Data analysis

MK

2023-07-27

load packages

```
library(tidyverse)
```

```
## ── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0 ──
## ✓ dplyr     1.1.2     ✓ readr     2.1.4
## ✓ forcats   1.0.0     ✓ stringr   1.5.0
## ✓ ggplot2   3.4.2     ✓ tibble    3.2.1
## ✓ lubridate 1.9.2     ✓ tidyr     1.3.0
## ✓ purrr     1.0.1
## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## ✖ dplyr::filter() masks stats::filter()
## ✖ dplyr::lag()    masks stats::lag()
## ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to becom
e errors
```

```
library(lme4)
```

```
## Loading required package: Matrix
##
## Attaching package: 'Matrix'
##
## The following objects are masked from 'package:tidyr':
##
##     expand, pack, unpack
```

```
library(emmeans)
library(car)
```

```
## Loading required package: carData
##
## Attaching package: 'car'
##
## The following object is masked from 'package:dplyr':
##
##     recode
##
## The following object is masked from 'package:purrr':
##
##     some
```

```
library(afex  )
```

```
## ************
## Welcome to afex. For support visit: http://afex.singmann.science/
## - Functions for ANOVAs: aov_car(), aov_ez(), and aov_4()
## - Methods for calculating p-values with mixed(): 'S', 'KR', 'LRT', and 'PB'
## - 'afex_aov' and 'mixed' objects can be passed to emmeans() for follow-up tests
## - Get and set global package options with: afex_options()
## - Set sum-to-zero contrasts globally: set_sum_contrasts()
## - For example analyses see: browseVignettes("afex")
## ************
##
## Attaching package: 'afex'
##
## The following object is masked from 'package:lme4':
##
##     lmer
```

```
contr=lmerControl(optimizer="bobyqa", optCtrl=list(maxfun=1000000))
contr1=glmerControl(optimizer="bobyqa", optCtrl=list(maxfun=1000000))
```

READ IN DATA

```
# read in datasets

fw_df <- read_csv("Data/final_word_region.csv")
```

```
## Rows: 1000 Columns: 19
## ── Column specification ────────────────────────────────────────────────────────
## Delimiter: ","
## chr  (8): idiom, condition, IA_LABEL, phrase_noun, IA_FIRST_RUN_DWELL_TIME, ...
## dbl (11): ppt_id, item_number, unique_item_id, IA_ID, list_number, noun_cloz...
##
## ℹ Use `spec()` to retrieve the full column specification for this data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
idiom_df <- read_csv("Data/whole_phrase_region.csv")
```

```
## Rows: 1000 Columns: 17
## ── Column specification ────────────────────────────────────────────────────────
## Delimiter: ","
## chr  (7): idiom, condition, IA_LABEL, phrase_noun, IA_FIRST_RUN_DWELL_TIME, ...
## dbl (10): ppt_id, item_number, unique_item_id, IA_ID, list_number, noun_cloz...
##
## ℹ Use `spec()` to retrieve the full column specification for this data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
idiom_fam_df <- read_csv("Data/IdiomFamiliarity_df.csv")
```

```
## Rows: 50 Columns: 2
## ── Column specification ────────────────────────────────────────────────────────
## Delimiter: ","
## dbl (2): ppt_id, idiom_familiarity_score
##
## ℹ Use `spec()` to retrieve the full column specification for this data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
idiom_cloz_prob_df <- read_csv("Data/IdiomClozeProbability_df.csv")
```

```
## Rows: 40 Columns: 2
## ── Column specification ────────────────────────────────────────────────────────
## Delimiter: ","
## dbl (2): unique_item_id, Cloze_probability
##
## ℹ Use `spec()` to retrieve the full column specification for this data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
LexTALE_df <- read_csv("Data/LexTALE_df.csv")
```

```
## Rows: 50 Columns: 2
## ── Column specification ────────────────────────────────────────────────────────
## Delimiter: ","
## dbl (2): ppt_id, LexTALE_score
##
## ℹ Use `spec()` to retrieve the full column specification for this data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
idiom_df <- idiom_df %>%
  mutate(condition = as.factor(condition)) %>%
  mutate(IA_FIRST_RUN_DWELL_TIME = as.numeric(IA_FIRST_RUN_DWELL_TIME)) %>%
  mutate(IA_REGRESSION_IN = as.numeric(IA_REGRESSION_IN)) %>%
  mutate(IA_SPILLOVER = as.numeric(IA_SPILLOVER))
```

```
## Warning: There was 1 warning in `mutate()`.
## ℹ In argument: `IA_FIRST_RUN_DWELL_TIME = as.numeric(IA_FIRST_RUN_DWELL_TIME)`.
## Caused by warning:
## ! NAs introduced by coercion
```

```
## Warning: There was 1 warning in `mutate()`.
## ℹ In argument: `IA_REGRESSION_IN = as.numeric(IA_REGRESSION_IN)`.
## Caused by warning:
## ! NAs introduced by coercion
```

```
## Warning: There was 1 warning in `mutate()`.
## ℹ In argument: `IA_SPILLOVER = as.numeric(IA_SPILLOVER)`.
## Caused by warning:
## ! NAs introduced by coercion
```

```
fw_df <- fw_df %>%
  mutate(condition = as.factor(condition)) %>%
  mutate(IA_FIRST_RUN_DWELL_TIME = as.numeric(IA_FIRST_RUN_DWELL_TIME)) %>%
  mutate(IA_REGRESSION_IN = as.numeric(IA_REGRESSION_IN)) %>%
  mutate(IA_SPILLOVER = as.numeric(IA_SPILLOVER)) %>%
  mutate(IA_FIRST_FIXATION_DURATION = as.numeric(IA_FIRST_FIXATION_DURATION))
```

```
## Warning: There was 1 warning in `mutate()`.
## ℹ In argument: `IA_FIRST_RUN_DWELL_TIME = as.numeric(IA_FIRST_RUN_DWELL_TIME)`.
## Caused by warning:
## ! NAs introduced by coercion
```

```
## Warning: There was 1 warning in `mutate()`.
## ℹ In argument: `IA_REGRESSION_IN = as.numeric(IA_REGRESSION_IN)`.
## Caused by warning:
## ! NAs introduced by coercion
```

```
## Warning: There was 1 warning in `mutate()`.
## ℹ In argument: `IA_SPILLOVER = as.numeric(IA_SPILLOVER)`.
## Caused by warning:
## ! NAs introduced by coercion
```

```
## Warning: There was 1 warning in `mutate()`.
## ℹ In argument: `IA_FIRST_FIXATION_DURATION =
##   as.numeric(IA_FIRST_FIXATION_DURATION)`.
## Caused by warning:
## ! NAs introduced by coercion
```

```
# Removing outliers

idiom_df <- idiom_df %>%
  mutate(IA_FIRST_RUN_DWELL_TIME = replace_na(IA_FIRST_RUN_DWELL_TIME,0)) %>%
  mutate(IA_DWELL_TIME = replace_na(IA_DWELL_TIME,0)) %>%
  mutate(IA_SPILLOVER = replace_na(IA_SPILLOVER, 0)) %>% # replace NA values with 0s in reading
time measures
  filter(IA_FIRST_RUN_DWELL_TIME <= 2000) %>%
  filter(IA_DWELL_TIME <= 2500)



fw_df <- fw_df %>%
  mutate(IA_FIRST_FIXATION_DURATION = replace_na(IA_FIRST_FIXATION_DURATION,0)) %>%
  filter(IA_FIRST_FIXATION_DURATION < 600)
```

```
# Join eye-tracking datasets with lextale, idiom familiarity and cloze probability datasets

idiom_df <- idiom_df %>%
  inner_join(idiom_fam_df, "ppt_id") %>%
  inner_join(LexTALE_df, "ppt_id") %>%
  inner_join(idiom_cloz_prob_df, "unique_item_id")

fw_df <- fw_df %>%
  inner_join(idiom_fam_df, "ppt_id") %>%
  inner_join(LexTALE_df, "ppt_id") %>%
  inner_join(idiom_cloz_prob_df, "unique_item_id")
```

```
# Combining eye-tracking datasets to
# spot track loss cases (where no fixations
# where made in idiom region and registered as
# 'skipped' in final word region)

combined_dfs <- idiom_df %>%
  full_join(fw_df, c("ppt_id", "unique_item_id", "item_number", "condition"))


combined_dfs <- combined_dfs %>%
  mutate(track_loss_cases = if_else(IA_DWELL_TIME.x == 0 & IA_SKIP == 1, 1,0))

combined_dfs %>%
  filter(track_loss_cases == "1") %>%
  group_by(condition) %>%
  summarise(cases = n()) %>%
  ungroup()
```

```
## # A tibble: 2 × 2
##   condition cases
##   <fct>     <int>
## 1 ID-LIT       10
## 2 nonID-LIT     6
```

```
combined_dfs <- combined_dfs %>%
  filter(track_loss_cases ==1)%>%
  select(item_number, condition, ppt_id, track_loss_cases)
```

```
fw_df <- fw_df %>%
  left_join(combined_dfs, c("item_number", "condition", "ppt_id")) %>%
  mutate(track_loss_cases = replace_na(track_loss_cases, 0))

# remove track loss cases from fw_df

fw_df <- fw_df %>%
  filter(track_loss_cases !=1)
```

```
# check for correlation between lextale scores and idiom familiarity scores

cor(idiom_df$idiom_familiarity_score,idiom_df$LexTALE_score, method = "pearson")
```

```
## [1] 0.5966319
```

```
cor(idiom_df$idiom_familiarity_score,idiom_df$noun_frequency, method = "pearson")
```

```
## [1] -0.001214499
```

```
cor(idiom_df$TRIAL_INDEX,idiom_df$noun_frequency, method = "pearson")
```

```
## [1] 0.01626599
```

```
## high correlation
```

