m15_202111_baseline -150 to 50, 200-300 ms difference wave

Load packages and define functions

This section load the packages `knitr`, `markdown`, `ez`, `stringr readr`, `tidyr`, and `dplyr`. It also define a function to compute the standard error of the mean and to calculate the mean, standard deviation and standard error for each condition. ## Load Packages

Function to calculate the standard error of the mean

```
sem = function(x)
{
  sqrt(var(x)/length(x))

}
```

Function to calculate the mean, the standard deviation and the standard error for each condition

`data` : a data frame `varname` : the name of a column containing the variable to be summariezed `groupnames` : vector of column names to be used as grouping variables

```
data_summary <- function(data, varname, groupnames){
  require(plyr)
  summary_func <- function(x, col){
    c(mean = mean(x[[col]], na.rm=TRUE),
      sd = sd(x[[col]], na.rm=TRUE),
      sem = sd(x[[col]])/sqrt(length(x)))
  }
  data_sum<-ddply(data, groupnames, .fun=summary_func,
                  varname)
  data_sum <- rename(data_sum, c("mean" = varname))
 return(data_sum)
}
```

Analyse Affix Frequency

Read in and format the data

Then filter into two datasets, one with 2 Relatedness Factors (related, unrelated) and 2 Productivity Factors (high, low) and another with just one factors—Priming Effects for High adn Low productivity calculated by subtracting Related scores from Unrelated.

```
m15_200_300_afx <- read_csv("M15_afxfrq_200_300_bsl_150_50.csv")
m15_diff_afx <-  filter(m15_200_300_afx, binlabel == "Priming_High" | binlabel == "Priming_Low")
m15_2by2_afx <-  filter(m15_200_300_afx, binlabel != "Priming_High" & binlabel != "Priming_Low")
```

Add factors *relatedness* and *productivity* for the 2-factor dataframe by separating 'binlabel' variable. Recodes the difference wave dataframe by removing the "Priming" part of the binlabel.

```
m15_2by2_afx <-separate(m15_2by2_afx, binlabel, into = c("relatedness", "productivity"), sep = "_")

m15_diff_afx$productivity <- ifelse(m15_diff_afx$binlabel == "Priming_Low", "Low", "High")
m15_diff_afx$binlabel <- NULL # removes binlabel column; no longer needed
```

Separate electrode labels into multiple factors based on *anteriority* and *laterality*. `tidyr::separate` makes separating columns simple by allowing you to pass an integer index of split position, including negatively indexed from the end of the string.

```
m15_diff_afx <- m15_diff_afx %>%
  separate(chlabel, into = c('anteriority', 'laterality'), sep = -1, convert = TRUE)

m15_diff_afx <- m15_diff_afx %>%
  mutate(laterality = replace(laterality, laterality == "Z", 0))  # Replacing "Z" value with 0

#Extract 5 x 3 matrix for analysis (F3 to P4)

m15_diff_afx_subset <-  filter(m15_diff_afx, laterality == 0 & anteriority!= "O" |
                                 laterality == 3 | laterality == 4)
```

