

# Supplementary material

Article: *Coupling of attention and saccades when viewing scenes with central and peripheral degradation*

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## (G)LMMs for Experiment 1

### Eye-movement behavior

#### Saccade amplitude

```
m1.sa <- lmer(lambdaampl ~ conexp + type + loc + type_loc +
              (conexp + type + loc + type_loc | subject) +
              (conexp + type + loc + type_loc || imageid),
              data=sactab, REML=FALSE)

summary(m1.sa, corr=FALSE)

# Linear mixed model fit by maximum likelihood ['lmerMod']
# Formula: lambdaampl ~ conexp + type + loc + type_loc + (conexp + type +
#   loc + type_loc | subject) + ((1 | imageid) + (0 + conexp |
#   imageid) + (0 + type | imageid) + (0 + loc | imageid) + (0 + type_loc | imageid))
# Data: sactab
```

```

#
#      AIC      BIC   logLik deviance df.resid
# 60826.7 61069.4 -30387.3 60774.7   83736
#
# Scaled residuals:
#      Min      1Q  Median      3Q      Max
# -3.8347 -0.6174  0.0257  0.6513  4.2425
#
# Random effects:
# Groups Name          Variance Std.Dev. Corr
# imageid type_loc      0.0008136 0.02852
# imageid.1 loc          0.0013418 0.03663
# imageid.2 type         0.0002710 0.01646
# imageid.3 conexp       0.0005133 0.02266
# imageid.4 (Intercept) 0.0007878 0.02807
# subject (Intercept) 0.0063693 0.07981
#          conexp       0.0013146 0.03626 -0.37
#          type         0.0003384 0.01839  0.41 -0.43
#          loc          0.0027205 0.05216 -0.12  0.08  0.46
#          type_loc     0.0005638 0.02375 -0.71  0.38 -0.25  0.26
# Residual              0.1199229 0.34630
# Number of obs: 83762, groups: imageid, 85; subject, 30
#
# Fixed effects:
#              Estimate Std. Error t value
# (Intercept)  1.680854   0.014935  112.55
# conexp       -0.011179   0.007660   -1.46
# type         0.053636   0.004668   11.49
# loc          0.177792   0.010669   16.66
# type_loc     0.023435   0.005976    3.92

```

## Fixation duration

```

m1.fd <- lmer(logfixdur ~ conexp + type + loc + type_loc +
              (conexp + type + loc + type_loc | subject) +
              (conexp + type + loc + type_loc || imageid),
              data=fixtab, REML=FALSE)

summary(m1.fd, corr=FALSE)

# Linear mixed model fit by maximum likelihood ['lmerMod']
# Formula: logfixdur ~ conexp + type + loc + type_loc + (conexp + type + loc + type_loc |
# subject) + ((1 | imageid) + (0 + conexp | imageid) + (0 + type | imageid) +
# (0 + loc | imageid) + (0 + type_loc | imageid))
# Data: fixtab
#
#      AIC      BIC   logLik deviance df.resid
# 90794.5 91036.2 -45371.2 90742.5   80621
#
# Scaled residuals:
#      Min      1Q  Median      3Q      Max
# -4.1850 -0.6416 -0.0356  0.6220  5.5291

```

```

#
# Random effects:
# Groups Name Variance Std.Dev. Corr
# imageid type_loc 0.0011451 0.03384
# imageid.1 loc 0.0003444 0.01856
# imageid.2 type 0.0005173 0.02274
# imageid.3 conexp 0.0006966 0.02639
# imageid.4 (Intercept) 0.0008172 0.02859
# subject (Intercept) 0.0108685 0.10425
# conexp 0.0010872 0.03297 -0.09
# type 0.0018458 0.04296 -0.22 -0.62
# loc 0.0020733 0.04553 -0.04 -0.45 0.68
# type_loc 0.0014625 0.03824 -0.32 0.29 -0.12 -0.23
# Residual 0.1789787 0.42306
# Number of obs: 80647, groups: imageid, 85; subject, 30
#
# Fixed effects:
# Estimate Std. Error t value
# (Intercept) 5.521438 0.019343 285.44
# conexp 0.035061 0.007624 4.60
# type 0.011892 0.008889 1.34
# loc 0.056363 0.009197 6.13
# type_loc -0.071716 0.008582 -8.36

