

Supplementary Material: Prosody of Focus in T1D

Table of Contents

1. Duration.....	2
1.1. Random Effects.....	3
1.2. Fixed Effects.....	3
1.3. Contrasts.....	10
1.4. Descriptive statistics of raw data for duration.....	15
1.5. Duration of Verbs.....	21
1.5.1. Random Effects.....	21
1.5.2. Fixed Effects.....	22
1.5.3. Contrasts.....	26
1.6. Plots.....	29
2. Nonmanuals.....	37
2.1. Random Effects.....	38
2.2. Fixed Effects.....	40
2.3. Contrasts.....	45
2.4. Descriptive statistics of raw data for nonmanuals.....	47
2.5. Plots.....	53
3. Duration where means of non-focus values were feed to analysis.....	54
3.1. Full Model.....	54
3.2. Contrasts.....	55

Load libraries

```
library(ggplot2)
library(languageR)
library(lme4)
library(Rmisc)
library(tidyverse)
library(lsr)
library(car)
library(emmeans)
library(dplyr)
library(magrittr)
library(gridExtra)
library(rstatix)
library(knitr)
library(rmarkdown)
options(max.print = 1000000)
options(scipen=999)
```

1. Duration

Items were chosen based on the phonetic structure of verbs, thus verb information and item information were coded same. Yet, the items could yield variation in the production of subject and object in addition to verb. This is why we treated item as a random effect in the model where focus, focus type, position, AoA, and session were fixed effects. Moreover, the phonetic structure of subject and object were not controlled, thus the effect of phonetic structure of the verb was analyzed separately only on the duration of verbs.

Load duration data

```
duration_data=read.csv("focus-data-nomean.csv")
str(duration_data)

## 'data.frame':  2160 obs. of  11 variables:
## $ Participant: int  1 1 1 1 1 1 1 1 1 1 ...
## $ Gender    : chr  "Male" "Male" "Male" "Male" ...
## $ Age      : int  25 25 25 25 25 25 25 25 25 ...
## $ AoA      : chr  "DoD" "DoD" "DoD" "DoD" ...
## $ Session   : int  1 1 1 1 1 1 2 2 2 2 ...
## $ FocusType : chr  "PF" "CF" "CF" "CF" ...
## $ Verb     : chr  "ACMAK" "ATMAK" "ACMAK" "YEMEK" ...
## $ Item     : int  3 2 3 1 1 2 3 3 1 2 ...
## $ Position  : chr  "Subject" "Subject" "Subject" "Subject" ...
## $ Focus    : chr  "Focus" "Focus" "Focus" "Focus" ...
## $ Duration  : num  0.23 0.22 0.24 0.18 0.06 0.26 0.1 0.56 0.14 0.1 ...
```

Convert variables to correct format

```
duration_data$Participant <- as.factor(duration_data$Participant)
duration_data$Gender <- as.factor(duration_data$Gender)
```

```

duration_data$Age <- as.numeric(duration_data$Age)
duration_data$AoA <- as.factor(duration_data$AoA)
duration_data$Session <- as.factor(duration_data$Session)
duration_data$FocusType <- as.factor(duration_data$FocusType)
duration_data$Verb <- as.factor(duration_data$Verb)
duration_data$Item <- as.factor(duration_data$Item)
duration_data$Position <- as.factor(duration_data$Position)
duration_data$Focus <- as.factor(duration_data$Focus)
duration_data$Duration <- as.numeric(duration_data$Duration)

```

1.1. Random Effects

Two models were run to assess if participant and item would capture variance better in the data. Model with both participant and item as random variables significantly captured the variance than the model where only participant as random variable.

```

duration.m0 = lmer(Duration ~ (1|Participant),
  data=duration_data,
  REML=F
)

duration.m1 = lmer(Duration ~ (1|Participant) + (1|Item),
  data=duration_data,
  REML=F
)
anova(duration.m0, duration.m1)

## Data: duration_data
## Models:
## duration.m0: Duration ~ (1 | Participant)
## duration.m1: Duration ~ (1 | Participant) + (1 | Item)
##      npar   AIC   BIC logLik deviance Chisq Df    Pr(>Chisq)
## duration.m0   3 -203.88 -186.86 104.94 -209.88
## duration.m1   4 -246.27 -223.57 127.13 -254.27 44.384 1 0.00000000002699 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

1.2. Fixed Effects

Age doesn't have a significant effect.

```

duration.m19 = lmer(Duration ~ Age + (1|Participant) + (1|Item),
  data=duration_data,
  REML=F
)
summary(duration.m19)

## Linear mixed model fit by maximum likelihood ['lmerMod']
## Formula: Duration ~ Age + (1 | Participant) + (1 | Item)
## Data: duration_data
##
##      AIC   BIC logLik deviance df.resid

```

```

## -322.2 -294.6 166.1 -332.2 1821
##
## Scaled residuals:
##   Min     1Q  Median     3Q      Max
## -3.6729 -0.6169 -0.1652  0.4981  5.8656
##
## Random effects:
##   Groups      Name      Variance Std.Dev.
## Participant (Intercept) 0.038255 0.19559
## Item      (Intercept) 0.001193 0.03454
## Residual                0.046666 0.21602
## Number of obs: 1826, groups: Participant, 17; Item, 3
##
## Fixed effects:
##           Estimate Std. Error t value
## (Intercept) 0.214321  0.238647  0.898
## Age         0.007269  0.006852  1.061
##
## Correlation of Fixed Effects:
##   (Intr)
## Age -0.976

```

Focus has a significant effect.

```

duration.m2 = lmer(Duration ~ Focus + (1|Participant) + (1|Item),
  data=duration_data,
  REML=F
)
anova(duration.m1, duration.m2)

## Data: duration_data
## Models:
## duration.m1: Duration ~ (1 | Participant) + (1 | Item)
## duration.m2: Duration ~ Focus + (1 | Participant) + (1 | Item)
##           npar   AIC   BIC logLik deviance Chisq Df    Pr(>Chisq)
## duration.m1   4 -246.27 -223.57 127.13 -254.27
## duration.m2   5 -298.71 -270.34 154.35 -308.71 54.441  1 0.00000000000001602
##
## duration.m1
## duration.m2 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

Focus type

```

duration.m3 = lmer(Duration ~ Focus + FocusType + (1|Participant) + (1|Item),
  data=duration_data,
  REML=F
)
anova(duration.m2, duration.m3)

```

```

## Data: duration_data
## Models:
## duration.m2: Duration ~ Focus + (1 | Participant) + (1 | Item)
## duration.m3: Duration ~ Focus + FocusType + (1 | Participant) + (1 | Item)
##      npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## duration.m2  5 -298.71 -270.34 154.35 -308.71
## duration.m3  6 -300.83 -266.80 156.42 -312.83 4.1279 1 0.04218 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

Focus*FocusType interaction is not significant.

```

duration.m4 = lmer(Duration ~ Focus*FocusType + (1|Participant) + (1|Item),
  data=duration_data,
  REML=F
)
anova(duration.m3, duration.m4)

```

```

## Data: duration_data
## Models:
## duration.m3: Duration ~ Focus + FocusType + (1 | Participant) + (1 | Item)
## duration.m4: Duration ~ Focus * FocusType + (1 | Participant) + (1 | Item)
##      npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## duration.m3  6 -300.83 -266.80 156.42 -312.83
## duration.m4  7 -302.08 -262.37 158.04 -316.08 3.242 1 0.07177 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

Position has a significant effect.

```

duration.m5 = lmer(Duration ~ Focus + FocusType + Position + (1|Participant) + (1|Item),
  data=duration_data,
  REML=F
)
anova(duration.m3, duration.m5)

```

```

## Data: duration_data
## Models:
## duration.m3: Duration ~ Focus + FocusType + (1 | Participant) + (1 | Item)
## duration.m5: Duration ~ Focus + FocusType + Position + (1 | Participant) + (1 | Item)
##      npar   AIC   BIC logLik deviance Chisq Df
## duration.m3  6 -300.83 -266.80 156.42 -312.83
## duration.m5  8 -772.06 -726.68 394.03 -788.06 475.23 2
##      Pr(>Chisq)
## duration.m3
## duration.m5 < 0.00000000000000022 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

Position*Focus interaction is significant.

```

duration.m6 = lmer(Duration ~ Focus + FocusType + Position*Focus + (1|Participant) + (1|Item),
  data=duration_data,
  REML=F
)
anova(duration.m5, duration.m6)

## Data: duration_data
## Models:
## duration.m5: Duration ~ Focus + FocusType + Position + (1 | Participant) + (1 | Item)
## duration.m6: Duration ~ Focus + FocusType + Position * Focus + (1 | Participant) + (1 | Item)
##      npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## duration.m5    8 -772.06 -726.68 394.03 -788.06
## duration.m6   10 -783.42 -726.70 401.71 -803.42 15.363  2 0.0004613 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

Position*FocusType interaction is significant.

```

duration.m7 = lmer(Duration ~ Focus + FocusType + Position*Focus + Position*FocusType +
  (1|Participant) + (1|Item),
  data=duration_data,
  REML=F
)
anova(duration.m6, duration.m7)

## Data: duration_data
## Models:
## duration.m6: Duration ~ Focus + FocusType + Position * Focus + (1 | Participant) + (1 | Item)
## duration.m7: Duration ~ Focus + FocusType + Position * Focus + Position * FocusType + (1 |
Participant) + (1 | Item)
##      npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## duration.m6   10 -783.42 -726.70 401.71 -803.42
## duration.m7   12 -801.15 -733.07 412.57 -825.15 21.724  2 0.00001918 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

Three-way interaction (Position*Focus*FocusType) isn't significant.

```

duration.m8 = lmer(Duration ~ Focus + FocusType + Position*Focus + Position*FocusType +
  Position*Focus*FocusType + (1|Participant) + (1|Item),
  data=duration_data,
  REML=F
)
anova(duration.m7, duration.m8)

## Data: duration_data
## Models:
## duration.m7: Duration ~ Focus + FocusType + Position * Focus + Position * FocusType + (1 |
Participant) + (1 | Item)
## duration.m8: Duration ~ Focus + FocusType + Position * Focus + Position * FocusType + Position *
Focus * FocusType + (1 | Participant) + (1 | Item)
##      npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)

```

```
## duration.m7 12 -801.15 -733.07 412.57 -825.15
## duration.m8 15 -801.49 -716.40 415.75 -831.49 6.3478 3 0.09586 .
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Focus*FocusType interaction yields better model than the one without interaction.

```
duration.m9 = lmer(Duration ~ Focus*FocusType + Position*Focus + Position*FocusType +
(1|Participant) + (1|Item),
  data=duration_data,
  REML=F
)
anova(duration.m7, duration.m9)

## Data: duration_data
## Models:
## duration.m7: Duration ~ Focus + FocusType + Position * Focus + Position * FocusType + (1 |
Participant) + (1 | Item)
## duration.m9: Duration ~ Focus * FocusType + Position * Focus + Position * FocusType + (1 |
Participant) + (1 | Item)
##          npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## duration.m7 12 -801.15 -733.07 412.57 -825.15
## duration.m9 13 -803.10 -729.36 414.55 -829.10 3.9573 1 0.04667 *
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

AoA has a significant effect.

```
duration.m10 = lmer(Duration ~ Focus*FocusType + Position*Focus + Position*FocusType + AoA +
(1|Participant) + (1|Item),
  data=duration_data,
  REML=F
)
anova(duration.m9, duration.m10)

## Data: duration_data
## Models:
## duration.m9: Duration ~ Focus * FocusType + Position * Focus + Position * FocusType + (1 |
Participant) + (1 | Item)
## duration.m10: Duration ~ Focus * FocusType + Position * Focus + Position * FocusType + AoA + (1 |
Participant) + (1 | Item)
##          npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## duration.m9 13 -803.10 -729.36 414.55 -829.10
## duration.m10 14 -805.17 -725.75 416.58 -833.17 4.0624 1 0.04385 *
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

AoA*Focus interaction isn't significant.

```
duration.m11 = lmer(Duration ~ Focus*FocusType + Position*Focus + Position*FocusType +
AoA*Focus + (1|Participant) + (1|Item),
  data=duration_data,
```

```

    REML=F
  )
anova(duration.m10, duration.m11)

## Data: duration_data
## Models:
## duration.m10: Duration ~ Focus * FocusType + Position * Focus + Position * FocusType + AoA + (1 | Participant) + (1 | Item)
## duration.m11: Duration ~ Focus * FocusType + Position * Focus + Position * FocusType + AoA * Focus + (1 | Participant) + (1 | Item)
##      npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## duration.m10  14 -805.17 -725.75 416.58 -833.17
## duration.m11  15 -803.69 -718.60 416.85 -833.69 0.5246 1 0.4689

```

AoA*Position interaction is significant.

```

duration.m12 = lmer(Duration ~ Focus*FocusType + Position*Focus + Position*FocusType + AoA*Position + (1|Participant) + (1|Item),
  data=duration_data,
  REML=F
)
anova(duration.m10, duration.m12)

## Data: duration_data
## Models:
## duration.m10: Duration ~ Focus * FocusType + Position * Focus + Position * FocusType + AoA + (1 | Participant) + (1 | Item)
## duration.m12: Duration ~ Focus * FocusType + Position * Focus + Position * FocusType + AoA * Position + (1 | Participant) + (1 | Item)
##      npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## duration.m10  14 -805.17 -725.75 416.58 -833.17
## duration.m12  16 -816.29 -725.53 424.15 -848.29 15.126 2 0.0005194 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

Session has a significant effect.

```

duration.m13 = lmer(Duration ~ Focus*FocusType + Position*Focus + Position*FocusType + AoA*Position + Session + (1|Participant) + (1|Item),
  data=duration_data,
  REML=F
)
anova(duration.m12, duration.m13)

## Data: duration_data
## Models:
## duration.m12: Duration ~ Focus * FocusType + Position * Focus + Position * FocusType + AoA * Position + (1 | Participant) + (1 | Item)
## duration.m13: Duration ~ Focus * FocusType + Position * Focus + Position * FocusType + AoA * Position + Session + (1 | Participant) + (1 | Item)
##      npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## duration.m12  16 -816.29 -725.53 424.15 -848.29

```



```
## duration.m13 17 -838.92 -742.48 436.46 -872.92 24.626 1 0.0000006961 ***
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Session*Focus interaction isn't significant.

```
duration.m14 = lmer(Duration ~ Focus*FocusType + Position*Focus + Position*FocusType +
AoA*Position + Session*Focus + (1|Participant) + (1|Item),
  data=duration_data,
  REML=F
)
anova(duration.m13, duration.m14)

## Data: duration_data
## Models:
## duration.m13: Duration ~ Focus * FocusType + Position * Focus + Position * FocusType + AoA *
Position + Session + (1 | Participant) + (1 | Item)
## duration.m14: Duration ~ Focus * FocusType + Position * Focus + Position * FocusType + AoA *
Position + Session * Focus + (1 | Participant) + (1 | Item)
##      npar  AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## duration.m13 17 -838.92 -742.48 436.46 -872.92
## duration.m14 18 -836.98 -734.87 436.49 -872.98 0.0641 1 0.8001
```

Session*Position interaction isn't significant.

```
duration.m15 = lmer(Duration ~ Focus*FocusType + Position*Focus + Position*FocusType +
AoA*Position + Session*Position + (1|Participant) + (1|Item),
  data=duration_data,
  REML=F
)
anova(duration.m13, duration.m15)

## Data: duration_data
## Models:
## duration.m13: Duration ~ Focus * FocusType + Position * Focus + Position * FocusType + AoA *
Position + Session + (1 | Participant) + (1 | Item)
## duration.m15: Duration ~ Focus * FocusType + Position * Focus + Position * FocusType + AoA *
Position + Session * Position + (1 | Participant) + (1 | Item)
##      npar  AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## duration.m13 17 -838.92 -742.48 436.46 -872.92
## duration.m15 19 -838.14 -730.36 438.07 -876.14 3.2207 2 0.1998
```

There is not a significant interaction of position, focus, and AoA.

Random slopes were also added to the model, yet the model did not converge.

```
duration.m20 = lmer(Duration ~ Focus*FocusType + Position*Focus + Position*FocusType +
AoA*Position + Session + (Focus*FocusType + Position*Focus + Position*FocusType + AoA*Position
+ Session|Participant) + (Focus*FocusType + Position*Focus + Position*FocusType + AoA*Position +
Session|Item),
  data=duration_data,
  REML=F
)
```

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

Model comparisons showed no three-way interaction among focus, focus type, and position on duration. Based on comparisons, significant independent variables on duration are focus, AoA, session, the interaction of focus and focus type, the interaction of position and focus, the interaction of position and focus type, and the interaction of AoA and position. Thus, the full model is duration.m13 to analyze duration data.

1.3. Contrasts

We used emmeans package to test all contrasts for each independent variable.

