m15_202111_baseline -150 to 50, 300-500 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_300_500_afx <- read_csv("M15_afxfrq_300_500_bsl_150_50.csv")
m15_diff_afx <-  filter(m15_300_500_afx, binlabel == "Priming_High" | binlabel == "Priming_Low")
m15_2by2_afx <-  filter(m15_300_500_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 3.4081657 0.011886517     *
3                         laterality   2  48 5.1218317 0.009634325     *
4                       productivity   1  24 3.7247942 0.065511258
5             anteriority:laterality   8 192 2.4203654 0.016358679     *
6           anteriority:productivity   4  96 0.3878594 0.816863007
7            laterality:productivity   2  48 0.1055398 0.900046913
8 anteriority:laterality:productivity   8 192 0.3689474 0.935939169
           ges
2 0.0107934649
3 0.0068495013
4 0.0512693055
5 0.0023599883
6 0.0012250712
7 0.0001027033
8 0.0002555112

$`Mauchly's Test for Sphericity`
                              Effect            W            p p<.05
2                        anteriority 0.0044157513 1.125435e-21     *
3                         laterality 0.6268336943 4.647847e-03     *
5             anteriority:laterality 0.0004902955 1.126790e-17     *
6           anteriority:productivity 0.0018322443 1.134203e-25     *
```

```
7             laterality:productivity 0.7911664741 6.762084e-02
8 anteriority:laterality:productivity 0.0081574352 3.270976e-08     *

$`Sphericity Corrections`
                               Effect       GGe      p[GG] p[GG]<.05       HFe
2                         anteriority 0.3102510 0.06666460           0.3188311
3                          laterality 0.7282439 0.01877613         * 0.7632394
5              anteriority:laterality 0.3564126 0.07647378           0.4094963
6            anteriority:productivity 0.3160856 0.58677269           0.3255741
7             laterality:productivity 0.8272438 0.86444442           0.8807627
8 anteriority:laterality:productivity 0.4631664 0.81613660           0.5582332
       p[HF] p[HF]<.05
2 0.06525662
3 0.01722445         *
5 0.06701650
6 0.59280363
7 0.87680759
8 0.84984576
```

Plot Means

Summarise the data

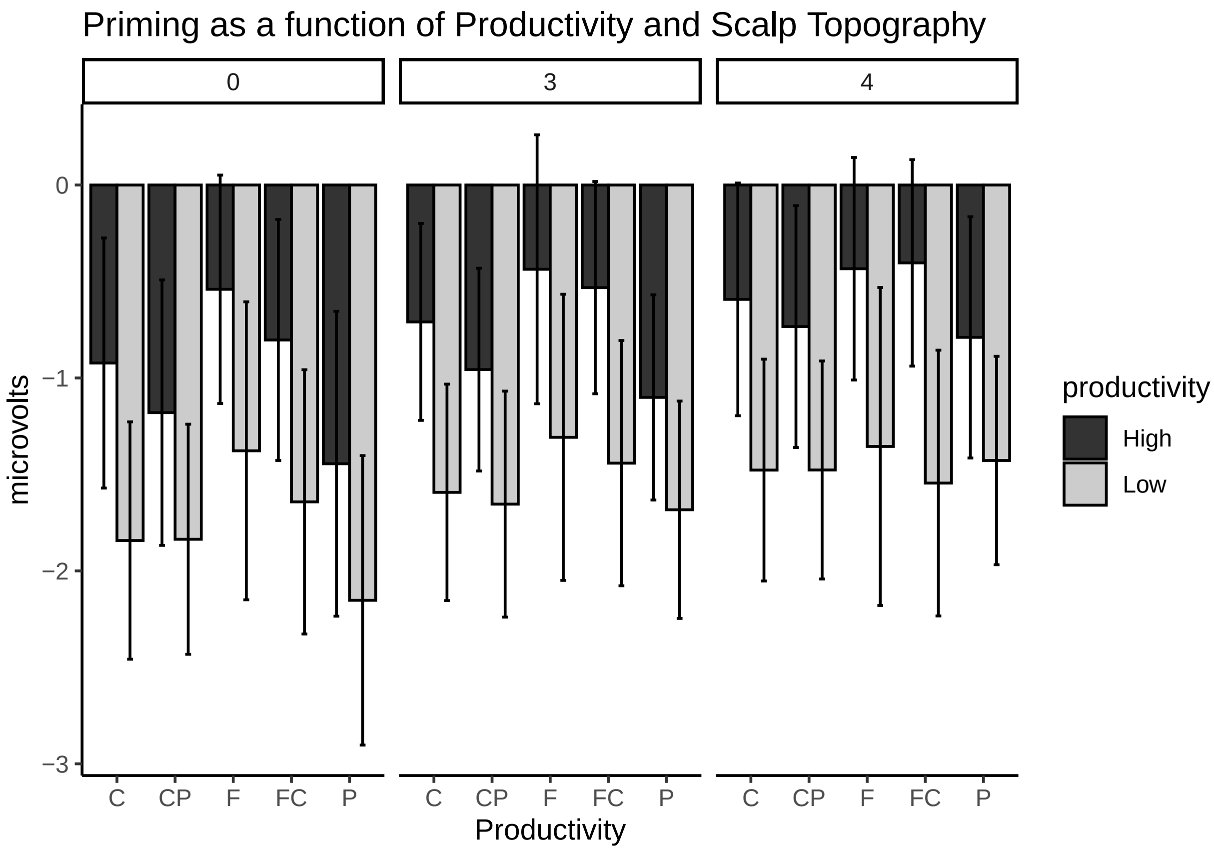
```r
df2_afx <- data_summary(m15_diff_afx_subset, varname="value",
                    groupnames=c("productivity", "laterality", "anteriority"))
# df2_afx$sem <- NULL

