Data analysis pilots

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Contents

Dataset loading

```
datasets       <- list.files(file.path("final_data"), pattern="*.csv", full.names = TRUE)
datasets       <- lapply(datasets, read_csv, show_col_types = FALSE)

d <- datasets[[1]]
for (i in seq(from=2, to=length(datasets)))
{
  d <- rbind(d, datasets[[i]])
}
```

Dataset preparation

```
d <- d %>% mutate(Subject=rep(seq_len(length(datasets)), each=100))
```

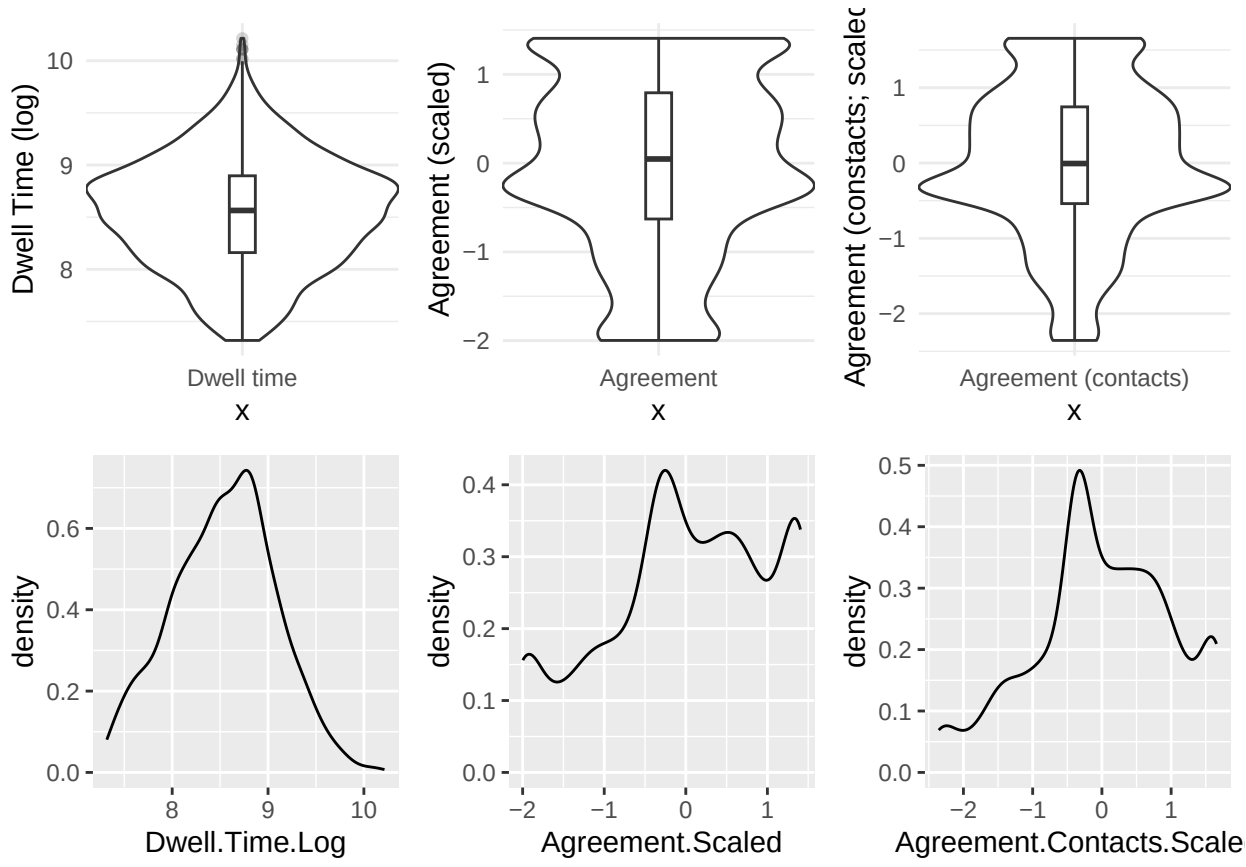
Then we remove total dwell times <=1500ms, scale the Agreement feature and take its square, and log-transform Dwell.Time. We do the same with Agreement.Contacts

```
d_final <- d %>% filter(Dwell.Time > 1500) %>%
  mutate(Dwell.Time.Log = log(Dwell.Time),
         Agreement.Scaled = (Agreement-mean(Agreement))/sd(Agreement),
         Squared.Agreement.Scaled=Agreement.Scaled^2,
         Agreement.Contacts.Scaled = (Agreement.Contacts-mean(Agreement.Contacts))/sd(Agreement.Contacts
         Squared.Agreement.Contacts.Scaled=Agreement.Contacts.Scaled^2,
         Index=as.factor(Index), Subject=as.factor(Subject))
```