Run ANOVA

```
# ezDesign(m15_diff_afx_subset, productivity, value, row = laterality, col = anteriority)

m15_diff_afx_aov <- ezANOVA(data = m15_diff_afx_subset, dv = value, wid = ERPset,
                        within = .(anteriority, laterality, productivity))
m15_diff_afx_aov
```

```
$ANOVA
                              Effect DFn DFd          F          p p<.05
2                        anteriority   4  96 0.52834234 0.71515584
3                         laterality   2  48 3.99836948 0.02476761     *
4                       productivity   1  24 0.92332786 0.34618442
5               anteriority:laterality   8 192 1.03134578 0.41383412
6             anteriority:productivity   4  96 0.03555546 0.99754287
7              laterality:productivity   2  48 0.24406165 0.78440561
8 anteriority:laterality:productivity   8 192 0.28982362 0.96875324
            ges
2 7.361252e-04
3 2.860604e-03
4 1.605738e-02
5 6.382910e-04
6 6.964002e-05
```

```
7 2.027002e-04
8 1.258461e-04

$`Mauchly's Test for Sphericity`
                             Effect           W            p p<.05
2                       anteriority 0.011651672 2.602754e-17     *
3                        laterality 0.837811378 1.306718e-01
5              anteriority:laterality 0.001129757 1.008052e-14     *
6            anteriority:productivity 0.001763739 7.600652e-26     *
7             laterality:productivity 0.836743407 1.287690e-01
8 anteriority:laterality:productivity 0.012148387 5.148720e-07     *

$`Sphericity Corrections`
                             Effect       GGe      p[GG] p[GG]<.05       HFe
2                       anteriority 0.3719148 0.54172055           0.3908021
3                        laterality 0.8604455 0.03127412         * 0.9206445
5              anteriority:laterality 0.3809618 0.38461527           0.4426265
6            anteriority:productivity 0.3170264 0.90107429           0.3266627
7             laterality:productivity 0.8596556 0.75121503           0.9196928
8 anteriority:laterality:productivity 0.4657992 0.87203290           0.5620599
       p[HF] p[HF]<.05
2 0.55024364
3 0.02827776         *
5 0.39067664
6 0.90652813
7 0.76618558
8 0.90242808
```

Plot Means

Summarise the data

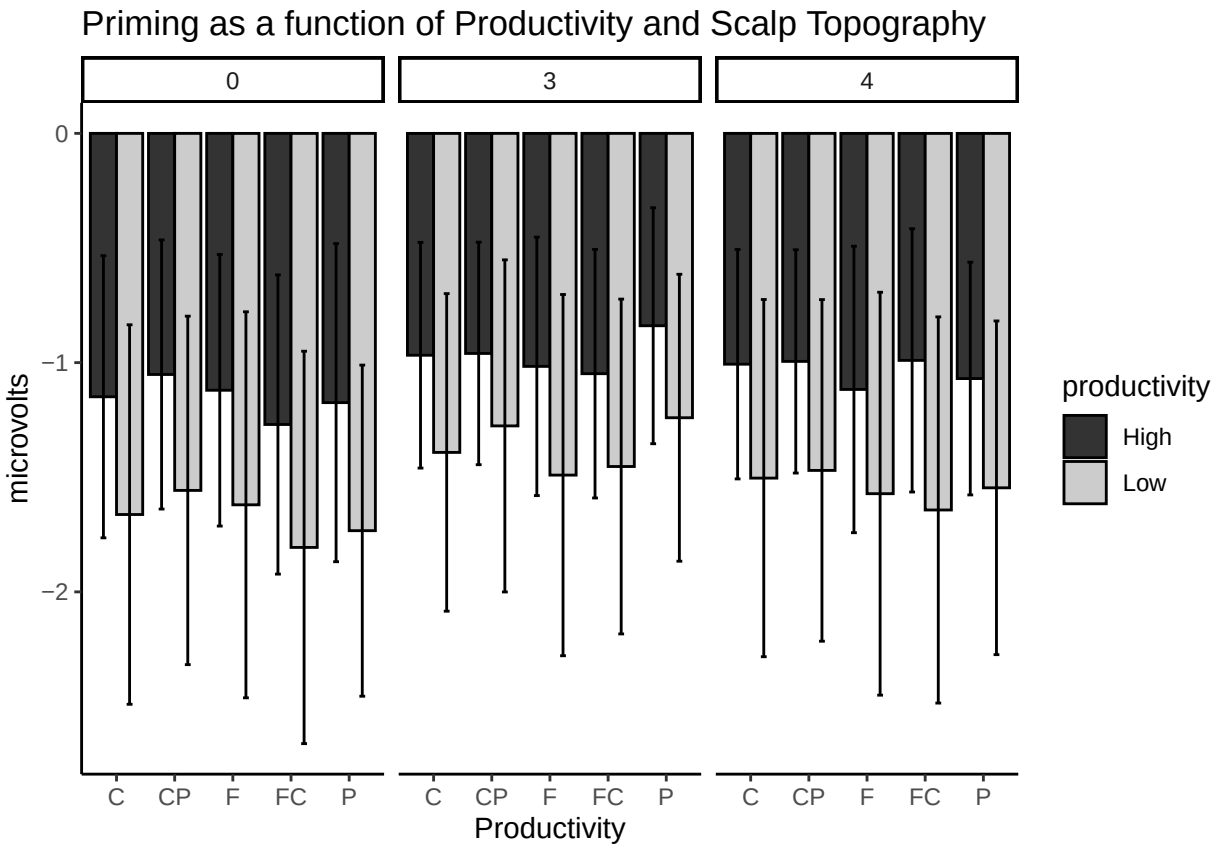
```
df2_afx <- data_summary(m15_diff_afx_subset, varname="value",
                    groupnames=c("productivity", "laterality", "anteriority"))
# df2_afx$sem <- NULL

head(df2_afx)
```

```
  productivity laterality anteriority    value       sd       sem
1         High          0           C -1.14896 1.740337 0.6153020
2         High          0          CP -1.05168 1.660167 0.5869578
3         High          0           F -1.12052 1.675466 0.5923668
4         High          0          FC -1.26984 1.846025 0.6526684
5         High          0           P -1.17448 1.962697 0.6939183
6         High          3           C -0.96772 1.392343 0.4922676
```

