxplot()
```




```
ggplot(reg_data, aes(x = as.factor(highTemp), y = SVD2)) + geom_boxplot()
```



Clustering of observations

```
ICCest(worker_id,SVD1,reg_data) #CI does not contain zero; significant
#> Warning in ICCest(worker_id, SVD1, reg_data): 'x' has been coerced to a factor
#> $ICC
#> [1] 0.4679765
#>
#> $LowerCI
#> [1] 0.3809611
#>
#> $UpperCI
#> [1] 0.5714229
#>
#> $N
#> [1] 61
#>
#> $k
#> [1] 23.02129
#>
#> $varw
#> [1] 0.1109908
#>
#> $vara
#> [1] 0.09762927
ICCest(worker_id,SVD2,reg_data) #CI does not contain zero; significant
#> Warning in ICCest(worker_id, SVD2, reg_data): 'x' has been coerced to a factor
```

```
#> $ICC
#> [1] 0.1101448
#>
#> $LowerCI
#> [1] 0.07055893
#>
#> $UpperCI
#> [1] 0.1707893
#>
#> $N
#> [1] 61
#>
#> $k
#> [1] 23.02129
#>
#> $varw
#> [1] 0.07647555
#>
#> $vara
#> [1] 0.009466017

#suggests multilevel models are appropriate for these data

ICCest(prompt_code,SVD1,reg_data) #CI does contains zero; not significant
#> Warning in ICCest(prompt_code, SVD1, reg_data): 'x' has been coerced to a
#> factor
#> $ICC
#> [1] -0.006923188
#>
#> $LowerCI
#> [1] -0.009977924
#>
#> $UpperCI
#> [1] 0.001177918
#>
#> $N
#> [1] 20
#>
#> $k
#> [1] 71.70869
#>
#> $varw
#> [1] 0.2063118
#>
#> $vara
#> [1] -0.001418515
ICCest(prompt_code,SVD2,reg_data) #CI contains zero; not significant
#> Warning in ICCest(prompt_code, SVD2, reg_data): 'x' has been coerced to a
#> factor
#> $ICC
#> [1] 0.007406709
#>
#> $LowerCI
```

```
#> [1] -0.001636156
#>
#> $UpperCI
#> [1] 0.03086913
#>
#> $N
#> [1] 20
#>
#> $k
#> [1] 71.70869
#>
#> $varw
#> [1] 0.08498509
#>
#> $vara
#> [1] 0.0006341568
```

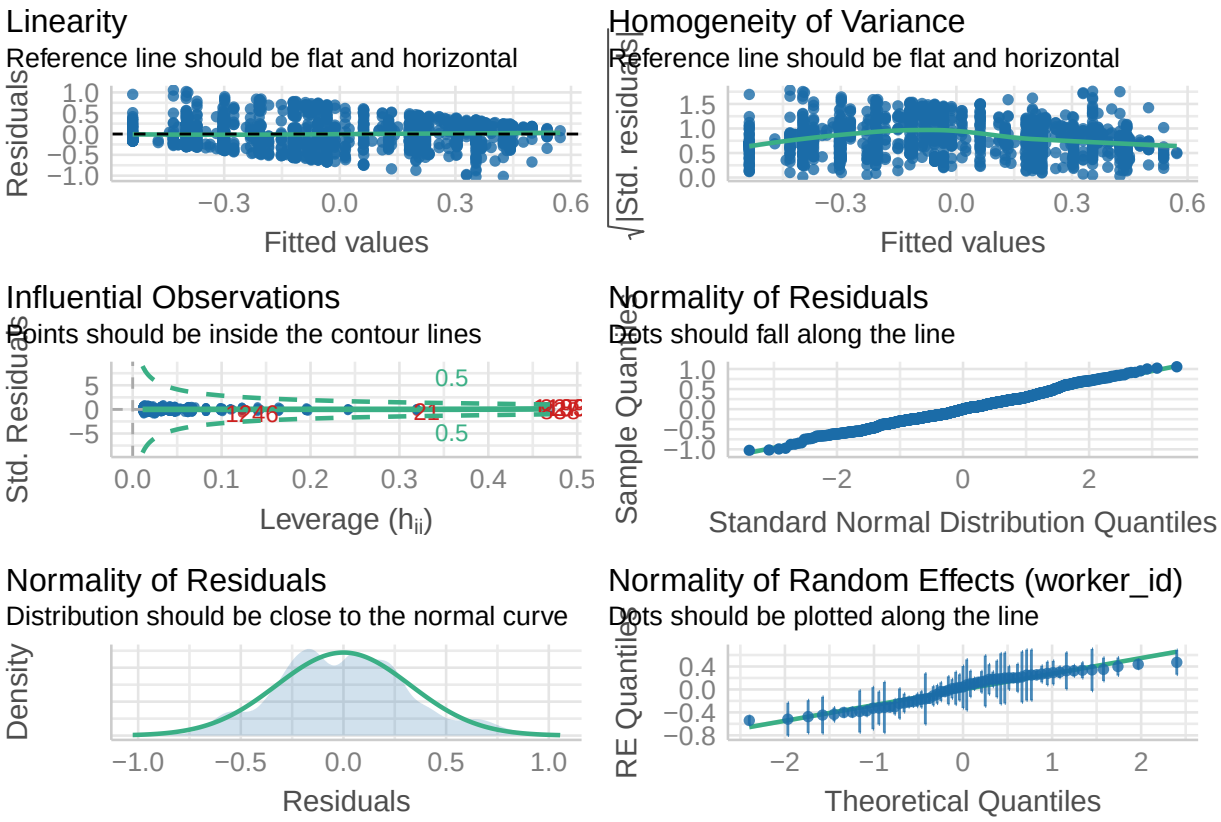
Regression analysis

SVD1