Variables plot (violin & boxplot + density)

```
violin_fixation <- ggplot(d_final, aes(x="Dwell time", y=Dwell.Time.Log)) +
  ylab("Dwell Time (log)") + theme_minimal() +
  theme(legend.position = "none") +
  geom_violin(width=1.2) + geom_boxplot(width=0.1, alpha=0.2)
```

```
violin_agreement <- ggplot(d_final, aes(x="Agreement", y=Agreement.Scaled)) +
  ylab("Agreement (scaled)") + theme_minimal() +
  theme(legend.position = "none") +
  geom_violin(width=1.2) + geom_boxplot(width=0.1, alpha=0.2)

violin_agreement_contacts <- ggplot(d_final, aes(x="Agreement (contacts)", y=Agreement.Contacts.Scaled)
  ylab("Agreement (constacts; scaled)") + theme_minimal() +
  theme(legend.position = "none") +
  geom_violin(width=1.2) + geom_boxplot(width=0.1, alpha=0.2)

density_fixation <- ggplot(d_final, aes(x=Dwell.Time.Log)) + geom_density()

density_agreement <- ggplot(d_final, aes(x=Agreement.Scaled)) + geom_density()

density_agreement_contacts <- ggplot(d_final, aes(x=Agreement.Contacts.Scaled)) + geom_density()

grid.arrange(violin_fixation, violin_agreement, violin_agreement_contacts,
             density_fixation, density_agreement, density_agreement_contacts,
             nrow=2)
```



Statistical models

Agreement

```
res_mixed <- lmer(Dwell.Time.Log ~ Agreement.Scaled + Squared.Agreement.Scaled + Condition_Share + Agre
                  (1 | Index) +
```

```
                    (Agreement.Scaled + Squared.Agreement.Scaled + Condition_Share + Agreement.Scaled*C
                  data=d_final, control = lmerControl(optimizer ="bobyqa"))
```

```
## boundary (singular) fit: see help('isSingular')
```