head(df2_afx)
```

```
  productivity laterality anteriority    value       sd       sem
1         High          0           C -0.92260 1.833008 0.6480661
2         High          0          CP -1.18000 1.945685 0.6879037
3         High          0           F -0.54064 1.674559 0.5920460
4         High          0          FC -0.80332 1.766818 0.6246644
5         High          0           P -1.44484 2.234579 0.7900429
6         High          3           C -0.70972 1.443597 0.5103886
```

Barplot with SD error bars

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

```r
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 = "micro
   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_300_500_med <- read_csv("m15_medsplt_300_500_bsl_150_50.csv")
m15_diff_med <-  filter(m15_300_500_med, binlabel == "Priming_High" | binlabel == "Priming_Low")
m15_2by2_med <-  filter(m15_300_500_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
```

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

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

##Run ANOVA

```r
# 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 3.006745074 0.02197021     *
3                          laterality   2  48 4.870856530 0.01185872     *
4                        productivity   1  24 0.004043669 0.94982349
5              anteriority:laterality   8 192 2.456366730 0.01487161     *
6            anteriority:productivity   4  96 0.688855566 0.60141478
7             laterality:productivity   2  48 4.405823165 0.01751026     *
8 anteriority:laterality:productivity   8 192 0.142993735 0.99703700
           ges
2 1.001284e-02
3 6.858902e-03
4 5.961797e-05
5 2.410285e-03
6 1.412322e-03
7 6.061745e-03
8 1.693543e-04

$`Mauchly's Test for Sphericity`
                               Effect            W            p p<.05
2                         anteriority 0.0040471522 4.537326e-22     *
3                          laterality 0.5588469677 1.241276e-03     *
5              anteriority:laterality 0.0004707785 8.051844e-18     *
6            anteriority:productivity 0.0069137418 1.187173e-19     *
7             laterality:productivity 0.8546900469 1.643612e-01
8 anteriority:laterality:productivity 0.0015600138 1.310658e-13     *

$`Sphericity Corrections`
                               Effect       GGe      p[GG] p[GG]<.05       HFe
2                         anteriority 0.3093180 0.08571510           0.3177541
3                          laterality 0.6938888 0.02384134         * 0.7229374
5              anteriority:laterality 0.3457137 0.07536932           0.3952495
6            anteriority:productivity 0.3428351 0.45668391           0.3566661
7             laterality:productivity 0.8731261 0.02243291         * 0.9359391
8 anteriority:laterality:productivity 0.3837447 0.93687370           0.4464213
       p[HF] p[HF]<.05
2 0.08433886
3 0.02230741         *
5 0.06633945
6 0.46194891
7 0.01984092         *
```

