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_abs)+scale(SpatialD_abs^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_abs) + scale(SpatialD_abs^2)) * (scale(TemporalD) +
##     scale(TemporalD^2)) + (1 | Subject)
##    Data: unity_indvd_data
## Control: glmerControl(optimizer = "bobyqa")
##
##      AIC      BIC   logLik deviance df.resid
##   9642.0   9714.5  -4811.0   9622.0    10390
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -6.8471 -0.5528 -0.1674  0.5478 15.6701
##
## Random effects:
```

```
##  Groups  Name        Variance Std.Dev.
##  Subject (Intercept) 0.524    0.7239
## Number of obs: 10400, groups:  Subject, 13
##
## Fixed effects:
##                                      Estimate Std. Error z value Pr(>|z|)
## (Intercept)                          -0.51867    0.20313  -2.553  0.01067
## scale(SpatialD_abs)                  -1.51265    0.09334 -16.205  < 2e-16
## scale(SpatialD_abs^2)                 0.10409    0.10101   1.031  0.30277
## scale(TemporalD)                     -0.62170    0.03284 -18.929  < 2e-16
## scale(TemporalD^2)                   -0.93321    0.03035 -30.743  < 2e-16
## scale(SpatialD_abs):scale(TemporalD) -0.26271    0.09151  -2.871  0.00409
## scale(SpatialD_abs):scale(TemporalD^2) -0.18433  0.09292  -1.984  0.04728
## scale(SpatialD_abs^2):scale(TemporalD)  0.07555  0.10472   0.721  0.47066
## scale(SpatialD_abs^2):scale(TemporalD^2)  0.11484  0.09828  1.168  0.24261
##
## (Intercept)                          *
## scale(SpatialD_abs)                  ***
## scale(SpatialD_abs^2)
## scale(TemporalD)                     ***
## scale(TemporalD^2)                   ***
## scale(SpatialD_abs):scale(TemporalD) **
## scale(SpatialD_abs):scale(TemporalD^2) *
## scale(SpatialD_abs^2):scale(TemporalD)
## scale(SpatialD_abs^2):scale(TemporalD^2)
## ---
## 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_abs)                  255.1663  1  < 2.2e-16 ***
## scale(SpatialD_abs^2)                  0.5050  1   0.477310
## scale(TemporalD)                     374.3714  1  < 2.2e-16 ***
## scale(TemporalD^2)                  1036.0283  1  < 2.2e-16 ***
## scale(SpatialD_abs):scale(TemporalD)   8.2414  1   0.004094 **
## scale(SpatialD_abs):scale(TemporalD^2)  3.9355  1   0.047278 *
## scale(SpatialD_abs^2):scale(TemporalD)  0.5204  1   0.470662
## scale(SpatialD_abs^2):scale(TemporalD^2)  1.3654  1   0.242611
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
confint(GLMMmodel_AV1)
```

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

```
##                                         2.5 %       97.5 %
## .sig01                               0.51000820  1.130907911
## (Intercept)                         -0.94828977 -0.089781808
```

```
## scale(SpatialD_abs)                       -1.69633681 -1.330302234
## scale(SpatialD_abs^2)                     -0.09490658  0.301272085
## scale(TemporalD)                          -0.68703852 -0.558207014
## scale(TemporalD^2)                        -0.99325363 -0.874240574
## scale(SpatialD_abs):scale(TemporalD)      -0.44210916 -0.083273262
## scale(SpatialD_abs):scale(TemporalD^2)    -0.36629630 -0.001946882
## scale(SpatialD_abs^2):scale(TemporalD)    -0.13085703  0.279867500
## scale(SpatialD_abs^2):scale(TemporalD^2) -0.07818122  0.307200281
```

Bimodal spatial localization (VE)

```
# 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

```
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_abs)+scale(SpatialD_abs^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_abs) + scale(SpatialD_abs^2)) * (scale(TemporalD) +
##     scale(TemporalD^2)) + (1 | Subject)
##    Data: VE_indvd_data
##
## REML criterion at convergence: 66632
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.2934 -0.6172  0.0045  0.5844  4.5871
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  Subject  (Intercept)  5.94    2.437
##  Residual             35.22    5.935
## Number of obs: 10400, groups:  Subject, 13
##
## Fixed effects:
```

```
##                                          Estimate Std. Error         df
## (Intercept)                                4.4958     0.6784    12.0000
## scale(SpatialD_abs)                        4.5044     0.2037 10379.0000
## scale(SpatialD_abs^2)                     -2.6961     0.2037 10379.0000
## scale(TemporalD)                          -0.8879     0.0582 10379.0000
## scale(TemporalD^2)                        -1.0841     0.0582 10379.0000
## scale(SpatialD_abs):scale(TemporalD)      -0.9991     0.2037 10379.0000
## scale(SpatialD_abs):scale(TemporalD^2)    -1.7111     0.2037 10379.0000
## scale(SpatialD_abs^2):scale(TemporalD)     0.4284     0.2037 10379.0000
## scale(SpatialD_abs^2):scale(TemporalD^2)   1.2319     0.2037 10379.0000
##                                         t value Pr(>|t|)
## (Intercept)                               6.626 2.44e-05 ***
## scale(SpatialD_abs)                      22.114  < 2e-16 ***
## scale(SpatialD_abs^2)                   -13.236  < 2e-16 ***
## scale(TemporalD)                        -15.256  < 2e-16 ***
## scale(TemporalD^2)                      -18.629  < 2e-16 ***
## scale(SpatialD_abs):scale(TemporalD)     -4.905 9.49e-07 ***
## scale(SpatialD_abs):scale(TemporalD^2)   -8.400  < 2e-16 ***
## scale(SpatialD_abs^2):scale(TemporalD)    2.103   0.0355 *
## scale(SpatialD_abs^2):scale(TemporalD^2)  6.048 1.52e-09 ***
## ---
## 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_abs)                     489.0323  1  < 2.2e-16 ***
## scale(SpatialD_abs^2)                   175.1989  1  < 2.2e-16 ***
## scale(TemporalD)                        232.7458  1  < 2.2e-16 ***
## scale(TemporalD^2)                      347.0306  1  < 2.2e-16 ***
## scale(SpatialD_abs):scale(TemporalD)     24.0587  1  9.344e-07 ***
## scale(SpatialD_abs):scale(TemporalD^2)   70.5599  1  < 2.2e-16 ***
## scale(SpatialD_abs^2):scale(TemporalD)    4.4219  1    0.03548 *
## scale(SpatialD_abs^2):scale(TemporalD^2) 36.5743  1  1.470e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
confint(lmer_resultsAV1)
```

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

```
##                                             2.5 %     97.5 %
## .sig01                                 1.65823729  3.6454080
## .sigma                                 5.85265063  6.0140117
## (Intercept)                            3.11773666  5.8737779
## scale(SpatialD_abs)                    4.10532191  4.9035411
## scale(SpatialD_abs^2)                 -3.09521552 -2.2969963
## scale(TemporalD)                      -1.00189058 -0.7738280
## scale(TemporalD^2)                    -1.19817561 -0.9701130
```

```
## scale(SpatialD_abs):scale(TemporalD)     -1.39827335 -0.6000158
## scale(SpatialD_abs):scale(TemporalD^2)   -2.11021239 -1.3119548
## scale(SpatialD_abs^2):scale(TemporalD)    0.02922002  0.8274776
## scale(SpatialD_abs^2):scale(TemporalD^2)  0.83278487  1.6310424
```