```
# mod.x.1 = lmerTest::lmer(SVD1 ~ genre*ownershipMetadata*highTemp + (1|worker_id),data = reg_data)
#
# mod.x.2 = lmerTest::lmer(SVD1 ~ genre*ownershipMetadata + genre*highTemp + ownershipMetadata*highTemp
#
#
# anova(mod.x.1,mod.x.2)
#
# mod.x.3 = lmerTest::lmer(SVD1 ~ genre + ownershipMetadata + highTemp + (1|worker_id),data = reg_data)
#
# anova(mod.x.2,mod.x.3)

mod.x.4 = lmerTest::lmer(SVD1 ~ ownershipMetadata + (1|worker_id),data = reg_data)

#anova(mod.x.3,mod.x.4)

summary(mod.x.4)
#> Linear mixed model fit by REML. t-tests use Satterthwaite's method [
#> lmerModLmerTest]
#> Formula: SVD1 ~ ownershipMetadata + (1 | worker_id)
#>    Data: reg_data
#>
#> REML criterion at convergence: 1061.9
#>
#> Scaled residuals:
#>     Min      1Q  Median      3Q     Max
#> -3.0915 -0.6637 -0.0028  0.6290  3.1789
#>
#> Random effects:
#>  Groups    Name        Variance Std.Dev.
#>  worker_id (Intercept) 0.09539  0.3089
#>  Residual              0.11026  0.3321
#> Number of obs: 1436, groups:  worker_id, 61
```

```
#>
#> Fixed effects:
#>                          Estimate Std. Error        df t value Pr(>|t|)
#> (Intercept)           3.360e-03  4.593e-02 6.577e+01   0.073 0.941916
#> ownershipMetadatauser 9.557e-02  2.450e-02 1.434e+03   3.900 0.000101 ***
#> ---
#> Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
#>
#> Correlation of Fixed Effects:
#>             (Intr)
#> ownrshpMtdt -0.317
```

```
check.x = check_model(mod.x.4, check = c("qq","normality","linearity", "homogeneity", "outliers","reqq"))
#> Not enough model terms in the conditional part of the model to check for
#>   multicollinearity.

check.x
```



Check model

```
check_outliers(mod.x.4,"mahalanobis")
#> Converting missing values (`NA`) into regular values currently not
#>   possible for variables of class `NULL`.
#> OK: No outliers detected.
#> - Based on the following method and threshold: mahalanobis (10.828).
#> - For variable: (Whole model)
```

```r
cohensd = function(diff_,g1,g2){
  diff_/(sqrt((sd(g1)^2 + sd(g2)^2)/2))
}
```

```r
diff_ = coefficients(mod.x.4)$worker_id$ownershipMetadatauser[1]
g1 = as.matrix(set$points$ownershipMetadata$user)[,"SVD1"]
g2 = as.matrix(set$points$ownershipMetadata$api)[,"SVD1"]

cohensd(diff_ = diff_,g1 = g1, g2 = g2)
#> [1] 0.2157699
```

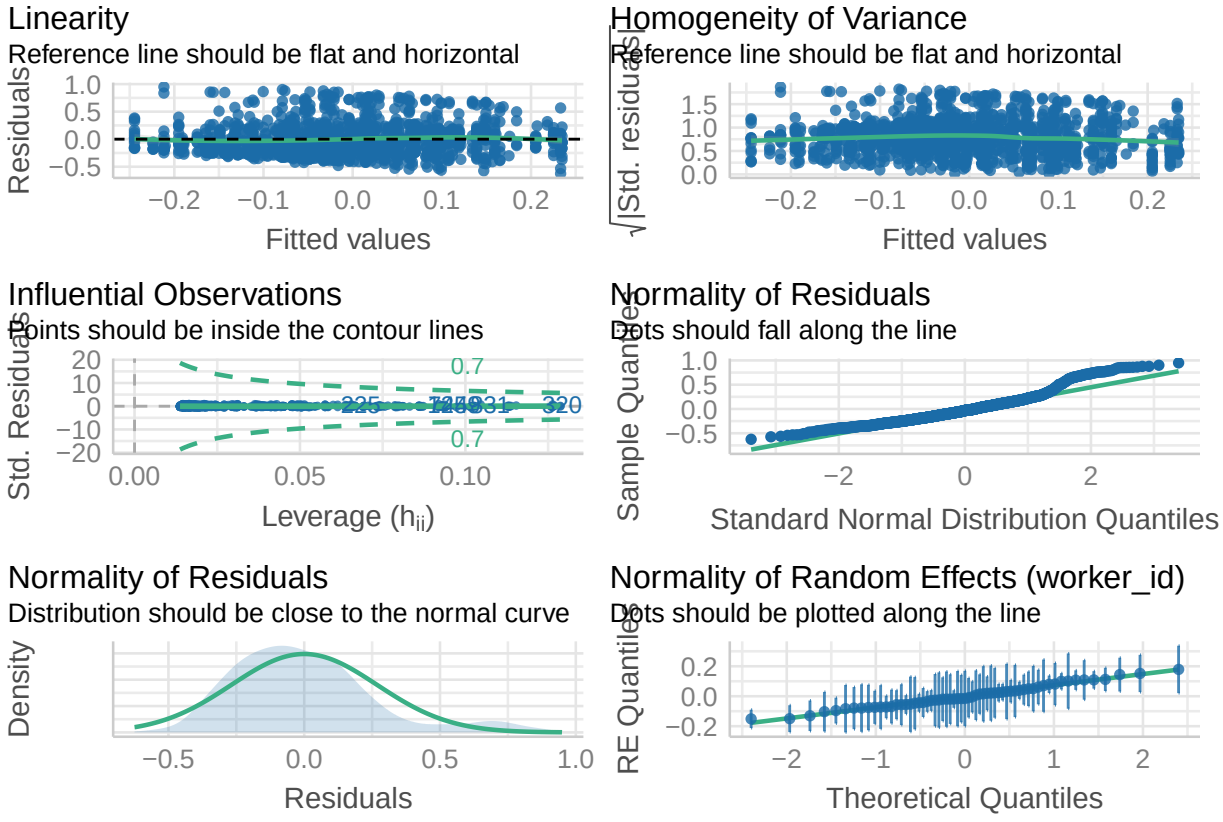
Effect size

SVD2

