Audiovisual integration across space and time stats analysis

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Unity judgment

```
# Data cleaning
setwd("/Users/oliviaxujiaming/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")]
```

GLMM as ordered factors

GLMM as numeric factors

```
class(unity_indvd_data$SpatialD_abs) = "Numeric"
class(unity_indvd_data$TemporalD) = "Numeric"

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)

```r
# Data cleaning
setwd("/Users/oliviaxujiaming/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))
```

LMM as ordered factors

LMM as numeric factors

```r
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"

lmer_resultsAV1 <- lmer(VE_pos ~ (scale(SpatialD)+scale(SpatialD^2))*
                          (scale(TemporalD)+scale(TemporalD^2)) +
                          (1|Subject), data=VE_indvd_data)

summary(lmer_resultsAV1,corr = FALSE)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## 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         df t value
## (Intercept)                          4.496e+00  6.784e-01  1.200e+01   6.626
## scale(SpatialD)                      6.007e-01  5.951e-02  1.038e+04  10.093
## scale(SpatialD^2)                    1.621e+00  5.951e-02  1.038e+04  27.231
## scale(TemporalD)                    -8.879e-01  5.951e-02  1.038e+04 -14.919
## scale(TemporalD^2)                  -1.084e+00  5.951e-02  1.038e+04 -18.217
## scale(SpatialD):scale(TemporalD)    -6.478e-02  5.952e-02  1.038e+04  -1.089
## scale(SpatialD):scale(TemporalD^2)   7.325e-02  5.952e-02  1.038e+04   1.231
## scale(SpatialD^2):scale(TemporalD)  -5.292e-01  5.952e-02  1.038e+04  -8.891
## scale(SpatialD^2):scale(TemporalD^2) -4.078e-01  5.952e-02  1.038e+04  -6.853
##                                     Pr(>|t|)
## (Intercept)                         2.44e-05 ***
```

```
## scale(SpatialD)                       < 2e-16 ***
## scale(SpatialD^2)                     < 2e-16 ***
## scale(TemporalD)                      < 2e-16 ***
## scale(TemporalD^2)                    < 2e-16 ***
## scale(SpatialD):scale(TemporalD)        0.276
## scale(SpatialD):scale(TemporalD^2)      0.218
## scale(SpatialD^2):scale(TemporalD)    < 2e-16 ***
## scale(SpatialD^2):scale(TemporalD^2) 7.65e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
Anova(lmer_resultsAV1)
```

```
## 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_resultsAV1)
```

```
## 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
```