Duration difference between focus and non-focus signs

```
emmeans(duration.m13, pairwise~Focus)

## $emmeans
## Focus emmean SE df lower.CL upper.CL
## Focus 0.540 0.0494 19.6 0.437 0.643
## NonFocus 0.465 0.0491 19.1 0.362 0.568
##
## Results are averaged over the levels of: FocusType, Position, AoA, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate SE df t.ratio p.value
## Focus - NonFocus 0.0748 0.00885 2139 8.443 <.0001
##
## Results are averaged over the levels of: FocusType, Position, AoA, Session
## Degrees-of-freedom method: kenward-roger
```

Contrasts showed that focus and non-focus distinction is significant in all positions for CF. Focus and non-focus distinction is significant only in subject position for PF. The difference between PF and CF is significant only in subject position.

```
emmeans(duration.m13, pairwise~Focus*FocusType|Position)

## $emmeans
## Position = Object:
## Focus FocusType emmean SE df lower.CL upper.CL
## Focus CF 0.413 0.0513 23.1 0.307 0.519
## NonFocus CF 0.341 0.0503 21.2 0.237 0.446
## Focus PF 0.384 0.0513 23.1 0.278 0.490
## NonFocus PF 0.347 0.0502 21.1 0.243 0.452
##
## Position = Subject:
## Focus FocusType emmean SE df lower.CL upper.CL
## Focus CF 0.634 0.0513 23.1 0.528 0.740
## NonFocus CF 0.492 0.0503 21.1 0.388 0.597
## Focus PF 0.538 0.0513 23.1 0.432 0.644
## NonFocus PF 0.431 0.0503 21.1 0.327 0.536
```

```

##
## Position = Verb:
## Focus FocusType emmean SE df lower.CL upper.CL
## Focus CF 0.636 0.0513 23.1 0.530 0.742
## NonFocus CF 0.573 0.0503 21.2 0.468 0.677
## Focus PF 0.634 0.0513 23.1 0.528 0.740
## NonFocus PF 0.605 0.0502 21.1 0.501 0.710
##
## Results are averaged over the levels of: AoA, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## Position = Object:
## contrast estimate SE df t.ratio p.value
## Focus CF - NonFocus CF 0.07194 0.0177 2139 4.056 0.0003
## Focus CF - Focus PF 0.02946 0.0187 2139 1.578 0.3915
## Focus CF - NonFocus PF 0.06610 0.0213 2139 3.105 0.0104
## NonFocus CF - Focus PF -0.04248 0.0213 2139 -1.994 0.1903
## NonFocus CF - NonFocus PF -0.00583 0.0156 2139 -0.373 0.9823
## Focus PF - NonFocus PF 0.03665 0.0177 2139 2.071 0.1629
##
## Position = Subject:
## contrast estimate SE df t.ratio p.value
## Focus CF - NonFocus CF 0.14169 0.0177 2139 8.006 <.0001
## Focus CF - Focus PF 0.09608 0.0187 2139 5.152 <.0001
## Focus CF - NonFocus PF 0.20249 0.0213 2139 9.524 <.0001
## NonFocus CF - Focus PF -0.04561 0.0213 2139 -2.143 0.1398
## NonFocus CF - NonFocus PF 0.06079 0.0156 2139 3.890 0.0006
## Focus PF - NonFocus PF 0.10640 0.0177 2139 6.014 <.0001
##
## Position = Verb:
## contrast estimate SE df t.ratio p.value
## Focus CF - NonFocus CF 0.06356 0.0177 2139 3.589 0.0019
## Focus CF - Focus PF 0.00258 0.0187 2139 0.138 0.9991
## Focus CF - NonFocus PF 0.03085 0.0212 2139 1.453 0.4666
## NonFocus CF - Focus PF -0.06099 0.0213 2139 -2.857 0.0224
## NonFocus CF - NonFocus PF -0.03271 0.0156 2139 -2.093 0.1558
## Focus PF - NonFocus PF 0.02828 0.0177 2139 1.596 0.3811
##
## Results are averaged over the levels of: AoA, Session
## Degrees-of-freedom method: kenward-roger
## P value adjustment: tukey method for comparing a family of 4 estimates

```

Duration difference between DoD and DoH participants

```

emmeans(duration.m13, pairwise~AoA)

## $emmeans
## AoA emmean SE df lower.CL upper.CL
## DoD 0.416 0.0620 23.2 0.288 0.545

```

```

## DoH 0.588 0.0676 23.8 0.449 0.728
##
## Results are averaged over the levels of: Focus, FocusType, Position, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate SE df t.ratio p.value
## DoD - DoH -0.172 0.0849 21.7 -2.026 0.0552
##
## Results are averaged over the levels of: Focus, FocusType, Position, Session
## Degrees-of-freedom method: kenward-roger

emmeans(duration.m13, pairwise~Focus|AoA)

## $emmeans
## AoA = DoD:
## Focus emmean SE df lower.CL upper.CL
## Focus 0.454 0.0623 23.6 0.325 0.582
## NonFocus 0.379 0.0621 23.3 0.251 0.507
##
## AoA = DoH:
## Focus emmean SE df lower.CL upper.CL
## Focus 0.626 0.0678 24.2 0.486 0.766
## NonFocus 0.551 0.0676 23.9 0.411 0.691
##
## Results are averaged over the levels of: FocusType, Position, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## AoA = DoD:
## contrast estimate SE df t.ratio p.value
## Focus - NonFocus 0.0748 0.00885 2139 8.443 <.0001
##
## AoA = DoH:
## contrast estimate SE df t.ratio p.value
## Focus - NonFocus 0.0748 0.00885 2139 8.443 <.0001
##
## Results are averaged over the levels of: FocusType, Position, Session
## Degrees-of-freedom method: kenward-roger

```

Duration differences of syntactic position by AoA

```

emmeans(duration.m13, pairwise~Position|AoA)

## $emmeans
## AoA = DoD:
## Position emmean SE df lower.CL upper.CL
## Object 0.308 0.0626 24.1 0.179 0.437
## Subject 0.423 0.0626 24.1 0.294 0.552
## Verb 0.518 0.0626 24.1 0.389 0.647

```

```

##
## AoA = DoH:
## Position emmean SE df lower.CL upper.CL
## Object 0.434 0.0682 24.8 0.294 0.575
## Subject 0.624 0.0682 24.8 0.484 0.765
## Verb 0.706 0.0682 24.8 0.566 0.847
##
## Results are averaged over the levels of: Focus, FocusType, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## AoA = DoD:
## contrast estimate SE df t.ratio p.value
## Object - Subject -0.1147 0.0143 2139 -8.045 <.0001
## Object - Verb -0.2095 0.0143 2139 -14.695 <.0001
## Subject - Verb -0.0948 0.0142 2139 -6.653 <.0001
##
## AoA = DoH:
## contrast estimate SE df t.ratio p.value
## Object - Subject -0.1899 0.0157 2139 -12.131 <.0001
## Object - Verb -0.2719 0.0157 2139 -17.344 <.0001
## Subject - Verb -0.0820 0.0157 2139 -5.233 <.0001
##
## Results are averaged over the levels of: Focus, FocusType, Session
## Degrees-of-freedom method: kenward-roger
## P value adjustment: tukey method for comparing a family of 3 estimates

```

Duration differences by Session

```

emmeans(duration.m13, pairwise~Session)

## $emmeans
## Session emmean SE df lower.CL upper.CL
## 1 0.523 0.0492 19.3 0.420 0.626
## 2 0.482 0.0492 19.3 0.379 0.585
##
## Results are averaged over the levels of: Focus, FocusType, Position, AoA
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate SE df t.ratio p.value
## Session1 - Session2 0.0415 0.00835 2139 4.963 <.0001
##
## Results are averaged over the levels of: Focus, FocusType, Position, AoA
## Degrees-of-freedom method: kenward-roger

emmeans(duration.m13, pairwise~Focus|FocusType)

## $emmeans
## FocusType = CF:

```

```

## Focus  emmean  SE  df lower.CL upper.CL
## Focus  0.561 0.0499 20.5  0.457  0.665
## NonFocus 0.469 0.0494 19.6  0.366  0.572
##
## FocusType = PF:
## Focus  emmean  SE  df lower.CL upper.CL
## Focus  0.518 0.0499 20.5  0.414  0.622
## NonFocus 0.461 0.0494 19.6  0.358  0.564
##
## Results are averaged over the levels of: Position, AoA, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## FocusType = CF:
## contrast      estimate    SE  df t.ratio p.value
## Focus - NonFocus 0.0924 0.0125 2139  7.373 <.0001
##
## FocusType = PF:
## contrast      estimate    SE  df t.ratio p.value
## Focus - NonFocus 0.0571 0.0125 2139  4.565 <.0001
##
## Results are averaged over the levels of: Position, AoA, Session
## Degrees-of-freedom method: kenward-roger

emmeans(duration.m13, pairwise~Focus|Position)

## $emmeans
## Position = Object:
## Focus  emmean  SE  df lower.CL upper.CL
## Focus  0.399 0.0504 21.5  0.294  0.503
## NonFocus 0.344 0.0496 20.0  0.241  0.448
##
## Position = Subject:
## Focus  emmean  SE  df lower.CL upper.CL
## Focus  0.586 0.0504 21.4  0.481  0.690
## NonFocus 0.462 0.0496 20.0  0.358  0.565
##
## Position = Verb:
## Focus  emmean  SE  df lower.CL upper.CL
## Focus  0.635 0.0504 21.5  0.530  0.740
## NonFocus 0.589 0.0496 20.0  0.486  0.693
##
## Results are averaged over the levels of: FocusType, AoA, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## Position = Object:
## contrast      estimate    SE  df t.ratio p.value
## Focus - NonFocus 0.0543 0.0153 2139  3.539 0.0004

```

```

##
## Position = Subject:
## contrast      estimate   SE  df t.ratio p.value
## Focus - NonFocus 0.1240 0.0153 2139 8.097 <.0001
##
## Position = Verb:
## contrast      estimate   SE  df t.ratio p.value
## Focus - NonFocus 0.0459 0.0153 2139 2.993 0.0028
##
## Results are averaged over the levels of: FocusType, AoA, Session
## Degrees-of-freedom method: kenward-roger

emmeans(duration.m13, pairwise~Position)

## $emmeans
## Position emmean   SE  df lower.CL upper.CL
## Object  0.371 0.0494 19.7  0.268  0.475
## Subject 0.524 0.0494 19.7  0.420  0.627
## Verb    0.612 0.0494 19.7  0.509  0.715
##
## Results are averaged over the levels of: Focus, FocusType, AoA, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## contrast      estimate   SE  df t.ratio p.value
## Object - Subject -0.1523 0.0109 2139 -13.988 <.0001
## Object - Verb    -0.2407 0.0109 2139 -22.087 <.0001
## Subject - Verb   -0.0884 0.0109 2139 -8.117 <.0001
##
## Results are averaged over the levels of: Focus, FocusType, AoA, Session
## Degrees-of-freedom method: kenward-roger
## P value adjustment: tukey method for comparing a family of 3 estimates

```

1.4. Descriptive statistics of raw data for duration

```

duration_descriptive = duration_data %>% filter(!is.na(Duration)) %>%
  summarySE(measurevar = "Duration", groupvars = c("Focus", "FocusType", "Position", "Verb", "AoA",
"Session"))

```

```
duration_descriptive
```

```

##   Focus FocusType Position Verb AoA Session N Duration   sd
## 1  Focus      CF   Object ACMAK DoD   1 11 0.3490000 0.2191096
## 2  Focus      CF   Object ACMAK DoD   2 11 0.3690909 0.1937759
## 3  Focus      CF   Object ACMAK DoH   1  9 0.6144444 0.2229412
## 4  Focus      CF   Object ACMAK DoH   2  9 0.5372222 0.2933546
## 5  Focus      CF   Object ATMAK DoD   1 11 0.3042727 0.2289865
## 6  Focus      CF   Object ATMAK DoD   2 11 0.3145455 0.1531250
## 7  Focus      CF   Object ATMAK DoH   1  9 0.3977778 0.1478832
## 8  Focus      CF   Object ATMAK DoH   2  9 0.3463333 0.1089885
## 9  Focus      CF   Object YEMEK DoD   1 10 0.3544000 0.1693984

```

## 10	Focus	CF	Object YEMEK DoD	2	11	0.3450000	0.1894598
## 11	Focus	CF	Object YEMEK DoH	1	9	0.5155556	0.1699346
## 12	Focus	CF	Object YEMEK DoH	2	9	0.5452222	0.1778144
## 13	Focus	CF	Subject ACMAK DoD	1	11	0.6095455	0.4833345
## 14	Focus	CF	Subject ACMAK DoD	2	11	0.5627273	0.2583153
## 15	Focus	CF	Subject ACMAK DoH	1	9	0.7516667	0.2962685
## 16	Focus	CF	Subject ACMAK DoH	2	9	0.7900000	0.4378427
## 17	Focus	CF	Subject ATMAK DoD	1	11	0.6186364	0.4848097
## 18	Focus	CF	Subject ATMAK DoD	2	11	0.4335455	0.2794356
## 19	Focus	CF	Subject ATMAK DoH	1	9	0.8235556	0.3838832
## 20	Focus	CF	Subject ATMAK DoH	2	9	0.7732222	0.4062092
## 21	Focus	CF	Subject YEMEK DoD	1	11	0.4968182	0.3513696
## 22	Focus	CF	Subject YEMEK DoD	2	11	0.4295455	0.3840147
## 23	Focus	CF	Subject YEMEK DoH	1	9	0.6324444	0.3623414
## 24	Focus	CF	Subject YEMEK DoH	2	9	0.8425556	0.4782011
## 25	Focus	CF	Verb ACMAK DoD	1	11	0.6080000	0.3422937
## 26	Focus	CF	Verb ACMAK DoD	2	11	0.5036364	0.2466687
## 27	Focus	CF	Verb ACMAK DoH	1	9	0.8233333	0.3001250
## 28	Focus	CF	Verb ACMAK DoH	2	9	0.7158889	0.3356220
## 29	Focus	CF	Verb ATMAK DoD	1	11	0.5404545	0.2701338
## 30	Focus	CF	Verb ATMAK DoD	2	11	0.5018182	0.2756290
## 31	Focus	CF	Verb ATMAK DoH	1	9	0.6147778	0.2093632
## 32	Focus	CF	Verb ATMAK DoH	2	9	0.5848889	0.2699108
## 33	Focus	CF	Verb YEMEK DoD	1	11	0.5218182	0.2325862
## 34	Focus	CF	Verb YEMEK DoD	2	11	0.5374545	0.3183713
## 35	Focus	CF	Verb YEMEK DoH	1	9	0.8050000	0.3469690
## 36	Focus	CF	Verb YEMEK DoH	2	9	0.7364444	0.3889200
## 37	Focus	PF	Object ACMAK DoD	1	11	0.3690909	0.1461817
## 38	Focus	PF	Object ACMAK DoD	2	11	0.3759091	0.2726245
## 39	Focus	PF	Object ACMAK DoH	1	9	0.4977778	0.2348818
## 40	Focus	PF	Object ACMAK DoH	2	9	0.4945556	0.2298299
## 41	Focus	PF	Object ATMAK DoD	1	11	0.3009091	0.1876409
## 42	Focus	PF	Object ATMAK DoD	2	11	0.2400000	0.1194152
## 43	Focus	PF	Object ATMAK DoH	1	9	0.2844444	0.1061969
## 44	Focus	PF	Object ATMAK DoH	2	9	0.3026667	0.1334316
## 45	Focus	PF	Object YEMEK DoD	1	11	0.3340909	0.1658737
## 46	Focus	PF	Object YEMEK DoD	2	11	0.3345455	0.1694322
## 47	Focus	PF	Object YEMEK DoH	1	9	0.5877778	0.4517405
## 48	Focus	PF	Object YEMEK DoH	2	9	0.4745556	0.1732535
## 49	Focus	PF	Subject ACMAK DoD	1	11	0.4881818	0.2952480
## 50	Focus	PF	Subject ACMAK DoD	2	11	0.4072727	0.2391377
## 51	Focus	PF	Subject ACMAK DoH	1	9	0.6950000	0.2690841
## 52	Focus	PF	Subject ACMAK DoH	2	9	0.7398889	0.2358630
## 53	Focus	PF	Subject ATMAK DoD	1	11	0.4583636	0.3723150
## 54	Focus	PF	Subject ATMAK DoD	2	11	0.3736364	0.2581578
## 55	Focus	PF	Subject ATMAK DoH	1	9	0.6150000	0.2070175
## 56	Focus	PF	Subject ATMAK DoH	2	9	0.4708889	0.1484953
## 57	Focus	PF	Subject YEMEK DoD	1	11	0.4416364	0.2940331
## 58	Focus	PF	Subject YEMEK DoD	2	11	0.3946364	0.2778785
## 59	Focus	PF	Subject YEMEK DoH	1	9	0.6577778	0.2856036
## 60	Focus	PF	Subject YEMEK DoH	2	9	0.5738889	0.2651035

## 61	Focus	PF	Verb ACMAK DoD	1	11	0.5821818	0.2559382
## 62	Focus	PF	Verb ACMAK DoD	2	11	0.5354545	0.3411265
## 63	Focus	PF	Verb ACMAK DoH	1	8	0.9343750	0.4587828
## 64	Focus	PF	Verb ACMAK DoH	2	9	0.7451111	0.3938228
## 65	Focus	PF	Verb ATMAK DoD	1	11	0.5056364	0.2820781
## 66	Focus	PF	Verb ATMAK DoD	2	11	0.4809091	0.2267798
## 67	Focus	PF	Verb ATMAK DoH	1	9	0.6738889	0.2987451
## 68	Focus	PF	Verb ATMAK DoH	2	9	0.7016667	0.2868035
## 69	Focus	PF	Verb YEMEK DoD	1	11	0.6350909	0.3241868
## 70	Focus	PF	Verb YEMEK DoD	2	11	0.5522727	0.4058286
## 71	Focus	PF	Verb YEMEK DoH	1	9	0.7158889	0.4086589
## 72	Focus	PF	Verb YEMEK DoH	2	9	0.7001111	0.2938794
## 73	NonFocus	CF	Object ACMAK DoD	1	20	0.3092500	0.1818492
## 74	NonFocus	CF	Object ACMAK DoD	2	22	0.2877273	0.1606218
## 75	NonFocus	CF	Object ACMAK DoH	1	17	0.5317647	0.2112237
## 76	NonFocus	CF	Object ACMAK DoH	2	18	0.5157222	0.1824828
## 77	NonFocus	CF	Object ATMAK DoD	1	22	0.2468182	0.1570983
## 78	NonFocus	CF	Object ATMAK DoD	2	22	0.2113636	0.1062027
## 79	NonFocus	CF	Object ATMAK DoH	1	18	0.2933333	0.1212193
## 80	NonFocus	CF	Object ATMAK DoH	2	18	0.2713889	0.1069036
## 81	NonFocus	CF	Object YEMEK DoD	1	22	0.2759545	0.1216946
## 82	NonFocus	CF	Object YEMEK DoD	2	22	0.2977273	0.1624495
## 83	NonFocus	CF	Object YEMEK DoH	1	18	0.4394444	0.1594650
## 84	NonFocus	CF	Object YEMEK DoH	2	18	0.4377778	0.1926471
## 85	NonFocus	CF	Subject ACMAK DoD	1	22	0.3452273	0.1820821
## 86	NonFocus	CF	Subject ACMAK DoD	2	22	0.4049091	0.2763584
## 87	NonFocus	CF	Subject ACMAK DoH	1	18	0.6659444	0.3408961
## 88	NonFocus	CF	Subject ACMAK DoH	2	18	0.5455000	0.2219895
## 89	NonFocus	CF	Subject ATMAK DoD	1	22	0.4211818	0.2493782
## 90	NonFocus	CF	Subject ATMAK DoD	2	22	0.3679545	0.3111372
## 91	NonFocus	CF	Subject ATMAK DoH	1	17	0.6939412	0.3436018
## 92	NonFocus	CF	Subject ATMAK DoH	2	18	0.5041667	0.2060469
## 93	NonFocus	CF	Subject YEMEK DoD	1	21	0.4109524	0.4444425
## 94	NonFocus	CF	Subject YEMEK DoD	2	22	0.3715909	0.3221482
## 95	NonFocus	CF	Subject YEMEK DoH	1	18	0.5760556	0.2904918
## 96	NonFocus	CF	Subject YEMEK DoH	2	18	0.5441111	0.3337808
## 97	NonFocus	CF	Verb ACMAK DoD	1	22	0.5623636	0.2563098
## 98	NonFocus	CF	Verb ACMAK DoD	2	22	0.5318636	0.3033350
## 99	NonFocus	CF	Verb ACMAK DoH	1	17	0.8042941	0.3179569
## 100	NonFocus	CF	Verb ACMAK DoH	2	18	0.7127778	0.3385402
## 101	NonFocus	CF	Verb ATMAK DoD	1	22	0.4914091	0.2395489
## 102	NonFocus	CF	Verb ATMAK DoD	2	22	0.4873636	0.2863366
## 103	NonFocus	CF	Verb ATMAK DoH	1	18	0.6425000	0.2786430
## 104	NonFocus	CF	Verb ATMAK DoH	2	18	0.6013889	0.2700207
## 105	NonFocus	CF	Verb YEMEK DoD	1	21	0.4119048	0.2333341
## 106	NonFocus	CF	Verb YEMEK DoD	2	22	0.4302273	0.2806984
## 107	NonFocus	CF	Verb YEMEK DoH	1	18	0.6423889	0.3592350
## 108	NonFocus	CF	Verb YEMEK DoH	2	17	0.6254118	0.3554286
## 109	NonFocus	PF	Object ACMAK DoD	1	22	0.3836818	0.2305421
## 110	NonFocus	PF	Object ACMAK DoD	2	22	0.2954545	0.1571692
## 111	NonFocus	PF	Object ACMAK DoH	1	18	0.5405556	0.2390784