```r
#mod.y.1 = lmerTest::lmer(SVD2 ~ genre*ownershipMetadata*highTemp + (1|worker_id),data = reg_data)

mod.y.2 = lmerTest::lmer(SVD2 ~ genre*ownershipMetadata + genre*highTemp + ownershipMetadata*highTemp +


#anova(mod.y.1,mod.y.2)

#mod.y.3 = lmerTest::lmer(SVD2 ~ genre*highTemp  + (1|worker_id),data = reg_data)

#anova(mod.y.2,mod.y.3) #prefer mod.y.2

summary(mod.y.2)
#> Linear mixed model fit by REML. t-tests use Satterthwaite's method [
#> lmerModLmerTest]
#> Formula:
#> SVD2 ~ genre * ownershipMetadata + genre * highTemp + ownershipMetadata *
#>     highTemp + (1 | worker_id)
#>    Data: reg_data
#>
#> REML criterion at convergence: 435.2
#>
#> Scaled residuals:
#>     Min      1Q  Median      3Q     Max
#> -2.2982 -0.6969 -0.1193  0.4837  3.4913
#>
#> Random effects:
#>  Groups    Name        Variance Std.Dev.
#>  worker_id (Intercept) 0.01008  0.1004
#>  Residual              0.07392  0.2719
#> Number of obs: 1436, groups:  worker_id, 61
#>
#> Fixed effects:
#>                                    Estimate Std. Error         df t value
#> (Intercept)                         0.01230    0.02997  232.67943   0.411
#> genrecreative                      -0.02239    0.02725 1419.38959  -0.822
#> ownershipMetadatauser              -0.10556    0.03052 1339.07994  -3.459
#> highTemp                            0.11331    0.02715 1400.36167   4.173
```

```
#> genrecreative:ownershipMetadatauser    0.05532    0.03049 1421.28379   1.815
#> genrecreative:highTemp                -0.06380    0.02977 1396.09968  -2.143
#> ownershipMetadatauser:highTemp        -0.03290    0.02946 1399.14816  -1.117
#>                                      Pr(>|t|)
#> (Intercept)                          0.681817
#> genrecreative                        0.411405
#> ownershipMetadatauser                0.000559 ***
#> highTemp                             3.18e-05 ***
#> genrecreative:ownershipMetadatauser 0.069809 .
#> genrecreative:highTemp               0.032306 *
#> ownershipMetadatauser:highTemp       0.264368
#> ---
#> Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
#>
#> Correlation of Fixed Effects:
#>             (Intr) gnrcrt ownrsM hghTmp gnrc:M gnrc:T
#> genrecreatv -0.618
#> ownrshpMtdt -0.661  0.472
#> highTemp    -0.587  0.466  0.459
#> gnrcrtv:wnM  0.385 -0.644 -0.607 -0.157
#> gnrcrtv:hgT  0.379 -0.620 -0.177 -0.653  0.156
#> ownrshpMt:T  0.303 -0.059 -0.483 -0.537  0.000  0.013
```

```
check.y = check_model(mod.y.2, check = c("qq","normality","linearity", "homogeneity", "outliers","reqq"))