```
8 0.95468920
```

##Plot Means ### Summarise the data

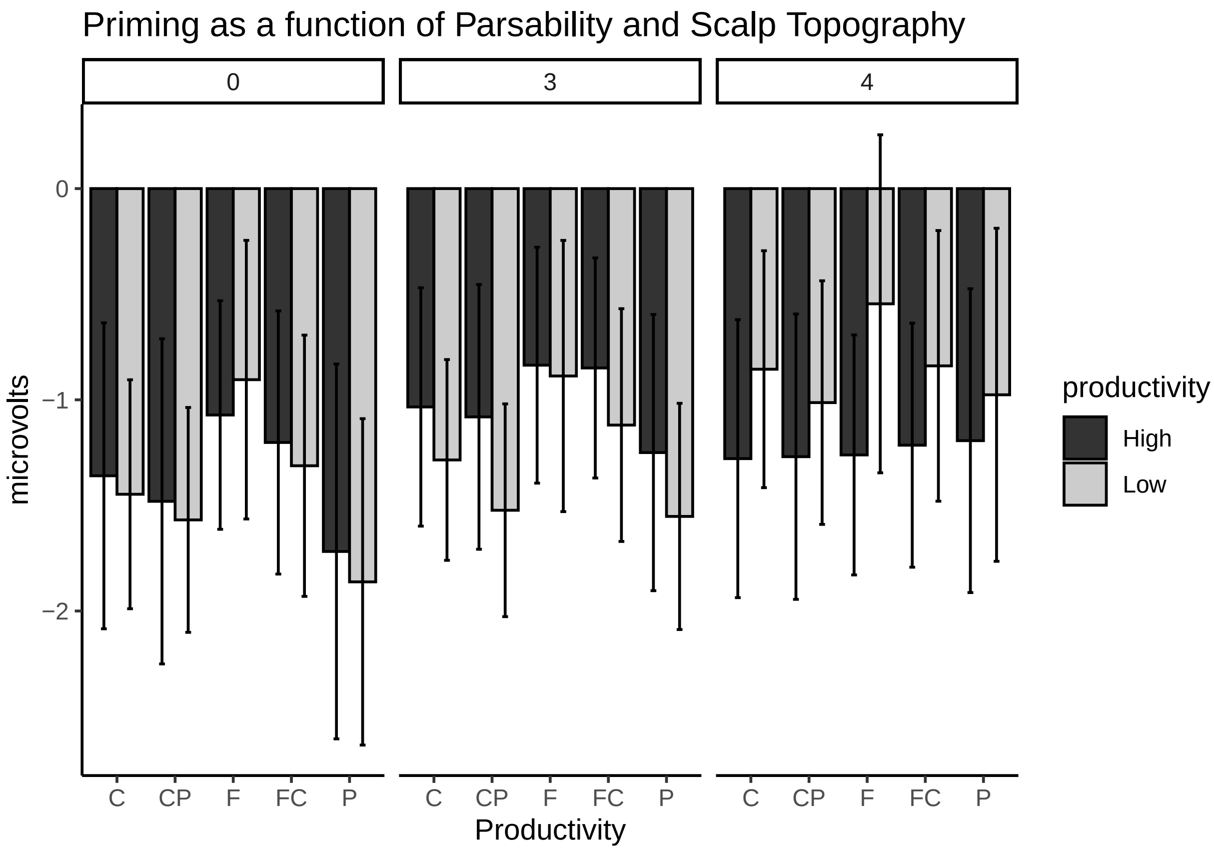
```
df2_med <- data_summary(m15_diff_med_subset, varname="value",
                    groupnames=c("productivity", "laterality", "anteriority"))
# df2_med$sem <- NULL

head(df2_med)
```

```
  productivity laterality anteriority    value       sd       sem
1         High          0           C -1.35976 2.049114 0.7244712
2         High          0          CP -1.48068 2.177337 0.7698049
3         High          0           F -1.07200 1.530590 0.5411451
4         High          0          FC -1.20204 1.762030 0.6229716
5         High          0           P -1.71800 2.509986 0.8874141
6         High          3           C -1.03380 1.595975 0.5642623
```

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 0.4489105 0.5092486       0.00850694
```

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 0.01202281 0.9135998       0.0002404162
```

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 0.7196636 0.4046362       0.01409672
```