## 112 NonFocus	PF	Object	ACMAK DoH	2	18	0.4523889	0.1684019
## 113 NonFocus	PF	Object	ATMAK DoD	1	22	0.2772273	0.1769439
## 114 NonFocus	PF	Object	ATMAK DoD	2	22	0.2409091	0.1692254
## 115 NonFocus	PF	Object	ATMAK DoH	1	18	0.3061111	0.1141794
## 116 NonFocus	PF	Object	ATMAK DoH	2	18	0.2488333	0.1037272
## 117 NonFocus	PF	Object	YEMEK DoD	1	22	0.2825000	0.1239600
## 118 NonFocus	PF	Object	YEMEK DoD	2	22	0.2886364	0.1740634
## 119 NonFocus	PF	Object	YEMEK DoH	1	18	0.4194444	0.1942246
## 120 NonFocus	PF	Object	YEMEK DoH	2	18	0.4169444	0.1766134
## 121 NonFocus	PF	Subject	ACMAK DoD	1	22	0.3793182	0.1763067
## 122 NonFocus	PF	Subject	ACMAK DoD	2	22	0.3438636	0.1904627
## 123 NonFocus	PF	Subject	ACMAK DoH	1	18	0.5300000	0.1576015
## 124 NonFocus	PF	Subject	ACMAK DoH	2	18	0.5408889	0.2241908
## 125 NonFocus	PF	Subject	ATMAK DoD	1	22	0.4595455	0.3394999
## 126 NonFocus	PF	Subject	ATMAK DoD	2	22	0.2771364	0.1932251
## 127 NonFocus	PF	Subject	ATMAK DoH	1	18	0.5741667	0.3170651
## 128 NonFocus	PF	Subject	ATMAK DoH	2	18	0.4425000	0.2252954
## 129 NonFocus	PF	Subject	YEMEK DoD	1	21	0.3524286	0.2565830
## 130 NonFocus	PF	Subject	YEMEK DoD	2	22	0.2656818	0.2059201
## 131 NonFocus	PF	Subject	YEMEK DoH	1	18	0.5558333	0.2897070
## 132 NonFocus	PF	Subject	YEMEK DoH	2	18	0.5148333	0.3356678
## 133 NonFocus	PF	Verb	ACMAK DoD	1	22	0.6045000	0.3149645
## 134 NonFocus	PF	Verb	ACMAK DoD	2	22	0.5135000	0.2954431
## 135 NonFocus	PF	Verb	ACMAK DoH	1	18	0.7660000	0.4244197
## 136 NonFocus	PF	Verb	ACMAK DoH	2	18	0.7671667	0.3374812
## 137 NonFocus	PF	Verb	ATMAK DoD	1	22	0.4789091	0.2519149
## 138 NonFocus	PF	Verb	ATMAK DoD	2	22	0.4983182	0.2719687
## 139 NonFocus	PF	Verb	ATMAK DoH	1	18	0.6646667	0.2815884
## 140 NonFocus	PF	Verb	ATMAK DoH	2	18	0.5980000	0.2668353
## 141 NonFocus	PF	Verb	YEMEK DoD	1	22	0.4953182	0.2687171
## 142 NonFocus	PF	Verb	YEMEK DoD	2	22	0.4289091	0.2436254
## 143 NonFocus	PF	Verb	YEMEK DoH	1	18	0.7302778	0.3891222
## 144 NonFocus	PF	Verb	YEMEK DoH	2	18	0.6551667	0.3356844
##	se	ci					
## 1	0.06606402	0.14719981					
## 2	0.05842563	0.13018041					
## 3	0.07431373	0.17136777					
## 4	0.09778488	0.22549234					
## 5	0.06904203	0.15383523					
## 6	0.04616893	0.10287079					
## 7	0.04929440	0.11367310					
## 8	0.03632951	0.08377600					
## 9	0.05356848	0.12118032					
## 10	0.05712427	0.12728080					
## 11	0.05664488	0.13062332					
## 12	0.05927145	0.13668021					
## 13	0.14573085	0.32470856					
## 14	0.07788501	0.17353861					
## 15	0.09875615	0.22773210					
## 16	0.14594757	0.33655571					
## 17	0.14617563	0.32569959					

18 0.08425301 0.18772741
19 0.12796105 0.29507872
20 0.13540308 0.31224006
21 0.10594191 0.23605328
22 0.11578478 0.25798457
23 0.12078046 0.27852024
24 0.15940036 0.36757789
25 0.10320544 0.22995606
26 0.07437342 0.16571430
27 0.10004166 0.23069648
28 0.11187399 0.25798189
29 0.08144841 0.18147836
30 0.08310528 0.18517010
31 0.06978773 0.16093079
32 0.08997028 0.20747184
33 0.07012739 0.15625357
34 0.09599255 0.21388474
35 0.11565634 0.26670400
36 0.12964000 0.29895039
37 0.04407544 0.09820621
38 0.08219936 0.18315160
39 0.07829392 0.18054611
40 0.07660996 0.17666289
41 0.05657585 0.12605884
42 0.03600505 0.08022425
43 0.03539896 0.08163015
44 0.04447721 0.10256463
45 0.05001281 0.11143548
46 0.05108573 0.11382611
47 0.15058015 0.34723846
48 0.05775117 0.13317443
49 0.08902061 0.19835028
50 0.07210272 0.16065486
51 0.08969470 0.20683635
52 0.07862100 0.18130036
53 0.11225719 0.25012462
54 0.07783751 0.17343278
55 0.06900584 0.15912775
56 0.04949844 0.11414361
57 0.08865431 0.19753411
58 0.08378352 0.18668131
59 0.09520122 0.21953440
60 0.08836783 0.20377658
61 0.07716827 0.17194162
62 0.10285350 0.22917188
63 0.16220423 0.38355205
64 0.13127425 0.30271897
65 0.08504975 0.18950265
66 0.06837669 0.15235276
67 0.09958169 0.22963578
68 0.09560117 0.22045669

69 0.09774600 0.21779167
70 0.12236191 0.27263933
71 0.13621964 0.31412305
72 0.09795981 0.22589572
73 0.04066273 0.08510806
74 0.03424467 0.07121570
75 0.05122927 0.10860119
76 0.04301161 0.09074657
77 0.03349347 0.06965348
78 0.02264248 0.04708762
79 0.02857166 0.06028094
80 0.02519741 0.05316189
81 0.02594537 0.05395635
82 0.03463434 0.07202606
83 0.03758626 0.07930008
84 0.04540735 0.09580113
85 0.03882004 0.08073069
86 0.05891982 0.12253047
87 0.08034999 0.16952366
88 0.05232342 0.11039276
89 0.05316761 0.11056810
90 0.06633466 0.13795049
91 0.08333567 0.17666373
92 0.04856572 0.10246471
93 0.09698531 0.20230781
94 0.06868224 0.14283253
95 0.06846957 0.14445816
96 0.07867289 0.16598530
97 0.05464544 0.11364140
98 0.06467124 0.13449121
99 0.07711588 0.16347836
100 0.07979469 0.16835209
101 0.05107200 0.10621004
102 0.06104716 0.12695452
103 0.06567678 0.13856590
104 0.06364450 0.13427815
105 0.05091767 0.10621240
106 0.05984511 0.12445471
107 0.08467250 0.17864336
108 0.08620410 0.18274454
109 0.04915174 0.10221664
110 0.03350859 0.06968493
111 0.05635133 0.11889091
112 0.03969270 0.08374428
113 0.03772456 0.07845252
114 0.03607897 0.07503033
115 0.02691234 0.05678006
116 0.02444873 0.05158230
117 0.02642835 0.05496077
118 0.03711043 0.07717537
119 0.04577918 0.09658563

```
## 120 0.04162818 0.08782777
## 121 0.03758871 0.07816999
## 122 0.04060678 0.08444642
## 123 0.03714703 0.07837339
## 124 0.05284228 0.11148746
## 125 0.07238162 0.15052581
## 126 0.04119573 0.08567120
## 127 0.07473296 0.15767275
## 128 0.05310264 0.11203678
## 129 0.05599101 0.11679520
## 130 0.04390231 0.09129985
## 131 0.06828460 0.14406790
## 132 0.07911765 0.16692366
## 133 0.06715066 0.13964744
## 134 0.06298869 0.13099215
## 135 0.10003669 0.21105897
## 136 0.07954508 0.16782545
## 137 0.05370844 0.11169282
## 138 0.05798393 0.12058418
## 139 0.06637101 0.14003059
## 140 0.06289368 0.13269406
## 141 0.05729068 0.11914250
## 142 0.05194111 0.10801744
## 143 0.09171698 0.19350592
## 144 0.07912158 0.16693193
```

1.5. Duration of Verbs

Since the phonetic structure of signs was only chosen from specific categories, we examined its effect only on the verb signs.

1.5.1. Random Effects

Stimuli was based on the verbs, so item and verb had the same information. This is why we treated only participant as random effect and treated verb as fixed effect.

```
verb=duration_data %>% filter(!is.na(Duration)) %>% filter(Position=="Verb")
```

```
DurationVerb.m0 = lmer(Duration ~ (1|Participant),
  data=verb,
  REML=F
)
```

```
summary(DurationVerb.m0)
```

```
## Linear mixed model fit by maximum likelihood ['lmerMod']
## Formula: Duration ~ (1 | Participant)
## Data: verb
##
##   AIC   BIC logLik deviance df.resid
## -262.8 -249.1  134.4 -268.8    713
```

```
##
## Scaled residuals:
##   Min     1Q   Median     3Q      Max
## -4.6790 -0.5853 -0.0591  0.5281  5.6402
##
## Random effects:
##   Groups      Name      Variance Std.Dev.
## Participant (Intercept) 0.06418  0.2533
## Residual                0.03579  0.1892
## Number of obs: 716, groups: Participant, 20
##
## Fixed effects:
##           Estimate Std. Error t value
## (Intercept) 0.59441   0.05709   10.41
```

1.5.2. Fixed Effects

Effect of focus on verb types

```
DurationVerb.m1 = lmer(Duration ~ Focus + (1|Participant),
  data=verb,
  REML=F
)

anova(DurationVerb.m0, DurationVerb.m1)

## Data: verb
## Models:
## DurationVerb.m0: Duration ~ (1 | Participant)
## DurationVerb.m1: Duration ~ Focus + (1 | Participant)
##           npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## DurationVerb.m0   3 -262.85 -249.12 134.42 -268.85
## DurationVerb.m1   4 -270.26 -251.97 139.13 -278.26 9.4184 1  0.002148 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Effect of focus and verb types on duration

```
DurationVerb.m2 = lmer(Duration ~ Focus + Verb + (1|Participant),
  data=verb,
  REML=F
)

anova(DurationVerb.m1, DurationVerb.m2)

## Data: verb
## Models:
## DurationVerb.m1: Duration ~ Focus + (1 | Participant)
## DurationVerb.m2: Duration ~ Focus + Verb + (1 | Participant)
##           npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## DurationVerb.m1   4 -270.26 -251.97 139.13 -278.26
## DurationVerb.m2   6 -302.38 -274.94 157.19 -314.38 36.114 2 0.00000001438
```

```
##
## DurationVerb.m1
## DurationVerb.m2 ***
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Interaction of focus and verb types is significant.

```
DurationVerb.m3 = lmer(Duration ~ Focus*Verb + (1|Participant),
  data=verb,
  REML=F
)
```

```
anova(DurationVerb.m2, DurationVerb.m3)
```

```
## Data: verb
## Models:
## DurationVerb.m2: Duration ~ Focus + Verb + (1 | Participant)
## DurationVerb.m3: Duration ~ Focus * Verb + (1 | Participant)
##      npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## DurationVerb.m2  6 -302.38 -274.94 157.19 -314.38
## DurationVerb.m3  8 -305.74 -269.15 160.87 -321.74 7.3654 2 0.02515 *
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Focus type doesn't have a significant effect.

```
DurationVerb.m4 = lmer(Duration ~ Focus*Verb + FocusType + (1|Participant),
  data=verb,
  REML=F
)
```

```
anova(DurationVerb.m3, DurationVerb.m4)
```

```
## Data: verb
## Models:
## DurationVerb.m3: Duration ~ Focus * Verb + (1 | Participant)
## DurationVerb.m4: Duration ~ Focus * Verb + FocusType + (1 | Participant)
##      npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## DurationVerb.m3  8 -305.74 -269.15 160.87 -321.74
## DurationVerb.m4  9 -306.26 -265.10 162.13 -324.26 2.5147 1 0.1128
```

Interaction of focus and focus type isn't significant.

```
DurationVerb.m5 = lmer(Duration ~ Focus*Verb + Focus*FocusType + (1|Participant),
  data=verb,
  REML=F
)
```

```
anova(DurationVerb.m3, DurationVerb.m5)
```

```

## Data: verb
## Models:
## DurationVerb.m3: Duration ~ Focus * Verb + (1 | Participant)
## DurationVerb.m5: Duration ~ Focus * Verb + Focus * FocusType + (1 | Participant)
##          npar  AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## DurationVerb.m3  8 -305.74 -269.15 160.87 -321.74
## DurationVerb.m5 10 -304.27 -258.54 162.14 -324.27 2.5295 2 0.2823

```

Interaction of verb and focus type isn't significant.

```

DurationVerb.m6 = lmer(Duration ~ Focus*Verb + Verb*FocusType + (1|Participant),
  data=verb,
  REML=F
)

```

```

anova(DurationVerb.m3, DurationVerb.m6)

```

```

## Data: verb
## Models:
## DurationVerb.m3: Duration ~ Focus * Verb + (1 | Participant)
## DurationVerb.m6: Duration ~ Focus * Verb + Verb * FocusType + (1 | Participant)
##          npar  AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## DurationVerb.m3  8 -305.74 -269.15 160.87 -321.74
## DurationVerb.m6 11 -302.95 -252.64 162.47 -324.95 3.2051 3 0.3611

```

AoA doesn't have an effect.

```

DurationVerb.m7 = lmer(Duration ~ Focus*Verb + AoA + (1|Participant),
  data=verb,
  REML=F
)

```

```

anova(DurationVerb.m3, DurationVerb.m7)

```

```

## Data: verb
## Models:
## DurationVerb.m3: Duration ~ Focus * Verb + (1 | Participant)
## DurationVerb.m7: Duration ~ Focus * Verb + AoA + (1 | Participant)
##          npar  AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## DurationVerb.m3  8 -305.74 -269.15 160.87 -321.74
## DurationVerb.m7  9 -306.61 -265.45 162.31 -324.61 2.8659 1 0.09048 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

AoA*verb has a significant effect.

```

DurationVerb.m8 = lmer(Duration ~ Focus*Verb + AoA*Verb + (1|Participant),
  data=verb,
  REML=F
)

```

```

anova(DurationVerb.m3, DurationVerb.m8)

```



```
## Data: verb
## Models:
## DurationVerb.m3: Duration ~ Focus * Verb + (1 | Participant)
## DurationVerb.m8: Duration ~ Focus * Verb + AoA * Verb + (1 | Participant)
##      npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## DurationVerb.m3  8 -305.74 -269.15 160.87 -321.74
## DurationVerb.m8 11 -309.55 -259.24 165.78 -331.55 9.8108 3 0.02024 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova(DurationVerb.m7, DurationVerb.m8)
```

```
## Data: verb
## Models:
## DurationVerb.m7: Duration ~ Focus * Verb + AoA + (1 | Participant)
## DurationVerb.m8: Duration ~ Focus * Verb + AoA * Verb + (1 | Participant)
##      npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## DurationVerb.m7  9 -306.61 -265.45 162.31 -324.61
## DurationVerb.m8 11 -309.55 -259.24 165.78 -331.55 6.945 2 0.03104 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Session has a significant effect.

```
DurationVerb.m9 = lmer(Duration ~ Focus*Verb + AoA*Verb + Session + (1|Participant),
  data=verb,
  REML=F
)
```

```
anova(DurationVerb.m8, DurationVerb.m9)
```

```
## Data: verb
## Models:
## DurationVerb.m8: Duration ~ Focus * Verb + AoA * Verb + (1 | Participant)
## DurationVerb.m9: Duration ~ Focus * Verb + AoA * Verb + Session + (1 | Participant)
##      npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## DurationVerb.m8 11 -309.55 -259.24 165.78 -331.55
## DurationVerb.m9 12 -316.78 -261.89 170.39 -340.78 9.221 1 0.002393 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Session*verb does not have a significant effect.

```
DurationVerb.m10 = lmer(Duration ~ Focus*Verb + AoA*Verb + Session*Verb + (1|Participant),
  data=verb,
  REML=F
)
```

```
anova(DurationVerb.m9, DurationVerb.m10)
```

```
## Data: verb
## Models:
```

```

## DurationVerb.m9: Duration ~ Focus * Verb + AoA * Verb + Session + (1 | Participant)
## DurationVerb.m10: Duration ~ Focus * Verb + AoA * Verb + Session * Verb + (1 | Participant)
##          npar   AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## DurationVerb.m9  12 -316.78 -261.89 170.39 -340.78
## DurationVerb.m10 14 -315.17 -251.14 171.59 -343.17 2.3987 2 0.3014

```

Model comparisons showed that there are significant effects of session and interactions of focus and verb type, & AoA and verb type on the duration of verb signs.

