ModelReportAll

Fiona Zhu

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Load the packages

```
options(mc.cores = parallel::detectCores()-1)
rstan_options (auto_write=TRUE)
```

```
#customize theme
theme_new <- theme_bw() +
  theme(panel.border = element_blank(),
        panel.grid.major = element_blank(),
        panel.grid.minor = element_blank(),
        axis.line = element_line(colour = "black"),
        strip.background = element_rect(color = "white", fill = "white"),
        panel.grid = element_blank())
```

Define the Rstan models and functions to plot

Definition of the function to merge rstan result data

To further uncover the underlying structure of the prior, we hypothesize that in addition to two local priors, there is a general global prior.Participants may combine both local and global priors for the final reproduction. There are multiple possibilities for integrating those local and global priors with the sensory inputs. For examples, the sensory input could first integrate with the local prior, and then integrate with the global prior (a hierarchical local-global model, see Figure 7B in D1 proposal).

Our Hypothesis

- H2: A hierarchical local-global model In H2, global and local priors are integrated first. That means local prior is integrated with sensory input firstly, then global prior integrates with sensory input.

The sensory input (D_s) first integrates with the local prior (P_L) to a posterior (D_L), which further integrates with the global prior (P_G) to generate a final posterior for reproduction (D_r).

- H3: Global prior (the dual integration model)

integration of local priors firstly, then integration of the global prior

Both local and global priors independently integrate with the sensory inputs to generate two posteriors (D_L) and (D_G), the latter two are combined together for reproduction (D_r).

compute parameters for all models

```
# function to run models on  lrz cluster parallely
runModel<- function(AllExpData, modelname, rltname){
  expList <- unique(AllExpData$Exp)
  subList <- unique(AllExpData$NSub)
  # H2_V1  There were 135 divergent transitions after warmup.
  sub_exp_dat <- list()
    for (expName in expList) {
      data_exp <- AllExpData %>% dplyr::filter(valid  == 1 & Exp == expName)
      data_exp$model <- modelname
```

```
      sub_exp <-  split(data_exp, data_exp$NSub) # split data for each subject
      for (subNo in subList) {
        sub_exp_dat <- list.append(sub_exp_dat, sub_exp[[subNo]])
      }
    }

  rlt <- runModelcluster(sub_exp_dat)
  saveRDS(rlt, file = paste0(getwd(), "/", rstanmodelPath, "/rlt/rlt_", rltname,".rds"))
}
```

```
# execute the model running
modellist_V3 <- c('H2_V3', 'H3_V3')

modellist <- modellist_V3
if (runModels == TRUE){
  for(model in modellist){
    runModel(AllExpData, model, model)
  }
}
```

Merge the Result data

To preprocess the model result data, and merge different model version data together.

```
#function to merge the model result data

funMergeMRlt <- function(modellist, path, version){
  rltfilename <- {}
  rltfilename <- c(rltfilename, paste0("rlt_", modellist, ".rds"))
  AllDat_Bayparlist <- {}
  AllDat_predY_mix <- {}
  AllDat_predY_s <- {}
  AllDat_predY_l <- {}
  modelResultAll <- list()
  merge.data.all <- {}
  merge.data <- readRDS(paste0(getwd(), "/", path, "/rlt/", rltfilename[1]))
  for (i in 1:length(merge.data)){
    modelResultAll <- list.append(modelResultAll, merge.data[[i]])
    AllDat_Bayparlist <- rbind(AllDat_Bayparlist, merge.data[[i]]$Baypar)
    AllDat_predY_mix <- rbind(AllDat_predY_mix, merge.data[[i]]$PredY_mix_list)
    AllDat_predY_s <- rbind(AllDat_predY_s, merge.data[[i]]$PredY_s_list)
    AllDat_predY_l <- rbind(AllDat_predY_l, merge.data[[i]]$PredY_l_list)
  }

  if (length(rltfilename) >= 2) {
    for (i in 2:length(rltfilename)){
      new.data = readRDS(paste0(getwd(), "/", path, "/rlt/", rltfilename[i]))
      for (i in 1:length(new.data)){
        modelResultAll <- list.append(modelResultAll,new.data[[i]])
        AllDat_Bayparlist <- rbind(AllDat_Bayparlist, new.data[[i]]$Baypar)
        AllDat_predY_mix <- rbind(AllDat_predY_mix, new.data[[i]]$PredY_mix_list)
        AllDat_predY_s <- rbind(AllDat_predY_s, new.data[[i]]$PredY_s_list)
        AllDat_predY_l <- rbind(AllDat_predY_l, new.data[[i]]$PredY_l_list)
      }
    }
```

```
  }
  write.csv(AllDat_Bayparlist, paste0(getwd(), "/", path, "/rlt/AllDat_Bayparlist_", version, ".csv"))
  write.csv(AllDat_predY_mix, paste0(getwd(), "/", path, "/rlt/AllDat_predY_mix_", version, ".csv"))
  write.csv(AllDat_predY_s, paste0(getwd(), "/", path, "/rlt/AllDat_predY_s_", version, ".csv"))
  write.csv(AllDat_predY_l, paste0(getwd(), "/", path, "/rlt/AllDat_predY_l_", version, ".csv"))
  saveRDS(modelResultAll, file = paste0(getwd(), "/", path, "/rlt/modelResultAll_", version, ".rds"))
}
```

load result data (V3)