Barplot with SD error bars

The function geom_errorbar() can be used to produce the error bars

```
library(ggplot2)
# Default bar plot
p<- ggplot(df2_afx, aes(x=anteriority, y=value, fill=productivity)) +
  geom_bar(stat="identity", color="black",
           position=position_dodge()) +
  facet_grid(.~laterality) +
  geom_errorbar(aes(ymin=value-sem, ymax=value+sem), width=.2,
                position=position_dodge(.9))

p+labs(title="Priming as a function of Productivity and Scalp Topography", x="Productivity", y = "microv
   theme_classic() + scale_fill_grey()
```



Analyse Stem to Wholeword Frequency Ratio (Median Split)

Read in and format the data

Then filter into two datasets, one with 2 Relatedness Factors (related, unrelated) and 2 Productivity Factors (high, low) and another with just one factors—Priming Effects for High adn Low productivity calculated by subtracting Related scores from Unrelated.

```
m15_200_300_med <- read_csv("m15_medsplt_200_300_bsl_150_50.csv")
m15_diff_med <-  filter(m15_200_300_med, binlabel == "Priming_High" | binlabel == "Priming_Low")
m15_2by2_med <-  filter(m15_200_300_med, binlabel != "Priming_High" & binlabel != "Priming_Low")
```

Add factors *relatedness* (and *productivity* for 2 x 2 df) by recoding 'binlabel' variable

```
m15_2by2_med <-separate(m15_2by2_med, binlabel, into = c("relatedness", "productivity"), sep = "_")

m15_diff_med$productivity <- ifelse(m15_diff_med$binlabel == "Priming_Low", "Low", "High")
m15_diff_med$binlabel <- NULL # removes binlabel column; no longer needed
```

Separate electrode labels into multiple factors based on *anteriority* and *laterality*. `tidyr::separate` makes separating columns simple by allowing you to pass an integer index of split position, including negatively indexed from the end of the string.

```
m15_diff_med <- m15_diff_med %>%
  separate(chlabel, into = c('anteriority', 'laterality'), sep = -1, convert = TRUE)

m15_diff_med <- m15_diff_med %>%
  mutate(laterality = replace(laterality, laterality == "Z", 0))  # Replacing "Z" value with 0

#Extract 5 x 3 matrix for analysis (F3 to P4)

m15_diff_med_subset <-  filter(m15_diff_med, laterality == 0 & anteriority!= "O" |
                                 laterality == 3 | laterality == 4)
```