```

## Task performance

### Memory questions

```

m1.ac <- glmer(answercorrect ~ conHPC + conHPP + conLPC + conLPP +
              (1 | subject) +
              (1 | imageid),
              data = anstab, family = binomial(link="logit"))

summary(m1.ac, corr=FALSE)

# Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
# Family: binomial ( logit )
# Formula: answercorrect ~ conHPC + conHPP + conLPC + conLPP + (1 | subject) + (1 | imageid)
# Data: anstab
#
# AIC      BIC    logLik deviance df.resid
# 1473.3  1509.2  -729.7  1459.3   1243
#
# Scaled residuals:
#   Min       1Q   Median       3Q      Max
# -3.0095 -0.7939  0.3873  0.6546  2.3023
#
# Random effects:
# Groups Name Variance Std.Dev.
# imageid (Intercept) 1.46284  1.2095
# subject (Intercept) 0.07567  0.2751

```

```

# Number of obs: 1250, groups:  imageid, 85; subject, 30
#
# Fixed effects:
#           Estimate Std. Error z value Pr(>|z|)
# (Intercept)  0.93818    0.20827   4.505 6.65e-06 ***
# conHPC      -0.05289    0.21810  -0.242  0.8084
# conHPP      -0.16974    0.21419  -0.792  0.4281
# conLPC      -0.45463    0.21027  -2.162  0.0306 *
# conLPP      -0.12615    0.21387  -0.590  0.5553

```

## Target detection

Detection probability

```

m1.dp <- glmer(responsegiven ~ conHPC + conHPP + conLPC + conLPP +
              (conHPC + conHPP + conLPC || subject) +
              (conHPC + conHPP || imageid),
              data = crittab, family = binomial(link="logit"))

summary(m1.dp, corr=FALSE)

# Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
# Family: binomial ( logit )
# Formula: responsegiven ~ conHPC + conHPP + conLPC + conLPP + (conHPC +
#   conHPP + conLPC || subject) + (conHPC + conHPP || imageid)
# Data: crittab
#
#      AIC      BIC   logLik deviance df.resid
# 7891.9  7974.4 -3934.0  7867.9    7138
#
# Scaled residuals:
#   Min      1Q  Median      3Q      Max
# -4.4877 -0.8044  0.4440  0.6057  2.5745
#
# Random effects:
# Groups Name      Variance Std.Dev.
# imageid conHPP      0.47861  0.6918
# imageid.1 conHPC      0.10216  0.3196
# imageid.2 (Intercept) 0.23838  0.4882
# subject conLPC      0.06104  0.2471
# subject.1 conHPP      0.59467  0.7711
# subject.2 conHPC      0.04341  0.2084
# subject.3 (Intercept) 0.25570  0.5057
# Number of obs: 7150, groups:  imageid, 85; subject, 30
#
# Fixed effects:
#           Estimate Std. Error z value Pr(>|z|)
# (Intercept)  1.35965    0.12536  10.846 < 2e-16 ***
# conHPC      -0.04206    0.11205  -0.375  0.70738
# conHPP      -0.80949    0.18331  -4.416 1.01e-05 ***
# conLPC      -0.09150    0.10177  -0.899  0.36860
# conLPP      -0.30874    0.09076  -3.402  0.00067 ***

```

## Reaction time

```
m1.rt <- lmer(lambdart ~ conHPC + conHPP + conLPC + conLPP +
              (conHPC + conHPP | subject) +
              (conHPC | imageid),
              data=rtdata, REML=FALSE)

summary(m1.rt, corr=FALSE)

# Linear mixed model fit by maximum likelihood ['lmerMod']
# Formula: lambdart ~ conHPC + conHPP + conLPC + conLPP + (conHPC + conHPP | subject) +
#           (conHPC | imageid)
# Data: rtdata
#
#           AIC      BIC   logLik deviance df.resid
# -37065.4 -36967.4 18547.7 -37095.4     5086
#
# Scaled residuals:
#      Min       1Q   Median       3Q      Max
# -3.3468 -0.6347  0.0172  0.6555  4.5087
#
# Random effects:
# Groups      Name      Variance Std.Dev. Corr
# imageid    (Intercept) 1.287e-06 0.0011346
#            conHPC      4.614e-07 0.0006793 0.16
# subject    (Intercept) 1.137e-05 0.0033723
#            conHPC      4.578e-07 0.0006766 0.15
#            conHPP      2.280e-06 0.0015100 0.23 0.38
# Residual                    3.871e-05 0.0062215
# Number of obs: 5101, groups: imageid, 85; subject, 30
#
# Fixed effects:
#              Estimate Std. Error t value
# (Intercept)  0.0691087  0.0006554 105.45
# conHPC       -0.0003524  0.0003093  -1.14
# conHPP       -0.0022269  0.0003963  -5.62
# conLPC       -0.0002485  0.0002616  -0.95
# conLPP       -0.0008170  0.0002782  -2.94
```