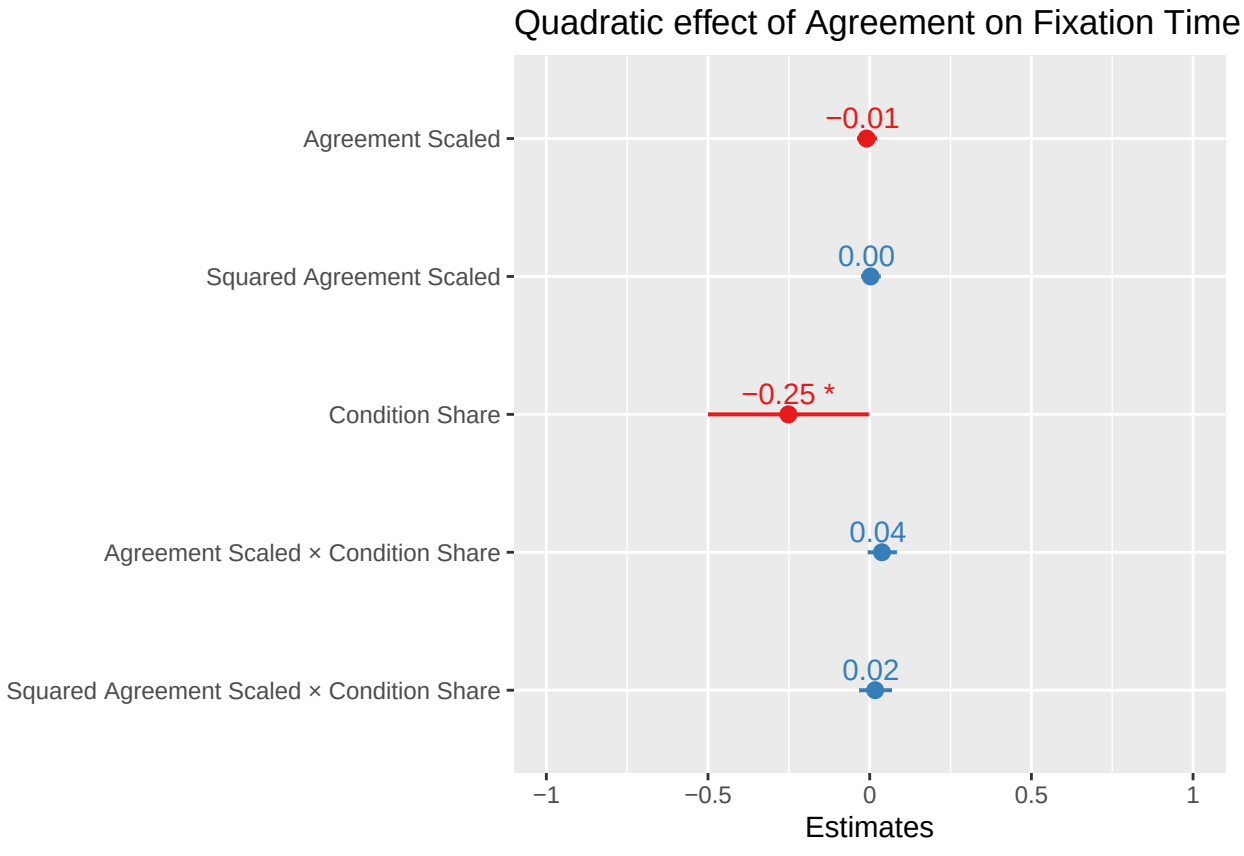
```
## Warning: Model failed to converge with 2 negative eigenvalues: -1.3e-05
## -4.7e-04
```

```
summary(res_mixed)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: Dwell.Time.Log ~ Agreement.Scaled + Squared.Agreement.Scaled +
##     Condition_Share + Agreement.Scaled * Condition_Share + Squared.Agreement.Scaled *
##     Condition_Share + (1 | Index) + (Agreement.Scaled + Squared.Agreement.Scaled +
##     Condition_Share + Agreement.Scaled * Condition_Share + Squared.Agreement.Scaled *
##     Condition_Share | Subject)
##    Data: d_final
## Control: lmerControl(optimizer = "bobyqa")
##
## REML criterion at convergence: 2820.1
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.2546 -0.6495 -0.0344  0.6160  3.7541
##
## Random effects:
##  Groups   Name                                        Variance  Std.Dev. Corr
##  Index    (Intercept)                                 0.0200991 0.14177
##  Subject  (Intercept)                                 0.0820210 0.28639
##           Agreement.Scaled                            0.0002062 0.01436   0.45
##           Squared.Agreement.Scaled                    0.0004584 0.02141  -0.84
##           Condition_Share                             0.0990397 0.31471  -0.36
##           Agreement.Scaled:Condition_Share            0.0010536 0.03246   0.26
##           Squared.Agreement.Scaled:Condition_Share    0.0030229 0.05498   0.56
##  Residual                                             0.1823998 0.42708
##
##
##
##
##  -0.86
##  -0.53  0.53
##  -0.52  0.17  0.07
##   0.32 -0.51 -0.66  0.59
##
## Number of obs: 2256, groups:  Index, 100; Subject, 26
##
## Fixed effects:
##                                          Estimate Std. Error        df t value
## (Intercept)                               8.603539   0.082744 12.749158 103.978
## Agreement.Scaled                         -0.009477   0.014720 38.665423  -0.644
## Squared.Agreement.Scaled                  0.002797   0.014496 23.461014   0.193
## Condition_Share                          -0.251466   0.126338 23.200045  -1.990
## Agreement.Scaled:Condition_Share          0.037930   0.022303 38.706171   1.701
## Squared.Agreement.Scaled:Condition_Share  0.016859   0.025027 18.692890   0.674
```

```
##                                          Pr(>|t|)
## (Intercept)                                <2e-16 ***
## Agreement.Scaled                           0.5235
## Squared.Agreement.Scaled                   0.8487
## Condition_Share                            0.0585 .
## Agreement.Scaled:Condition_Share           0.0970 .
## Squared.Agreement.Scaled:Condition_Share   0.5088
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) Agrm.S Sq.A.S Cndt_S A.S:C_
## Agrmnt.Scld  0.058
## Sqrd.Agrm.S -0.479  0.170
## Conditn_Shr -0.635 -0.038  0.309
## Agrmn.S:C_S -0.042 -0.586 -0.098  0.068
## Sqr.A.S:C_S  0.273 -0.095 -0.556 -0.343  0.425
## optimizer (bobyqa) convergence code: 0 (OK)
## boundary (singular) fit: see help('isSingular')
```

```
plot_model(res_mixed,
           #axis.labels=c("Agreement (Quadratic)", "Agreement"),
           show.values=TRUE, show.p=TRUE,
           title="Quadratic effect of Agreement on Fixation Times")
```