1.5.3. Contrasts

Contrasts showed that focus and non-focus distinction is significant only in verb YEMEK, but not in other verbs.

```

emmeans(DurationVerb.m9, pairwise~Focus|Verb)

## $emmeans
## Verb = ACMAK:
## Focus  emmean  SE  df lower.CL upper.CL
## Focus  0.677 0.0595 28.3  0.555  0.798
## NonFocus 0.657 0.0577 24.8  0.539  0.776
##
## Verb = ATMAK:
## Focus  emmean  SE  df lower.CL upper.CL
## Focus  0.576 0.0595 28.2  0.454  0.697
## NonFocus 0.558 0.0577 24.8  0.439  0.677
##
## Verb = YEMEK:
## Focus  emmean  SE  df lower.CL upper.CL
## Focus  0.652 0.0595 28.2  0.530  0.774
## NonFocus 0.550 0.0577 24.8  0.431  0.669
##
## Results are averaged over the levels of: AoA, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## Verb = ACMAK:
## contrast      estimate  SE  df t.ratio p.value
## Focus - NonFocus 0.0191 0.0249 704  0.767 0.4434
##
## Verb = ATMAK:
## contrast      estimate  SE  df t.ratio p.value
## Focus - NonFocus 0.0177 0.0248 704  0.715 0.4746
##
## Verb = YEMEK:
## contrast      estimate  SE  df t.ratio p.value
## Focus - NonFocus 0.1016 0.0248 704  4.088 <.0001
##
## Results are averaged over the levels of: AoA, Session
## Degrees-of-freedom method: kenward-roger

```

DoH and DoD participants have different duration for verb signs, but no three way interaction among focus, verb, and AoA.

```
emmeans(DurationVerb.m9, pairwise~Verb|AoA)

## $emmeans
## AoA = DoD:
## Verb emmean SE df lower.CL upper.CL
## ACMAK 0.558 0.0767 23.8 0.399 0.716
## ATMAK 0.498 0.0767 23.8 0.340 0.656
## YEMEK 0.498 0.0767 23.8 0.339 0.656
##
## AoA = DoH:
## Verb emmean SE df lower.CL upper.CL
## ACMAK 0.776 0.0848 23.8 0.601 0.952
## ATMAK 0.635 0.0848 23.8 0.460 0.810
## YEMEK 0.705 0.0848 23.8 0.530 0.880
##
## Results are averaged over the levels of: Focus, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## AoA = DoD:
## contrast estimate SE df t.ratio p.value
## ACMAK - ATMAK 0.05964 0.0230 704 2.588 0.0266
## ACMAK - YEMEK 0.06006 0.0231 704 2.602 0.0256
## ATMAK - YEMEK 0.00042 0.0231 704 0.018 0.9998
##
## AoA = DoH:
## contrast estimate SE df t.ratio p.value
## ACMAK - ATMAK 0.14108 0.0255 704 5.541 <.0001
## ACMAK - YEMEK 0.07162 0.0255 704 2.808 0.0142
## ATMAK - YEMEK -0.06947 0.0254 704 -2.738 0.0174
##
## Results are averaged over the levels of: Focus, Session
## Degrees-of-freedom method: kenward-roger
## P value adjustment: tukey method for comparing a family of 3 estimates

emmeans(DurationVerb.m9, pairwise~AoA|Verb)

## $emmeans
## Verb = ACMAK:
## AoA emmean SE df lower.CL upper.CL
## DoD 0.558 0.0767 23.8 0.399 0.716
## DoH 0.776 0.0848 23.8 0.601 0.952
##
## Verb = ATMAK:
## AoA emmean SE df lower.CL upper.CL
## DoD 0.498 0.0767 23.8 0.340 0.656
## DoH 0.635 0.0848 23.8 0.460 0.810
```

```

##
## Verb = YEMEK:
## AoA emmean SE df lower.CL upper.CL
## DoD 0.498 0.0767 23.8 0.339 0.656
## DoH 0.705 0.0848 23.8 0.530 0.880
##
## Results are averaged over the levels of: Focus, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## Verb = ACMAK:
## contrast estimate SE df t.ratio p.value
## DoD - DoH -0.219 0.114 23.7 -1.915 0.0677
##
## Verb = ATMAK:
## contrast estimate SE df t.ratio p.value
## DoD - DoH -0.137 0.114 23.7 -1.202 0.2412
##
## Verb = YEMEK:
## contrast estimate SE df t.ratio p.value
## DoD - DoH -0.207 0.114 23.7 -1.814 0.0824
##
## Results are averaged over the levels of: Focus, Session
## Degrees-of-freedom method: kenward-roger

```

As observed in all duration data, participants had shorter signing durations for verb signs in Session 2.

```

emmeans(DurationVerb.m9, pairwise~Session)

## $emmeans
## Session emmean SE df lower.CL upper.CL
## 1 0.632 0.0568 23 0.515 0.750
## 2 0.591 0.0568 23 0.474 0.709
##
## Results are averaged over the levels of: Focus, Verb, AoA
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate SE df t.ratio p.value
## Session1 - Session2 0.041 0.0135 704 3.029 0.0025
##
## Results are averaged over the levels of: Focus, Verb, AoA
## Degrees-of-freedom method: kenward-roger

emmeans(DurationVerb.m9, pairwise~Verb)

## $emmeans
## Verb emmean SE df lower.CL upper.CL
## ACMAK 0.667 0.0573 24.0 0.549 0.785

```

```

## ATMAK 0.567 0.0573 23.9 0.448 0.685
## YEMEK 0.601 0.0573 23.9 0.483 0.719
##
## Results are averaged over the levels of: Focus, AoA, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate SE df t.ratio p.value
## ACMAK - ATMAK 0.1004 0.0177 704 5.680 <.0001
## ACMAK - YEMEK 0.0658 0.0177 704 3.722 0.0006
## ATMAK - YEMEK -0.0345 0.0176 704 -1.958 0.1235
##
## Results are averaged over the levels of: Focus, AoA, Session
## Degrees-of-freedom method: kenward-roger
## P value adjustment: tukey method for comparing a family of 3 estimates

```

1.6. Plots

#Plot - Focus Type

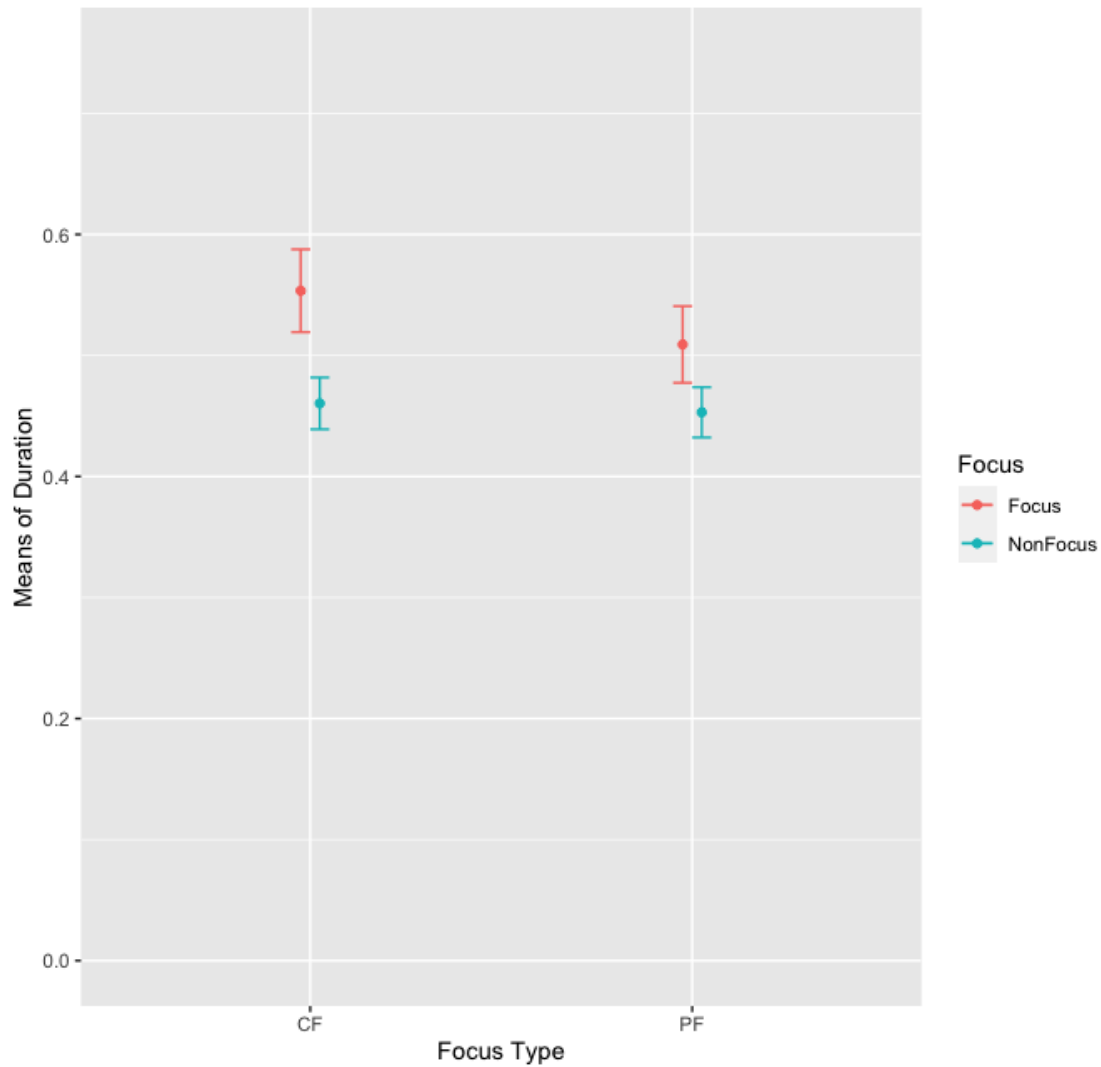
```

focus_type_summary=duration_data %>%
  filter(!is.na(Duration)) %>%
  summarySE(measurevar = "Duration", groupvars = c("Focus", "FocusType"))

ggplot(focus_type_summary,
  aes(x = FocusType, y=Duration, color=Focus)) +
  geom_errorbar(aes(ymin=Duration-ci, ymax=Duration+ci), width=.1, position = position_dodge(0.1)) +
  geom_line(position = position_dodge(0.1)) +
  geom_point(position=position_dodge(0.1)) +
  coord_cartesian(ylim = c(0, 0.75)) +
  labs(y = "Means of Duration", x = "Focus Type", title = "Duration of Focused and Non-Focused Signs by Focus Type")

```

Duration of Focused and Non-Focused Signs by Focus Type



```
ggsave("FocusType.png")

#Plot - Focus and Position

focus_position_summary=duration_data %>%
  filter(!is.na(Duration)) %>%
  summarySE(measurevar = "Duration", groupvars = c("Focus", "Position"))

ggplot(focus_position_summary,
  aes(x = factor(Position, level = c("Subject", "Object", "Verb")),
    y = Duration, group = Focus, color = Focus)) + # make sure to include group and color
```

```
geom_line(position = position_dodge()) + geom_point(position=position_dodge()) +  
coord_cartesian(ylim = c(0.15, 0.75)) +
```

```
geom_point() +
```

```
geom_errorbar(aes(ymin = Duration-ci, ymax = Duration+ci), width = 0.1) +  
stat_summary(aes(x=Position, y = Duration), fun = mean, geom = "line") +
```

```
labs(title = "Duration of Focus Signs by Syntactic Role",
```

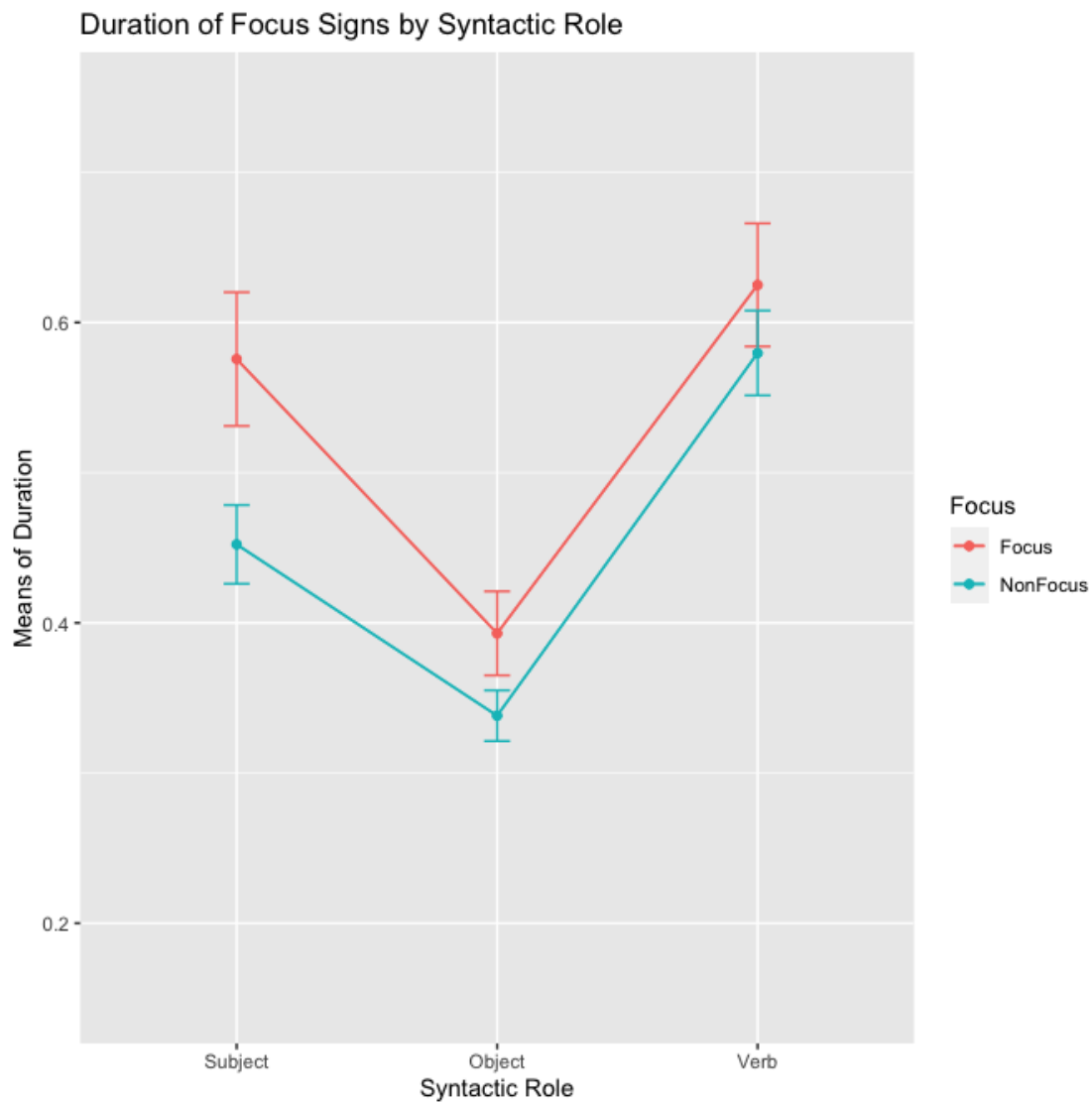
```
      x = "Syntactic Role", y = "Means of Duration")
```

```
## Warning: Width not defined
```

```
## i Set with `position_dodge(width = ...)`
```

```
## Warning: Width not defined
```

```
## i Set with `position_dodge(width = ...)`
```



```

ggsave("FocusPosition.png")

## Warning: Width not defined
## i Set with `position_dodge(width = ...)`
## Width not defined
## i Set with `position_dodge(width = ...)`

#Plot - Focus Type and Position

focus_type_position_summary=duration_data %>%
  filter(!is.na(Duration)) %>%
  summarySE(measurevar = "Duration", groupvars = c("FocusType", "Position"))

ggplot(focus_type_position_summary,

       aes(x = factor(Position, level = c("Subject", "Object", "Verb")),

          y = Duration, group = FocusType, color = FocusType)) + # make sure to include group and
color

  geom_line(position = position_dodge()) + geom_point(position=position_dodge()) +
  coord_cartesian(ylim = c(0.15, 0.75)) +

  geom_point() +

  geom_errorbar(aes(ymin = Duration-ci, ymax = Duration+ci), width = 0.1) +
  stat_summary(aes(x=Position, y = Duration), fun = mean, geom = "line") +

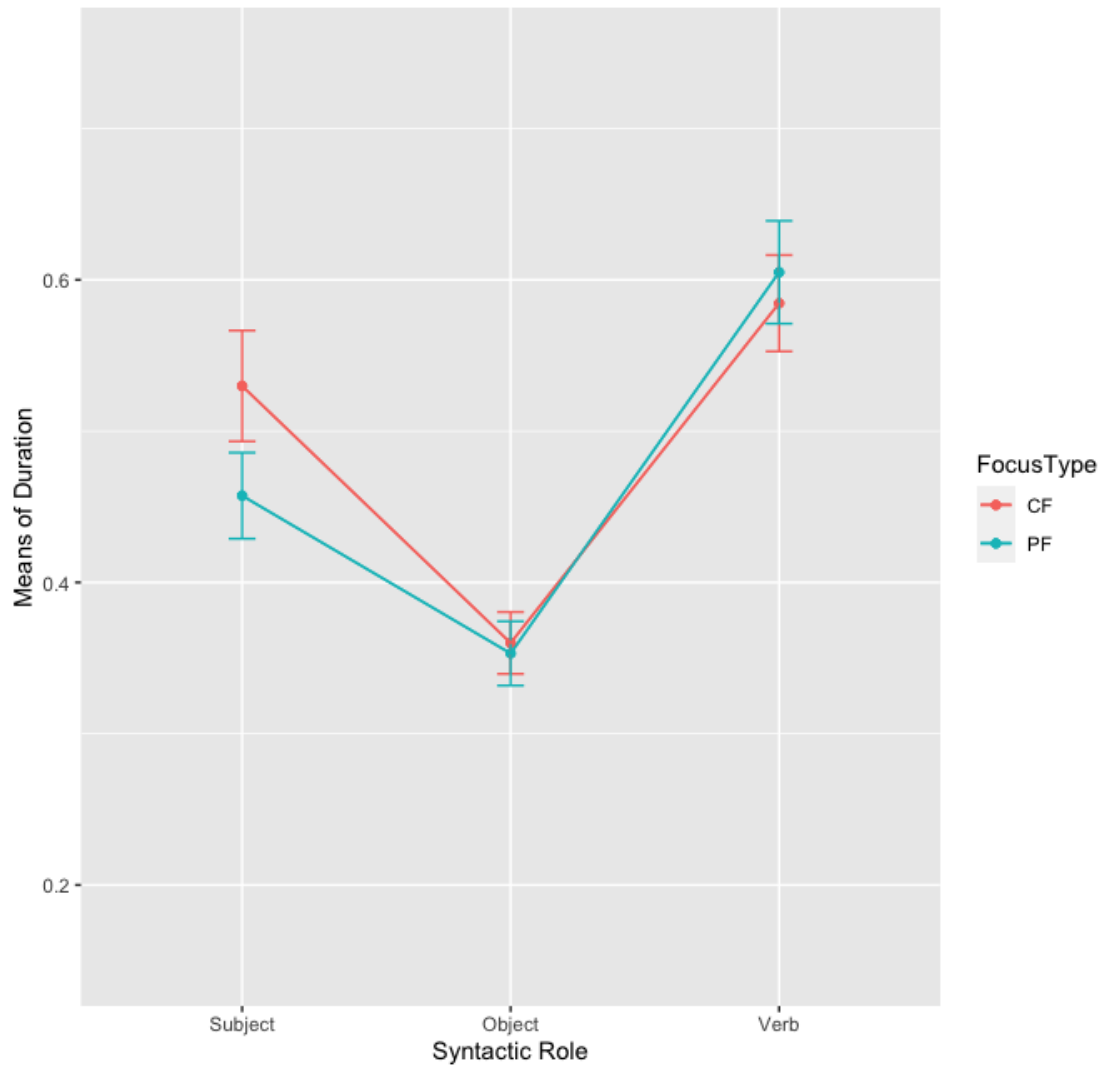
  labs(title = "Duration of Focused Signs by Focus Types and Syntactic Role",

       x = "Syntactic Role", y = "Means of Duration")

## Warning: Width not defined
## i Set with `position_dodge(width = ...)`
## Width not defined
## i Set with `position_dodge(width = ...)`