MODELS

Final Word Region

```
fw_df <- fw_df %>%
  mutate(z.LexTALE_score = scale(LexTALE_score, center = TRUE, scale = FALSE))%>%
  mutate(z.Trial_Index = scale(TRIAL_INDEX, center = TRUE, scale = FALSE))
```

First fixation duration

```
fw_firstfixdur.mod1 <- lmer(log(IA_FIRST_FIXATION_DURATION) ~ 1 + condition * (z.LexTALE_score
                           + TRIAL_INDEX) +
                      (1+condition + TRIAL_INDEX|ppt_id)+
                      (1+condition * (z.LexTALE_score + TRIAL_INDEX)|item_number),
                       data = fw_df %>%
                      filter(IA_FIRST_FIXATION_DURATION >0), REML = FALSE,
                    control = contr
                    )
```

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

```
## Warning: Model failed to converge with 2 negative eigenvalues: -2.0e-01
## -5.7e+00
```

```
summary(fw_firstfixdur.mod1)
```

```
## Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
##   method [lmerModLmerTest]
## Formula: log(IA_FIRST_FIXATION_DURATION) ~ 1 + condition * (z.LexTALE_score +
##     TRIAL_INDEX) + (1 + condition + TRIAL_INDEX | ppt_id) + (1 +
##     condition * (z.LexTALE_score + TRIAL_INDEX) | item_number)
##    Data: fw_df %>% filter(IA_FIRST_FIXATION_DURATION > 0)
## Control: contr
##
##      AIC      BIC   logLik deviance df.resid
##    383.5    542.5   -157.7    315.5      759
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -7.6485 -0.5967 -0.0239  0.5525  2.9834
##
## Random effects:
##  Groups      Name                                Variance  Std.Dev. Corr
##  ppt_id      (Intercept)                         0.000e+00 0.000000
##              conditionnonID-LIT                  4.793e-03 0.069229  NaN
##              TRIAL_INDEX                         3.597e-06 0.001897  NaN  1.00
##  item_number (Intercept)                         3.087e-03 0.055561
##              conditionnonID-LIT                  2.754e-03 0.052476 -0.96
##              z.LexTALE_score                     9.888e-06 0.003145 -0.62  0.37
##              TRIAL_INDEX                         2.926e-06 0.001711 -0.89  0.79
##              conditionnonID-LIT:z.LexTALE_score 1.969e-05 0.004438  0.71 -0.48
##              conditionnonID-LIT:TRIAL_INDEX      5.965e-06 0.002442  0.32 -0.35
##  Residual                                        7.961e-02 0.282149
##
##
##
##
##
##
##
##   0.73
##  -0.99 -0.82
##  -0.10  0.11  0.08
##
## Number of obs: 793, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                    Estimate Std. Error         df t value
## (Intercept)                        5.449e+00  3.203e-02  3.088e+01 170.100
## conditionnonID-LIT                -5.128e-02  4.460e-02  6.530e+01  -1.150
## z.LexTALE_score                   -1.779e-03  1.332e-03  2.242e+01  -1.335
## TRIAL_INDEX                       -2.067e-03  1.351e-03  6.636e+01  -1.531
## conditionnonID-LIT:z.LexTALE_score  3.765e-05  1.960e-03  2.246e+01   0.019
## conditionnonID-LIT:TRIAL_INDEX      2.109e-03  1.886e-03  6.714e+01   1.118
##                                   Pr(>|t|)
## (Intercept)                         <2e-16 ***
## conditionnonID-LIT                   0.254
## z.LexTALE_score                      0.195
```

```
## TRIAL_INDEX                          0.131
## conditionnonID-LIT:z.LexTALE_score    0.985
## conditionnonID-LIT:TRIAL_INDEX        0.267
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL TRIAL_ cID-LIT:.
## cndtnID-LIT -0.709
## z.LxTALE_sc -0.077  0.017
## TRIAL_INDEX -0.854  0.647    0.080
## cID-LIT:.LT  0.116 -0.016   -0.584 -0.109
## cID-LIT:TRI  0.579 -0.812    0.007 -0.623 -0.020
## optimizer (bobyqa) convergence code: 0 (OK)
## boundary (singular) fit: see help('isSingular')
```

```
fw_firstfixdur.mod0.1 <- lmer(log(IA_FIRST_FIXATION_DURATION) ~ 1 + condition * (z.LexTALE_score
                          + TRIAL_INDEX) +
                    (1+condition + TRIAL_INDEX|ppt_id)+
                    (1+condition * (z.LexTALE_score + TRIAL_INDEX)||item_number),
                     data = fw_df %>%
                    filter(IA_FIRST_FIXATION_DURATION >0), REML = FALSE,
                  control = contr
                  )
```

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

```
summary(fw_firstfixdur.mod0.1)
```

```
## Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
##   method [lmerModLmerTest]
## Formula: log(IA_FIRST_FIXATION_DURATION) ~ 1 + condition * (z.LexTALE_score +
##     TRIAL_INDEX) + (1 + condition + TRIAL_INDEX | ppt_id) + (1 +
##     condition * (z.LexTALE_score + TRIAL_INDEX) || item_number)
##    Data: fw_df %>% filter(IA_FIRST_FIXATION_DURATION > 0)
## Control: contr
##
##      AIC      BIC   logLik deviance df.resid
##    357.2    474.1   -153.6    307.2      768
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -7.8362 -0.5756 -0.0298  0.5536  2.8886
##
## Random effects:
##  Groups        Name                              Variance  Std.Dev.  Corr
##  ppt_id        (Intercept)                       9.029e-03 9.502e-02
##                conditionnonID-LIT                3.245e-03 5.696e-02  0.04
##                TRIAL_INDEX                       7.538e-07 8.682e-04 -0.83
##  item_number   (Intercept)                       3.007e-11 5.483e-06
##  item_number.1 conditionID-LIT                   6.232e-04 2.496e-02
##                conditionnonID-LIT                4.283e-05 6.544e-03 -1.00
##  item_number.2 z.LexTALE_score                   0.000e+00 0.000e+00
##  item_number.3 TRIAL_INDEX                       0.000e+00 0.000e+00
##  item_number.4 conditionID-LIT:z.LexTALE_score   7.349e-06 2.711e-03
##                conditionnonID-LIT:z.LexTALE_score 9.540e-07 9.767e-04 -1.00
##  item_number.5 conditionID-LIT:TRIAL_INDEX       3.162e-07 5.623e-04
##                conditionnonID-LIT:TRIAL_INDEX    9.120e-06 3.020e-03 1.00
##  Residual                                        7.786e-02 2.790e-01
##
##
##
##   0.52
##
##
##
##
##
##
##
##
##
##
## Number of obs: 793, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                    Estimate Std. Error         df t value
## (Intercept)                       5.437e+00  3.290e-02  9.511e+01 165.267
## conditionnonID-LIT               -3.699e-02  4.303e-02  1.970e+02  -0.860
## z.LexTALE_score                  -1.555e-03  1.506e-03  2.956e+01  -1.033
## TRIAL_INDEX                      -1.596e-03  1.276e-03  4.338e+02  -1.250
```

```
## conditionnonID-LIT:z.LexTALE_score  3.756e-05  1.824e-03  1.895e+01   0.021
## conditionnonID-LIT:TRIAL_INDEX      1.528e-03  1.872e-03  2.118e+02   0.816
##                                    Pr(>|t|)
## (Intercept)                          <2e-16 ***
## conditionnonID-LIT                    0.391
## z.LexTALE_score                       0.310
## TRIAL_INDEX                           0.212
## conditionnonID-LIT:z.LexTALE_score    0.984
## conditionnonID-LIT:TRIAL_INDEX        0.415
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL TRIAL_ cID-LIT:.
## cndtnID-LIT -0.639
## z.LxTALE_sc  0.036 -0.030
## TRIAL_INDEX -0.811  0.605   -0.021
## cID-LIT:.LT -0.034  0.060   -0.554  0.021
## cID-LIT:TRI  0.532 -0.811    0.015 -0.641 -0.042
## optimizer (bobyqa) convergence code: 0 (OK)
## boundary (singular) fit: see help('isSingular')
```

```
fw_firstfixdur.mod0.2 <- lmer(log(IA_FIRST_FIXATION_DURATION) ~ 1 + condition * z.LexTALE_score+
                    (1+condition|ppt_id)+
                    (1+condition|item_number),
                     data = fw_df %>%
                    filter(IA_FIRST_FIXATION_DURATION >0), REML = FALSE,
                  control = contr)
```