Agreement (contacts)

```
res_mixed <- lmer(Dwell.Time.Log ~ Agreement.Contacts.Scaled + Squared.Agreement.Contacts.Scaled + Condi
                    (1 | Index) +
                    (Agreement.Contacts.Scaled + Squared.Agreement.Contacts.Scaled + Condition_Share + A
                  data=d_final, control = lmerControl(optimizer ="bobyqa"))
```

```
## boundary (singular) fit: see help('isSingular')
```

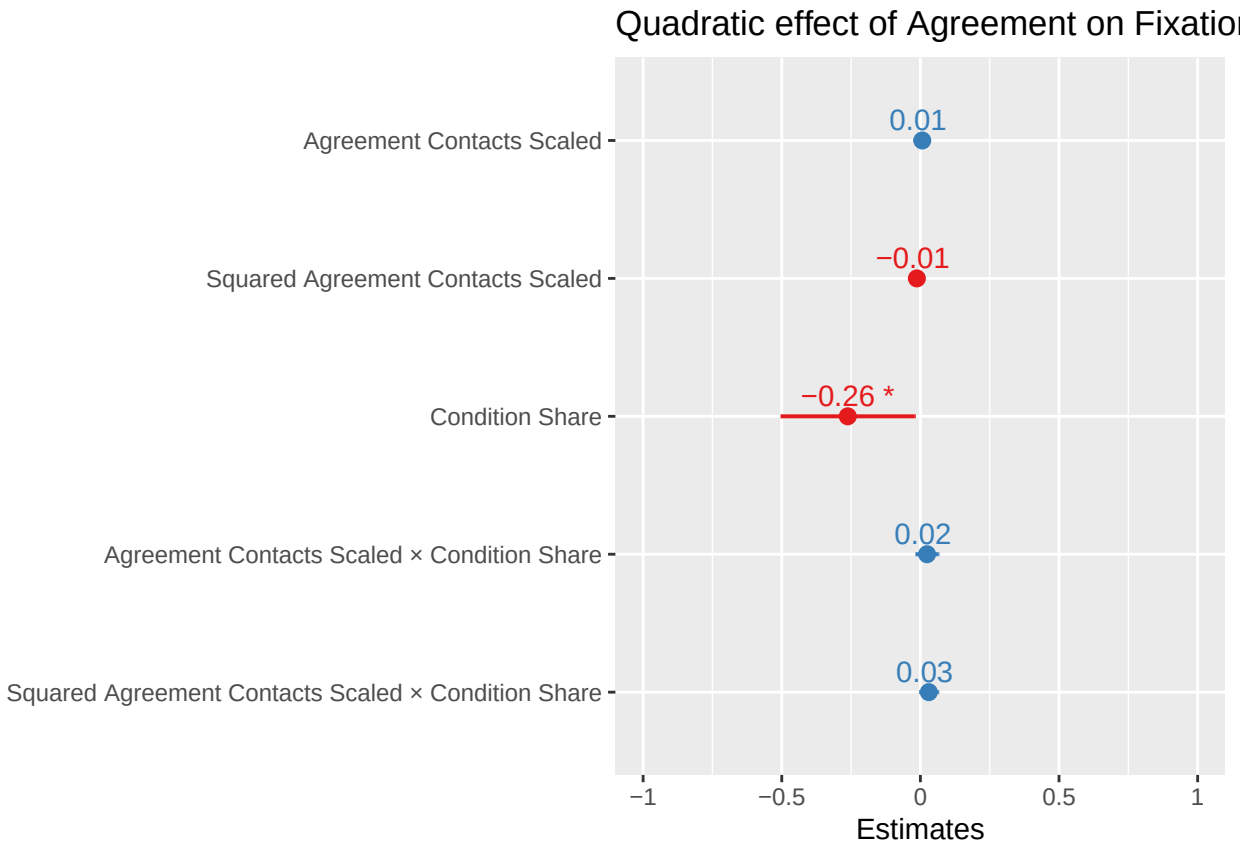
```
## Warning: Model failed to converge with 4 negative eigenvalues: -3.6e-05
## -5.0e-05 -5.8e-05 -1.1e+01
```

```
summary(res_mixed)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## Dwell.Time.Log ~ Agreement.Contacts.Scaled + Squared.Agreement.Contacts.Scaled +
##     Condition_Share + Agreement.Contacts.Scaled * Condition_Share +
##     Squared.Agreement.Contacts.Scaled * Condition_Share + (1 |
##     Index) + (Agreement.Contacts.Scaled + Squared.Agreement.Contacts.Scaled +
##     Condition_Share + Agreement.Contacts.Scaled * Condition_Share +
##     Squared.Agreement.Contacts.Scaled * Condition_Share | Subject)
##    Data: d_final
## Control: lmerControl(optimizer = "bobyqa")
##
## REML criterion at convergence: 2824.4
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.2045 -0.6569 -0.0214  0.6181  3.7307
##
## Random effects:
##  Groups   Name                                                Variance  Std.Dev.
##  Index    (Intercept)                                         2.015e-02 0.141950
##  Subject  (Intercept)                                         7.082e-02 0.266116
##           Agreement.Contacts.Scaled                           1.136e-05 0.003370
##           Squared.Agreement.Contacts.Scaled                   3.750e-05 0.006124
##           Condition_Share                                     1.353e-01 0.367824
##           Agreement.Contacts.Scaled:Condition_Share           7.142e-04 0.026724
##           Squared.Agreement.Contacts.Scaled:Condition_Share 2.013e-04 0.014188
##  Residual                                                     1.834e-01 0.428298
##  Corr
##
##
##   1.00
##   0.50  0.50
##  -0.45 -0.45 -0.39
##  -0.41 -0.41 -0.04 -0.63
##  -0.49 -0.49 -0.41 -0.49  0.92
##
## Number of obs: 2256, groups:  Index, 100; Subject, 26
##
## Fixed effects:
##                                                    Estimate Std. Error
```

