

Audiovisual integration across space and time stats analysis

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Unity judgment

```
# First some data cleaning
setwd("/Users/oliviaxujiang/Desktop/NYU_research/Project_1/Experiment code/Stats/New")
unity_indvd_data = read_excel('Ujdg_BimodalLocalization_AV_new.xlsx')
unity_indvd_data["Ujdg"][unity_indvd_data["Ujdg"]==2] <- 0
unity_indvd_data <- unity_indvd_data %>%
  mutate(SpatialD = Vloc - Aloc, SpatialD_abs = abs(SpatialD))
unity_indvd_data <- subset (unity_indvd_data, select = -c(Aloc,Vloc))
unity_indvd_data <- unity_indvd_data[,c("Ujdg", "TemporalD", "SpatialD",
                                         "SpatialD_abs", "Subject")]
class(unity_indvd_data$SpatialD_abs) = "Numeric"
class(unity_indvd_data$TemporalD) = "Numeric"
```

GLMM

```
# as numeric factors (quadratic)
GLMMmodel_AV1 <- glmer(Ujdg ~ (scale(SpatialD)+scale(SpatialD^2))*(scale(TemporalD)+scale(TemporalD^2))
  (1|Subject),
  data = unity_indvd_data, family='binomial',
  control = glmerControl(optimizer='bobyqa'))
summary(GLMMmodel_AV1, corr = FALSE)
```

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
## Approximation) [glmerMod]
## Family: binomial ( logit )
## Formula: Ujdg ~ (scale(SpatialD) + scale(SpatialD^2)) * (scale(TemporalD) +
## scale(TemporalD^2)) + (1 | Subject)
## Data: unity_indvd_data
## Control: glmerControl(optimizer = "bobyqa")
##
##      AIC      BIC   logLik deviance df.resid
##  9897.5   9970.0  -4938.8   9877.5    10390
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -5.157 -0.596 -0.137  0.607 43.657
##
## Random effects:
##  Groups Name      Variance Std.Dev.
## Subject (Intercept) 0.5033   0.7094
## Number of obs: 10400, groups: Subject, 13
##
```

```
## Fixed effects:
##
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -0.663061   0.199676  -3.321 0.000898 ***
## scale(SpatialD) -0.124142   0.035104  -3.536 0.000406 ***
## scale(SpatialD^2) -1.532152   0.041583 -36.846 < 2e-16 ***
## scale(TemporalD) -0.703674   0.036554 -19.250 < 2e-16 ***
## scale(TemporalD^2) -0.974144   0.031870 -30.567 < 2e-16 ***
## scale(SpatialD):scale(TemporalD) -0.103640   0.038555  -2.688 0.007186 **
## scale(SpatialD):scale(TemporalD^2)  0.001165   0.032763   0.036 0.971637
## scale(SpatialD^2):scale(TemporalD) -0.367298   0.043272  -8.488 < 2e-16 ***
## scale(SpatialD^2):scale(TemporalD^2) -0.245064   0.035489  -6.905 5e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
Anova(GLMMmodel_AV1)
```

```
## Analysis of Deviance Table (Type II Wald chisquare tests)
##
## Response: Ujdg
##
##              Chisq Df Pr(>Chisq)
## scale(SpatialD)      10.3325  1  0.001307 **
## scale(SpatialD^2)    1597.9479  1 < 2.2e-16 ***
## scale(TemporalD)      333.5158  1 < 2.2e-16 ***
## scale(TemporalD^2)    972.3330  1 < 2.2e-16 ***
## scale(SpatialD):scale(TemporalD)      7.2258  1  0.007186 **
## scale(SpatialD):scale(TemporalD^2)      0.0013  1  0.971637
## scale(SpatialD^2):scale(TemporalD)     72.0494  1 < 2.2e-16 ***
## scale(SpatialD^2):scale(TemporalD^2)    47.6852  1 5.004e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
confint(GLMMmodel_AV1)
```

```
## Computing profile confidence intervals ...
```

```
##              2.5 %      97.5 %
## .sig01      0.49960617  1.10866751
## (Intercept) -1.08509029 -0.24190516
## scale(SpatialD) -0.19321525 -0.05554545
## scale(SpatialD^2) -1.61504113 -1.45200347
## scale(TemporalD) -0.77644567 -0.63309721
## scale(TemporalD^2) -1.03723304 -0.91228514
## scale(SpatialD):scale(TemporalD) -0.17952305 -0.02831397
## scale(SpatialD):scale(TemporalD^2) -0.06311914  0.06533959
## scale(SpatialD^2):scale(TemporalD) -0.45333230 -0.28365713
## scale(SpatialD^2):scale(TemporalD^2) -0.31514475 -0.17600545
```

Bimodal spatial localization (VE)

```
# First some data cleaning
setwd("/Users/oliviaxujiang/Desktop/NYU_research/Project_1/Experiment code/Stats/New")
rm(list = ls())
```