##Run ANOVA

```
# ezDesign(m15_diff_med_subset, productivity, value, row = laterality, col = anteriority)

m15_diff_med_aov <- ezANOVA(data = m15_diff_med_subset, dv = value, wid = ERPset,
                        within = .(anteriority, laterality, productivity))
m15_diff_med_aov
```

```
$ANOVA
                             Effect DFn DFd         F           p p<.05
2                       anteriority   4  96 0.6184925 0.650394969
3                        laterality   2  48 4.2035920 0.020785652     *
4                      productivity   1  24 2.2567575 0.146076777
5              anteriority:laterality   8 192 0.8014123 0.602026767
6            anteriority:productivity   4  96 0.2716869 0.895566173
7             laterality:productivity   2  48 6.7881028 0.002534426     *
8 anteriority:laterality:productivity   8 192 0.1267136 0.998073554
           ges
2 0.0010198224
3 0.0036956664
4 0.0267036177
5 0.0006047989
6 0.0006234518
7 0.0065631882
8 0.0001110054

$'Mauchly's Test for Sphericity'
                             Effect           W           p p<.05
2                       anteriority 0.012195836 4.162116e-17     *
3                        laterality 0.777065993 5.498774e-02
5              anteriority:laterality 0.001126735 9.866613e-15     *
```

```
6            anteriority:productivity 0.001339990 4.224460e-27     *
7             laterality:productivity 0.741431943 3.204940e-02     *
8 anteriority:laterality:productivity 0.002873556 1.505431e-11     *

$`Sphericity Corrections`
                              Effect       GGe       p[GG] p[GG]<.05       HFe
2                        anteriority 0.3720926 0.498405052           0.3910119
3                         laterality 0.8177056 0.028932244         * 0.8693493
5              anteriority:laterality 0.3847704 0.499819178           0.4478221
6            anteriority:productivity 0.2953861 0.645200830           0.3017143
7             laterality:productivity 0.7945538 0.005313739         * 0.8417266
8 anteriority:laterality:productivity 0.3969128 0.950650850           0.4644879
       p[HF] p[HF]<.05
2 0.505848480
3 0.026340768         *
5 0.515669559
6 0.650055229
7 0.004480493         *
8 0.966393027
```

##Plot Means ### Summarise the data

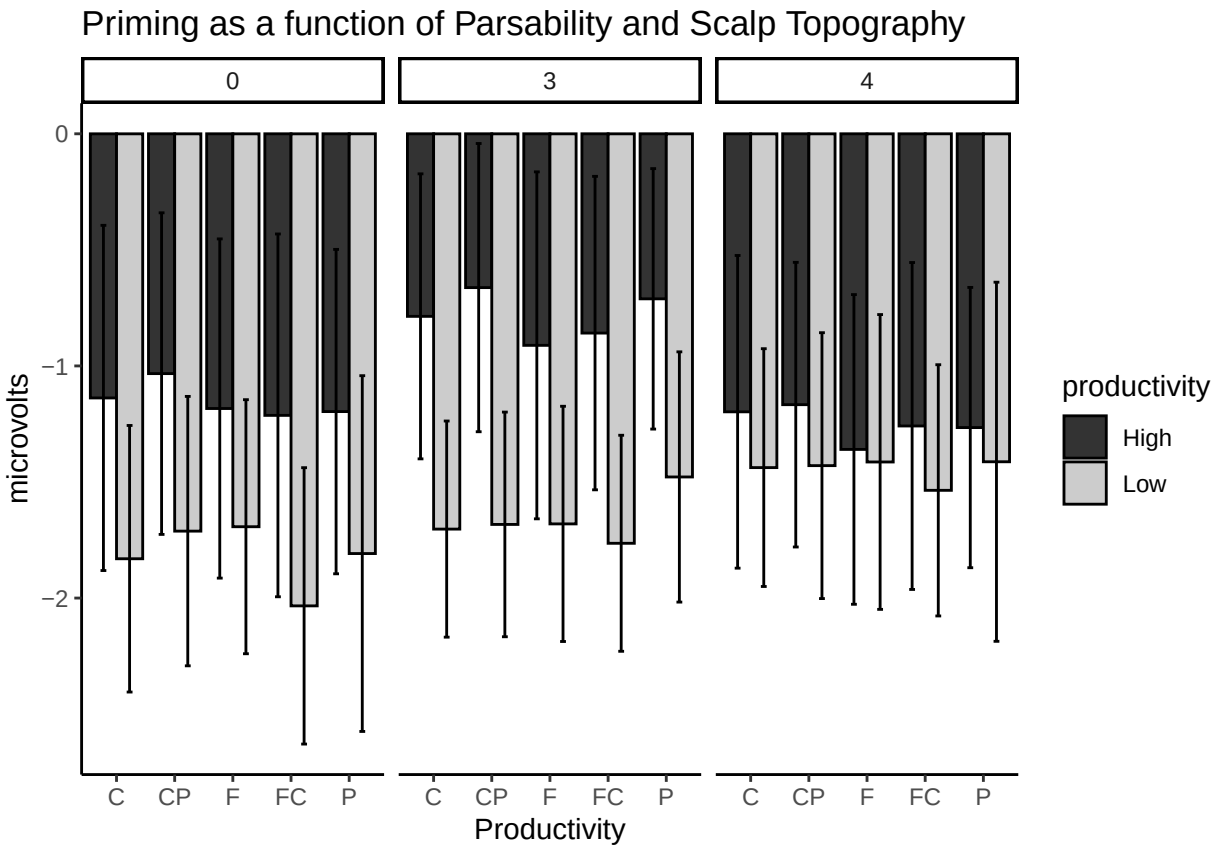
```
df2_med <- data_summary(m15_diff_med_subset, varname="value",
                    groupnames=c("productivity", "laterality", "anteriority"))
# df2_med$sem <- NULL

head(df2_med)
```

```
  productivity laterality anteriority    value       sd       sem
1         High          0           C -1.13792 2.103095 0.7435563
2         High          0          CP -1.03312 1.959312 0.6927215
3         High          0           F -1.18348 2.066630 0.7306640
4         High          0          FC -1.21304 2.210276 0.7814506
5         High          0           P -1.19672 1.976511 0.6988022
6         High          3           C -0.78644 1.736572 0.6139709
```