check.y
```



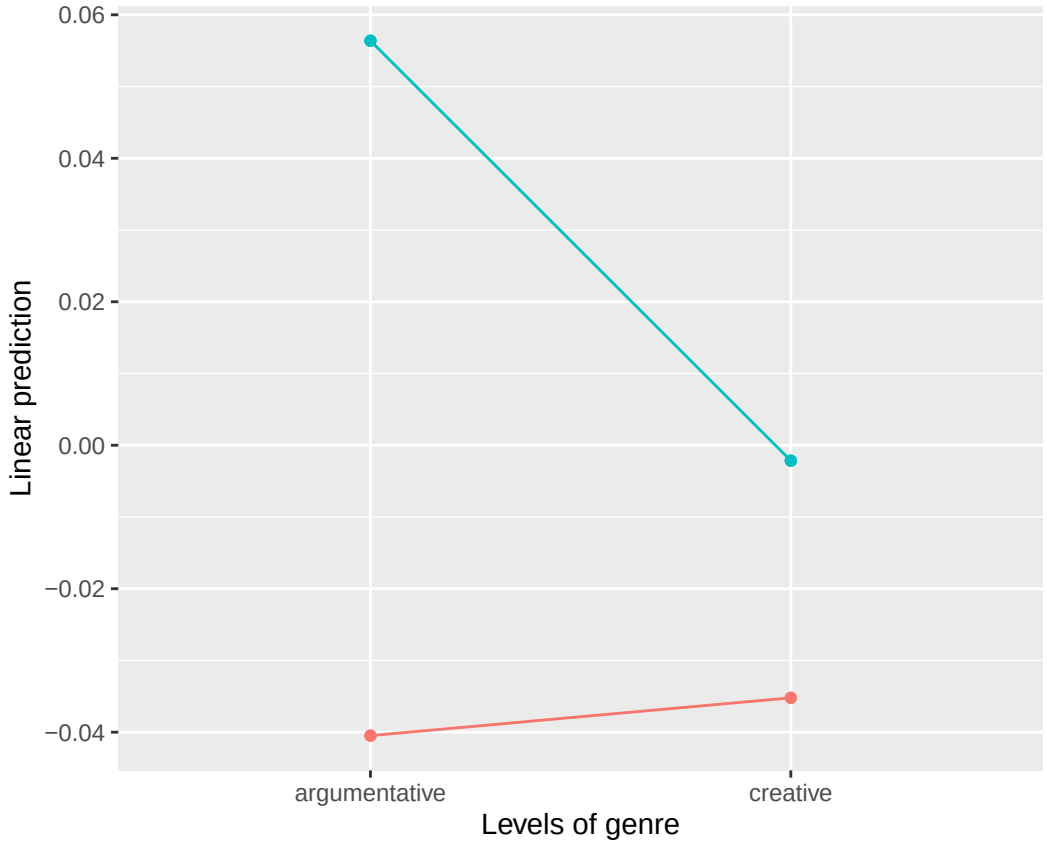
check model

```
check_outliers(mod.y.2,"mahalanobis")
#> Converting missing values (`NA`) into regular values currently not
#>   possible for variables of class `NULL`.
#> OK: No outliers detected.
#> - Based on the following method and threshold: mahalanobis (13.816).
#> - For variable: (Whole model)
```

```
emm.y.1 = emmeans(mod.y.2, specs = pairwise ~ ownershipMetadata, weights = "proportional")
#> NOTE: Results may be misleading due to involvement in interactions
emm.y.2 = emmeans(mod.y.2, specs = pairwise ~ highTemp, weights = "proportional")
#> NOTE: Results may be misleading due to involvement in interactions
```

Estimate marginal means

```
emmip(mod.y.2, highTemp ~ genre)
```



Viewing interactions

```
#x = ref_grid(mod.y.2)
#broom::tidy(x)

diff_ = 0.0899
g1 = as.matrix(set$points$ownershipMetadata$user)[,"SVD2"]
g2 = as.matrix(set$points$ownershipMetadata$api)[,"SVD2"]
```

```
cohensd(diff_ = diff_,g1 = g1, g2 = g2)
#> [1] 0.3113426
```

Effect sizes (ownership)

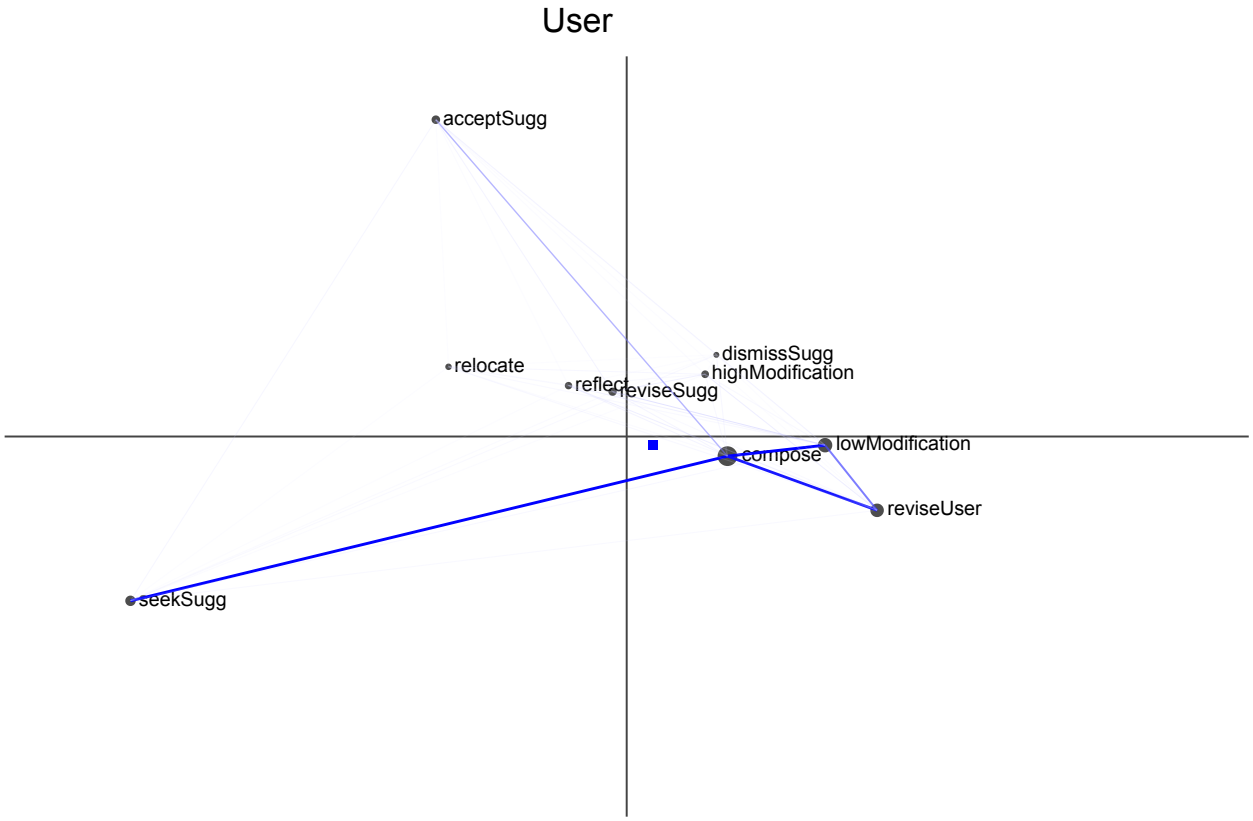
```
diff_ = -0.067
g1 = as.matrix(set$points$highTemp$'1')[,"SVD2"]
g2 = as.matrix(set$points$highTemp$'0')[,"SVD2"]

