Group analysis

This document is a group analysis of the impact of training on the duration of taps and trills in Spanish 1 students (6 total). The data is analyzed using linear mixed effects models in which the outcome variable was rhotic duration. The fixed effect predictor was the factor *time* (pre and post test) and the models also included a random intercept per participant to take into account the nested structure of the data. Nested model comparisons were carried out to assess main effects and interactions. Normality of residuals were assessed by a visual inspection of Q-Q plots in each model. All analyses were run in R.

```
srt_101_trill$duration = as.numeric(srt_101_trill$duration)
```

```
## Warning: NAs introduced by coercion
```

```
srt_101_tap$duration = as.numeric(srt_101_tap$duration)
```

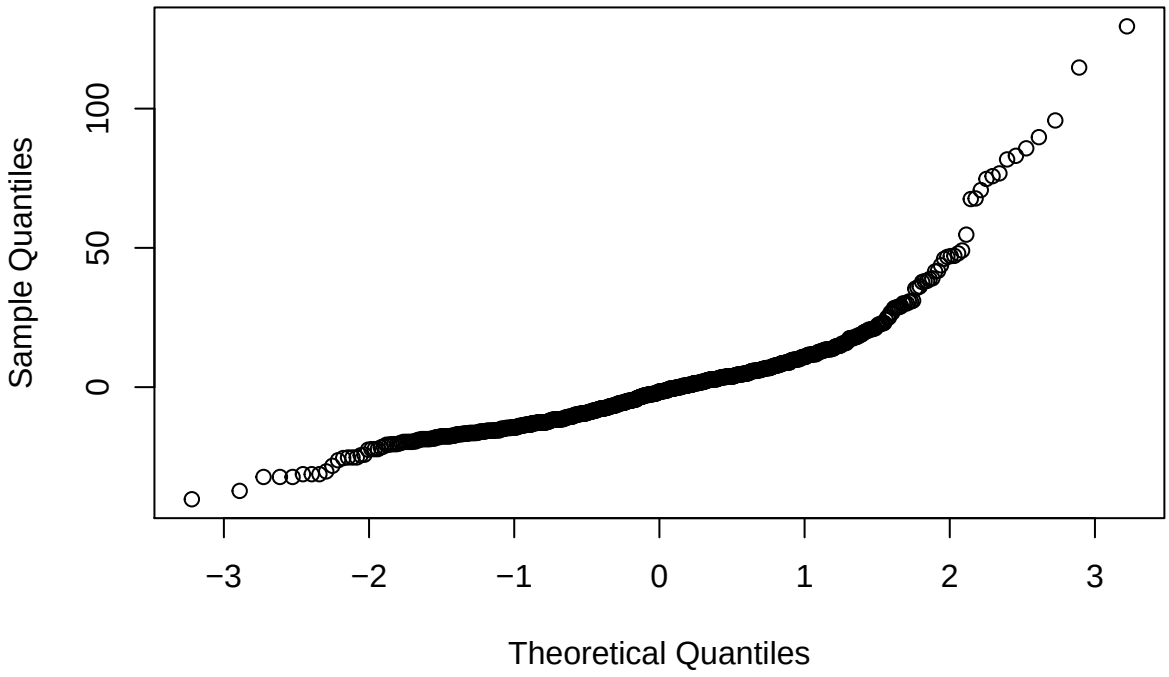
```
## Warning: NAs introduced by coercion
```

```
# Do nested model comparisons to determine
# whether a main effect for time exists

null_mod_tap_sp1 = lmer(duration ~ 1 +