Barplot with SD error bars

The function geom_errorbar() can be used to produce the error bars

```
library(ggplot2)
# Default bar plot
p<- ggplot(df2_med, aes(x=anteriority, y=value, fill=productivity)) +
  geom_bar(stat="identity", color="black",
           position=position_dodge()) +
  facet_grid(.~laterality) +
  geom_errorbar(aes(ymin=value-sem, ymax=value+sem), width=.2,
                position=position_dodge(.9))
p+labs(title="Priming as a function of Parsability and Scalp Topography", x="Productivity", y = "microv
   theme_classic() + scale_fill_grey()
```



Planned Comparisons

This section explores the significant "Laterality x Parsability" interaction obtained for the "m15_diff_med_subset" df above, by doing a one-factor ANOVA test (high vs low parsability) for each of the three levels of laterality.

Effect of Parsability in the LH

```
# ezDesign(m15_diff_med_subset, productivity, value, row = laterality, col = anteriority)

m15_diff_med_aov_pc1 <- ezANOVA(data = filter(m15_diff_med_subset,m15_diff_med_subset$laterality==3),
                            dv = value,
                            wid = ERPset,
                            within_full = .(anteriority, laterality, productivity),
                            within = .(productivity))
m15_diff_med_aov_pc1
```

```
$ANOVA
        Effect DFn DFd        F          p p<.05        ges
2 productivity   1  24 5.237524 0.03120682     * 0.07903091
```