```
## (Intercept)                                          8.618766   0.076945
## Agreement.Contacts.Scaled                            0.006745   0.013970
## Squared.Agreement.Contacts.Scaled                   -0.012674   0.011433
## Condition_Share                                     -0.261895   0.123285
## Agreement.Contacts.Scaled:Condition_Share             0.024094   0.021005
## Squared.Agreement.Contacts.Scaled:Condition_Share     0.030468   0.017316
##                                                           df t value Pr(>|t|)
## (Intercept)                                          12.830448 112.013   <2e-16
## Agreement.Contacts.Scaled                           417.875079   0.483   0.6295
## Squared.Agreement.Contacts.Scaled                     6.253790  -1.109   0.3084
## Condition_Share                                      22.393086  -2.124   0.0449
## Agreement.Contacts.Scaled:Condition_Share            94.336630   1.147   0.2543
## Squared.Agreement.Contacts.Scaled:Condition_Share    29.905233   1.760   0.0887
##
## (Intercept)                                         ***
## Agreement.Contacts.Scaled
## Squared.Agreement.Contacts.Scaled
## Condition_Share                                     *
## Agreement.Contacts.Scaled:Condition_Share
## Squared.Agreement.Contacts.Scaled:Condition_Share .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) Ag.C.S Sq.A.C.S Cndt_S A.C.S:
## Agrmnt.Cn.S  0.030
## Sqrd.Ag.C.S -0.070  0.238
## Conditn_Shr -0.603 -0.019  0.041
## Agr.C.S:C_S -0.021 -0.610 -0.149   -0.273
## S.A.C.S:C_S  0.043 -0.159 -0.641   -0.260  0.354
## optimizer (bobyqa) convergence code: 0 (OK)
## boundary (singular) fit: see help('isSingular')
```

```
plot_model(res_mixed,
           #axis.labels=c("Agreement (Quadratic)", "Agreement"),
           show.values=TRUE, show.p=TRUE,
           title="Quadratic effect of Agreement on Fixation Times")
```