```


Duration of Focused Signs by Focus Types and Syntactic Role



```

ggsave("FocusTypePosition.png")

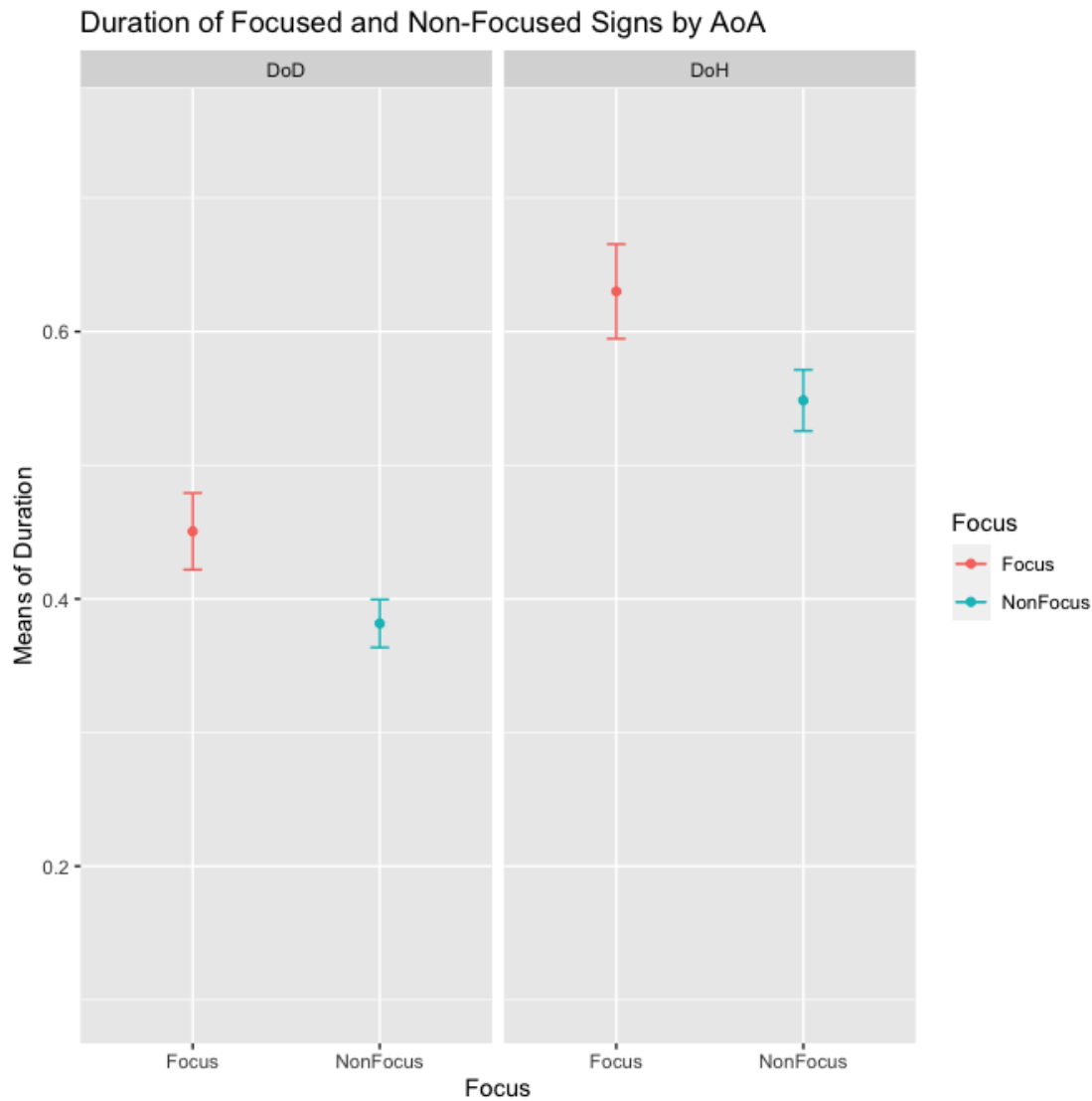
## Warning: Width not defined
## i Set with `position_dodge(width = ...)`
## Width not defined
## i Set with `position_dodge(width = ...)`

#Plots - AoA

focus_aoa_summary=duration_data %>%
  filter(!is.na(Duration)) %>%
  summarySE(measurevar = "Duration", groupvars = c("Focus", "AoA"))

ggplot(focus_aoa_summary, aes(x=Focus, y=Duration, color=Focus)) +
  geom_errorbar(aes(ymin=Duration-ci, ymax=Duration+ci), width=.1, position = position_dodge(0.1)) +
  geom_line(position = position_dodge(0.1)) + geom_point(position=position_dodge(0.1)) +
  
```

```
coord_cartesian(ylim = c(0.10, 0.75)) + facet_wrap(~AoA) +
labs(y = "Means of Duration", x = "Focus", title = "Duration of Focused and Non-Focused Signs by
AoA")
```



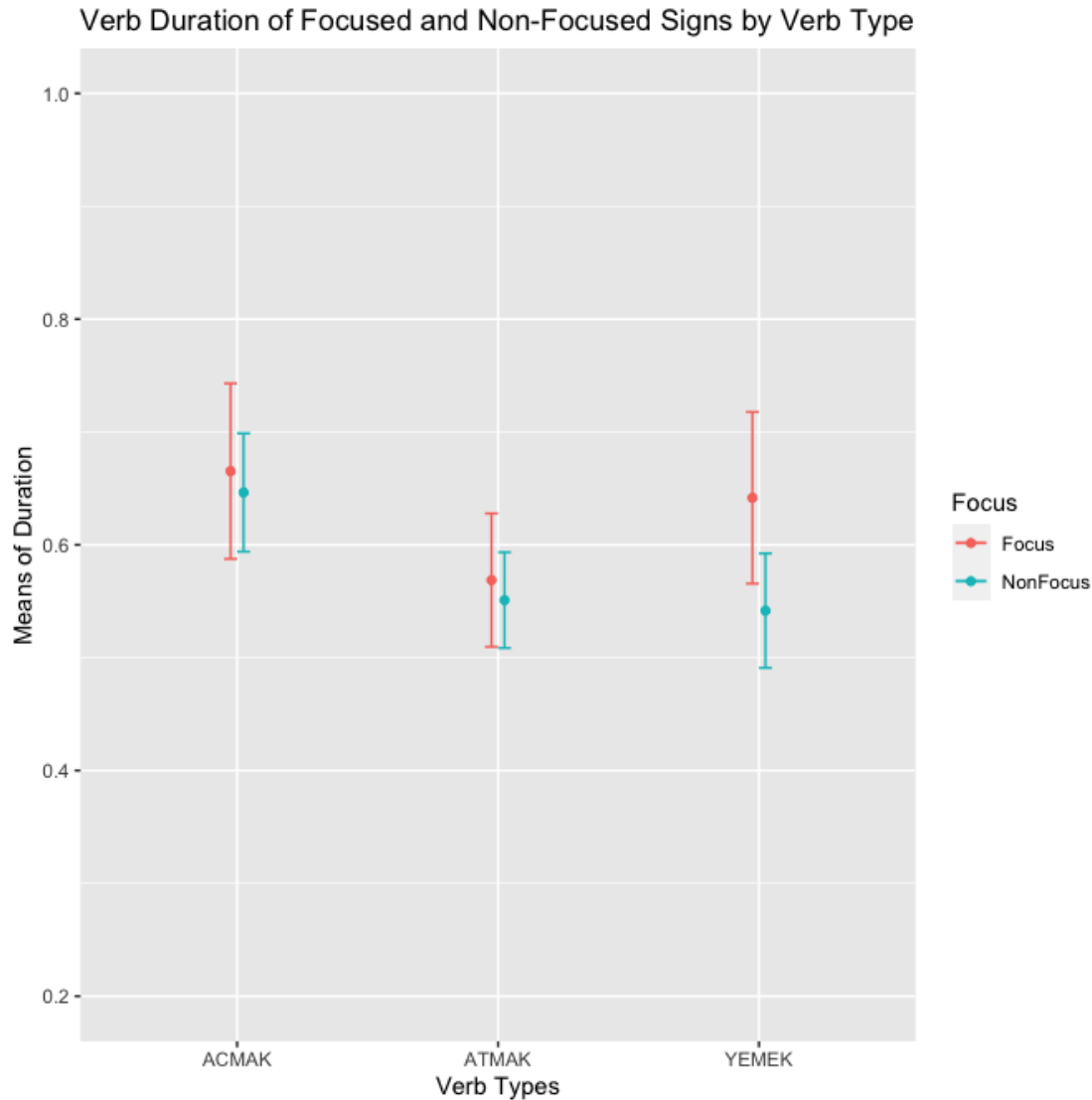
```
ggsave("FocusAoA.png")
```

```
#Plot - Verb Type
```

```
verb_summary=duration_data %>%
  filter(!is.na(Duration)) %>% filter(Position=="Verb") %>%
  summarySE(measurevar = "Duration", groupvars = c("Focus", "Verb", "Position"))
```

```
verb_summary %>% ggplot(aes(x=Verb, y=Duration, color=Focus)) +
  geom_errorbar(aes(ymin=Duration-ci, ymax=Duration+ci), width=.1, position = position_dodge(0.1)) +
  geom_line(position = position_dodge(0.1)) + geom_point(position=position_dodge(0.1)) +
```

```
coord_cartesian(ylim = c(0.20, 1)) +
labs(title = "Verb Duration of Focused and Non-Focused Signs by Verb Type",
      x = "Verb Types", y = "Means of Duration")
```



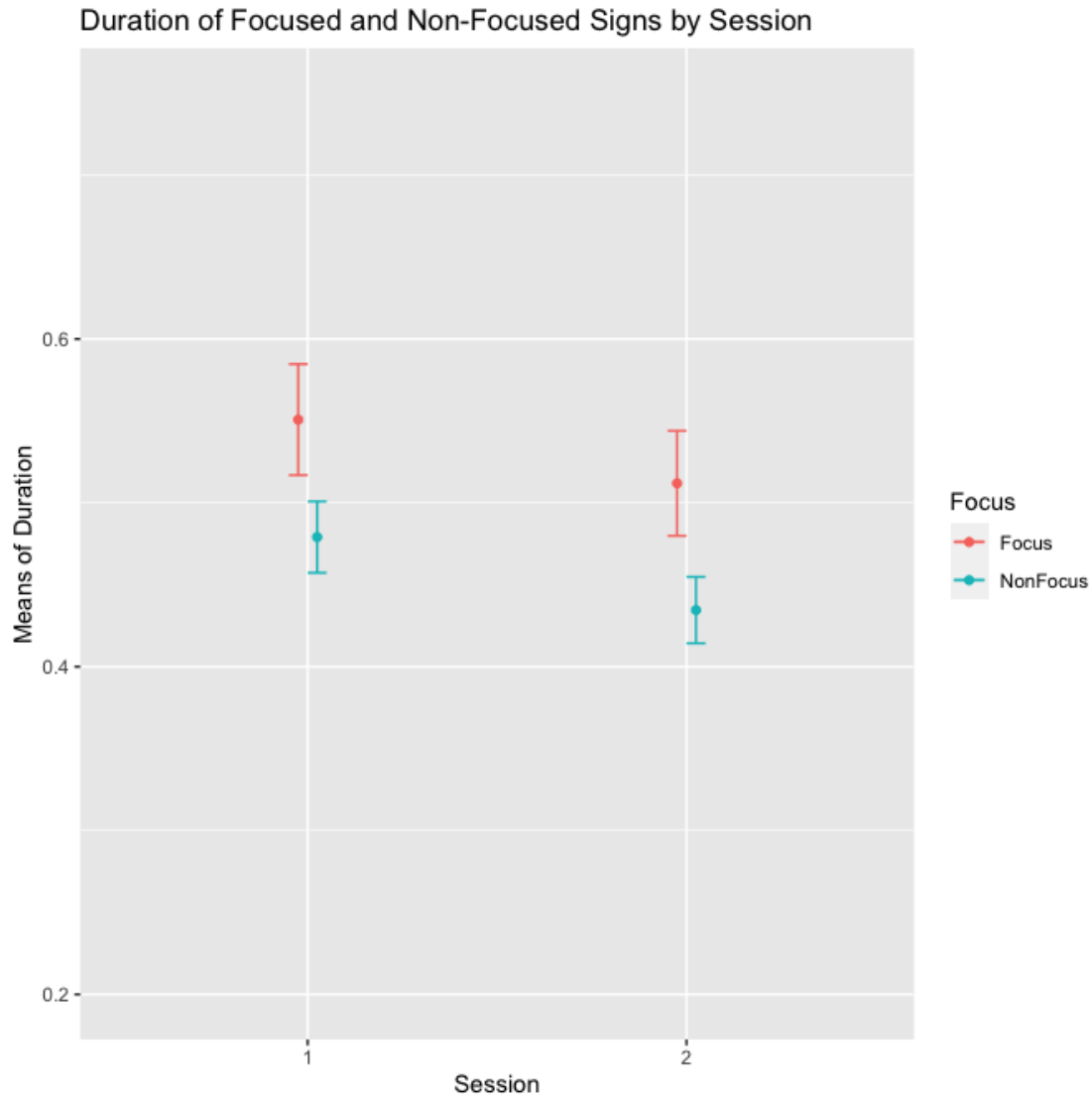
```
ggsave("VerbTypes.png")
```

```
#Plots - Session
```

```
session_summary=duration_data %>%
  filter(!is.na(Duration)) %>%
  summarySE(measurevar = "Duration", groupvars = c("Focus", "Session"))
```

```
session_summary %>% ggplot(aes(x=Session, y=Duration, color=Focus)) +
  geom_errorbar(aes(ymin=Duration-ci, ymax=Duration+ci), width=.1, position = position_dodge(0.1)) +
  geom_line(position = position_dodge(0.1)) + geom_point(position=position_dodge(0.1)) +
```

```
coord_cartesian(ylim = c(0.20, 0.75)) +
labs(title = "Duration of Focused and Non-Focused Signs by Session",
      x = "Session", y = "Means of Duration")
```



```
ggsave("Session.png")

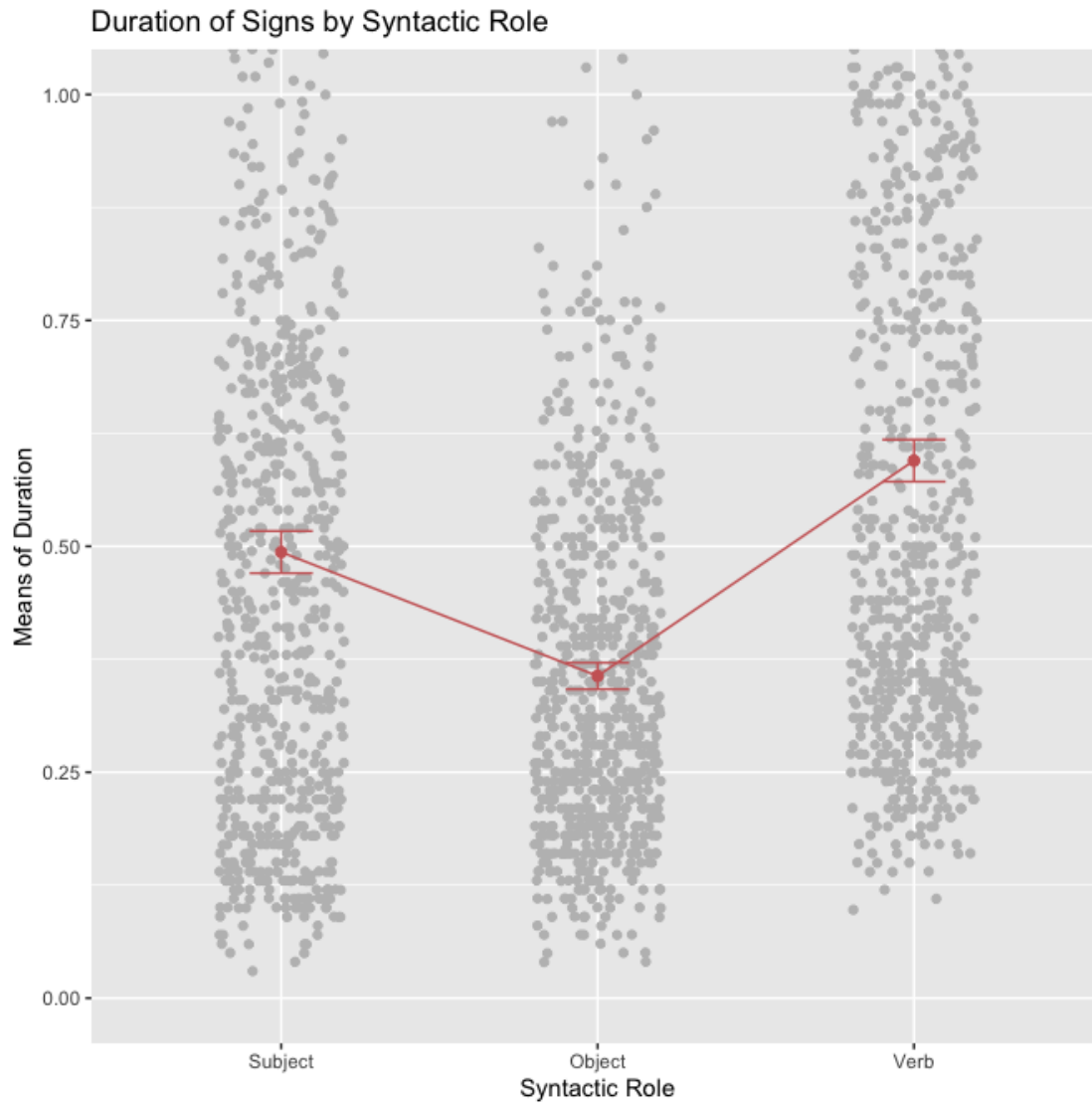
all_summary=duration_data %>%
  filter(!is.na(Duration)) %>%
  summarySE(measurevar = "Duration", groupvars = c("Position"))

duration_data %>%
  filter(!is.na(Duration)) %>%
  ggplot(aes(x = factor(Position, level = c("Subject", "Object", "Verb")),
            y = Duration, group = Position, color=Position)) +
```

```

geom_jitter( position = position_jitter(0.2), color = "gray") +
geom_line(aes(group = 1), data = all_summary, color="#CC6666") +
coord_cartesian(ylim = c(0, 1)) +
geom_errorbar(
  aes(ymin = Duration-ci, ymax = Duration+ci),
  data = all_summary, color="#CC6666", width = 0.2) +
geom_point(data = all_summary, color="#CC6666", size = 2) +
labs(title = "Duration of Signs by Syntactic Role",
  x = "Syntactic Role", y = "Means of Duration")

```



```
ggsave("AllDataPosition.png")
```

2. Nonmanuals

Load nonmanual data

```

NMMDData = read.csv("nmm-data.csv")
str(NMMDData)

## 'data.frame':  2160 obs. of  14 variables:
## $ Participant: int  1 1 1 1 1 1 1 1 1 1 ...
## $ Gender    : chr  "Male" "Male" "Male" "Male" ...
## $ Age      : int  25 25 25 25 25 25 25 25 25 ...
## $ AoA     : chr  "DoD" "DoD" "DoD" "DoD" ...
## $ Item     : int  3 2 3 1 1 2 3 3 1 2 ...
## $ Session  : int  1 1 1 1 1 1 2 2 2 2 ...
## $ Position : chr  "Subject" "Subject" "Subject" "Subject" ...
## $ FocusType: chr  "PF" "CF" "CF" "CF" ...
## $ Verb     : chr  "ACMAK" "ATMAK" "ACMAK" "YEMEK" ...
## $ Focus    : chr  "Focus" "Focus" "Focus" "Focus" ...
## $ NMM     : int  0 1 0 0 0 0 0 0 0 0 ...
## $ eb      : int  0 0 0 0 0 0 0 0 0 0 ...
## $ hn      : int  0 0 0 0 0 0 0 0 0 0 ...
## $ sq      : int  0 1 0 0 0 0 0 0 0 0 ...