## Detection probability as a function of saccade length

```
m1.sl <- glmer(responsegiven ~ sl5 + sl10 +
               (sl5 + sl10 | subject) +
               (sl5 || imageid),
               data=angtab, family=binomial(link="logit"))

summary(m1.sl, corr=FALSE)

# Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
# Family: binomial ( logit )
# Formula: responsegiven ~ sl5 + sl10 + (sl5 + sl10 | subject) + (sl5 || imageid)
# Data: angtab
#
#           AIC      BIC   logLik deviance df.resid
```

```

# 7489.2 7564.6 -3733.6 7467.2 7040
#
# Scaled residuals:
#   Min      1Q  Median      3Q      Max
# -4.1467 -0.7730  0.3966  0.5839  1.9025
#
# Random effects:
#   Groups   Name                Variance Std.Dev. Corr
#   imageid  sl5                 0.09403  0.3066
#   imageid.1 (Intercept) 0.22148  0.4706
#   subject  (Intercept) 0.28836  0.5370
#           sl5                 0.29782  0.5457  -0.67
#           sl10                0.13178  0.3630  -0.77  0.83
# Number of obs: 7051, groups:  imageid, 85; subject, 30
#
# Fixed effects:
#               Estimate Std. Error z value Pr(>|z|)
# (Intercept)   1.6093      0.1187  13.560 <2e-16 ***
# sl5           -1.2413      0.1246  -9.967 <2e-16 ***
# sl10          -1.5897      0.1164 -13.662 <2e-16 ***

```

## (G)LMMs for Experiment 2

### Eye-movement behavior

#### Saccade amplitude

```

m2.sa <- lmer(lambdaampl ~ conexp + type + loc + type_loc +
              (conexp + type + loc + type_loc | subject) +
              (conexp + type + loc + type_loc | imageid),
              data=sactab, REML=FALSE)

summary(m2.sa, corr=FALSE)

# Linear mixed model fit by maximum likelihood ['lmerMod']
# Formula: lambdaampl ~ conexp + type + loc + type_loc + (conexp + type + loc + type_loc |
#   subject) + (conexp + type + loc + type_loc | imageid)
#   Data: sactab
#
#   AIC      BIC    logLik deviance df.resid
# 24896.3 25230.4 -12412.2 24824.3   79128
#
# Scaled residuals:
#   Min      1Q  Median      3Q      Max
# -4.2621 -0.6163  0.0166  0.6461  4.1084
#
# Random effects:
#   Groups   Name                Variance Std.Dev. Corr
#   imageid  (Intercept) 0.0005478  0.02340
#           conexp      0.0003915  0.01979  -0.56

```

```

#           type          0.0005091 0.02256 -0.32 -0.17
#           loc           0.0006529 0.02555  0.22 -0.10 -0.03
#           type_loc      0.0004209 0.02051 -0.59  0.04  0.55 -0.04
# subject (Intercept) 0.0057129 0.07558
#           conexp       0.0012627 0.03553 -0.20
#           type         0.0007445 0.02728  0.28 -0.64
#           loc          0.0019106 0.04371 -0.36  0.37 -0.33
#           type_loc     0.0014438 0.03800 -0.63  0.60 -0.55  0.20
# Residual              0.0793687 0.28172
# Number of obs: 79164, groups:  imageid, 85; subject, 30
#
# Fixed effects:
#           Estimate Std. Error t value
# (Intercept) 1.575381  0.014067 111.99
# conexp      -0.015843  0.007276  -2.18
# type         0.055293  0.005992   9.23
# loc          0.172034  0.008745 19.67
# type_loc     0.018597  0.007628   2.44