cohensd(diff_ = diff_,g1 = g1, g2 = g2)
#> [1] -0.2303132
```

Effect sizes (temp)

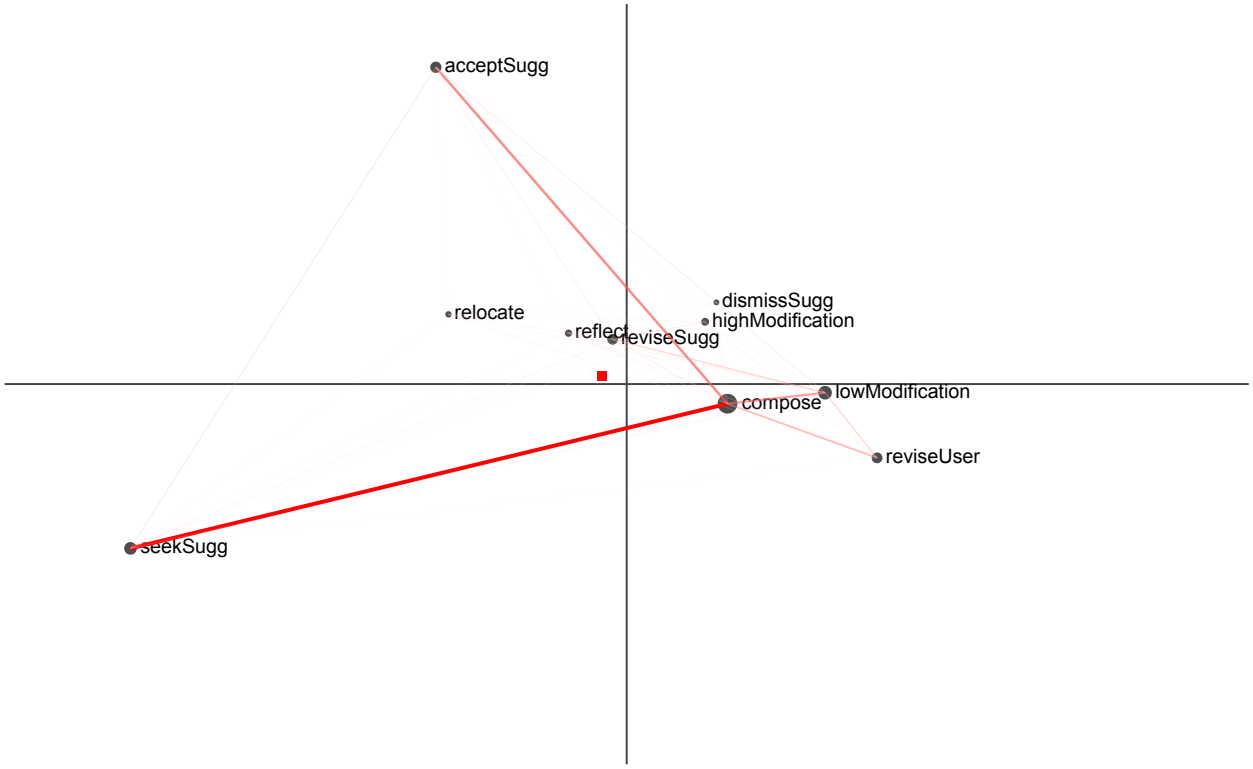
ENA plots

Mean networks (ownership)