```

Convert variables to correct format

```

NMMDData$Participant <- as.factor(NMMDData$Participant)
NMMDData$Gender <- as.factor(NMMDData$Gender)
NMMDData$Age <- as.numeric(NMMDData$Age)
NMMDData$AoA <- as.factor(NMMDData$AoA)
NMMDData$Item <- as.factor(NMMDData$Item)
NMMDData$Session <- as.factor(NMMDData$Session)
NMMDData$Position <- as.factor(NMMDData$Position)
NMMDData$FocusType <- as.factor(NMMDData$FocusType)
NMMDData$Verb <- as.factor(NMMDData$Verb)
NMMDData$Focus <- as.factor(NMMDData$Focus)
NMMDData$NMM <- as.numeric(NMMDData$NMM)
NMMDData$eb <- as.numeric(NMMDData$eb)
NMMDData$hn <- as.numeric(NMMDData$hn)
NMMDData$sq <- as.numeric(NMMDData$sq)

```

2.1. Random Effects

```

NMM.m0 = lmer(NMM ~ (1|Participant),
             data=NMMDData,
             REML=F)

summary(NMM.m0)

## Linear mixed model fit by maximum likelihood ['lmerMod']
## Formula: NMM ~ (1 | Participant)
## Data: NMMDData
##
##   AIC   BIC logLik deviance df.resid
## 2209.1 2226.1 -1101.5 2203.1   2144
##
## Scaled residuals:

```

```

##   Min   1Q Median   3Q   Max
## -1.3214 -0.6032 -0.3887 -0.1610  2.3403
##
## Random effects:
##   Groups   Name      Variance Std.Dev.
## Participant (Intercept) 0.01401  0.1184
## Residual              0.15984  0.3998
## Number of obs: 2147, groups: Participant, 20
##
## Fixed effects:
##           Estimate Std. Error t value
## (Intercept) 0.22395   0.02784   8.045

NMM.m1 = lmer(NMM ~ (1|Participant) + (1|Item),
             data=NMMDData,
             REML=F)

summary(NMM.m1)

## Linear mixed model fit by maximum likelihood ['lmerMod']
## Formula: NMM ~ (1 | Participant) + (1 | Item)
## Data: NMMDData
##
##   AIC   BIC logLik deviance df.resid
## 2211.1 2233.8 -1101.5 2203.1   2143
##
## Scaled residuals:
##   Min   1Q Median   3Q   Max
## -1.3214 -0.6032 -0.3887 -0.1610  2.3403
##
## Random effects:
##   Groups   Name      Variance Std.Dev.
## Participant (Intercept) 0.01401  0.1184
## Item (Intercept) 0.00000  0.0000
## Residual              0.15984  0.3998
## Number of obs: 2147, groups: Participant, 20; Item, 3
##
## Fixed effects:
##           Estimate Std. Error t value
## (Intercept) 0.22395   0.02784   8.045
## optimizer (nloptwrap) convergence code: 0 (OK)
## boundary (singular) fit: see help('isSingular')

anova(NMM.m0, NMM.m1)

## Data: NMMDData
## Models:
## NMM.m0: NMM ~ (1 | Participant)
## NMM.m1: NMM ~ (1 | Participant) + (1 | Item)
##      npar  AIC   BIC logLik deviance Chisq Df Pr(>Chisq)

```

```
## NMM.m0 3 2209.1 2226.1 -1101.5 2203.1
## NMM.m1 4 2211.1 2233.8 -1101.5 2203.1 0 1 1
```

2.2. Fixed Effects

Age doesn't have a significant effect.

```
NMM.m13 = lmer(NMM ~ Age + (1|Participant) + (1|Item),
              data=NMMDData,
              REML=F)

summary(NMM.m13)

## Linear mixed model fit by maximum likelihood ['lmerMod']
## Formula: NMM ~ Age + (1 | Participant) + (1 | Item)
## Data: NMMDData
##
##   AIC   BIC logLik deviance df.resid
## 1824.7 1852.3 -907.4 1814.7   1821
##
## Scaled residuals:
##   Min     1Q   Median     3Q      Max
## -1.3504 -0.6113 -0.3089 -0.1561  2.3871
##
## Random effects:
## Groups   Name      Variance Std.Dev.
## Participant (Intercept) 0.01522  0.1233
## Item      (Intercept) 0.00000  0.0000
## Residual                0.15461  0.3932
## Number of obs: 1826, groups: Participant, 17; Item, 3
##
## Fixed effects:
##              Estimate Std. Error t value
## (Intercept) 0.1891643  0.1560198  1.212
## Age         0.0008145  0.0044955  0.181
##
## Correlation of Fixed Effects:
##   (Intr)
## Age -0.980
## optimizer (nloptwrap) convergence code: 0 (OK)
## boundary (singular) fit: see help('isSingular')
```

Focus doesn't have a significant effect.

```
NMM.m2 = lmer(NMM ~ Focus + (1|Participant) + (1|Item),
              data=NMMDData,
              REML=F)

anova(NMM.m1, NMM.m2)

## Data: NMMDData
## Models:
```



```
## NMM.m1: NMM ~ (1 | Participant) + (1 | Item)
## NMM.m2: NMM ~ Focus + (1 | Participant) + (1 | Item)
##      npar  AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## NMM.m1   4 2211.1 2233.8 -1101.5  2203.1
## NMM.m2   5 2212.5 2240.9 -1101.3  2202.5 0.544  1   0.4608
```

Position has a significant effect

```
NMM.m3 = lmer(NMM ~ Position + (1|Participant) + (1|Item),
              data=NMMDData,
              REML=F)
```

```
anova(NMM.m1, NMM.m3)
```

```
## Data: NMMDData
## Models:
## NMM.m1: NMM ~ (1 | Participant) + (1 | Item)
## NMM.m3: NMM ~ Position + (1 | Participant) + (1 | Item)
##      npar  AIC   BIC logLik deviance Chisq Df      Pr(>Chisq)
## NMM.m1   4 2211.1 2233.8 -1101.54  2203.1
## NMM.m3   6 1963.8 1997.9 -975.91  1951.8 251.25 2 < 0.00000000000000022 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova(NMM.m2, NMM.m3)
```

```
## Data: NMMDData
## Models:
## NMM.m2: NMM ~ Focus + (1 | Participant) + (1 | Item)
## NMM.m3: NMM ~ Position + (1 | Participant) + (1 | Item)
##      npar  AIC   BIC logLik deviance Chisq Df      Pr(>Chisq)
## NMM.m2   5 2212.5 2240.9 -1101.26  2202.5
## NMM.m3   6 1963.8 1997.9 -975.91  1951.8 250.7 1 < 0.00000000000000022 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Focus Type seems to have a significant effect on nonmanual production, but non-focus items were also coded for focus type. Thus, this effect comes from the all data rather than due to focus itself. The effect doesn't hold when we test the interaction of focus and focus type.

```
NMM.m4 = lmer(NMM ~ Position + FocusType + (1|Participant) + (1|Item),
              data=NMMDData,
              REML=F)
```

```
anova(NMM.m3, NMM.m4)
```

```
## Data: NMMDData
## Models:
## NMM.m3: NMM ~ Position + (1 | Participant) + (1 | Item)
## NMM.m4: NMM ~ Position + FocusType + (1 | Participant) + (1 | Item)
##      npar  AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
```

```
## NMM.m3 6 1963.8 1997.9 -975.91 1951.8
## NMM.m4 7 1959.6 1999.3 -972.80 1945.6 6.2261 1 0.01259 *
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#Focus type interaction does not have a significant effect.*

```
NMM.m5 = lmer(NMM ~ Position + Focus*FocusType + (1|Participant) + (1|Item),
             data=NMMDData,
             REML=F)
```

```
anova(NMM.m4, NMM.m5)
```

```
## Data: NMMDData
```

```
## Models:
```

```
## NMM.m4: NMM ~ Position + FocusType + (1 | Participant) + (1 | Item)
```

```
## NMM.m5: NMM ~ Position + Focus * FocusType + (1 | Participant) + (1 | Item)
```

```
## npar AIC BIC logLik deviance Chisq Df Pr(>Chisq)
```

```
## NMM.m4 7 1959.6 1999.3 -972.80 1945.6
```

```
## NMM.m5 9 1962.8 2013.8 -972.39 1944.8 0.8238 2 0.6624
```

AoA doesn't have a significant effect.

```
NMM.m6 = lmer(NMM ~ Position + AoA + (1|Participant) + (1|Item),
             data=NMMDData,
             REML=F)
```

```
anova(NMM.m3, NMM.m6)
```

```
## Data: NMMDData
```

```
## Models:
```

```
## NMM.m3: NMM ~ Position + (1 | Participant) + (1 | Item)
```

```
## NMM.m6: NMM ~ Position + AoA + (1 | Participant) + (1 | Item)
```

```
## npar AIC BIC logLik deviance Chisq Df Pr(>Chisq)
```

```
## NMM.m3 6 1963.8 1997.9 -975.91 1951.8
```

```
## NMM.m6 7 1965.4 2005.1 -975.70 1951.4 0.4184 1 0.5177
```

Position*AoA has an effect.

```
NMM.m7 = lmer(NMM ~ Position + AoA*Position + (1|Participant) + (1|Item),
             data=NMMDData,
             REML=F)
```

```
anova(NMM.m3, NMM.m7)
```

```
## Data: NMMDData
```

```
## Models:
```

```
## NMM.m3: NMM ~ Position + (1 | Participant) + (1 | Item)
```

```
## NMM.m7: NMM ~ Position + AoA * Position + (1 | Participant) + (1 | Item)
```

```
## npar AIC BIC logLik deviance Chisq Df Pr(>Chisq)
```

```
## NMM.m3  6 1963.8 1997.9 -975.91  1951.8
## NMM.m7  9 1955.3 2006.3 -968.65  1937.3 14.524  3  0.002272 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova(NMM.m6, NMM.m7)
```

```
## Data: NMMDData
## Models:
## NMM.m6: NMM ~ Position + AoA + (1 | Participant) + (1 | Item)
## NMM.m7: NMM ~ Position + AoA * Position + (1 | Participant) + (1 | Item)
##      npar  AIC  BIC logLik deviance Chisq Df Pr(>Chisq)
## NMM.m6   7 1965.4 2005.1 -975.70  1951.4
## NMM.m7   9 1955.3 2006.3 -968.65  1937.3 14.105  2 0.0008651 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Session has a significant effect.

```
NMM.m8 = lmer(NMM ~ Position + AoA*Position + Session + (1|Participant) + (1|Item),
              data=NMMDData,
              REML=F)
```

```
anova(NMM.m7, NMM.m8)
```

```
## Data: NMMDData
## Models:
## NMM.m7: NMM ~ Position + AoA * Position + (1 | Participant) + (1 | Item)
## NMM.m8: NMM ~ Position + AoA * Position + Session + (1 | Participant) + (1 | Item)
##      npar  AIC  BIC logLik deviance Chisq Df Pr(>Chisq)
## NMM.m7   9 1955.3 2006.3 -968.65  1937.3
## NMM.m8  10 1952.8 2009.5 -966.41  1932.8 4.4924  1  0.03405 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Session*Position interaction isn't significant.

```
NMM.m9 = lmer(NMM ~ Position + AoA*Position + Session*Position + (1|Participant) + (1|Item),
              data=NMMDData,
              REML=F)
```

```
anova(NMM.m8, NMM.m9)
```

```
## Data: NMMDData
## Models:
## NMM.m8: NMM ~ Position + AoA * Position + Session + (1 | Participant) + (1 | Item)
## NMM.m9: NMM ~ Position + AoA * Position + Session * Position + (1 | Participant) + (1 | Item)
##      npar  AIC  BIC logLik deviance Chisq Df Pr(>Chisq)
## NMM.m8  10 1952.8 2009.5 -966.41  1932.8
## NMM.m9  12 1955.1 2023.2 -965.55  1931.1 1.7132  2  0.4246
```

Session*AoA interaction isn't significant.

```
NMM.m10 = lmer(NMM ~ Position + AoA*Position + Session*AoA + (1|Participant) + (1|Item),
  data=NMMDData,
  REML=F)
```

```
anova(NMM.m8, NMM.m10)
```

```
## Data: NMMDData
```

```
## Models:
```

```
## NMM.m8: NMM ~ Position + AoA * Position + Session + (1 | Participant) + (1 | Item)
```

```
## NMM.m10: NMM ~ Position + AoA * Position + Session * AoA + (1 | Participant) + (1 | Item)
```

```
##      npar  AIC  BIC logLik deviance Chisq Df Pr(>Chisq)
```

```
## NMM.m8   10 1952.8 2009.5 -966.41  1932.8
```

```
## NMM.m10  11 1953.1 2015.5 -965.56  1931.1 1.6999 1  0.1923
```

Three-way interaction of position, session, and AoA isn't significant.

```
NMM.m11 = lmer(NMM ~ Position + AoA*Position + Session*AoA*Position + (1|Participant) +
  (1|Item),
  data=NMMDData,
  REML=F)
```

```
anova(NMM.m8, NMM.m11)
```

```
## Data: NMMDData
```

```
## Models:
```

```
## NMM.m8: NMM ~ Position + AoA * Position + Session + (1 | Participant) + (1 | Item)
```

```
## NMM.m11: NMM ~ Position + AoA * Position + Session * AoA * Position + (1 | Participant) + (1 |
  Item)
```

```
##      npar  AIC  BIC logLik deviance Chisq Df Pr(>Chisq)
```

```
## NMM.m8   10 1952.8 2009.5 -966.41  1932.8
```

```
## NMM.m11  15 1958.9 2044.0 -964.44  1928.9 3.9256 5  0.5602
```

Verb doesn't have a significant effect.

```
NMM.m12 = lmer(NMM ~ Position + Position*AoA + Session + Verb + (1|Participant) + (1|Item),
  data=NMMDData,
  REML=F)
```

```
anova(NMM.m8, NMM.m12)
```

```
## Data: NMMDData
```

```
## Models:
```

```
## NMM.m8: NMM ~ Position + AoA * Position + Session + (1 | Participant) + (1 | Item)
```

```
## NMM.m12: NMM ~ Position + Position * AoA + Session + Verb + (1 | Participant) + (1 | Item)
```

```
##      npar  AIC  BIC logLik deviance Chisq Df Pr(>Chisq)
```

```
## NMM.m8   10 1952.8 2009.5 -966.41  1932.8
```

```
## NMM.m12  12 1954.7 2022.8 -965.36  1930.7 2.0969 2  0.3505
```

Random slopes were also added to the model, yet the model did not converge.

```

NMM.m13 = lmer(NMM ~ Position + AoA*Position + Session + (Position + AoA*Position +
Session|Participant) + (Position + AoA*Position + Session|Item),
  data=NMMData,
  REML=F)

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

anova(NMM.m8, NMM.m13)

## Data: NMMData
## Models:
## NMM.m8: NMM ~ Position + AoA * Position + Session + (1 | Participant) + (1 | Item)
## NMM.m13: NMM ~ Position + AoA * Position + Session + (Position + AoA * Position + Session |
Participant) + (Position + AoA * Position + Session | Item)
##      npar  AIC   BIC logLik deviance Chisq Df Pr(>Chisq)
## NMM.m8   10 1952.8 2009.5 -966.41  1932.8
## NMM.m13   64 1936.9 2299.9 -904.44  1808.9 123.93 54 0.0000002029 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

Model comparisons showed no significant effect of focus on nonmanual production. The significant independent variables are position, session, and the interaction of AoA and position. There is no three way interaction among position, session, and AoA. Thus, the full model is nmm.m8 to analyze nonmanual data.

2.3. Contrasts

Contrasts showed that subject position had significantly more nonmanuals than object and verb. Object had significantly less nonmanuals than verb.

```

emmeans(NMM.m8, pairwise~Position)

## $emmeans
## Position emmean SE df lower.CL upper.CL
## Object 0.0963 0.0314 29.3 0.0321 0.160
## Subject 0.4140 0.0314 29.3 0.3498 0.478
## Verb 0.1681 0.0314 29.2 0.1039 0.232
##
## Results are averaged over the levels of: AoA, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## contrast estimate SE df t.ratio p.value
## Object - Subject -0.3177 0.0200 2130 -15.901 <.0001
## Object - Verb -0.0718 0.0199 2130 -3.600 0.0009
## Subject - Verb 0.2459 0.0200 2130 12.316 <.0001
##
## Results are averaged over the levels of: AoA, Session
## Degrees-of-freedom method: kenward-roger
## P value adjustment: tukey method for comparing a family of 3 estimates

```

Production of nonmanuals change by AoA. While overall pattern seen in the above contrasts was the same with DoH participants. Difference between object and verb was not significant for DoD participants.

```
emmeans(NMM.m8, pairwise~Position|AoA)

## $emmeans
## AoA = DoD:
## Position emmean SE df lower.CL upper.CL
## Object 0.1122 0.0421 30.3 0.0262 0.198
## Subject 0.3556 0.0421 30.2 0.2697 0.441
## Verb 0.1566 0.0421 30.2 0.0707 0.243
##
## AoA = DoH:
## Position emmean SE df lower.CL upper.CL
## Object 0.0805 0.0465 30.4 -0.0144 0.175
## Subject 0.4724 0.0466 30.5 0.3774 0.567
## Verb 0.1795 0.0465 30.4 0.0846 0.274
##
## Results are averaged over the levels of: Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## AoA = DoD:
## contrast estimate SE df t.ratio p.value
## Object - Subject -0.2434 0.0268 2130 -9.089 <.0001
## Object - Verb -0.0445 0.0268 2130 -1.662 0.2203
## Subject - Verb 0.1990 0.0267 2130 7.438 <.0001
##
## AoA = DoH:
## contrast estimate SE df t.ratio p.value
## Object - Subject -0.3920 0.0297 2130 -13.218 <.0001
## Object - Verb -0.0991 0.0296 2130 -3.351 0.0024
## Subject - Verb 0.2929 0.0297 2130 9.877 <.0001
##
## Results are averaged over the levels of: Session
## Degrees-of-freedom method: kenward-roger
## P value adjustment: tukey method for comparing a family of 3 estimates
```

Participants produced significantly less nonmanuals in Session 2.