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

```
## Warning: Model failed to converge with 1 negative eigenvalue: -3.5e+02
```

```
summary(fw_firstfixdur.mod0.2)
```

```
## Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
##   method [lmerModLmerTest]
## Formula: log(IA_FIRST_FIXATION_DURATION) ~ 1 + condition * z.LexTALE_score +
##     (1 + condition | ppt_id) + (1 + condition | item_number)
##    Data: fw_df %>% filter(IA_FIRST_FIXATION_DURATION > 0)
## Control: contr
##
##      AIC      BIC   logLik deviance df.resid
##    354.1    405.6   -166.1    332.1      782
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -7.8042 -0.6287 -0.0387  0.5682  3.0694
##
## Random effects:
##  Groups      Name                Variance  Std.Dev. Corr
##  ppt_id      (Intercept)         0.0000000 0.00000
##              conditionnonID-LIT  0.0107848 0.10385   NaN
##  item_number (Intercept)         0.0002949 0.01717
##              conditionnonID-LIT  0.0025312 0.05031  0.17
##  Residual                        0.0839397 0.28972
## Number of obs: 793, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                    Estimate Std. Error         df t value
## (Intercept)                        5.406e+00  1.510e-02  2.085e+01 358.011
## conditionnonID-LIT                -7.386e-03  2.783e-02  2.933e+01  -0.265
## z.LexTALE_score                   -1.784e-03  1.084e-03  6.871e+02  -1.645
## conditionnonID-LIT:z.LexTALE_score  3.331e-04  1.926e-03  8.235e+01   0.173
##                                   Pr(>|t|)
## (Intercept)                         <2e-16 ***
## conditionnonID-LIT                   0.793
## z.LexTALE_score                      0.100
## conditionnonID-LIT:z.LexTALE_score   0.863
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL
## cndtnID-LIT -0.490
## z.LxTALE_sc  0.062 -0.034
## cID-LIT:.LT -0.035  0.035   -0.563
## optimizer (bobyqa) convergence code: 0 (OK)
## boundary (singular) fit: see help('isSingular')
```

```
fw_firstfixdur.mod0.3 <- lmer(log(IA_FIRST_FIXATION_DURATION) ~ 1 + condition * z.LexTALE_score+
                      (1+condition|ppt_id)+
                      (1+condition|item_number),
                       data = fw_df %>%
                      filter(IA_FIRST_FIXATION_DURATION >0), REML = FALSE,
                    control = contr)
```

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

```
## Warning: Model failed to converge with 1 negative eigenvalue: -3.5e+02
```

```
summary(fw_firstfixdur.mod0.3)
```

```
## Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
##   method [lmerModLmerTest]
## Formula: log(IA_FIRST_FIXATION_DURATION) ~ 1 + condition * z.LexTALE_score +
##     (1 + condition | ppt_id) + (1 + condition | item_number)
##    Data: fw_df %>% filter(IA_FIRST_FIXATION_DURATION > 0)
## Control: contr
##
##      AIC      BIC   logLik deviance df.resid
##    354.1    405.6   -166.1    332.1      782
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -7.8042 -0.6287 -0.0387  0.5682  3.0694
##
## Random effects:
##  Groups      Name                Variance  Std.Dev. Corr
##  ppt_id      (Intercept)         0.0000000 0.00000
##              conditionnonID-LIT  0.0107848 0.10385   NaN
##  item_number (Intercept)         0.0002949 0.01717
##              conditionnonID-LIT  0.0025312 0.05031  0.17
##  Residual                        0.0839397 0.28972
## Number of obs: 793, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                    Estimate Std. Error         df t value
## (Intercept)                         5.406e+00  1.510e-02  2.085e+01 358.011
## conditionnonID-LIT                 -7.386e-03  2.783e-02  2.933e+01  -0.265
## z.LexTALE_score                    -1.784e-03  1.084e-03  6.871e+02  -1.645
## conditionnonID-LIT:z.LexTALE_score  3.331e-04  1.926e-03  8.235e+01   0.173
##                                    Pr(>|t|)
## (Intercept)                          <2e-16 ***
## conditionnonID-LIT                    0.793
## z.LexTALE_score                       0.100
## conditionnonID-LIT:z.LexTALE_score    0.863
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL
## cndtnID-LIT -0.490
## z.LxTALE_sc  0.062 -0.034
## cID-LIT:.LT -0.035  0.035   -0.563
## optimizer (bobyqa) convergence code: 0 (OK)
## boundary (singular) fit: see help('isSingular')
```

```
fw_firstfixdur.mod0.4 <- lmer(log(IA_FIRST_FIXATION_DURATION) ~ 1 + condition * z.LexTALE_score+
                      (1+condition|ppt_id)+
                      (1|item_number),
                       data = fw_df %>%
                      filter(IA_FIRST_FIXATION_DURATION >0), REML = FALSE,
                    control = contr)
```