```

## Fixation duration

```

m2.fd <- lmer(logfixdur ~ conexp + type + loc + type_loc +
              (conexp + type + loc + type_loc | subject) +
              (conexp + type + loc + type_loc || imageid),
              data=fixtab, REML=FALSE)

summary(m2.fd, corr=FALSE)

# Linear mixed model fit by maximum likelihood ['lmerMod']
# Formula: logfixdur ~ conexp + type + loc + type_loc + (conexp + type + loc + type_loc |
# subject) + ((1 | imageid) + (0 + conexp | imageid) + (0 + type | imageid) +
# (0 + loc | imageid) + (0 + type_loc | imageid))
# Data: fixtab
#
#           AIC          BIC    logLik deviance df.resid
# 79515.8  79755.9 -39731.9  79463.8    75862
#
# Scaled residuals:
#      Min       1Q   Median       3Q      Max
# -4.7950 -0.6412 -0.0453  0.6196  6.3883
#
# Random effects:
# Groups   Name              Variance Std.Dev. Corr
# imageid  type_loc          0.0004059 0.02015
# imageid.1 loc              0.0004646 0.02155
# imageid.2 type             0.0007982 0.02825
# imageid.3 conexp           0.0008470 0.02910
# imageid.4 (Intercept)     0.0006880 0.02623
# subject  (Intercept)     0.0077486 0.08803
#           conexp         0.0024356 0.04935 -0.35
#           type           0.0023603 0.04858  0.41 -0.54
#           loc            0.0032373 0.05690  0.25 -0.53  0.52

```

```

#           type_loc    0.0011567 0.03401  0.42 -0.22  0.60  0.51
# Residual           0.1654596 0.40677
# Number of obs: 75888, groups:  imageid, 85; subject, 30
#
# Fixed effects:
#           Estimate Std. Error t value
# (Intercept)  5.609572  0.016389  342.3
# conexp       0.012451  0.010236   1.2
# type         0.035433  0.009959   3.6
# loc          0.056610  0.011158   5.1
# type_loc    -0.038385  0.007378  -5.2

```

## Task performance

### Memory questions

```

m2.ac <- glmer(answercorrect ~ conHPC + conHPP + conLPC + conLPP +
              (1 | subject) +
              (1 | imageid),
              data = anstab, family = binomial(link="logit"))

summary(m2.ac, corr=FALSE)

# Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
# Family: binomial ( logit )
# Formula: answercorrect ~ conHPC + conHPP + conLPC + conLPP + (1 | subject) + (1 | imageid)
# Data: anstab
#
# AIC      BIC    logLik deviance df.resid
# 1510.5   1546.5  -748.3  1496.5   1252
#
# Scaled residuals:
#      Min       1Q   Median       3Q      Max
# -3.0896 -0.8102  0.4104  0.6406  1.8146
#
# Random effects:
# Groups Name      Variance Std.Dev.
# imageid (Intercept) 1.22803  1.1082
# subject (Intercept) 0.07666  0.2769
# Number of obs: 1259, groups:  imageid, 85; subject, 30
#
# Fixed effects:
#           Estimate Std. Error z value Pr(>|z|)
# (Intercept)  1.03566    0.20377   5.082 3.73e-07 ***
# conHPC       -0.40572    0.21215  -1.912  0.0558 .
# conHPP       -0.29774    0.21257  -1.401  0.1613
# conLPC       -0.51730    0.21197  -2.440  0.0147 *
# conLPP       -0.03527    0.21594  -0.163  0.8703

```



## Target detection

Detection probability

```
m2.dp <- glmer(responsegiven ~ conHPC + conHPP + conLPC + conLPP +
              (conHPC | subject) +
              (conHPC + conHPP || imageid),
              data = crittab, family = binomial(link="logit"))

summary(m2.dp, corr=FALSE)

# Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
# Family: binomial ( logit )
# Formula: responsegiven ~ conHPC + conHPP + conLPC + conLPP + (conHPC |
#   subject) + (conHPC + conHPP || imageid)
# Data: crittab
#
#      AIC      BIC   logLik deviance df.resid
# 7842.0  7916.9 -3910.0  7820.0    6707
#
# Scaled residuals:
#   Min       1Q   Median       3Q      Max
# -3.8277 -0.8968  0.4815  0.6498  2.5633
#
# Random effects:
# Groups   Name                Variance Std.Dev. Corr
# imageid  conHPP                0.1211  0.3479
# imageid.1 conHPC                0.1392  0.3731
# imageid.2 (Intercept)         0.1968  0.4436
# subject  (Intercept)         0.1741  0.4173
#          conHPC                0.6303  0.7939 -0.57
# Number of obs: 6718, groups:  imageid, 85; subject, 30
#
# Fixed effects:
#              Estimate Std. Error z value Pr(>|z|)
# (Intercept)  1.183286   0.111434  10.619 < 2e-16 ***
# conHPC       -1.415904   0.175259  -8.079 6.53e-16 ***
# conHPP       -0.129542   0.099970  -1.296  0.195
# conLPC       -0.369845   0.087386  -4.232 2.31e-05 ***
# conLPP        0.009012   0.094091   0.096  0.924
```