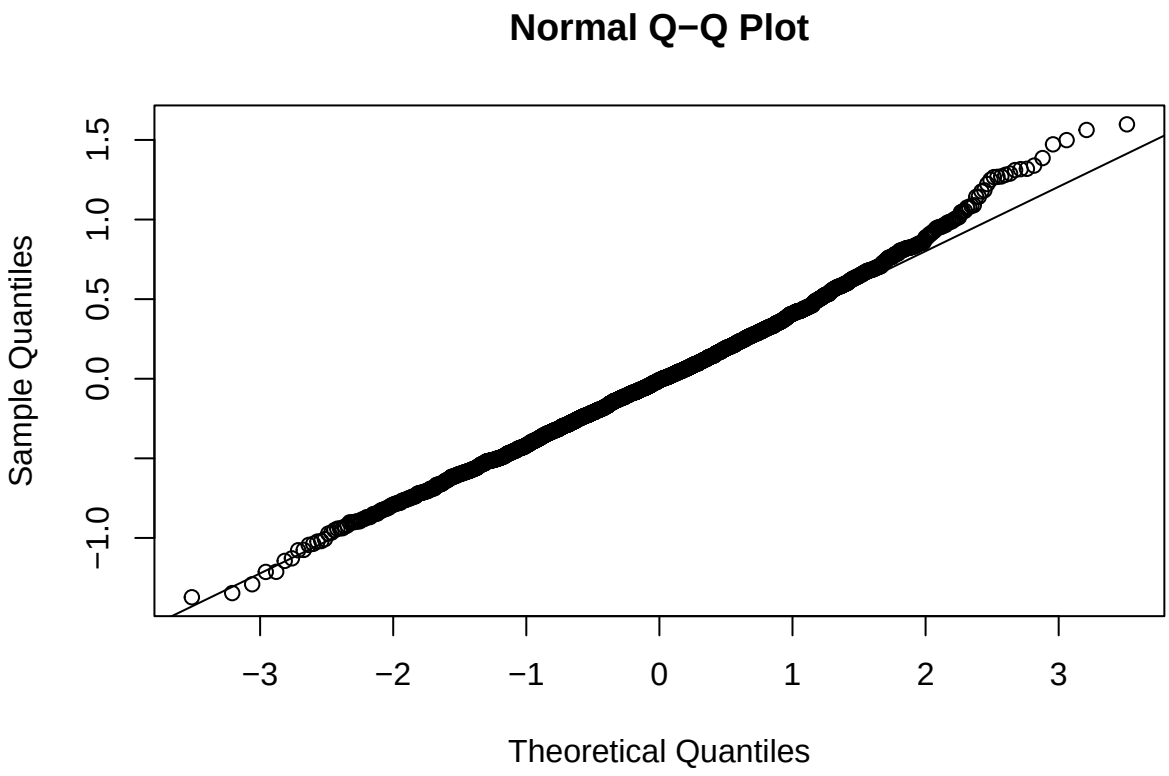

```
# quad_function <- function(x, alpha, beta1, beta2)
# {
#   return(alpha + beta1*x + beta2*x^2)
# }
```