Effect of Parsability at the Midline

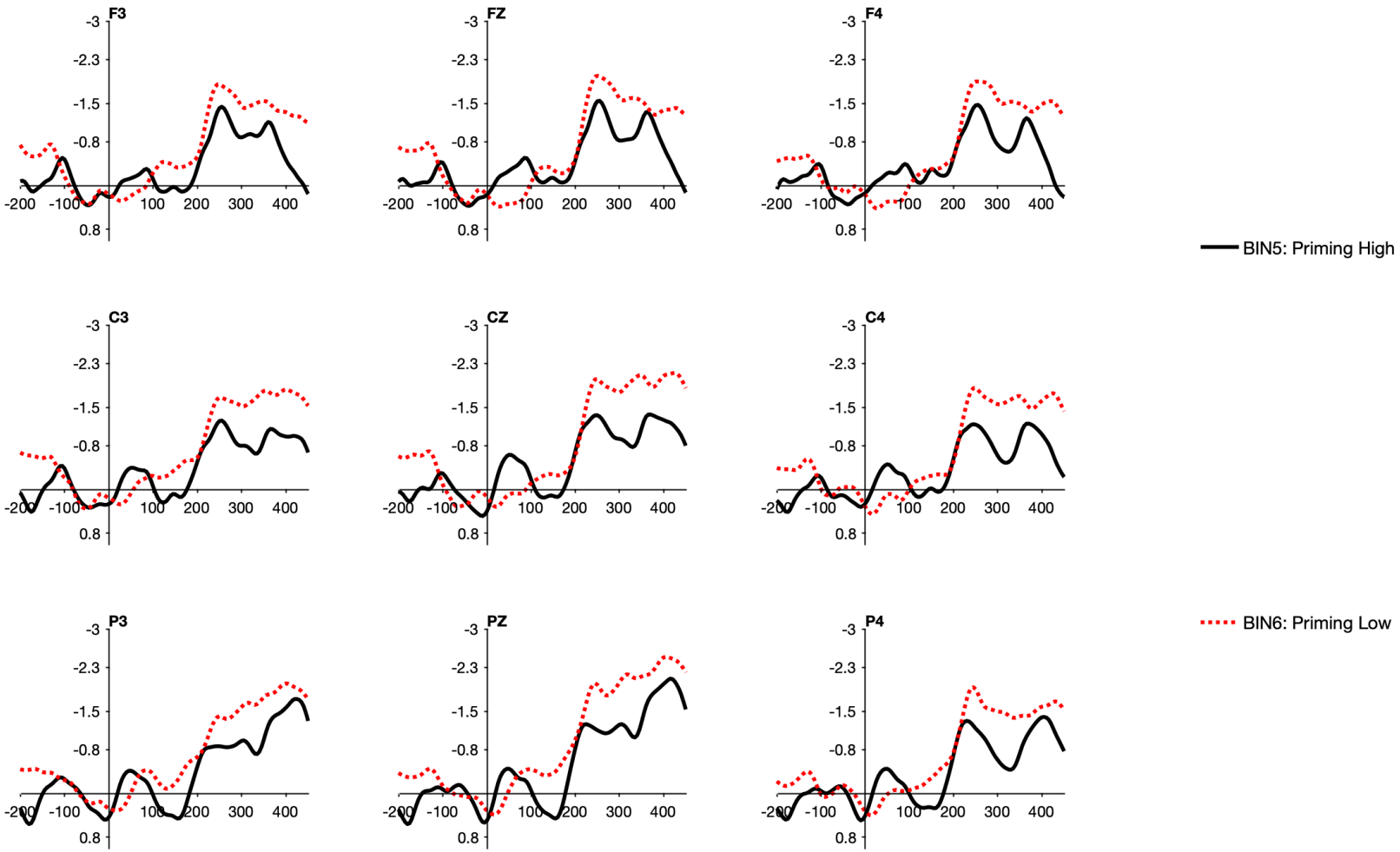
```
m15_diff_med_aov_pc2 <- ezANOVA(data = filter(m15_diff_med_subset,m15_diff_med_subset$laterality==0),
                            dv = value,
                            wid = ERPset,
                            within_full = .(anteriority, laterality, productivity),
                            within = .(productivity))
m15_diff_med_aov_pc2
```