                          (1 | participant),
                        data = srt_101_tap)


time_mod_tap_sp1 = lmer(duration ~ time +
                          (1 | participant),
                        data = srt_101_tap)

anova(null_mod_tap_sp1, time_mod_tap_sp1)
```

```
## refitting model(s) with ML (instead of REML)
```

```
## Data: srt_101_tap
## Models:
## null_mod_tap_sp1: duration ~ 1 + (1 | participant)
## time_mod_tap_sp1: duration ~ time + (1 | participant)
##                  npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
## null_mod_tap_sp1    3 6883.5 6897.4 -3438.7   6877.5
## time_mod_tap_sp1    4 6734.4 6753.1 -3363.2   6726.4 151.04  1  < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
qqnorm(resid(time_mod_tap_sp1))
```




```
null_mod_trill_sp1 = lmer(duration ~ 1 +
                            (1 | participant),
                          data = srt_101_trill)


time_mod_trill_sp1 = lmer(duration ~ time +
                            (1 | participant),
                          data = srt_101_trill)

anova(null_mod_trill_sp1, time_mod_trill_sp1)
```

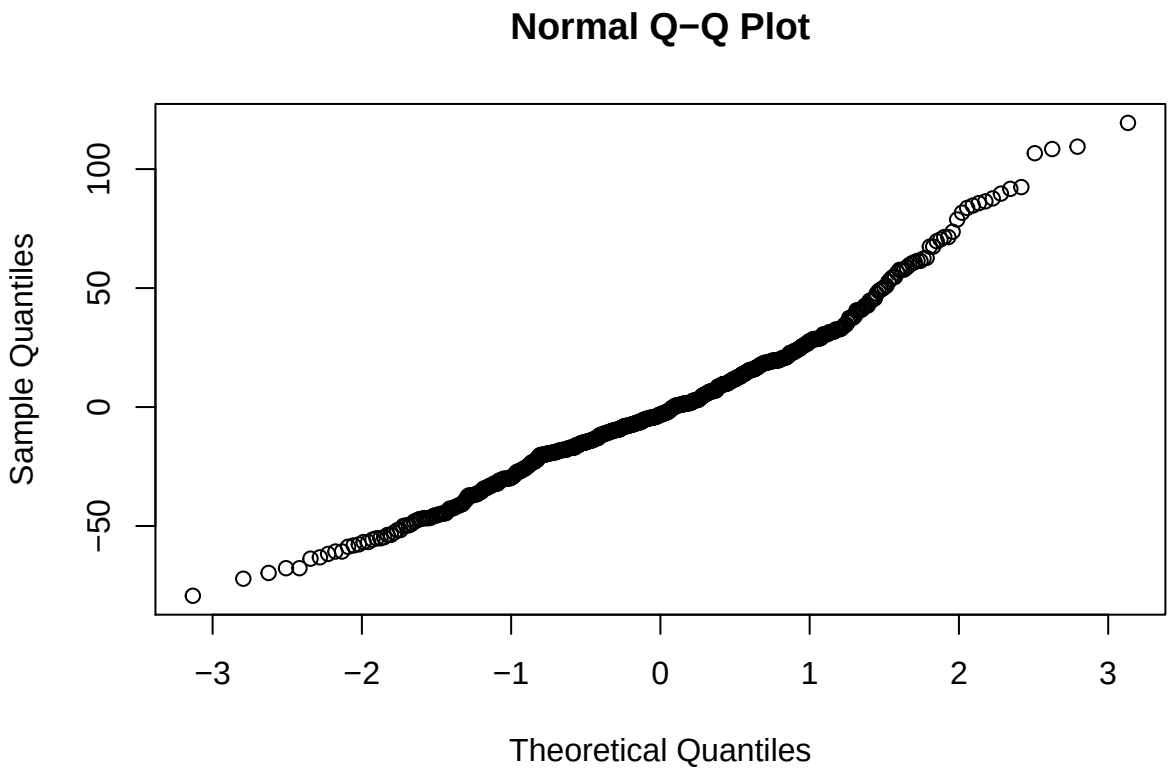
```
## refitting model(s) with ML (instead of REML)
```

```
## Data: srt_101_trill
## Models:
## null_mod_trill_sp1: duration ~ 1 + (1 | participant)
## time_mod_trill_sp1: duration ~ time + (1 | participant)
##                    npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
## null_mod_trill_sp1    3 5743.2 5756.3 -2868.6   5737.2
## time_mod_trill_sp1    4 5643.2 5660.7 -2817.6   5635.2 101.94  1  < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
fixef(time_mod_trill_sp1)
```

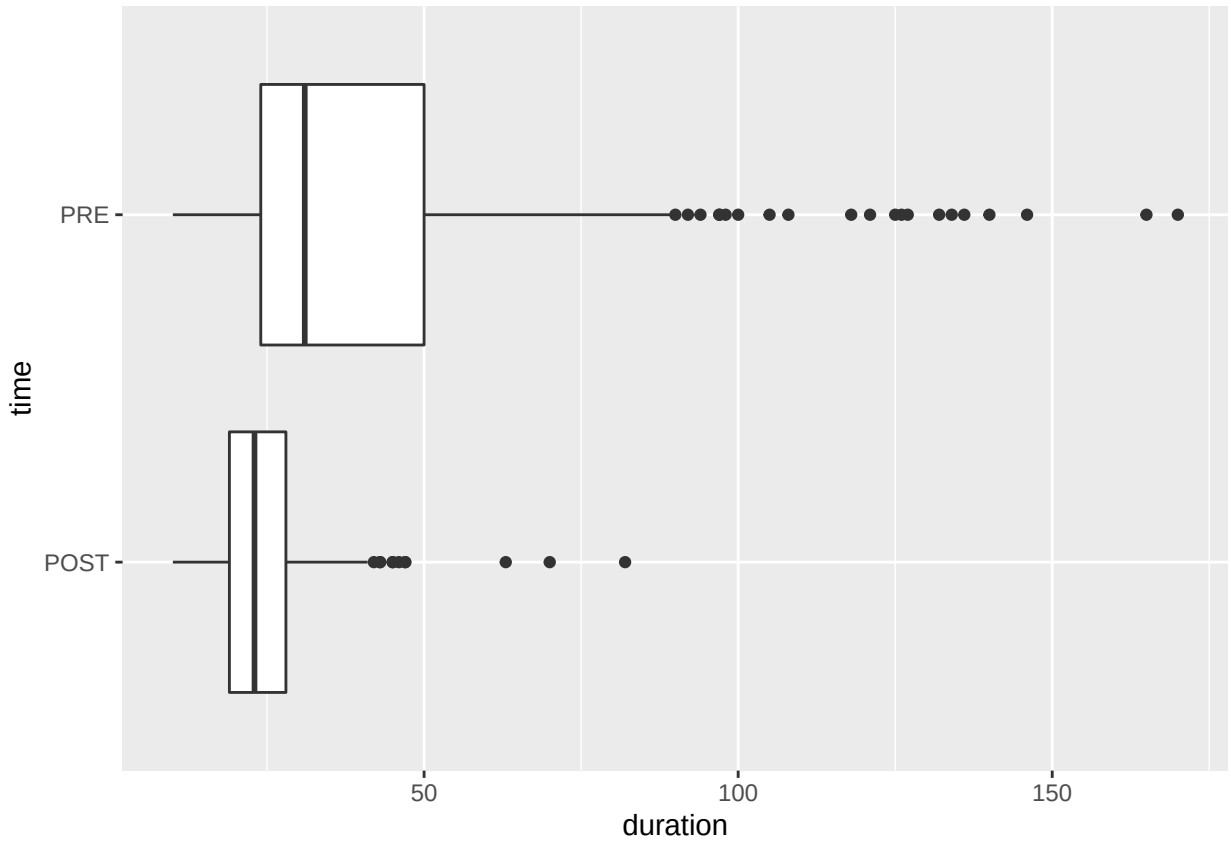
```
## (Intercept)     timePRE
##    84.77896   -27.59351
```

```
qqnorm(resid(time_mod_trill_sp1))
```



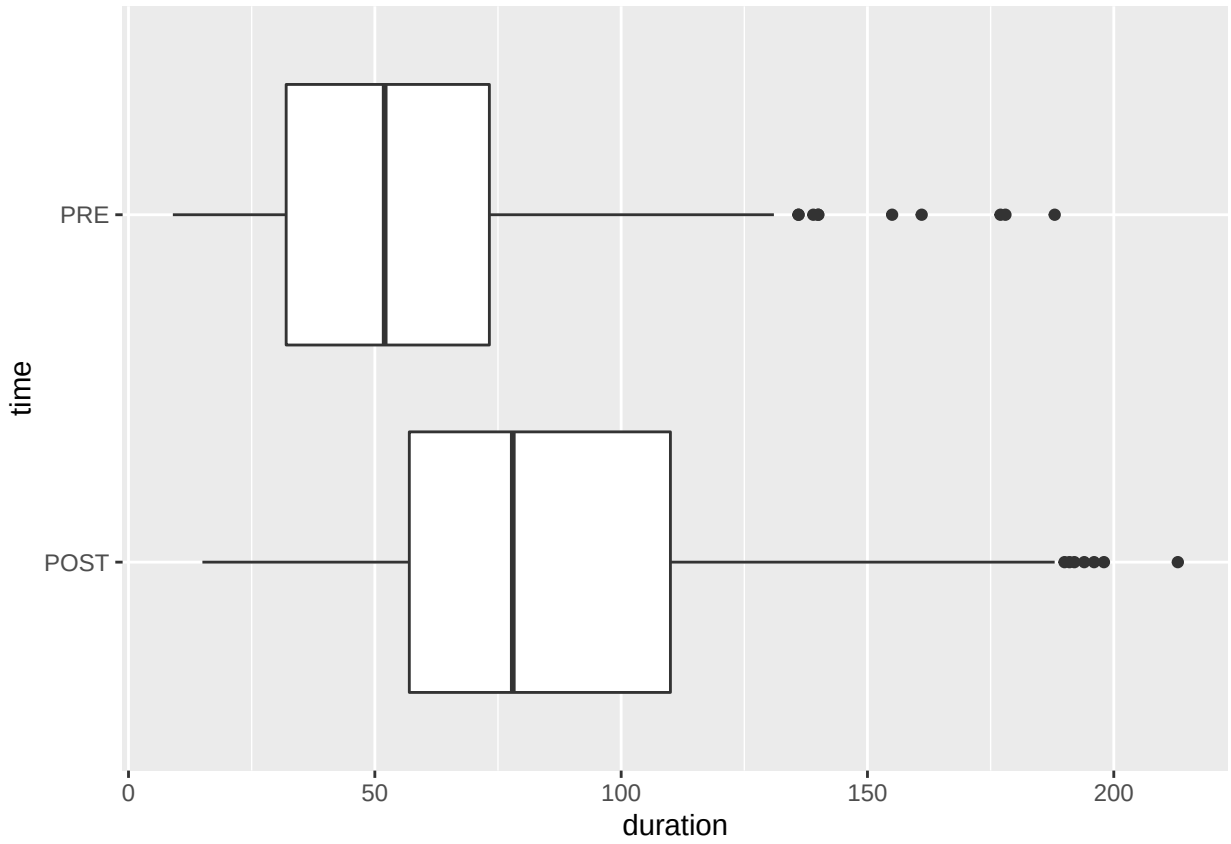

```
srt_101_tap %>%
  ggplot(aes(x = duration, y = time)) + geom_boxplot()
```

```
## Warning: Removed 33 rows containing non-finite values (stat_boxplot).
```




```
srt_101_trill %>%
  ggplot(aes(x = duration, y = time)) + geom_boxplot()
```

```
## Warning: Removed 23 rows containing non-finite values (stat_boxplot).
```




```
summary(time_mod_trill_sp1)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: duration ~ time + (1 | participant)
##    Data: srt_101_trill
##
## REML criterion at convergence: 5625.4
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.5275 -0.5788 -0.0955  0.5673  3.8059
##
## Random effects:
##  Groups      Name        Variance Std.Dev.
##  participant (Intercept) 462.3    21.50
##  Residual                984.7    31.38
## Number of obs: 577, groups:  participant, 6
##
## Fixed effects:
##             Estimate Std. Error      df t value Pr(>|t|)
## (Intercept)   84.779      8.968   5.214   9.454 0.000178 ***
## timePRE      -27.594      2.614 570.024 -10.555  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
```

```
##          (Intr)
## timePRE -0.143
```