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

```
## Warning: Model failed to converge with 1 negative eigenvalue: -8.4e+02
```

```
summary(fw_firstfixdur.mod0.4)
```

```
## Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
##   method [lmerModLmerTest]
## Formula: log(IA_FIRST_FIXATION_DURATION) ~ 1 + condition * z.LexTALE_score +
##     (1 + condition | ppt_id) + (1 | item_number)
##    Data: fw_df %>% filter(IA_FIRST_FIXATION_DURATION > 0)
## Control: contr
##
##      AIC      BIC   logLik deviance df.resid
##    351.9    394.0   -166.9    333.9      784
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -7.8985 -0.6455 -0.0500  0.5497  3.0539
##
## Random effects:
##  Groups      Name               Variance Std.Dev. Corr
##  ppt_id      (Intercept)        0.000000 0.00000
##              conditionnonID-LIT 0.010501 0.10247   NaN
##  item_number (Intercept)        0.001004 0.03168
##  Residual                       0.084660 0.29096
## Number of obs: 793, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                    Estimate Std. Error         df t value
## (Intercept)                        5.405e+00  1.631e-02  5.407e+01 331.450
## conditionnonID-LIT                -7.947e-03  2.540e-02  1.052e+02  -0.313
## z.LexTALE_score                   -1.817e-03  1.090e-03  7.214e+02  -1.667
## conditionnonID-LIT:z.LexTALE_score  3.895e-04  1.922e-03  9.640e+01   0.203
##                                   Pr(>|t|)
## (Intercept)                         <2e-16 ***
## conditionnonID-LIT                  0.7550
## z.LexTALE_score                     0.0959 .
## conditionnonID-LIT:z.LexTALE_score  0.8398
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL
## cndtnID-LIT -0.520
## z.LxTALE_sc  0.060 -0.038
## cID-LIT:.LT -0.034  0.040   -0.568
## optimizer (bobyqa) convergence code: 0 (OK)
## boundary (singular) fit: see help('isSingular')
```

```
fw_firstfixdur.mod0.5 <- lmer(log(IA_FIRST_FIXATION_DURATION) ~ 1 + condition * z.LexTALE_score+
                     (1|ppt_id)+
                     (1|item_number),
                      data = fw_df %>%
                     filter(IA_FIRST_FIXATION_DURATION >0), REML = FALSE,
                    control = contr)

summary(fw_firstfixdur.mod0.5)
```

```
## Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
##   method [lmerModLmerTest]
## Formula: log(IA_FIRST_FIXATION_DURATION) ~ 1 + condition * z.LexTALE_score +
##     (1 | ppt_id) + (1 | item_number)
##    Data: fw_df %>% filter(IA_FIRST_FIXATION_DURATION > 0)
## Control: contr
##
##      AIC      BIC   logLik deviance df.resid
##    332.0    364.8   -159.0    318.0      786
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -8.3993 -0.5986 -0.0299  0.5601  2.8909
##
## Random effects:
##  Groups      Name        Variance Std.Dev.
##  ppt_id      (Intercept) 0.008061 0.08978
##  item_number (Intercept) 0.001059 0.03254
##  Residual                0.081593 0.28564
## Number of obs: 793, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                   Estimate Std. Error         df t value
## (Intercept)                       5.404e+00  2.060e-02  6.603e+01 262.373
## conditionnonID-LIT               -6.864e-03  2.044e-02  7.409e+02  -0.336
## z.LexTALE_score                  -1.713e-03  1.458e-03  8.926e+01  -1.175
## conditionnonID-LIT:z.LexTALE_score  1.681e-04  1.527e-03  7.384e+02   0.110
##                                  Pr(>|t|)
## (Intercept)                        <2e-16 ***
## conditionnonID-LIT                  0.737
## z.LexTALE_score                     0.243
## conditionnonID-LIT:z.LexTALE_score    0.912
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL
## cndtnID-LIT -0.497
## z.LxTALE_sc  0.034 -0.035
## cID-LIT:.LT -0.034  0.061   -0.517
```

```
fw_firstfixdur.mod.null <- lmer(log(IA_FIRST_FIXATION_DURATION) ~ 1 + z.LexTALE_score+
                     (1|ppt_id)+
                     (1|item_number),
                      data = fw_df %>%
                     filter(IA_FIRST_FIXATION_DURATION >0), REML = FALSE,
                   control = contr)

summary(fw_firstfixdur.mod.null)
```

```
## Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
##   method [lmerModLmerTest]
## Formula: log(IA_FIRST_FIXATION_DURATION) ~ 1 + z.LexTALE_score + (1 |
##     ppt_id) + (1 | item_number)
##    Data: fw_df %>% filter(IA_FIRST_FIXATION_DURATION > 0)
## Control: contr
##
##      AIC      BIC   logLik deviance df.resid
##    328.2    351.5   -159.1    318.2      788
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -8.4095 -0.5858 -0.0350  0.5607  2.8818
##
## Random effects:
##  Groups      Name        Variance Std.Dev.
##  ppt_id      (Intercept) 0.008051 0.08973
##  item_number (Intercept) 0.001054 0.03246
##  Residual                0.081614 0.28568
## Number of obs: 793, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                  Estimate Std. Error        df t value Pr(>|t|)
## (Intercept)      5.401012   0.017866 37.567524 302.305   <2e-16 ***
## z.LexTALE_score -0.001632   0.001247 48.375875  -1.309    0.197
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr)
## z.LxTALE_sc 0.019
```

```
anova(fw_firstfixdur.mod.null, fw_firstfixdur.mod0.5)
```

```
## Data: fw_df %>% filter(IA_FIRST_FIXATION_DURATION > 0)
## Models:
## fw_firstfixdur.mod.null: log(IA_FIRST_FIXATION_DURATION) ~ 1 + z.LexTALE_score + (1 | ppt_id)
+ (1 | item_number)
## fw_firstfixdur.mod0.5: log(IA_FIRST_FIXATION_DURATION) ~ 1 + condition * z.LexTALE_score + (1
| ppt_id) + (1 | item_number)
##                          npar    AIC    BIC  logLik deviance  Chisq Df
## fw_firstfixdur.mod.null    5 328.17 351.55 -159.09   318.17
## fw_firstfixdur.mod0.5      7 332.04 364.77 -159.02   318.04 0.1297  2
##                          Pr(>Chisq)
## fw_firstfixdur.mod.null
## fw_firstfixdur.mod0.5       0.9372
```

Skipping likelihood

```
fw_skipping.mod0 <- glmer(IA_SKIP ~ 1 + condition * z.LexTALE_score + TRIAL_INDEX +
                     (1+condition + TRIAL_INDEX|ppt_id)+
                     (1+condition * z.LexTALE_score + TRIAL_INDEX|item_number),
                      data = fw_df,
                    family = "binomial",
                    control = contr1
                    )
```

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

```
summary(fw_skipping.mod0)
```

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: IA_SKIP ~ 1 + condition * z.LexTALE_score + TRIAL_INDEX + (1 +
##     condition + TRIAL_INDEX | ppt_id) + (1 + condition * z.LexTALE_score +
##     TRIAL_INDEX | item_number)
##    Data: fw_df
## Control: contr1
##
##      AIC      BIC   logLik deviance df.resid
##   1105.7   1232.8   -526.9   1053.7      955
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -1.9682 -0.5668 -0.3941  0.6789  4.3701
##
## Random effects:
##  Groups      Name                                Variance  Std.Dev. Corr
##  ppt_id      (Intercept)                         2.550e-01 0.504961
##              conditionnonID-LIT                  3.287e-02 0.181307 1.00
##              TRIAL_INDEX                         8.885e-05 0.009426 1.00  1.00
##  item_number (Intercept)                         3.933e-01 0.627170
##              conditionnonID-LIT                  1.744e-01 0.417590 -0.20
##              z.LexTALE_score                     5.062e-04 0.022498 -0.37 -0.69
##              TRIAL_INDEX                         7.256e-04 0.026937 -0.46 -0.55
##              conditionnonID-LIT:z.LexTALE_score 1.193e-03 0.034540 -0.57  0.58
##
##
##
##
##
##
##
##
##   0.85
##  -0.46 -0.10
## Number of obs: 981, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)                     -1.201017   0.250111  -4.802 1.57e-06 ***
## conditionnonID-LIT              -0.022431   0.206453  -0.109  0.91348
## z.LexTALE_score                  0.041547   0.014390   2.887  0.00389 **
## TRIAL_INDEX                     -0.002492   0.009745  -0.256  0.79814
## conditionnonID-LIT:z.LexTALE_score  0.003680   0.017667   0.208  0.83500
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL TRIAL_
## cndtnID-LIT -0.318
## z.LxTALE_sc -0.195  0.030
## TRIAL_INDEX -0.572 -0.149    0.177
```

```
## cID-LIT:.LT -0.037 -0.141   -0.472 -0.042
## optimizer (bobyqa) convergence code: 0 (OK)
## boundary (singular) fit: see help('isSingular')
```

```
vif(fw_skipping.mod0)
```

```
##                 condition           z.LexTALE_score               TRIAL_INDEX
##                  1.045974                  1.329522                  1.059134
## condition:z.LexTALE_score
##                  1.314798
```

```
fw_skipping.mod0.1 <- glmer(IA_SKIP ~ 1 + condition * z.LexTALE_score +
                     (1+condition|ppt_id)+
                     (1+condition + z.LexTALE_score |item_number),
                      data = fw_df,
                    family = "binomial",
                    #control = contr1
                    )
```

```
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, :
## Model failed to converge with max|grad| = 0.0128105 (tol = 0.002, component 1)
```

```
summary(fw_skipping.mod0.1)
```

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: IA_SKIP ~ 1 + condition * z.LexTALE_score + (1 + condition |
##     ppt_id) + (1 + condition + z.LexTALE_score | item_number)
##    Data: fw_df
##
##      AIC      BIC   logLik deviance df.resid
##   1089.6   1153.2   -531.8   1063.6      968
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -1.7946 -0.5777 -0.4231  0.7555  3.2881
##
## Random effects:
##  Groups      Name                Variance Std.Dev. Corr
##  ppt_id      (Intercept)         0.432008 0.65727
##              conditionnonID-LIT  0.029102 0.17059  1.00
##  item_number (Intercept)         0.431751 0.65708
##              conditionnonID-LIT  0.256340 0.50630  -0.76
##              z.LexTALE_score     0.000118 0.01086  -0.51 -0.18
## Number of obs: 981, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                    Estimate Std. Error z value Pr(>|z|)
## (Intercept)                       -1.222164   0.213797  -5.716 1.09e-08 ***
## conditionnonID-LIT                 0.015851   0.208699   0.076  0.93946
## z.LexTALE_score                    0.041307   0.013128   3.147  0.00165 **
## conditionnonID-LIT:z.LexTALE_score -0.003458   0.014391  -0.240  0.81012
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL
## cndtnID-LIT -0.572
## z.LxTALE_sc -0.206  0.106
## cID-LIT:.LT  0.106 -0.214   -0.474
## optimizer (Nelder_Mead) convergence code: 0 (OK)
## Model failed to converge with max|grad| = 0.0128105 (tol = 0.002, component 1)
```

```
fw_skipping.mod0.2 <- glmer(IA_SKIP ~ 1 + condition * z.LexTALE_score +
                     (1+condition|ppt_id)+
                     (1+condition|item_number),
                      data = fw_df,
                    family = "binomial",
                    #control = contr1
                    )
```

```
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, :
## Model failed to converge with max|grad| = 0.0459811 (tol = 0.002, component 1)
```

```
summary(fw_skipping.mod0.2)
```