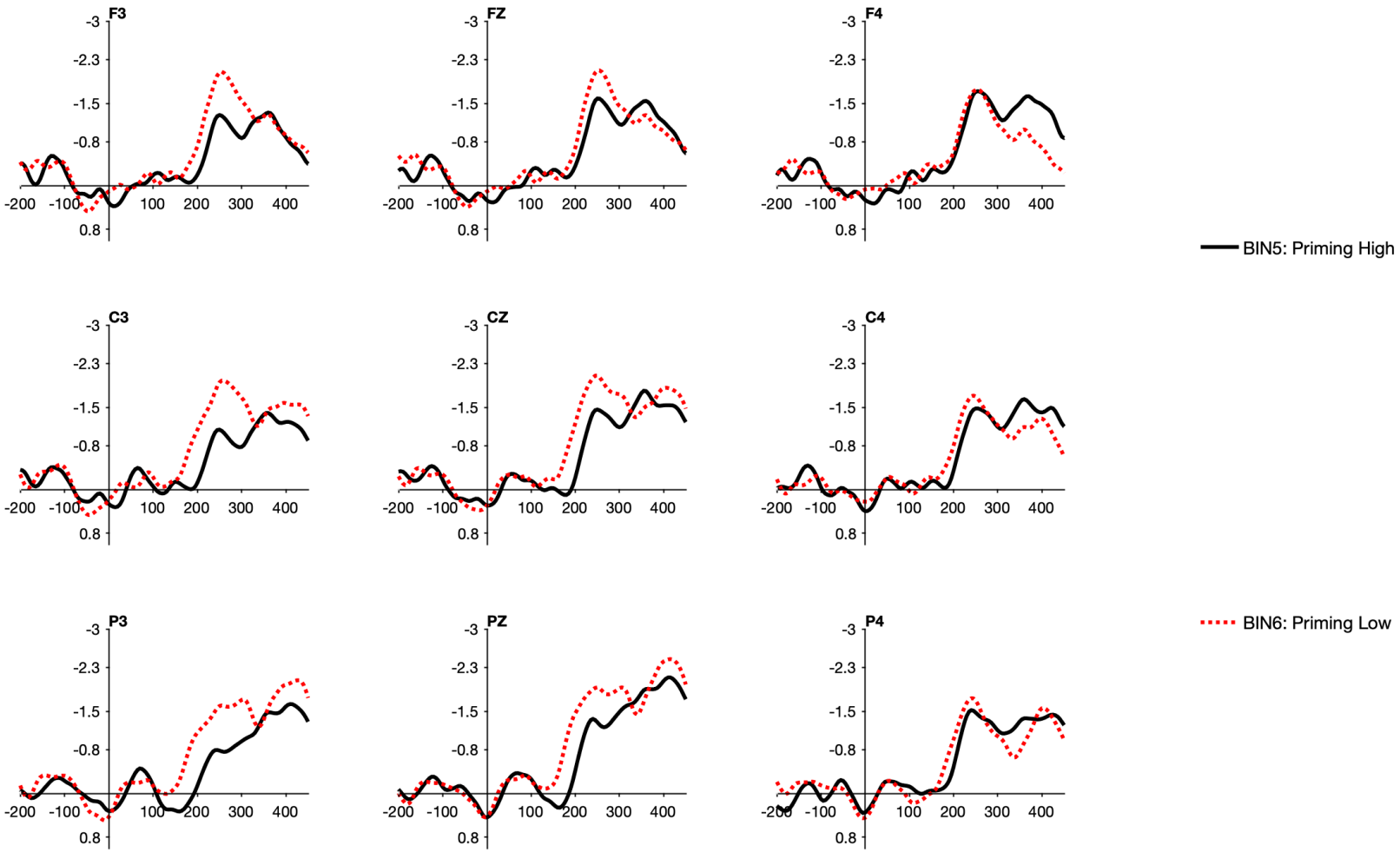
```
$ANOVA
        Effect DFn DFd        F         p p<.05        ges
2 productivity   1  24 2.160319 0.1546037       0.03487824
```

Effect of Parsability in the RH

```
m15_diff_med_aov_pc3 <- ezANOVA(data = filter(m15_diff_med_subset,m15_diff_med_subset$laterality==4),
                            dv = value,
                            wid = ERPset,
                            within_full = .(anteriority, laterality, productivity),
                            within = .(productivity))
m15_diff_med_aov_pc3
```

```
$ANOVA
        Effect DFn DFd         F        p p<.05        ges
2 productivity   1  24 0.2955651 0.591691       0.00362955
```


F3
FZ
F4
C3
CZ
C4
P3
PZ
P4
-3
-2.3
-1.5
-0.8
0.8
-200
-100
100
200
300
400
BIN5: Priming High
BIN6: Priming Low


F3
FZ
F4
C3
CZ
C4
P3
PZ
P4
-3
-2.3
-1.5
-0.8
0.8
-200
-100
100
200
300
400
BIN5: Priming High
BIN6: Priming Low