Analysis on the Rstan model parameters

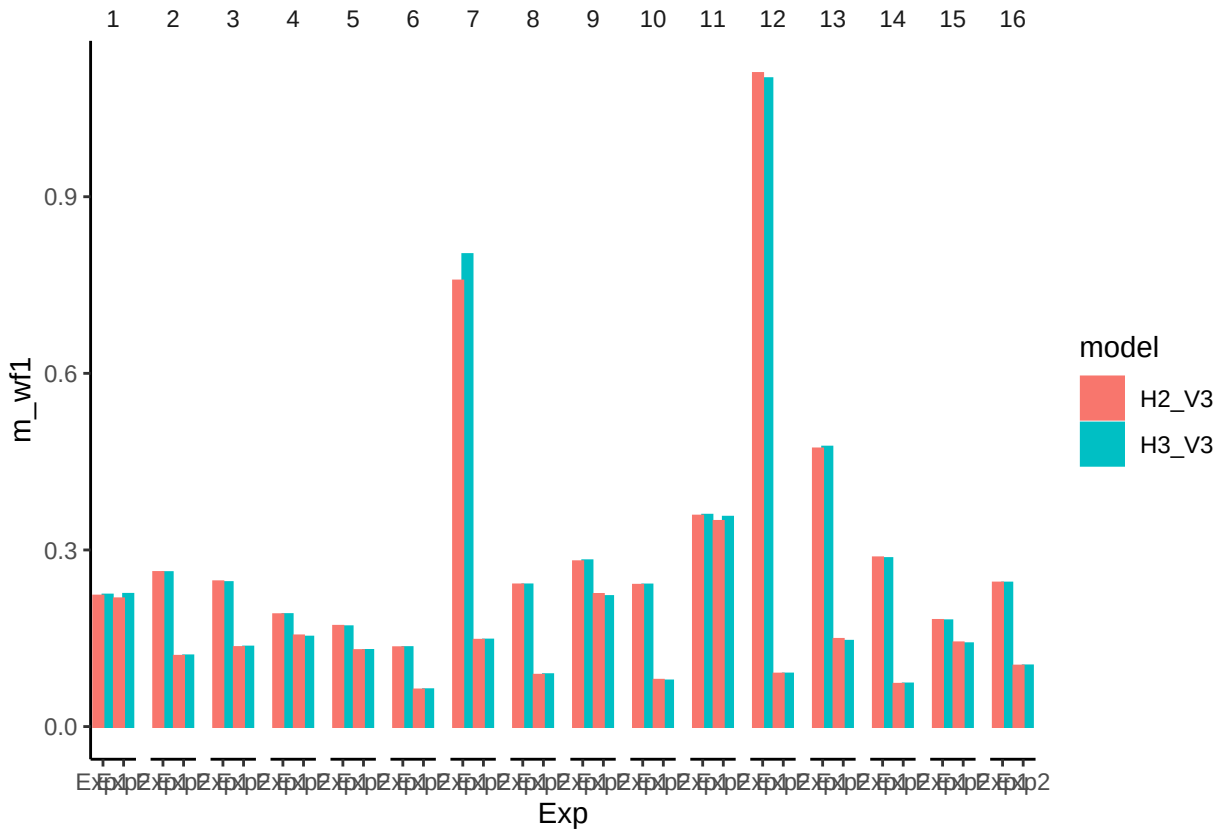
Parameters

```
m_Baypar <- dplyr::group_by(AllDat_Bayparlist3, Nsub,Exp, model) %>%
  dplyr::summarize(m_wf1 = mean(wf1), m_wf2 = mean(wf2),
                   m_wf3 = mean(wf3), m_wf_sm =mean(wf_sm),
                   m_mu1 = mean(mu1), m_mu2 = mean(mu2), m_mu3 = mean(mu3),
                   m_sig_m_square =mean(sig_m_square))
m_Baypar
```