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: IA_SKIP ~ 1 + condition * z.LexTALE_score + (1 + condition |
##     ppt_id) + (1 + condition | item_number)
##    Data: fw_df
##
##      AIC      BIC   logLik deviance df.resid
##   1084.7   1133.5   -532.3   1064.7      971
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -1.6306 -0.5714 -0.4198  0.7456  3.3226
##
## Random effects:
##  Groups      Name               Variance Std.Dev. Corr
##  ppt_id      (Intercept)        0.42827  0.6544
##              conditionnonID-LIT 0.02927  0.1711   1.00
##  item_number (Intercept)        0.41064  0.6408
##              conditionnonID-LIT 0.24416  0.4941   -0.79
## Number of obs: 981, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)                     -1.204625   0.209571  -5.748 9.03e-09 ***
## conditionnonID-LIT               0.016265   0.205970   0.079  0.93706
## z.LexTALE_score                  0.038899   0.012391   3.139  0.00169 **
## conditionnonID-LIT:z.LexTALE_score -0.004168   0.014035  -0.297  0.76649
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL
## cndtnID-LIT -0.581
## z.LxTALE_sc -0.117  0.112
## cID-LIT:.LT  0.098 -0.191   -0.487
## optimizer (Nelder_Mead) convergence code: 0 (OK)
## Model failed to converge with max|grad| = 0.0459811 (tol = 0.002, component 1)
```

```
fw_skipping.mod0.3 <- glmer(IA_SKIP ~ 1 + condition * z.LexTALE_score +
                      (1+condition|ppt_id)+
                      (1+condition|item_number),
                       data = fw_df,
                     family = "binomial",
                     #control = contr1
                     )
```

```
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, :
## Model failed to converge with max|grad| = 0.0459811 (tol = 0.002, component 1)
```

```
summary(fw_skipping.mod0.3)
```

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: IA_SKIP ~ 1 + condition * z.LexTALE_score + (1 + condition |
##     ppt_id) + (1 + condition | item_number)
##    Data: fw_df
##
##      AIC      BIC   logLik deviance df.resid
##   1084.7   1133.5   -532.3   1064.7      971
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -1.6306 -0.5714 -0.4198  0.7456  3.3226
##
## Random effects:
##  Groups      Name               Variance Std.Dev. Corr
##  ppt_id      (Intercept)        0.42827  0.6544
##              conditionnonID-LIT 0.02927  0.1711   1.00
##  item_number (Intercept)        0.41064  0.6408
##              conditionnonID-LIT 0.24416  0.4941   -0.79
## Number of obs: 981, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)                     -1.204625   0.209571  -5.748 9.03e-09 ***
## conditionnonID-LIT               0.016265   0.205970   0.079  0.93706
## z.LexTALE_score                  0.038899   0.012391   3.139  0.00169 **
## conditionnonID-LIT:z.LexTALE_score -0.004168   0.014035  -0.297  0.76649
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL
## cndtnID-LIT -0.581
## z.LxTALE_sc -0.117  0.112
## cID-LIT:.LT  0.098 -0.191   -0.487
## optimizer (Nelder_Mead) convergence code: 0 (OK)
## Model failed to converge with max|grad| = 0.0459811 (tol = 0.002, component 1)
```

```
fw_skipping.mod0.4 <- glmer(IA_SKIP ~ 1 + condition * z.LexTALE_score +
                     (1+condition|ppt_id)+
                     (1|item_number),
                      data = fw_df,
                    family = "binomial",
                    #control = contr1
                    )
```

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

```
summary(fw_skipping.mod0.4)
```

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: IA_SKIP ~ 1 + condition * z.LexTALE_score + (1 + condition |
##     ppt_id) + (1 | item_number)
##    Data: fw_df
##
##      AIC      BIC   logLik deviance df.resid
##   1083.6   1122.7   -533.8   1067.6      973
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -1.8180 -0.5851 -0.4207  0.7649  3.3394
##
## Random effects:
##  Groups      Name               Variance Std.Dev. Corr
##  ppt_id      (Intercept)        0.39269  0.6266
##              conditionnonID-LIT 0.04699  0.2168   1.00
##  item_number (Intercept)        0.21916  0.4681
## Number of obs: 981, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)                     -1.161085   0.179699  -6.461 1.04e-10 ***
## conditionnonID-LIT              -0.044005   0.168080  -0.262  0.79347
## z.LexTALE_score                  0.037705   0.012074   3.123  0.00179 **
## conditionnonID-LIT:z.LexTALE_score -0.002628   0.014008  -0.188  0.85117
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL
## cndtnID-LIT -0.345
## z.LxTALE_sc -0.126  0.119
## cID-LIT:.LT  0.100 -0.209   -0.461
## optimizer (Nelder_Mead) convergence code: 0 (OK)
## boundary (singular) fit: see help('isSingular')
```

```
fw_skipping.mod0.5 <- glmer(IA_SKIP ~ 1 + condition * z.LexTALE_score +
                     (1|ppt_id)+
                     (1|item_number),
                      data = fw_df,
                    family = "binomial",
                    #control = contr1
                    )

summary(fw_skipping.mod0.5)
```

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: IA_SKIP ~ 1 + condition * z.LexTALE_score + (1 | ppt_id) + (1 |
##     item_number)
##    Data: fw_df
##
##      AIC      BIC   logLik deviance df.resid
##   1080.8   1110.1   -534.4   1068.8      975
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -1.6677 -0.5796 -0.4272  0.7838  3.4047
##
## Random effects:
##  Groups      Name        Variance Std.Dev.
##  ppt_id      (Intercept) 0.5301   0.7281
##  item_number (Intercept) 0.2149   0.4636
## Number of obs: 981, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)                      -1.18591    0.18665  -6.354  2.1e-10 ***
## conditionnonID-LIT                0.01347    0.15740   0.086  0.93179
## z.LexTALE_score                   0.03818    0.01286   2.968  0.00299 **
## conditionnonID-LIT:z.LexTALE_score -0.00398    0.01372  -0.290  0.77170
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL
## cndtnID-LIT -0.427
## z.LxTALE_sc -0.115  0.115
## cID-LIT:.LT  0.093 -0.199   -0.551
```

Whole phrase region

```
idiom_df <- idiom_df %>%
  mutate(z.LexTALE_score = scale(LexTALE_score, center = TRUE, scale = FALSE))%>%
  mutate(z.Trial_Index = scale(TRIAL_INDEX, center = TRUE, scale = FALSE))
```

First pass reading time

```
FirstPassRT_mod0 <- lmer(log(IA_FIRST_RUN_DWELL_TIME) ~ 1 + condition * (z.LexTALE_score
                         + z.Trial_Index) +
                       (1+condition + z.Trial_Index|ppt_id)+
                       (1+condition * (z.LexTALE_score + z.Trial_Index)|item_number),
                        data = idiom_df %>%
                       filter(IA_FIRST_RUN_DWELL_TIME >0), REML = FALSE
                     )
```