```
user_pts = as.matrix(set$points$ownershipMetadata$user)
api_pts = as.matrix(set$points$ownershipMetadata$api)

user_net = colMeans(as.matrix(set$line.weights$ownershipMetadata$user))
api_net = colMeans(as.matrix(set$line.weights$ownershipMetadata$api))

plot_user = ena.plot(set, scale.to = "network", title = "User")  %>%
       #ena.plot.points(points = creat_pts, colors = c("blue"))  %>%
       ena.plot.group(point = user_pts,
                      colors =c("blue"), confidence.interval = "none")  %>%
       ena.plot.network(network = user_net,colors = c("blue") )


plot_api = ena.plot(set, scale.to = "network", title = "Api")  %>%
      # ena.plot.points(points = arg_pts, colors = c("red"))  %>%
       ena.plot.group(point = api_pts,
                      colors =c("red"), confidence.interval = "none")  %>%
       ena.plot.network(network = api_net,colors = c("red") )

plot_user$plot
```

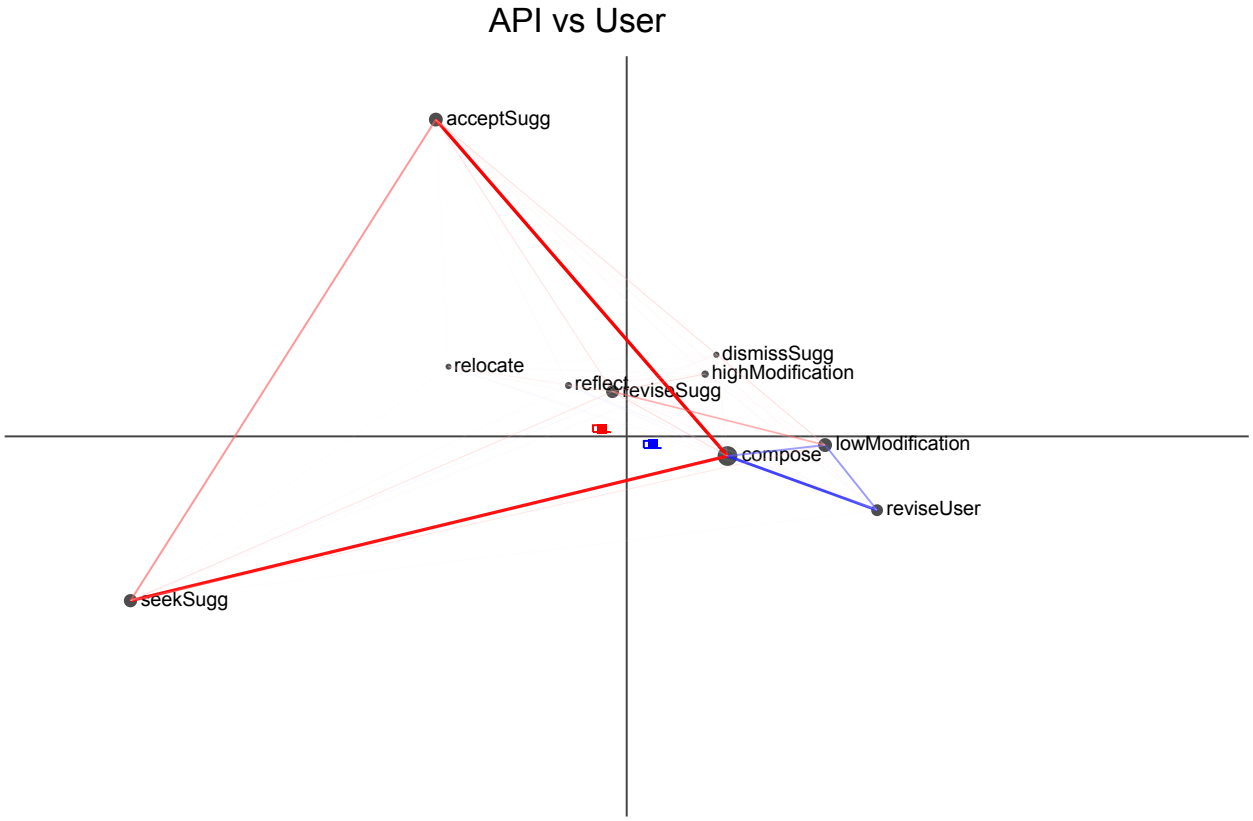



```
plot_api$plot
```



Network subtraction (ownership)

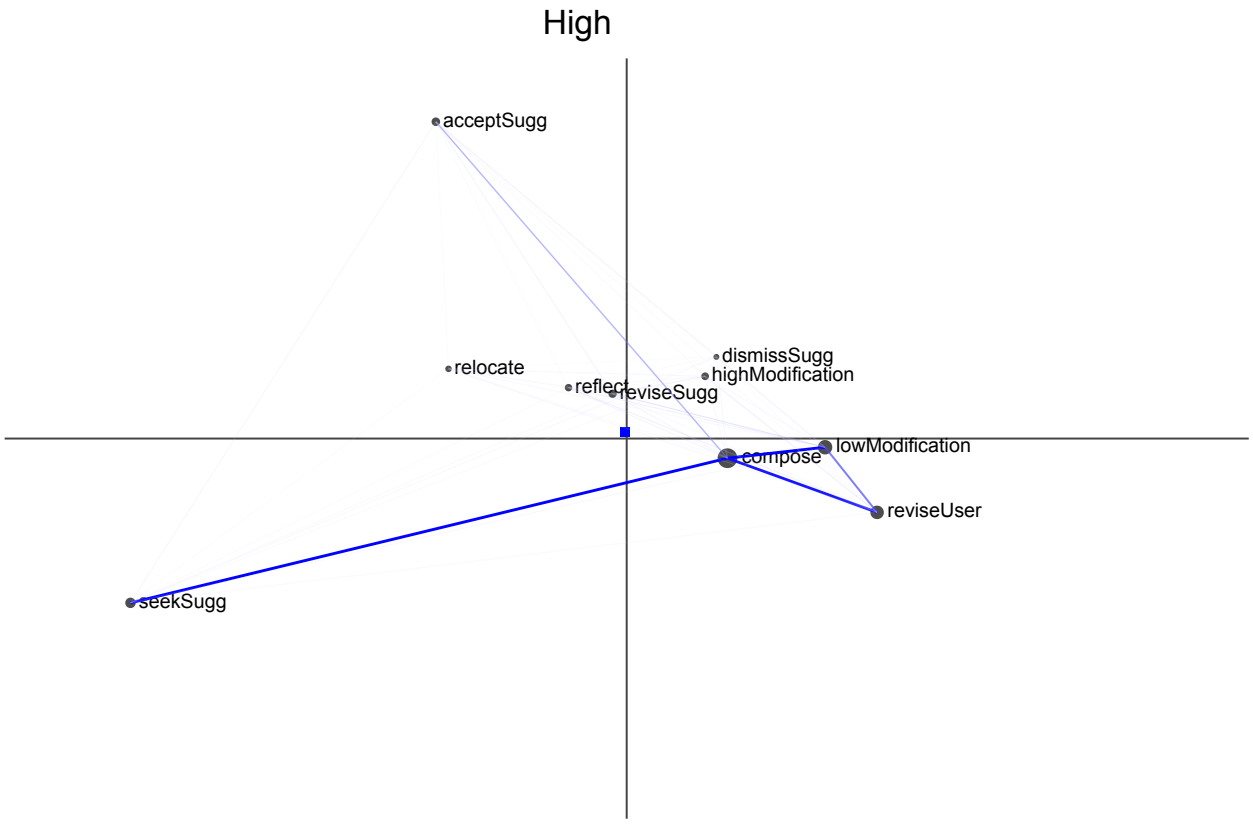
```
net_mult = 3

plot_sub = ena.plot(set, scale.to = "network", title = "API vs User")  %>%
       ena.plot.group(point = user_pts,
                      colors =c("blue"), confidence.interval = "box")  %>%
       ena.plot.group(point = api_pts,
                      colors =c("red"), confidence.interval = "box") %>%
       ena.plot.network(network = (user_net - api_net) * net_mult,colors = c("blue","red") )
plot_sub$plot
```



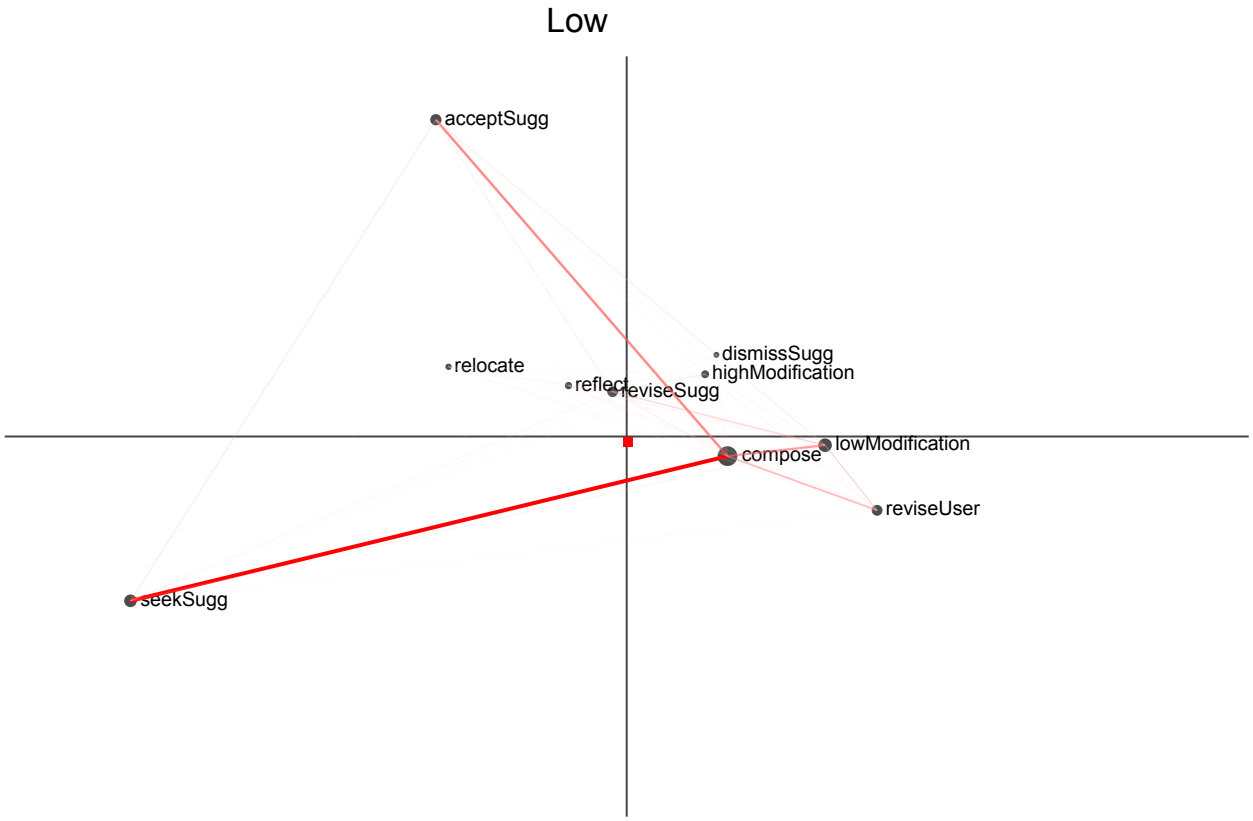
Mean networks (temp)