```

VE_indvd_data <- read_excel("Trial_by_trial_AlocResp_BimodalLocalization_AV_new.xlsx")
VE_indvd_data <- VE_indvd_data %>%
  mutate(SpatialD = Vloc - Aloc, SpatialD_abs = abs(SpatialD))
#VE_indvd_data$SpatialD_abs<-factor(VE_indvd_data$SpatialD_abs, ordered=TRUE) #treat as ordered factor
#VE_indvd_data$TemporalD<-factor(VE_indvd_data$TemporalD, ordered=TRUE)
#VE_indvd_data$Subject<-factor(VE_indvd_data$Subject)
class(VE_indvd_data$SpatialD_abs) = "Numeric"
class(VE_indvd_data$TemporalD) = "Numeric"
class(VE_indvd_data$Subject) = "Numeric"
class(VE_indvd_data$VE_pos) = "Numeric"

```

LMM

```

lmer_resultsA <- lmer(VE_pos ~ (scale(SpatialD)+scale(SpatialD^2))*(scale(TemporalD)+scale(TemporalD^2)),
summary(lmer_resultsA)

```

```

## Linear mixed model fit by REML ['lmerMod']
## Formula: VE_pos ~ (scale(SpatialD) + scale(SpatialD^2)) * (scale(TemporalD) +
##      scale(TemporalD^2)) + (1 | Subject)
##      Data: VE_indvd_data
##
## REML criterion at convergence: 67103.3
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -4.1815 -0.6104 -0.0324  0.5712  4.2139
##
## Random effects:
##      Groups   Name                Variance Std.Dev.
##      Subject  (Intercept)         5.938    2.437
##      Residual                    36.830    6.069
## Number of obs: 10400, groups:  Subject, 13
##
## Fixed effects:
##                                     Estimate Std. Error t value
## (Intercept)                       4.49576    0.67845   6.626
## scale(SpatialD)                   0.60065    0.05951  10.093
## scale(SpatialD^2)                  1.62056    0.05951  27.231
## scale(TemporalD)                   -0.88786    0.05951 -14.919
## scale(TemporalD^2)                 -1.08414    0.05951 -18.217
## scale(SpatialD):scale(TemporalD)  -0.06478    0.05952  -1.089
## scale(SpatialD):scale(TemporalD^2) 0.07325    0.05952   1.231
## scale(SpatialD^2):scale(TemporalD) -0.52915    0.05952  -8.891
## scale(SpatialD^2):scale(TemporalD^2) -0.40784    0.05952  -6.853
##
## Correlation of Fixed Effects:
##              (Intr) sc(SD) sc(SD^2) sc(TD) s(TD^2 s(SD):(TD) s(SD):(TD^
## scal(SptlD)  0.000
## scl(SptD^2)  0.000  0.000
## scl(TmprlD)  0.000  0.000  0.000
## scl(TmpD^2)  0.000  0.000  0.000  0.000
## sc(SD):(TD)  0.000  0.000  0.000  0.000  0.000
## s(SD):(TD^2  0.000  0.000  0.000  0.000  0.000  0.000

```

```
## s(SD^2):(TD) 0.000 0.000 0.000 0.000 0.000 0.000 0.000
## s(SD^2):(TD^ 0.000 0.000 0.000 0.000 0.000 0.000 0.000
## s(SD^2):(TD)
## scal(Spt1D)
## scl(SptD^2)
## scl(Tmpr1D)
## scl(TmpD^2)
## sc(SD):(TD)
## s(SD):(TD^2
## s(SD^2):(TD)
## s(SD^2):(TD^ 0.000
```

```
Anova(lmer_resultsA)
```

```
## Analysis of Deviance Table (Type II Wald chisquare tests)
##
## Response: VE_pos
## Chisq Df Pr(>Chisq)
## scale(SpatialD) 101.8668 1 < 2.2e-16 ***
## scale(SpatialD^2) 741.5084 1 < 2.2e-16 ***
## scale(TemporalD) 222.5745 1 < 2.2e-16 ***
## scale(TemporalD^2) 331.8649 1 < 2.2e-16 ***
## scale(SpatialD):scale(TemporalD) 1.1849 1 0.2764
## scale(SpatialD):scale(TemporalD^2) 1.5147 1 0.2184
## scale(SpatialD^2):scale(TemporalD) 79.0491 1 < 2.2e-16 ***
## scale(SpatialD^2):scale(TemporalD^2) 46.9604 1 7.244e-12 ***
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
confint(lmer_resultsA)
```

```
## Computing profile confidence intervals ...
```

```
## 2.5 % 97.5 %
## .sig01 1.65763094 3.64513228
## .sigma 5.98488580 6.14989265
## (Intercept) 3.11773666 5.87377790
## scale(SpatialD) 0.48404401 0.71725949
## scale(SpatialD^2) 1.50394992 1.73716540
## scale(TemporalD) -1.00446701 -0.77125153
## scale(TemporalD^2) -1.20075204 -0.96753656
## scale(SpatialD):scale(TemporalD) -0.18139747 0.05182923
## scale(SpatialD):scale(TemporalD^2) -0.04336576 0.18986094
## scale(SpatialD^2):scale(TemporalD) -0.64575963 -0.41253293
## scale(SpatialD^2):scale(TemporalD^2) -0.52445653 -0.29122983
```