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

```
summary(FirstPassRT_mod0)
```

```
## Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
##   method [lmerModLmerTest]
## Formula: log(IA_FIRST_RUN_DWELL_TIME) ~ 1 + condition * (z.LexTALE_score +
##     z.Trial_Index) + (1 + condition + z.Trial_Index | ppt_id) +
##     (1 + condition * (z.LexTALE_score + z.Trial_Index) | item_number)
##    Data: idiom_df %>% filter(IA_FIRST_RUN_DWELL_TIME > 0)
##
##      AIC      BIC   logLik deviance df.resid
##   1366.8   1532.8   -649.4   1298.8      942
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.6388 -0.4794  0.1213  0.6299  3.1555
##
## Random effects:
##  Groups      Name                                Variance  Std.Dev. Corr
##  ppt_id      (Intercept)                         5.484e-02 0.234175
##              conditionnonID-LIT                  9.680e-03 0.098387  0.08
##              z.Trial_Index                       1.180e-05 0.003435  0.29 -0.93
##  item_number (Intercept)                         2.435e-02 0.156054
##              conditionnonID-LIT                  1.017e-02 0.100847 -0.68
##              z.LexTALE_score                     4.484e-06 0.002118  0.70 -1.00
##              z.Trial_Index                       1.109e-05 0.003331  0.52 -0.98
##              conditionnonID-LIT:z.LexTALE_score 3.724e-06 0.001930 -1.00  0.67
##              conditionnonID-LIT:z.Trial_Index   6.756e-06 0.002599 -0.69 -0.06
##  Residual                                        1.877e-01 0.433255
##
##
##
##
##
##
##
##   0.97
##  -0.69 -0.50
##   0.04  0.26  0.70
##
## Number of obs: 976, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                    Estimate Std. Error         df t value
## (Intercept)                         6.123e+00  5.205e-02  4.155e+01 117.628
## conditionnonID-LIT                  2.167e-02  3.851e-02  2.562e+01   0.563
## z.LexTALE_score                    -1.216e-02  3.012e-03  4.891e+01  -4.038
## z.Trial_Index                      -8.422e-04  1.999e-03  4.480e+01  -0.421
## conditionnonID-LIT:z.LexTALE_score -1.103e-03  2.411e-03  5.591e+01  -0.458
## conditionnonID-LIT:z.Trial_Index    3.817e-03  2.578e-03  1.366e+02   1.481
##                                   Pr(>|t|)
## (Intercept)                        < 2e-16 ***
## conditionnonID-LIT                 0.57852
## z.LexTALE_score                    0.00019 ***
## z.Trial_Index                      0.67557
```

```
## conditionnonID-LIT:z.LexTALE_score  0.64908
## conditionnonID-LIT:z.Trial_Index    0.14095
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL z.Tr_I cID-LIT:.L
## cndtnID-LIT -0.447
## z.LxTALE_sc  0.079 -0.091
## z.Tril_Indx  0.180 -0.302    0.049
## cID-LIT:.LT -0.121  0.074   -0.292 -0.022
## cID-LIT:.T_ -0.106 -0.006    0.008 -0.606  0.008
## optimizer (nloptwrap) convergence code: 0 (OK)
## boundary (singular) fit: see help('isSingular')
```

```
vif(FirstPassRT_mod0)
```

```
##                 condition           z.LexTALE_score             z.Trial_Index
##                  1.183487                  1.100861                  1.858214
## condition:z.LexTALE_score   condition:z.Trial_Index
##                  1.096427                  1.687665
```

```
FirstPassRT_mod1 <- lmer(log(IA_FIRST_RUN_DWELL_TIME) ~ 1 + condition * (z.LexTALE_score
                           + z.Trial_Index) +
                     (1+condition|ppt_id)+
                     (1+condition|item_number),
                      data = idiom_df %>%
                     filter(IA_FIRST_RUN_DWELL_TIME >0), REML = FALSE
                   )

summary(FirstPassRT_mod1)
```

```
## Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
##   method [lmerModLmerTest]
## Formula: log(IA_FIRST_RUN_DWELL_TIME) ~ 1 + condition * (z.LexTALE_score +
##     z.Trial_Index) + (1 + condition | ppt_id) + (1 + condition |
##     item_number)
##    Data: idiom_df %>% filter(IA_FIRST_RUN_DWELL_TIME > 0)
##
##      AIC      BIC   logLik deviance df.resid
##   1335.9   1399.4   -654.9   1309.9      963
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.4422 -0.4434  0.1193  0.6278  3.3148
##
## Random effects:
##  Groups      Name                Variance Std.Dev. Corr
##  ppt_id      (Intercept)         0.053870 0.23210
##              conditionnonID-LIT  0.006167 0.07853  0.16
##  item_number (Intercept)         0.023469 0.15319
##              conditionnonID-LIT  0.005751 0.07584  -0.72
##  Residual                        0.194361 0.44086
## Number of obs: 976, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                    Estimate Std. Error         df t value
## (Intercept)                         6.120166   0.051526  41.301907 118.778
## conditionnonID-LIT                  0.024149   0.034794  17.217605   0.694
## z.LexTALE_score                    -0.012187   0.002985  49.570049  -4.082
## z.Trial_Index                      -0.001013   0.001805 903.492467  -0.561
## conditionnonID-LIT:z.LexTALE_score -0.001033   0.002355  40.609456  -0.439
## conditionnonID-LIT:z.Trial_Index    0.004058   0.002533 908.959611   1.602
##                                   Pr(>|t|)
## (Intercept)                        < 2e-16 ***
## conditionnonID-LIT                0.496905
## z.LexTALE_score                   0.000162 ***
## z.Trial_Index                     0.574741
## conditionnonID-LIT:z.LexTALE_score 0.663321
## conditionnonID-LIT:z.Trial_Index   0.109513
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL z.Tr_I cID-LIT:.L
## cndtnID-LIT -0.427
## z.LxTALE_sc  0.005  0.000
## z.Tril_Indx  0.000  0.000   -0.007
## cID-LIT:.LT -0.001  0.005   -0.296  0.009
## cID-LIT:.T_  0.001  0.002    0.004 -0.718 -0.015
```

```
vif(FirstPassRT_mod1)
```

```
##                 condition           z.LexTALE_score             z.Trial_Index
##                  1.000036                  1.096299                  2.064970
## condition:z.LexTALE_score   condition:z.Trial_Index
##                  1.096528                  2.065247
```

```
FirstPassRT_mod.null <- lmer(log(IA_FIRST_RUN_DWELL_TIME) ~ 1 + (z.LexTALE_score
                          + z.Trial_Index) +
                     (1+condition|ppt_id)+
                     (1+condition|item_number),
                      data = idiom_df %>%
                     filter(IA_FIRST_RUN_DWELL_TIME >0), REML = FALSE
                   )

summary(FirstPassRT_mod.null)
```

```
## Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
##   method [lmerModLmerTest]
## Formula:
## log(IA_FIRST_RUN_DWELL_TIME) ~ 1 + (z.LexTALE_score + z.Trial_Index) +
##     (1 + condition | ppt_id) + (1 + condition | item_number)
##    Data: idiom_df %>% filter(IA_FIRST_RUN_DWELL_TIME > 0)
##
##      AIC      BIC   logLik deviance df.resid
##   1333.0   1381.9   -656.5   1313.0      966
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.3952 -0.4615  0.1210  0.6173  3.2646
##
## Random effects:
##  Groups      Name               Variance Std.Dev. Corr
##  ppt_id      (Intercept)        0.054809 0.23411
##              conditionnonID-LIT 0.005228 0.07231  0.18
##  item_number (Intercept)        0.023600 0.15362
##              conditionnonID-LIT 0.006684 0.08176  -0.69
##  Residual                       0.194889 0.44146
## Number of obs: 976, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                   Estimate Std. Error         df t value Pr(>|t|)
## (Intercept)       6.135139   0.046852  53.015698 130.947  < 2e-16 ***
## z.LexTALE_score  -0.012583   0.002871  49.407722  -4.382 6.12e-05 ***
## z.Trial_Index     0.001066   0.001258 917.569725   0.847    0.397
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) z.LTAL
## z.LxTALE_sc  0.006
## z.Tril_Indx  0.002 -0.007
```

```
anova(FirstPassRT_mod.null,FirstPassRT_mod1)
```

```
## Data: idiom_df %>% filter(IA_FIRST_RUN_DWELL_TIME > 0)
## Models:
## FirstPassRT_mod.null: log(IA_FIRST_RUN_DWELL_TIME) ~ 1 + (z.LexTALE_score + z.Trial_Index) +
(1 + condition | ppt_id) + (1 + condition | item_number)
## FirstPassRT_mod1: log(IA_FIRST_RUN_DWELL_TIME) ~ 1 + condition * (z.LexTALE_score + z.Trial_I
ndex) + (1 + condition | ppt_id) + (1 + condition | item_number)
##                      npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
## FirstPassRT_mod.null   10 1333.0 1381.9 -656.52   1313.0
## FirstPassRT_mod1       13 1335.9 1399.4 -654.94   1309.9 3.1735  3     0.3656
```

Total reading time

```
TotalRT_mod0 <- lmer(log(IA_DWELL_TIME) ~ 1 + condition * (z.LexTALE_score
                          + z.Trial_Index) +
                     (1+condition + z.Trial_Index|ppt_id)+
                     (1+condition * (z.LexTALE_score + z.Trial_Index)|item_number),
                      data = idiom_df %>%
                     filter(IA_DWELL_TIME >0), REML = FALSE
                   )
```