```
high_pts = as.matrix(set$points$highTemp$'1')
low_pts = as.matrix(set$points$highTemp$'0')

high_net = colMeans(as.matrix(set$line.weights$highTemp$'1'))
low_net = colMeans(as.matrix(set$line.weights$highTemp$'0'))

plot_high = ena.plot(set, scale.to = "network", title = "High")  %>%
       #ena.plot.points(points = creat_pts, colors = c("blue"))  %>%
       ena.plot.group(point = high_pts,
                      colors =c("blue"), confidence.interval = "none")  %>%
       ena.plot.network(network = user_net,colors = c("blue") )


plot_low = ena.plot(set, scale.to = "network", title = "Low")  %>%
      # ena.plot.points(points = arg_pts, colors = c("red"))  %>%
```

```
      ena.plot.group(point = low_pts,
                     colors =c("red"), confidence.interval = "none")  %>%
      ena.plot.network(network = api_net,colors = c("red") )

plot_high$plot
```

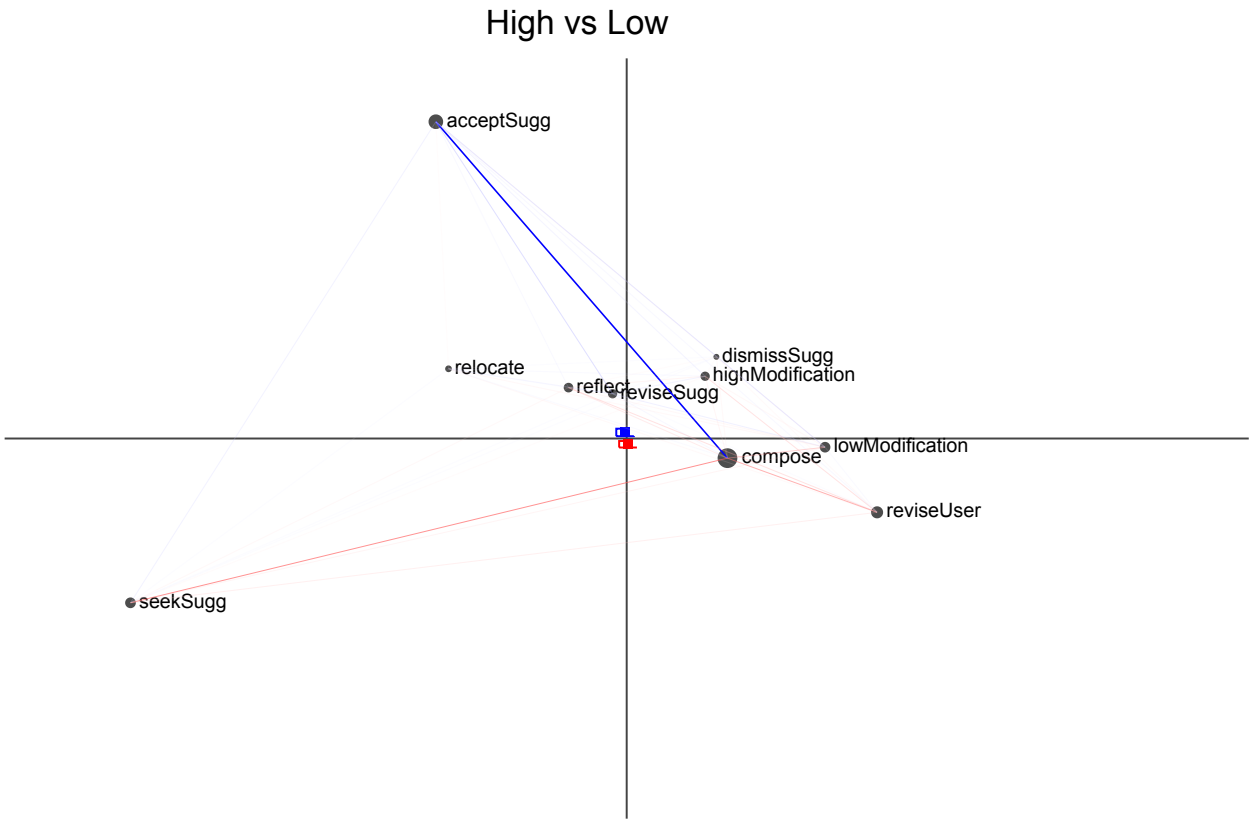



```
plot_low$plot
```



Network subtraction (temp)

```
net_mult = 3

plot_sub_temp = ena.plot(set, scale.to = "network", title = "High vs Low")  %>%
       ena.plot.group(point = high_pts,
                      colors =c("blue"), confidence.interval = "box")  %>%
       ena.plot.group(point = low_pts,
                      colors =c("red"), confidence.interval = "box") %>%
       ena.plot.network(network = (high_net - low_net) * net_mult,colors = c("blue","red") )
plot_sub_temp$plot
```


High vs Low
acceptSugg
relocate
dismissSugg
highModification
reviseSugg
lowModification
compose
reviseUser
seekSugg