Reaction time

```
m2.rt <- lmer(lambdart ~ conHPC + conHPP + conLPC + conLPP +
             (conHPC + conHPP | subject) +
             (1 | imageid),
             data=rtdata, REML=FALSE)

summary(m2.rt, corr=FALSE)

# Linear mixed model fit by maximum likelihood ['lmerMod']
# Formula: lambdart ~ conHPC + conHPP + conLPC + conLPP + (conHPC + conHPP | subject) +
#   (1 | imageid)
# Data: rtdata
```

```

#
#      AIC      BIC   logLik deviance df.resid
# -32817.4 -32734.0 16421.7 -32843.4    4486
#
# Scaled residuals:
#      Min       1Q   Median       3Q      Max
# -3.6726 -0.6189  0.0268  0.6592  3.6778
#
# Random effects:
# Groups Name          Variance Std.Dev. Corr
# imageid (Intercept) 1.058e-06 0.0010284
# subject (Intercept) 1.092e-05 0.0033052
#          conHPC      7.895e-07 0.0008885 -0.58
#          conHPP      1.024e-06 0.0010121 -0.10  0.50
# Residual              3.776e-05 0.0061453
# Number of obs: 4499, groups:  imageid, 85; subject, 30
#
# Fixed effects:
#              Estimate Std. Error t value
# (Intercept)  0.0672954  0.0006437 104.54
# conHPC       -0.0028416  0.0003635  -7.82
# conHPP       -0.0007348  0.0003318  -2.21
# conLPC       -0.0007592  0.0002773  -2.74
# conLPP       -0.0004085  0.0002810  -1.45

```

Detection probability as a function of saccade length

```

m2.sl <- glmer(responsegiven ~ sl5_10 + sl10 +
              (sl5_10 + sl10 | subject) +
              (1 | imageid),
              data=angtab, family=binomial(link="logit"))

summary(m2.sl, corr=FALSE)

# Generalized linear mixed model fit by maximum likelihood (Laplace Approximation) ['glmerMod']
# Family: binomial ( logit )
# Formula: responsegiven ~ sl5_10 + sl10 + (sl5_10 + sl10 | subject) + (1 | imageid)
# Data: angtab
#
#      AIC      BIC   logLik deviance df.resid
# 7515.6  7583.6 -3747.8  7495.6    6665
#
# Scaled residuals:
#      Min       1Q   Median       3Q      Max
# -3.4190 -0.8089  0.4360  0.6054  2.2394
#
# Random effects:
# Groups Name          Variance Std.Dev. Corr
# imageid (Intercept) 0.1643  0.4054
# subject (Intercept) 0.1919  0.4381
#          sl5_10     0.2365  0.4863  -0.45
#          sl10       0.1053  0.3245  -0.54  0.92
# Number of obs: 6675, groups:  imageid, 85; subject, 30

```

```
#  
# Fixed effects:  
#           Estimate Std. Error z value Pr(>|z|)  
# (Intercept)  1.36618    0.09955   13.72  <2e-16 ***  
# sl5_10      -1.41277    0.11128  -12.70  <2e-16 ***  
# sl10       -1.82425    0.10822  -16.86  <2e-16 ***
```

Raw data and complete *R* analyses code for this article are available at the Potsdam Mind Research Repository (PMR2): [http://read.psych.uni-potsdam.de/index.php?option=com\\_content&view=article&id=148:perspa&catid=10:publications&Itemid=14](http://read.psych.uni-potsdam.de/index.php?option=com_content&view=article&id=148:perspa&catid=10:publications&Itemid=14)