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

```
summary(TotalRT_mod0)
```

```
## Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
##   method [lmerModLmerTest]
## Formula:
## log(IA_DWELL_TIME) ~ 1 + condition * (z.LexTALE_score + z.Trial_Index) +
##     (1 + condition + z.Trial_Index | ppt_id) + (1 + condition *
##     (z.LexTALE_score + z.Trial_Index) | item_number)
##    Data: idiom_df %>% filter(IA_DWELL_TIME > 0)
##
##      AIC      BIC   logLik deviance df.resid
##   1178.1   1344.2   -555.1   1110.1      942
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -5.2938 -0.5264  0.0025  0.5968  2.8041
##
## Random effects:
##  Groups      Name                                Variance  Std.Dev. Corr
##  ppt_id      (Intercept)                         6.008e-02 0.245107
##              conditionnonID-LIT                  1.130e-02 0.106288 -0.01
##              z.Trial_Index                       2.756e-05 0.005249  0.17 -0.07
##  item_number (Intercept)                         1.611e-02 0.126943
##              conditionnonID-LIT                  2.022e-02 0.142184 -0.84
##              z.LexTALE_score                     2.032e-05 0.004508  0.53 -0.67
##              z.Trial_Index                       3.925e-05 0.006265 -0.30  0.49
##              conditionnonID-LIT:z.LexTALE_score  3.747e-05 0.006122 -0.59  0.73
##              conditionnonID-LIT:z.Trial_Index    8.469e-05 0.009203  0.45 -0.64
##  Residual                                        1.489e-01 0.385831
##
##
##
##
##
##
##
##  -0.90
##  -0.99  0.90
##   0.99 -0.93 -0.99
##
## Number of obs: 976, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                    Estimate Std. Error         df t value
## (Intercept)                         6.4602927  0.0482488 47.4114680 133.895
## conditionnonID-LIT                 -0.0210476  0.0431955 21.8207566  -0.487
## z.LexTALE_score                    -0.0071757  0.0031724 49.1395821  -2.262
## z.Trial_Index                       0.0030145  0.0022642 21.3349897   1.331
## conditionnonID-LIT:z.LexTALE_score -0.0025422  0.0026420 29.8357217  -0.962
## conditionnonID-LIT:z.Trial_Index   -0.0007781  0.0030549 22.9753451  -0.255
##                                   Pr(>|t|)
## (Intercept)                         <2e-16 ***
## conditionnonID-LIT                  0.6309
## z.LexTALE_score                     0.0282 *
```

```
## z.Trial_Index                       0.1971
## conditionnonID-LIT:z.LexTALE_score   0.3437
## conditionnonID-LIT:z.Trial_Index     0.8012
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL z.Tr_I cID-LIT:.L
## cndtnID-LIT -0.522
## z.LxTALE_sc  0.105 -0.156
## z.Tril_Indx -0.068  0.211   -0.184
## cID-LIT:.LT -0.179  0.283   -0.393  0.295
## cID-LIT:.T_  0.176 -0.313    0.219 -0.770 -0.357
## optimizer (nloptwrap) convergence code: 0 (OK)
## boundary (singular) fit: see help('isSingular')
```

```
vif(TotalRT_mod0)
```

```
##                 condition           z.LexTALE_score             z.Trial_Index
##                  1.156818                  1.193540                  2.464094
## condition:z.LexTALE_score   condition:z.Trial_Index
##                  1.342238                  2.682323
```

```
TotalRT_mod0.1 <- lmer(log(IA_DWELL_TIME) ~ 1 + condition * (z.LexTALE_score
                          + z.Trial_Index) +
                    (1+condition|ppt_id)+
                    (1+condition|item_number),
                     data = idiom_df %>%
                    filter(IA_DWELL_TIME >0), REML = FALSE
                  )

summary(TotalRT_mod0.1)
```

```
## Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
##   method [lmerModLmerTest]
## Formula:
## log(IA_DWELL_TIME) ~ 1 + condition * (z.LexTALE_score + z.Trial_Index) +
##     (1 + condition | ppt_id) + (1 + condition | item_number)
##    Data: idiom_df %>% filter(IA_DWELL_TIME > 0)
##
##      AIC      BIC   logLik deviance df.resid
##   1154.0   1217.4   -564.0   1128.0      963
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -5.4790 -0.5506  0.0313  0.6263  2.6516
##
## Random effects:
##  Groups      Name               Variance Std.Dev. Corr
##  ppt_id      (Intercept)        0.06244  0.2499
##              conditionnonID-LIT 0.01096  0.1047   -0.05
##  item_number (Intercept)        0.01537  0.1240
##              conditionnonID-LIT 0.01862  0.1365   -0.81
##  Residual                       0.15788  0.3973
## Number of obs: 976, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                    Estimate Std. Error         df t value
## (Intercept)                         6.458e+00  4.844e-02  4.817e+01 133.322
## conditionnonID-LIT                 -1.746e-02  4.243e-02  2.181e+01  -0.412
## z.LexTALE_score                    -7.098e-03  3.081e-03  4.790e+01  -2.304
## z.Trial_Index                       2.795e-03  1.637e-03  8.992e+02   1.707
## conditionnonID-LIT:z.LexTALE_score -2.429e-03  2.285e-03  4.998e+01  -1.063
## conditionnonID-LIT:z.Trial_Index   -7.984e-04  2.292e-03  9.033e+02  -0.348
##                                   Pr(>|t|)
## (Intercept)                         <2e-16 ***
## conditionnonID-LIT                  0.6847
## z.LexTALE_score                     0.0256 *
## z.Trial_Index                       0.0881 .
## conditionnonID-LIT:z.LexTALE_score   0.2929
## conditionnonID-LIT:z.Trial_Index     0.7276
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL z.Tr_I cID-LIT:.L
## cndtnID-LIT -0.505
## z.LxTALE_sc  0.006 -0.001
## z.Tril_Indx  0.000  0.000   -0.006
## cID-LIT:.LT -0.001  0.004   -0.303  0.008
## cID-LIT:.T_  0.000  0.002    0.004 -0.718 -0.014
```

```
TotalRT_mod.null <- lmer(log(IA_DWELL_TIME) ~ 1 + (z.LexTALE_score
                         + z.Trial_Index) +
                     (1+condition|ppt_id)+
                     (1+condition|item_number),
                      data = idiom_df %>%
                     filter(IA_DWELL_TIME >0), REML = FALSE
                   )
summary(TotalRT_mod.null)
```

```
## Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
##   method [lmerModLmerTest]
## Formula: log(IA_DWELL_TIME) ~ 1 + (z.LexTALE_score + z.Trial_Index) +
##     (1 + condition | ppt_id) + (1 + condition | item_number)
##    Data: idiom_df %>% filter(IA_DWELL_TIME > 0)
##
##      AIC      BIC   logLik deviance df.resid
##   1149.4   1198.2   -564.7   1129.4      966
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -5.4805 -0.5449  0.0454  0.6405  2.6132
##
## Random effects:
##  Groups      Name               Variance Std.Dev. Corr
##  ppt_id      (Intercept)        0.06243  0.2499
##              conditionnonID-LIT 0.01207  0.1099   -0.07
##  item_number (Intercept)        0.01557  0.1248
##              conditionnonID-LIT 0.01899  0.1378   -0.81
##  Residual                       0.15790  0.3974
## Number of obs: 976, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                   Estimate Std. Error         df t value Pr(>|t|)
## (Intercept)       6.447659   0.041756  55.709054 154.411  < 2e-16 ***
## z.LexTALE_score  -0.008091   0.002932  48.653616  -2.759  0.00814 **
## z.Trial_Index     0.002383   0.001140 910.090918   2.090  0.03692 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) z.LTAL
## z.LxTALE_sc  0.007
## z.Tril_Indx  0.002 -0.006
```

```
anova(TotalRT_mod0.1, TotalRT_mod.null)
```

```
## Data: idiom_df %>% filter(IA_DWELL_TIME > 0)
## Models:
## TotalRT_mod.null: log(IA_DWELL_TIME) ~ 1 + (z.LexTALE_score + z.Trial_Index) + (1 + condition | ppt_id) + (1 + condition | item_number)
## TotalRT_mod0.1: log(IA_DWELL_TIME) ~ 1 + condition * (z.LexTALE_score + z.Trial_Index) + (1 + condition | ppt_id) + (1 + condition | item_number)
##                  npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
## TotalRT_mod.null   10 1149.4 1198.2 -564.69   1129.4
## TotalRT_mod0.1     13 1154.0 1217.5 -563.98   1128.0 1.4092  3     0.7034
```

