

Behavioral output paper 1

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General data manipulation

In the following block, we do some general manipulation on the dataset. We first check the data to see how it looks. Then we load in the relevant libraries for analysis. Finally, we convert some variables to factors.

Slow timescale

In the next part, we look at the behavioral effects on the slow timescale. Note that slow timescale means that we look at effects over experimental blocks. Thus, our independent variables are block number (accounting for condition), and condition. Block numbers within a condition range from 1 to 8 (both included), condition is binary ('novel', or 'recurring'). A condition that is 'novel' means that the stimuli are never seen before, and are unique to this block. 'Recurring' blocks show stimuli (and their associated mappings) that repeat throughout the experiment. We look at variations in both reaction times (RT) and errors made. For both dependent variables, we investigate the main effect of block number and condition, and their interaction effect. We use the functions `lmer()` and `glmer` to accomplish this, respectively.

```
# log(RT) ~ block number + condition + (block number x condition)
rt.block_cond = lmer(RT_log ~ (1|Subject_nr) + Block_specific * Condition,
                     data = df)
aov1 = Anova(rt.block_cond,
             type = "III",
             test.statistic = "F")
aov1

## Analysis of Deviance Table (Type III Wald F tests with Kenward-Roger df)
##
## Response: RT_log
##
##          F Df Df.res    Pr(>F)
## (Intercept) 116543.633  1     23 < 2.2e-16 ***
## Block_specific    25.779  7    10118 < 2.2e-16 ***
## Condition        542.869  1    10118 < 2.2e-16 ***
## Block_specific:Condition    14.499  7    10118 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

# error rate ~ block number + condition + (block number x condition)
acc.block_cond = glmer(Error_int ~ (1|Subject_nr) + Block_specific * Condition,
                       data = df,
                       family = binomial,
                       control = glmerControl(optimizer = "Nelder_Mead"))
```

```
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, :
## Model failed to converge with max|grad| = 0.00789695 (tol = 0.002, component 1)

## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, : Model is nearly unidentifiable:
## - Rescale variables?
```

```
aov2 = Anova(acc.block_cond,
             type = "III",
             test.statistic = "Chisq")
aov2
```

```
## Analysis of Deviance Table (Type III Wald chisquare tests)
##
## Response: Error_int
##
##              Chisq Df Pr(>Chisq)
## (Intercept)    0.1707  1  0.6794809
## Block_specific 34.2872  7  1.522e-05 ***
## Condition      0.0262  1  0.8714090
## Block_specific:Condition 27.2951  7  0.0002949 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Fast timescale

In the subsequent analysis, we look at the effects of stimulus repetition on both RT and error rate. Note that we first do an extra manipulation: we subset the data to make sure that the maximum amount of stimulus repetitions is 8. This makes sure that we can compare between conditions, since both the novel and the recurring condition will have a maximal repetition occurrence of 8. We only look at the main effect of stimulus repetition, not at the main effect of condition.

```
# make a subset for when repetitions <= 8
df.reduced = df[as.numeric(as.character(df$Repetitions_overall)) <= 8, ]

# log(RT) ~ repetitions
rt.reps = lmer(RT_log ~ (1|Subject_nr) + Repetitions_block,
              data = df.reduced)
aov3 = Anova(rt.reps,
             type = "III",
             test.statistic = "F")
aov3
```

```
## Analysis of Deviance Table (Type III Wald F tests with Kenward-Roger df)
##
## Response: RT_log
##
##              F Df Df.res    Pr(>F)
## (Intercept) 109125.246  1  23.0 < 2.2e-16 ***
## Repetitions_block    61.483  7 5561.3 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```

# error rate ~ repetitions
acc.reps = glmer(Error_int ~ (1|Subject_nr) + Repetitions_block,
                  data      = df.reduced,
                  family    = binomial,
                  control = glmerControl(optimizer = "Nelder_Mead"))
aov4 = Anova(acc.reps ,
              type      = "III",
              test.statistic = "Chisq")
aov4

```

```

## Analysis of Deviance Table (Type III Wald chisquare tests)
##
## Response: Error_int
##               Chisq Df Pr(>Chisq)
## (Intercept)    1.6401  1    0.2003
## Repetitions_block 122.3843  7    <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```