```
emmeans(NMM.m8, pairwise~Session)

## $emmeans
## Session emmean SE df lower.CL upper.CL
## 1 0.243 0.0303 25.1 0.181 0.306
## 2 0.209 0.0303 25.1 0.147 0.271
##
## Results are averaged over the levels of: Position, AoA
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
```

```
##
## $contrasts
## contrast      estimate    SE  df t.ratio p.value
## Session1 - Session2  0.0343 0.0162 2130  2.118  0.0343
##
## Results are averaged over the levels of: Position, AoA
## Degrees-of-freedom method: kenward-roger
```

2.4. Descriptive statistics of raw data for nonmanuals

```
nmm_descriptive = NMMDData %>% filter(!is.na(NMM)) %>%
  summarySE(measurevar = "NMM", groupvars = c("Focus", "FocusType", "Position", "Verb", "AoA",
"Session"))
```

```
nmm_descriptive
```

##	Focus	FocusType	Position	Verb	AoA	Session	N	NMM	sd
## 1	Focus	CF	Object	ACMAK	DoD	1	11	0.09090909	0.3015113
## 2	Focus	CF	Object	ACMAK	DoD	2	11	0.27272727	0.4670994
## 3	Focus	CF	Object	ACMAK	DoH	1	9	0.22222222	0.4409586
## 4	Focus	CF	Object	ACMAK	DoH	2	8	0.00000000	0.0000000
## 5	Focus	CF	Object	ATMAK	DoD	1	11	0.09090909	0.3015113
## 6	Focus	CF	Object	ATMAK	DoD	2	11	0.00000000	0.0000000
## 7	Focus	CF	Object	ATMAK	DoH	1	9	0.11111111	0.3333333
## 8	Focus	CF	Object	ATMAK	DoH	2	9	0.00000000	0.0000000
## 9	Focus	CF	Object	YEMEK	DoD	1	11	0.09090909	0.3015113
## 10	Focus	CF	Object	YEMEK	DoD	2	11	0.18181818	0.4045199
## 11	Focus	CF	Object	YEMEK	DoH	1	9	0.11111111	0.3333333
## 12	Focus	CF	Object	YEMEK	DoH	2	9	0.00000000	0.0000000
## 13	Focus	CF	Subject	ACMAK	DoD	1	11	0.36363636	0.5045250
## 14	Focus	CF	Subject	ACMAK	DoD	2	11	0.54545455	0.5222330
## 15	Focus	CF	Subject	ACMAK	DoH	1	9	0.22222222	0.4409586
## 16	Focus	CF	Subject	ACMAK	DoH	2	9	0.66666667	0.5000000
## 17	Focus	CF	Subject	ATMAK	DoD	1	11	0.54545455	0.5222330
## 18	Focus	CF	Subject	ATMAK	DoD	2	11	0.45454545	0.5222330
## 19	Focus	CF	Subject	ATMAK	DoH	1	9	0.77777778	0.4409586
## 20	Focus	CF	Subject	ATMAK	DoH	2	9	0.55555556	0.5270463
## 21	Focus	CF	Subject	YEMEK	DoD	1	11	0.18181818	0.4045199
## 22	Focus	CF	Subject	YEMEK	DoD	2	11	0.54545455	0.5222330
## 23	Focus	CF	Subject	YEMEK	DoH	1	9	0.11111111	0.3333333
## 24	Focus	CF	Subject	YEMEK	DoH	2	9	0.55555556	0.5270463
## 25	Focus	CF	Verb	ACMAK	DoD	1	11	0.18181818	0.4045199
## 26	Focus	CF	Verb	ACMAK	DoD	2	11	0.27272727	0.4670994
## 27	Focus	CF	Verb	ACMAK	DoH	1	9	0.22222222	0.4409586
## 28	Focus	CF	Verb	ACMAK	DoH	2	9	0.33333333	0.5000000
## 29	Focus	CF	Verb	ATMAK	DoD	1	11	0.27272727	0.4670994
## 30	Focus	CF	Verb	ATMAK	DoD	2	11	0.18181818	0.4045199
## 31	Focus	CF	Verb	ATMAK	DoH	1	9	0.11111111	0.3333333
## 32	Focus	CF	Verb	ATMAK	DoH	2	9	0.11111111	0.3333333
## 33	Focus	CF	Verb	YEMEK	DoD	1	11	0.36363636	0.5045250
## 34	Focus	CF	Verb	YEMEK	DoD	2	11	0.18181818	0.4045199
## 35	Focus	CF	Verb	YEMEK	DoH	1	9	0.11111111	0.3333333

## 36	Focus	CF	Verb YEMEK DoH	2	9	0.22222222	0.4409586
## 37	Focus	PF	Object ACMAK DoD	1	11	0.27272727	0.4670994
## 38	Focus	PF	Object ACMAK DoD	2	11	0.18181818	0.4045199
## 39	Focus	PF	Object ACMAK DoH	1	9	0.33333333	0.5000000
## 40	Focus	PF	Object ACMAK DoH	2	9	0.22222222	0.4409586
## 41	Focus	PF	Object ATMAK DoD	1	11	0.00000000	0.0000000
## 42	Focus	PF	Object ATMAK DoD	2	11	0.00000000	0.0000000
## 43	Focus	PF	Object ATMAK DoH	1	9	0.00000000	0.0000000
## 44	Focus	PF	Object ATMAK DoH	2	9	0.11111111	0.3333333
## 45	Focus	PF	Object YEMEK DoD	1	11	0.18181818	0.4045199
## 46	Focus	PF	Object YEMEK DoD	2	11	0.09090909	0.3015113
## 47	Focus	PF	Object YEMEK DoH	1	9	0.11111111	0.3333333
## 48	Focus	PF	Object YEMEK DoH	2	9	0.00000000	0.0000000
## 49	Focus	PF	Subject ACMAK DoD	1	11	0.18181818	0.4045199
## 50	Focus	PF	Subject ACMAK DoD	2	10	0.10000000	0.3162278
## 51	Focus	PF	Subject ACMAK DoH	1	9	0.55555556	0.5270463
## 52	Focus	PF	Subject ACMAK DoH	2	8	0.37500000	0.5175492
## 53	Focus	PF	Subject ATMAK DoD	1	11	0.45454545	0.5222330
## 54	Focus	PF	Subject ATMAK DoD	2	11	0.18181818	0.4045199
## 55	Focus	PF	Subject ATMAK DoH	1	9	0.44444444	0.5270463
## 56	Focus	PF	Subject ATMAK DoH	2	9	0.33333333	0.5000000
## 57	Focus	PF	Subject YEMEK DoD	1	11	0.45454545	0.5222330
## 58	Focus	PF	Subject YEMEK DoD	2	11	0.27272727	0.4670994
## 59	Focus	PF	Subject YEMEK DoH	1	9	0.44444444	0.5270463
## 60	Focus	PF	Subject YEMEK DoH	2	9	0.44444444	0.5270463
## 61	Focus	PF	Verb ACMAK DoD	1	11	0.00000000	0.0000000
## 62	Focus	PF	Verb ACMAK DoD	2	11	0.18181818	0.4045199
## 63	Focus	PF	Verb ACMAK DoH	1	9	0.33333333	0.5000000
## 64	Focus	PF	Verb ACMAK DoH	2	9	0.33333333	0.5000000
## 65	Focus	PF	Verb ATMAK DoD	1	11	0.09090909	0.3015113
## 66	Focus	PF	Verb ATMAK DoD	2	11	0.00000000	0.0000000
## 67	Focus	PF	Verb ATMAK DoH	1	9	0.33333333	0.5000000
## 68	Focus	PF	Verb ATMAK DoH	2	9	0.22222222	0.4409586
## 69	Focus	PF	Verb YEMEK DoD	1	11	0.09090909	0.3015113
## 70	Focus	PF	Verb YEMEK DoD	2	11	0.09090909	0.3015113
## 71	Focus	PF	Verb YEMEK DoH	1	9	0.11111111	0.3333333
## 72	Focus	PF	Verb YEMEK DoH	2	9	0.11111111	0.3333333
## 73	NonFocus	CF	Object ACMAK DoD	1	20	0.20000000	0.4103913
## 74	NonFocus	CF	Object ACMAK DoD	2	22	0.04545455	0.2132007
## 75	NonFocus	CF	Object ACMAK DoH	1	18	0.16666667	0.3834825
## 76	NonFocus	CF	Object ACMAK DoH	2	18	0.05555556	0.2357023
## 77	NonFocus	CF	Object ATMAK DoD	1	22	0.18181818	0.3947710
## 78	NonFocus	CF	Object ATMAK DoD	2	22	0.09090909	0.2942449
## 79	NonFocus	CF	Object ATMAK DoH	1	18	0.00000000	0.0000000
## 80	NonFocus	CF	Object ATMAK DoH	2	18	0.00000000	0.0000000
## 81	NonFocus	CF	Object YEMEK DoD	1	22	0.18181818	0.3947710
## 82	NonFocus	CF	Object YEMEK DoD	2	22	0.09090909	0.2942449
## 83	NonFocus	CF	Object YEMEK DoH	1	18	0.11111111	0.3233808
## 84	NonFocus	CF	Object YEMEK DoH	2	18	0.05555556	0.2357023
## 85	NonFocus	CF	Subject ACMAK DoD	1	22	0.40909091	0.5032363
## 86	NonFocus	CF	Subject ACMAK DoD	2	22	0.18181818	0.3947710

## 87 NonFocus	CF Subject ACMAK DoH	1 18 0.50000000 0.5144958
## 88 NonFocus	CF Subject ACMAK DoH	2 17 0.41176471 0.5072997
## 89 NonFocus	CF Subject ATMAK DoD	1 22 0.54545455 0.5096472
## 90 NonFocus	CF Subject ATMAK DoD	2 22 0.22727273 0.4289320
## 91 NonFocus	CF Subject ATMAK DoH	1 17 0.52941176 0.5144958
## 92 NonFocus	CF Subject ATMAK DoH	2 18 0.61111111 0.5016313
## 93 NonFocus	CF Subject YEMEK DoD	1 22 0.45454545 0.5096472
## 94 NonFocus	CF Subject YEMEK DoD	2 22 0.54545455 0.5096472
## 95 NonFocus	CF Subject YEMEK DoH	1 18 0.72222222 0.4608886
## 96 NonFocus	CF Subject YEMEK DoH	2 18 0.55555556 0.5113100
## 97 NonFocus	CF Verb ACMAK DoD	1 21 0.19047619 0.4023739
## 98 NonFocus	CF Verb ACMAK DoD	2 22 0.18181818 0.3947710
## 99 NonFocus	CF Verb ACMAK DoH	1 18 0.11111111 0.3233808
## 100 NonFocus	CF Verb ACMAK DoH	2 17 0.11764706 0.3321056
## 101 NonFocus	CF Verb ATMAK DoD	1 22 0.13636364 0.3512501
## 102 NonFocus	CF Verb ATMAK DoD	2 22 0.13636364 0.3512501
## 103 NonFocus	CF Verb ATMAK DoH	1 18 0.11111111 0.3233808
## 104 NonFocus	CF Verb ATMAK DoH	2 18 0.16666667 0.3834825
## 105 NonFocus	CF Verb YEMEK DoD	1 22 0.22727273 0.4289320
## 106 NonFocus	CF Verb YEMEK DoD	2 22 0.09090909 0.2942449
## 107 NonFocus	CF Verb YEMEK DoH	1 18 0.11111111 0.3233808
## 108 NonFocus	CF Verb YEMEK DoH	2 18 0.16666667 0.3834825
## 109 NonFocus	PF Object ACMAK DoD	1 22 0.09090909 0.2942449
## 110 NonFocus	PF Object ACMAK DoD	2 22 0.09090909 0.2942449
## 111 NonFocus	PF Object ACMAK DoH	1 18 0.11111111 0.3233808
## 112 NonFocus	PF Object ACMAK DoH	2 18 0.11111111 0.3233808
## 113 NonFocus	PF Object ATMAK DoD	1 22 0.18181818 0.3947710
## 114 NonFocus	PF Object ATMAK DoD	2 21 0.04761905 0.2182179
## 115 NonFocus	PF Object ATMAK DoH	1 18 0.00000000 0.0000000
## 116 NonFocus	PF Object ATMAK DoH	2 18 0.05555556 0.2357023
## 117 NonFocus	PF Object YEMEK DoD	1 22 0.09090909 0.2942449
## 118 NonFocus	PF Object YEMEK DoD	2 22 0.00000000 0.0000000
## 119 NonFocus	PF Object YEMEK DoH	1 18 0.11111111 0.3233808
## 120 NonFocus	PF Object YEMEK DoH	2 18 0.05555556 0.2357023
## 121 NonFocus	PF Subject ACMAK DoD	1 21 0.14285714 0.3585686
## 122 NonFocus	PF Subject ACMAK DoD	2 22 0.27272727 0.4558423
## 123 NonFocus	PF Subject ACMAK DoH	1 18 0.50000000 0.5144958
## 124 NonFocus	PF Subject ACMAK DoH	2 16 0.50000000 0.5163978
## 125 NonFocus	PF Subject ATMAK DoD	1 22 0.50000000 0.5117663
## 126 NonFocus	PF Subject ATMAK DoD	2 22 0.09090909 0.2942449
## 127 NonFocus	PF Subject ATMAK DoH	1 18 0.38888889 0.5016313
## 128 NonFocus	PF Subject ATMAK DoH	2 18 0.33333333 0.4850713
## 129 NonFocus	PF Subject YEMEK DoD	1 22 0.36363636 0.4923660
## 130 NonFocus	PF Subject YEMEK DoD	2 22 0.50000000 0.5117663
## 131 NonFocus	PF Subject YEMEK DoH	1 18 0.38888889 0.5016313
## 132 NonFocus	PF Subject YEMEK DoH	2 18 0.33333333 0.4850713
## 133 NonFocus	PF Verb ACMAK DoD	1 22 0.27272727 0.4558423
## 134 NonFocus	PF Verb ACMAK DoD	2 22 0.13636364 0.3512501
## 135 NonFocus	PF Verb ACMAK DoH	1 18 0.16666667 0.3834825
## 136 NonFocus	PF Verb ACMAK DoH	2 18 0.22222222 0.4277926
## 137 NonFocus	PF Verb ATMAK DoD	1 22 0.09090909 0.2942449

## 138 NonFocus	PF	Verb ATMAK DoD	2 22 0.09090909 0.2942449
## 139 NonFocus	PF	Verb ATMAK DoH	1 18 0.16666667 0.3834825
## 140 NonFocus	PF	Verb ATMAK DoH	2 18 0.16666667 0.3834825
## 141 NonFocus	PF	Verb YEMEK DoD	1 22 0.13636364 0.3512501
## 142 NonFocus	PF	Verb YEMEK DoD	2 22 0.18181818 0.3947710
## 143 NonFocus	PF	Verb YEMEK DoH	1 18 0.22222222 0.4277926
## 144 NonFocus	PF	Verb YEMEK DoH	2 18 0.22222222 0.4277926

se ci

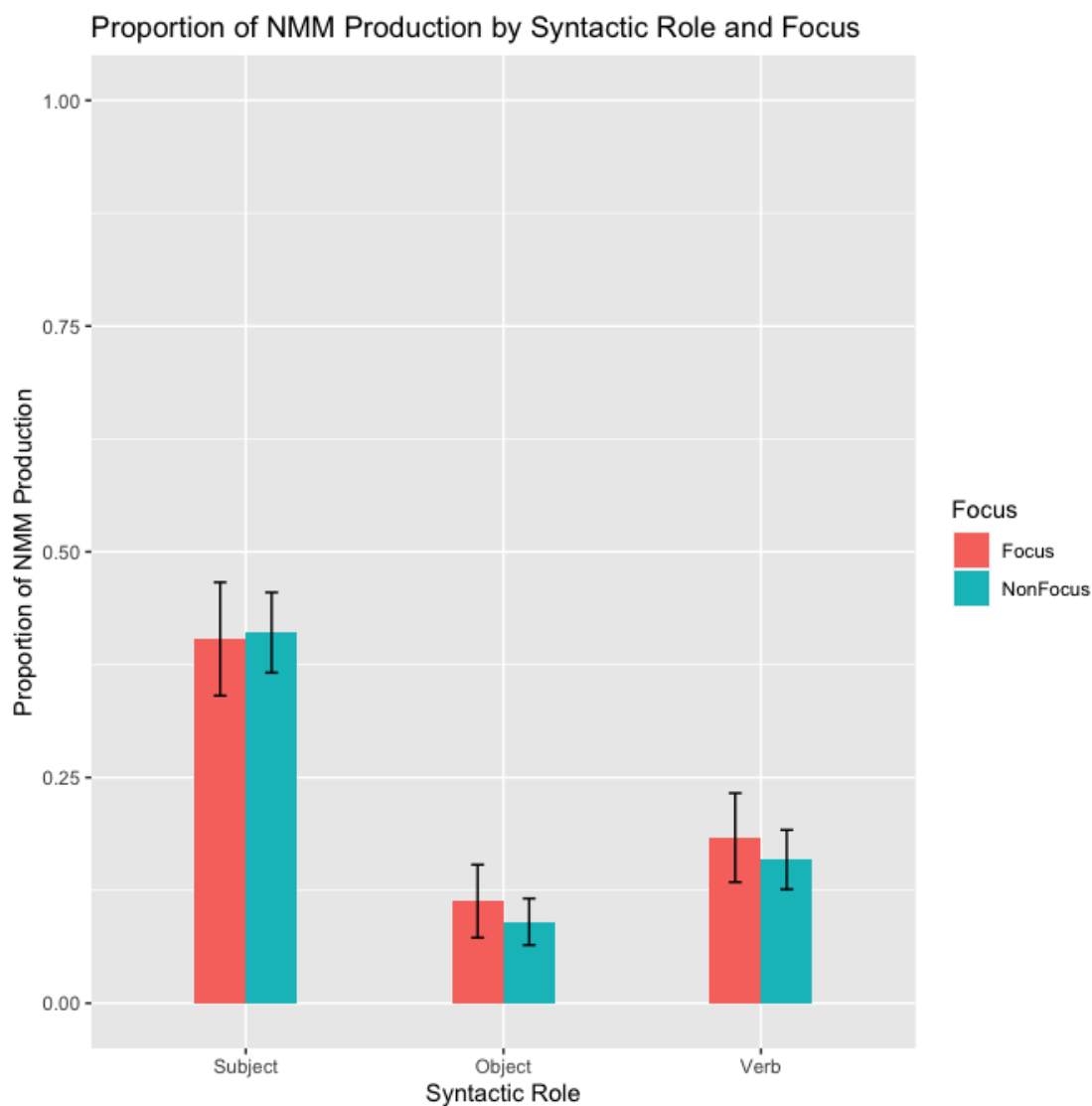
## 1	0.09090909	0.20255808
## 2	0.14083576	0.31380162
## 3	0.14698618	0.33895075
## 4	0.00000000	0.00000000
## 5	0.09090909	0.20255808
## 6	0.00000000	0.00000000
## 7	0.11111111	0.25622268
## 8	0.00000000	0.00000000
## 9	0.09090909	0.20255808
## 10	0.12196734	0.27176018
## 11	0.11111111	0.25622268
## 12	0.00000000	0.00000000
## 13	0.15212000	0.33894449
## 14	0.15745916	0.35084088
## 15	0.14698618	0.33895075
## 16	0.16666667	0.38433402
## 17	0.15745916	0.35084088
## 18	0.15745916	0.35084088
## 19	0.14698618	0.33895075
## 20	0.17568209	0.40512363
## 21	0.12196734	0.27176018
## 22	0.15745916	0.35084088
## 23	0.11111111	0.25622268
## 24	0.17568209	0.40512363
## 25	0.12196734	0.27176018
## 26	0.14083576	0.31380162
## 27	0.14698618	0.33895075
## 28	0.16666667	0.38433402
## 29	0.14083576	0.31380162
## 30	0.12196734	0.27176018
## 31	0.11111111	0.25622268
## 32	0.11111111	0.25622268
## 33	0.15212000	0.33894449
## 34	0.12196734	0.27176018
## 35	0.11111111	0.25622268
## 36	0.14698618	0.33895075
## 37	0.14083576	0.31380162
## 38	0.12196734	0.27176018
## 39	0.16666667	0.38433402
## 40	0.14698618	0.33895075
## 41	0.00000000	0.00000000
## 42	0.00000000	0.00000000
## 43	0.00000000	0.00000000

44 0.11111111 0.25622268
45 0.12196734 0.27176018
46 0.09090909 0.20255808
47 0.11111111 0.25622268
48 0.00000000 0.00000000
49 0.12196734 0.27176018
50 0.10000000 0.22621572
51 0.17568209 0.40512363
52 0.18298126 0.43268193
53 0.15745916 0.35084088
54 0.12196734 0.27176018
55 0.17568209 0.40512363
56 0.16666667 0.38433402
57 0.15745916 0.35084088
58 0.14083576 0.31380162
59 0.17568209 0.40512363
60 0.17568209 0.40512363
61 0.00000000 0.00000000
62 0.12196734 0.27176018
63 0.16666667 0.38433402
64 0.16666667 0.38433402
65 0.09090909 0.20255808
66 0.00000000 0.00000000
67 0.16666667 0.38433402
68 0.14698618 0.33895075
69 0.09090909 0.20255808
70 0.09090909 0.20255808
71 0.11111111 0.25622268
72 0.11111111 0.25622268
73 0.09176629 0.19206906
74 0.04545455 0.09452790
75 0.09038769 0.19070136
76 0.05555556 0.11721198
77 0.08416546 0.17503166
78 0.06273323 0.13046090
79 0.00000000 0.00000000
80 0.00000000 0.00000000
81 0.08416546 0.17503166
82 0.06273323 0.13046090
83 0.07622159 0.16081351
84 0.05555556 0.11721198
85 0.10729034 0.22312247
86 0.08416546 0.17503166
87 0.12126781 0.25585272
88 0.12303824 0.26082942
89 0.10865715 0.22596491
90 0.09144862 0.19017781
91 0.12478355 0.26452931
92 0.11823564 0.24945539
93 0.10865715 0.22596491
94 0.10865715 0.22596491

95 0.10863248 0.22919451
96 0.12051692 0.25426848
97 0.08780519 0.18315841
98 0.08416546 0.17503166
99 0.07622159 0.16081351
100 0.08054743 0.17075293
101 0.07488677 0.15573556
102 0.07488677 0.15573556
103 0.07622159 0.16081351
104 0.09038769 0.19070136
105 0.09144862 0.19017781
106 0.06273323 0.13046090
107 0.07622159 0.16081351
108 0.09038769 0.19070136
109 0.06273323 0.13046090
110 0.06273323 0.13046090
111 0.07622159 0.16081351
112 0.07622159 0.16081351
113 0.08416546 0.17503166
114 0.04761905 0.09933159
115 0.00000000 0.00000000
116 0.05555556 0.11721198
117 0.06273323 0.13046090
118 0.00000000 0.00000000
119 0.07622159 0.16081351
120 0.05555556 0.11721198
121 0.07824608 0.16321846
122 0.09718591 0.20210916
123 0.12126781 0.25585272
124 0.12909944 0.27516895
125 0.10910895 0.22690447
126 0.06273323 0.13046090
127 0.11823564 0.24945539
128 0.11433239 0.24122026
129 0.10497278 0.21830284
130 0.10910895 0.22690447
131 0.11823564 0.24945539
132 0.11433239 0.24122026
133 0.09718591 0.20210916
134 0.07488677 0.15573556
135 0.09038769 0.19070136
136 0.10083169 0.21273627
137 0.06273323 0.13046090
138 0.06273323 0.13046090
139 0.09038769 0.19070136
140 0.09038769 0.19070136
141 0.07488677 0.15573556
142 0.08416546 0.17503166
143 0.10083169 0.21273627
144 0.10083169 0.21273627

2.5. Plots