Spillover

```
Spillover_mod0 <- lmer(log(IA_SPILLOVER) ~ 1 + condition * (z.LexTALE_score
                           + z.Trial_Index) +
                     (1+condition + z.Trial_Index|ppt_id)+
                     (1+condition * (z.LexTALE_score + z.Trial_Index)|item_number),
                      data = idiom_df %>%
                     filter(IA_SPILLOVER >0), REML = FALSE
                   )
```

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

```
summary(Spillover_mod0)
```

```
## Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
##   method [lmerModLmerTest]
## Formula:
## log(IA_SPILLOVER) ~ 1 + condition * (z.LexTALE_score + z.Trial_Index) +
##     (1 + condition + z.Trial_Index | ppt_id) + (1 + condition *
##     (z.LexTALE_score + z.Trial_Index) | item_number)
##    Data: idiom_df %>% filter(IA_SPILLOVER > 0)
##
##      AIC      BIC   logLik deviance df.resid
##    282.1    432.8   -107.1    214.1      587
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.2683 -0.6717 -0.0972  0.5085  3.3285
##
## Random effects:
##  Groups      Name                                Variance  Std.Dev. Corr
##  ppt_id      (Intercept)                         1.432e-02 0.119672
##              conditionnonID-LIT                  1.356e-03 0.036819 -0.95
##              z.Trial_Index                       1.544e-06 0.001243  0.74 -0.51
##  item_number (Intercept)                         2.859e-03 0.053473
##              conditionnonID-LIT                  2.876e-03 0.053632  0.15
##              z.LexTALE_score                     3.842e-06 0.001960 -0.61 -0.36
##              z.Trial_Index                       5.816e-06 0.002412 -0.92 -0.51
##              conditionnonID-LIT:z.LexTALE_score  1.019e-06 0.001009  0.57  0.35
##              conditionnonID-LIT:z.Trial_Index    1.539e-05 0.003923  0.52  0.32
##  Residual                                        7.195e-02 0.268234
##
##
##
##
##
##
##
##   0.74
##   0.16 -0.54
##  -0.99 -0.66 -0.27
##
## Number of obs: 621, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                    Estimate Std. Error        df t value
## (Intercept)                         5.446325   0.026350 33.062451 206.695
## conditionnonID-LIT                  0.009019   0.026081 21.398898   0.346
## z.LexTALE_score                    -0.004130   0.001792 40.990525  -2.304
## z.Trial_Index                      -0.001943   0.001523 45.721188  -1.275
## conditionnonID-LIT:z.LexTALE_score  0.002194   0.001675 78.436205   1.309
## conditionnonID-LIT:z.Trial_Index    0.002190   0.002167 30.939842   1.011
##                                    Pr(>|t|)
## (Intercept)                          <2e-16 ***
## conditionnonID-LIT                   0.7329
## z.LexTALE_score                      0.0264 *
```

```
## z.Trial_Index                        0.2086
## conditionnonID-LIT:z.LexTALE_score   0.1942
## conditionnonID-LIT:z.Trial_Index     0.3199
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL z.Tr_I cID-LIT:.L
## cndtnID-LIT -0.465
## z.LxTALE_sc -0.018 -0.090
## z.Tril_Indx -0.114 -0.082    0.026
## cID-LIT:.LT -0.015  0.124   -0.598  0.012
## cID-LIT:.T_  0.109  0.032   -0.085 -0.701 -0.046
## optimizer (nloptwrap) convergence code: 0 (OK)
## boundary (singular) fit: see help('isSingular')
```

```
Spillover_mod0.1 <- lmer(log(IA_SPILLOVER) ~ 1 + condition * (z.LexTALE_score
                           + z.Trial_Index) +
                     (1|ppt_id)+
                     (1|item_number),
                      data = idiom_df %>%
                     filter(IA_SPILLOVER >0), REML = FALSE
                   )

summary(Spillover_mod0.1)
```

```
## Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
##   method [lmerModLmerTest]
## Formula:
## log(IA_SPILLOVER) ~ 1 + condition * (z.LexTALE_score + z.Trial_Index) +
##     (1 | ppt_id) + (1 | item_number)
##    Data: idiom_df %>% filter(IA_SPILLOVER > 0)
##
##      AIC      BIC   logLik deviance df.resid
##    241.7    281.6   -111.9    223.7      612
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.2506 -0.6779 -0.0717  0.5295  3.3702
##
## Random effects:
##  Groups      Name        Variance Std.Dev.
##  ppt_id      (Intercept) 0.010123 0.10061
##  item_number (Intercept) 0.004285 0.06546
##  Residual                0.075282 0.27438
## Number of obs: 621, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                                    Estimate Std. Error         df t value
## (Intercept)                         5.440606   0.026316  54.173453 206.739
## conditionnonID-LIT                  0.017309   0.022533 574.160327   0.768
## z.LexTALE_score                    -0.004319   0.001610  78.969258  -2.683
## z.Trial_Index                      -0.002266   0.001425 591.181118  -1.590
## conditionnonID-LIT:z.LexTALE_score  0.002161   0.001640 570.927386   1.318
## conditionnonID-LIT:z.Trial_Index    0.002606   0.001989 587.850542   1.310
##                                   Pr(>|t|)
## (Intercept)                        < 2e-16 ***
## conditionnonID-LIT                 0.44272
## z.LexTALE_score                    0.00889 **
## z.Trial_Index                      0.11244
## conditionnonID-LIT:z.LexTALE_score 0.18812
## conditionnonID-LIT:z.Trial_Index   0.19062
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) cnID-LIT z.LTAL z.Tr_I cID-LIT:.L
## cndtnID-LIT -0.440
## z.LxTALE_sc  0.056 -0.063
## z.Tril_Indx -0.010  0.014   -0.045
## cID-LIT:.LT -0.053  0.122   -0.520  0.048
## cID-LIT:.T_  0.004 -0.024    0.030 -0.718 -0.033
```

```
Spillover_mod.NULL <- lmer(log(IA_SPILLOVER) ~ 1 + (z.LexTALE_score
                        + z.Trial_Index) +
                     (1|ppt_id)+
                     (1|item_number),
                      data = idiom_df %>%
                     filter(IA_SPILLOVER >0), REML = FALSE
                   )

summary(Spillover_mod.NULL)
```

```
## Linear mixed model fit by maximum likelihood . t-tests use Satterthwaite's
##   method [lmerModLmerTest]
## Formula: log(IA_SPILLOVER) ~ 1 + (z.LexTALE_score + z.Trial_Index) + (1 |
##     ppt_id) + (1 | item_number)
##    Data: idiom_df %>% filter(IA_SPILLOVER > 0)
##
##      AIC      BIC   logLik deviance df.resid
##    239.7    266.3   -113.8    227.7      615
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.1136 -0.6719 -0.0973  0.4987  3.3892
##
## Random effects:
##  Groups      Name        Variance Std.Dev.
##  ppt_id      (Intercept) 0.010648 0.10319
##  item_number (Intercept) 0.004079 0.06387
##  Residual                0.075668 0.27508
## Number of obs: 621, groups:  ppt_id, 50; item_number, 20
##
## Fixed effects:
##                   Estimate Std. Error         df t value Pr(>|t|)
## (Intercept)      5.450e+00  2.364e-02  3.619e+01 230.558   <2e-16 ***
## z.LexTALE_score -3.243e-03  1.399e-03  4.294e+01  -2.318   0.0253 *
## z.Trial_Index   -9.648e-04  9.936e-04  5.869e+02  -0.971   0.3319
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) z.LTAL
## z.LxTALE_sc  0.038
## z.Tril_Indx -0.014 -0.019
```

```
anova(Spillover_mod.NULL, Spillover_mod0.1)
```

```
## Data: idiom_df %>% filter(IA_SPILLOVER > 0)
## Models:
## Spillover_mod.NULL: log(IA_SPILLOVER) ~ 1 + (z.LexTALE_score + z.Trial_Index) + (1 | ppt_id)
+ (1 | item_number)
## Spillover_mod0.1: log(IA_SPILLOVER) ~ 1 + condition * (z.LexTALE_score + z.Trial_Index) + (1
| ppt_id) + (1 | item_number)
##                    npar    AIC    BIC  logLik deviance  Chisq Df Pr(>Chisq)
## Spillover_mod.NULL    6 239.68 266.26 -113.84   227.68
## Spillover_mod0.1      9 241.74 281.62 -111.87   223.74 3.9363  3     0.2684
```