Random effect plot

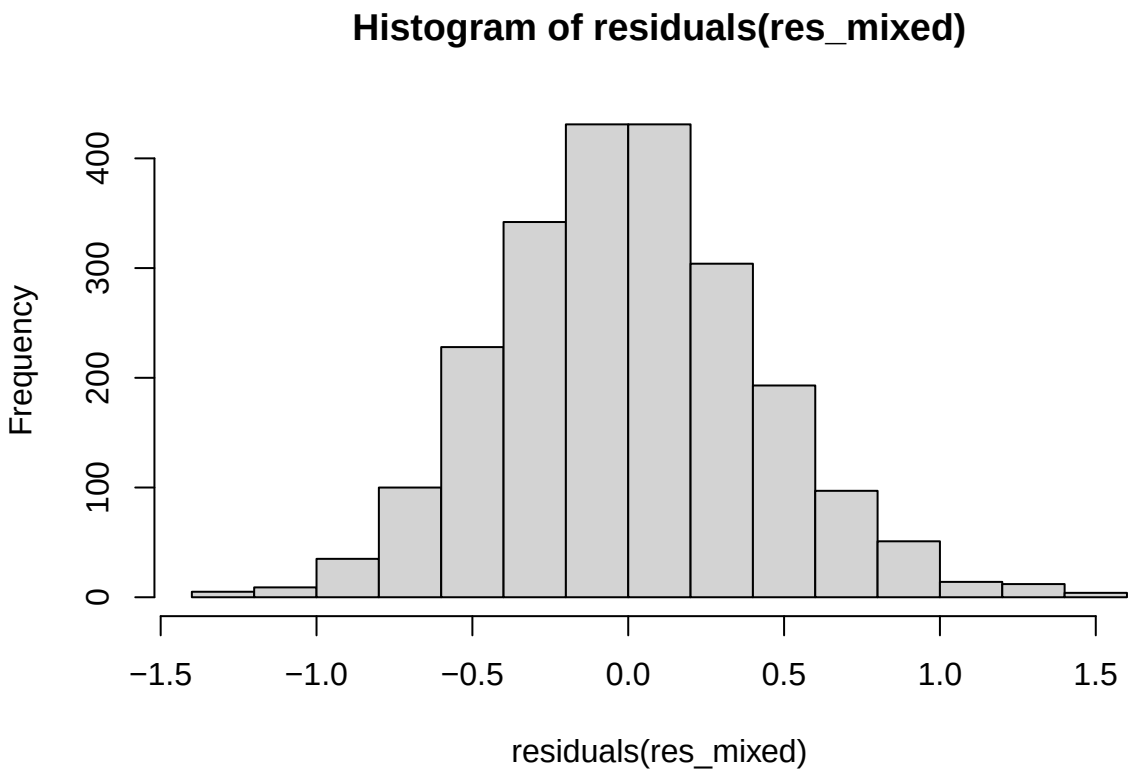
```
# ggplot() +
#   geom_point(data=d_final, aes(Agreement.Scaled, Dwell.Time.Log)) +
#   geom_function(fun=quad_function,
#                 args=list(alpha=summary(res_mixed)[["coefficients"]][1],
#                                       beta1=summary(res_mixed)[["coefficients"]][2],
#                                       beta2=summary(res_mixed)[["coefficients"]][3]),
#                 color="blue",
#                 linewidth=1.5)
```

Residuals analysis

```
qqnorm(residuals(res_mixed))
qqline(residuals(res_mixed))
```




```
hist(residuals(res_mixed))
```




```
ks.test(x=residuals(res_mixed), y='pnorm')
```

```
##
##  Asymptotic one-sample Kolmogorov-Smirnov test
##
## data:  residuals(res_mixed)
## D = 0.20997, p-value < 2.2e-16
## alternative hypothesis: two-sided
```