```
nmn_position_summary=NMMDData %>%  
  filter(!is.na(NMM)) %>%  
  summarySE(measurevar = "NMM", groupvars = c("Focus", "Position"))  
  
ggplot(nmn_position_summary, aes(x=factor(Position, level = c("Subject", "Object", "Verb")),  
  y=NMM, fill=Focus)) +  
  geom_bar(stat="identity", na.rm = TRUE, width=0.4, position = "dodge")+  
  geom_errorbar(aes(ymin=NMM-ci, ymax=NMM+ci), width=.1, position = position_dodge(0.4)) +  
  coord_cartesian(ylim = c(0, 1)) +  
  labs(y = "Proportion of NMM Production", x = "Syntactic Role", title = "Proportion of NMM  
Production by Syntactic Role and Focus")
```



```
ggsave("NMMPproportion.png")
```

3. Duration where means of non-focus values were feed to analysis

Duration for non-focused signs was obtained twice when the other syntactic roles were focused. One way to analyze the data was run the full model on the data where two instances were entered separately. This analysis is provided in the first section and is the one reported in the manuscript. Another way for the analysis was run the same model on the data where non-focus values came from the means of two instances. This section presents the results on the data where the means of non-focus items were considered.

```
#Load data

duration_data_mean=read.csv("focus-data-mean.csv")
str(duration_data_mean)

## 'data.frame':  1440 obs. of  11 variables:
## $ Participant: int  1 1 1 1 1 1 2 2 2 2 ...
## $ Gender    : chr  "Male" "Male" "Male" "Male" ...
## $ Age      : int  25 25 25 25 25 25 35 35 35 35 ...
## $ AoA      : chr  "DoD" "DoD" "DoD" "DoD" ...
## $ Item     : int  3 1 2 3 1 2 3 1 2 1 ...
## $ Session  : int  1 1 1 2 2 2 1 1 1 2 ...
## $ Position : chr  "Subject" "Subject" "Subject" "Subject" ...
## $ FocusType: chr  "PF" "PF" "PF" "PF" ...
## $ Verb     : chr  "ACMAK" "YEMEK" "ATMAK" "ACMAK" ...
## $ Focus    : chr  "Focus" "Focus" "Focus" "Focus" ...
## $ Duration : num  0.23 0.06 0.26 0.1 0.18 0.12 0.41 0.21 0.18 0.18 ...
```

Convert variables to correct format

```
duration_data_mean$Participant <- as.factor(duration_data_mean$Participant)
duration_data_mean$Gender <- as.factor(duration_data_mean$Gender)
duration_data_mean$Age <- as.numeric(duration_data_mean$Age)
duration_data_mean$AoA <- as.factor(duration_data_mean$AoA)
duration_data_mean$Session <- as.factor(duration_data_mean$Session)
duration_data_mean$FocusType <- as.factor(duration_data_mean$FocusType)
duration_data_mean$Verb <- as.factor(duration_data_mean$Verb)
duration_data_mean$Item <- as.factor(duration_data_mean$Item)
duration_data_mean$Position <- as.factor(duration_data_mean$Position)
duration_data_mean$Focus <- as.factor(duration_data_mean$Focus)
duration_data_mean$Duration <- as.numeric(duration_data_mean$Duration)
```

We fed the full model used above with the data where the means of non-focus values were entered.

3.1. Full Model

```
duration_mean.m13 = lmer(Duration ~ Focus*FocusType + Position*Focus + Position*FocusType +
AoA*Position + Session + (1|Participant) + (1|Item),
data=duration_data_mean,
```

```
REML=F
)
```

3.2. Contrasts

When we fed the model with the data where the means of non-focus items were taken, only change was the significance of PF by positions. While PF was significantly marked in only in subject position with each value was separately entered, it was significantly marked in all positions with means of values were entered.

```
emmeans(duration_mean.m13, pairwise~Focus*FocusType|Position)

## $emmeans
## Position = Object:
## Focus FocusType emmean SE df lower.CL upper.CL
## Focus CF 0.302 0.0284 9.00 0.238 0.366
## NonFocus CF 0.236 0.0284 9.00 0.172 0.301
## Focus PF 0.286 0.0284 9.00 0.222 0.350
## NonFocus PF 0.247 0.0284 9.00 0.183 0.312
##
## Position = Subject:
## Focus FocusType emmean SE df lower.CL upper.CL
## Focus CF 0.423 0.0284 9.00 0.359 0.488
## NonFocus CF 0.306 0.0284 9.00 0.242 0.370
## Focus PF 0.352 0.0284 9.02 0.288 0.416
## NonFocus PF 0.262 0.0284 9.00 0.197 0.326
##
## Position = Verb:
## Focus FocusType emmean SE df lower.CL upper.CL
## Focus CF 0.443 0.0284 9.00 0.379 0.507
## NonFocus CF 0.373 0.0284 9.00 0.309 0.437
## Focus PF 0.449 0.0284 9.00 0.385 0.513
## NonFocus PF 0.406 0.0284 9.00 0.342 0.470
##
## Results are averaged over the levels of: AoA, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## Position = Object:
## contrast estimate SE df t.ratio p.value
## Focus CF - NonFocus CF 0.06572 0.0144 1429 4.556 <.0001
## Focus CF - Focus PF 0.01605 0.0144 1429 1.113 0.6818
## Focus CF - NonFocus PF 0.05480 0.0177 1429 3.102 0.0106
## NonFocus CF - Focus PF -0.04967 0.0177 1429 -2.812 0.0257
## NonFocus CF - NonFocus PF -0.01092 0.0144 1429 -0.757 0.8735
## Focus PF - NonFocus PF 0.03875 0.0144 1429 2.686 0.0367
##
## Position = Subject:
## contrast estimate SE df t.ratio p.value
## Focus CF - NonFocus CF 0.11708 0.0144 1429 8.115 <.0001
```

```

## Focus CF - Focus PF    0.07151 0.0144 1429  4.951 <.0001
## Focus CF - NonFocus PF  0.16162 0.0177 1429  9.149 <.0001
## NonFocus CF - Focus PF -0.04557 0.0177 1429 -2.574 0.0497
## NonFocus CF - NonFocus PF 0.04454 0.0144 1429  3.087 0.0111
## Focus PF - NonFocus PF  0.09011 0.0144 1429  6.239 <.0001
##
## Position = Verb:
## contrast      estimate    SE  df t.ratio p.value
## Focus CF - NonFocus CF  0.07017 0.0144 1429  4.865 <.0001
## Focus CF - Focus PF    -0.00613 0.0144 1429 -0.425 0.9743
## Focus CF - NonFocus PF  0.03707 0.0177 1429  2.099 0.1540
## NonFocus CF - Focus PF -0.07630 0.0177 1429 -4.319 0.0001
## NonFocus CF - NonFocus PF -0.03310 0.0144 1429 -2.295 0.0997
## Focus PF - NonFocus PF  0.04320 0.0144 1429  2.995 0.0148
##
## Results are averaged over the levels of: AoA, Session
## Degrees-of-freedom method: kenward-roger
## P value adjustment: tukey method for comparing a family of 4 estimates

```

Duration difference between focus and non-focus signs

```

emmeans(duration_mean.m13, pairwise~Focus)

## $emmeans
## Focus emmean  SE  df lower.CL upper.CL
## Focus  0.376 0.0265 6.44  0.312  0.440
## NonFocus 0.305 0.0265 6.44  0.241  0.369
##
## Results are averaged over the levels of: FocusType, Position, AoA, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## contrast      estimate    SE  df t.ratio p.value
## Focus - NonFocus 0.0708 0.00721 1429  9.819 <.0001
##
## Results are averaged over the levels of: FocusType, Position, AoA, Session
## Degrees-of-freedom method: kenward-roger

```

Duration difference between DoD and DoH participants

```

emmeans(duration_mean.m13, pairwise~AoA)

## $emmeans
## AoA emmean  SE  df lower.CL upper.CL
## DoD 0.310 0.0294 9.58  0.244  0.376
## DoH 0.371 0.0308 11.29  0.303  0.439
##
## Results are averaged over the levels of: Focus, FocusType, Position, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##

```



```

## $contrasts
## contrast estimate SE df t.ratio p.value
## DoD - DoH -0.0613 0.0295 20.8 -2.077 0.0504
##
## Results are averaged over the levels of: Focus, FocusType, Position, Session
## Degrees-of-freedom method: kenward-roger

emmeans(duration_mean.m13, pairwise~Focus|AoA)

## $emmeans
## AoA = DoD:
## Focus emmean SE df lower.CL upper.CL
## Focus 0.345 0.0296 9.92 0.279 0.411
## NonFocus 0.274 0.0296 9.92 0.208 0.340
##
## AoA = DoH:
## Focus emmean SE df lower.CL upper.CL
## Focus 0.407 0.0311 11.66 0.339 0.474
## NonFocus 0.336 0.0310 11.65 0.268 0.404
##
## Results are averaged over the levels of: FocusType, Position, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## AoA = DoD:
## contrast estimate SE df t.ratio p.value
## Focus - NonFocus 0.0708 0.00721 1429 9.819 <.0001
##
## AoA = DoH:
## contrast estimate SE df t.ratio p.value
## Focus - NonFocus 0.0708 0.00721 1429 9.819 <.0001
##
## Results are averaged over the levels of: FocusType, Position, Session
## Degrees-of-freedom method: kenward-roger

```

Duration differences of syntactic position by AoA

```

emmeans(duration_mean.m13, pairwise~Position|AoA)

## $emmeans
## AoA = DoD:
## Position emmean SE df lower.CL upper.CL
## Object 0.241 0.0302 10.9 0.175 0.308
## Subject 0.302 0.0302 10.9 0.236 0.369
## Verb 0.386 0.0302 10.9 0.319 0.452
##
## AoA = DoH:
## Position emmean SE df lower.CL upper.CL
## Object 0.294 0.0318 13.0 0.226 0.363
## Subject 0.369 0.0318 13.0 0.301 0.438
## Verb 0.450 0.0318 13.0 0.381 0.518

```

```

##
## Results are averaged over the levels of: Focus, FocusType, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## AoA = DoD:
## contrast      estimate    SE  df t.ratio p.value
## Object - Subject -0.0608 0.0119 1429 -5.104 <.0001
## Object - Verb   -0.1443 0.0119 1429 -12.116 <.0001
## Subject - Verb  -0.0835 0.0119 1429 -7.012 <.0001
##
## AoA = DoH:
## contrast      estimate    SE  df t.ratio p.value
## Object - Subject -0.0748 0.0132 1429 -5.672 <.0001
## Object - Verb   -0.1552 0.0132 1429 -11.784 <.0001
## Subject - Verb  -0.0804 0.0132 1429 -6.098 <.0001
##
## Results are averaged over the levels of: Focus, FocusType, Session
## Degrees-of-freedom method: kenward-roger
## P value adjustment: tukey method for comparing a family of 3 estimates

```

Duration differences by Session

```

emmeans(duration.m13, pairwise~Session)

## $emmeans
## Session emmean    SE  df lower.CL upper.CL
## 1      0.523 0.0492 19.3  0.420  0.626
## 2      0.482 0.0492 19.3  0.379  0.585
##
## Results are averaged over the levels of: Focus, FocusType, Position, AoA
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## contrast      estimate    SE  df t.ratio p.value
## Session1 - Session2 0.0415 0.00835 2139 4.963 <.0001
##
## Results are averaged over the levels of: Focus, FocusType, Position, AoA
## Degrees-of-freedom method: kenward-roger

emmeans(duration.m13, pairwise~Focus|FocusType)

## $emmeans
## FocusType = CF:
## Focus  emmean    SE  df lower.CL upper.CL
## Focus  0.561 0.0499 20.5  0.457  0.665
## NonFocus 0.469 0.0494 19.6  0.366  0.572
##
## FocusType = PF:
## Focus  emmean    SE  df lower.CL upper.CL

```

```

## Focus  0.518 0.0499 20.5  0.414  0.622
## NonFocus 0.461 0.0494 19.6  0.358  0.564
##
## Results are averaged over the levels of: Position, AoA, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## FocusType = CF:
## contrast      estimate    SE  df t.ratio p.value
## Focus - NonFocus  0.0924 0.0125 2139  7.373 <.0001
##
## FocusType = PF:
## contrast      estimate    SE  df t.ratio p.value
## Focus - NonFocus  0.0571 0.0125 2139  4.565 <.0001
##
## Results are averaged over the levels of: Position, AoA, Session
## Degrees-of-freedom method: kenward-roger

emmeans(duration.m13, pairwise~Focus|Position)

## $emmeans
## Position = Object:
## Focus  emmean    SE  df lower.CL upper.CL
## Focus  0.399 0.0504 21.5  0.294  0.503
## NonFocus 0.344 0.0496 20.0  0.241  0.448
##
## Position = Subject:
## Focus  emmean    SE  df lower.CL upper.CL
## Focus  0.586 0.0504 21.4  0.481  0.690
## NonFocus 0.462 0.0496 20.0  0.358  0.565
##
## Position = Verb:
## Focus  emmean    SE  df lower.CL upper.CL
## Focus  0.635 0.0504 21.5  0.530  0.740
## NonFocus 0.589 0.0496 20.0  0.486  0.693
##
## Results are averaged over the levels of: FocusType, AoA, Session
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
##
## $contrasts
## Position = Object:
## contrast      estimate    SE  df t.ratio p.value
## Focus - NonFocus  0.0543 0.0153 2139  3.539 0.0004
##
## Position = Subject:
## contrast      estimate    SE  df t.ratio p.value
## Focus - NonFocus  0.1240 0.0153 2139  8.097 <.0001
##
## Position = Verb:

```

```
## contrast      estimate    SE  df t.ratio p.value
## Focus - NonFocus 0.0459 0.0153 2139  2.993 0.0028
##
## Results are averaged over the levels of: FocusType, AoA, Session
## Degrees-of-freedom method: kenward-roger
```