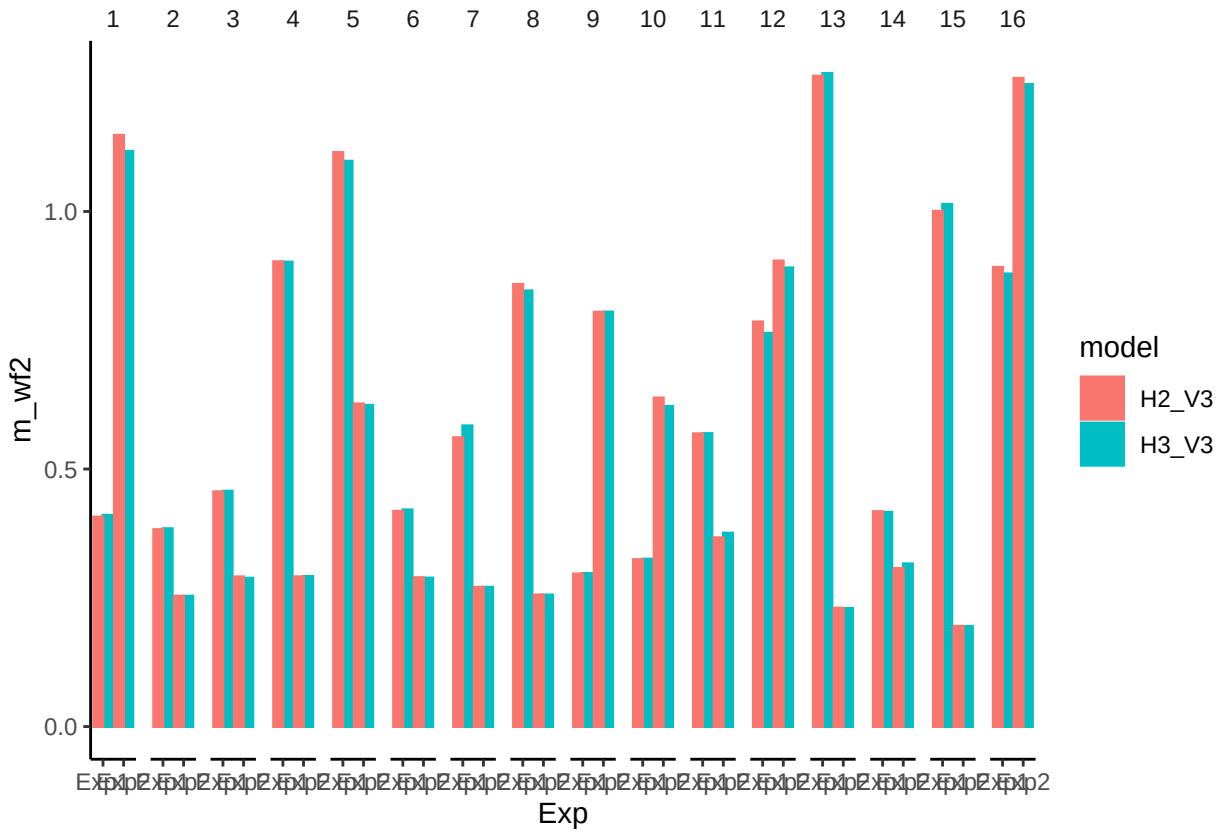
```
## # A tibble: 64 x 11
## # Groups:   Nsub, Exp [32]
##     Nsub Exp   model m_wf1 m_wf2 m_wf3 m_wf_sm m_mu1 m_mu2 m_mu3
##    <dbl> <chr> <chr> <dbl> <dbl> <dbl>   <dbl> <dbl> <dbl> <dbl>
##  1     1 Exp1  H2_V3 0.222 0.407  1.37   1.04  0.597  1.69 0.775
##  2     1 Exp1  H3_V3 0.223 0.410  1.38   1.04  0.595  1.67 0.779
##  3     1 Exp2  H2_V3 0.217 1.15   1.05   0.969 0.742  1.63 1.18
##  4     1 Exp2  H3_V3 0.225 1.12   1.04   0.969 0.742  1.64 1.18
##  5     2 Exp1  H2_V3 0.262 0.383  1.20   0.939 0.605  1.92 1.60
##  6     2 Exp1  H3_V3 0.262 0.384  1.21   0.939 0.604  1.92 1.59
##  7     2 Exp2  H2_V3 0.119 0.253  1.38   1.87  0.551  1.02 1.38
##  8     2 Exp2  H3_V3 0.120 0.253  1.38   1.88  0.550  1.02 1.37
##  9     3 Exp1  H2_V3 0.246 0.456  1.54   1.19  0.532  1.07 1.31
## 10     3 Exp1  H3_V3 0.245 0.457  1.54   1.18  0.534  1.07 1.29
## # ... with 54 more rows, and 1 more variable: m_sig_m_square <dbl>
```

wf in models

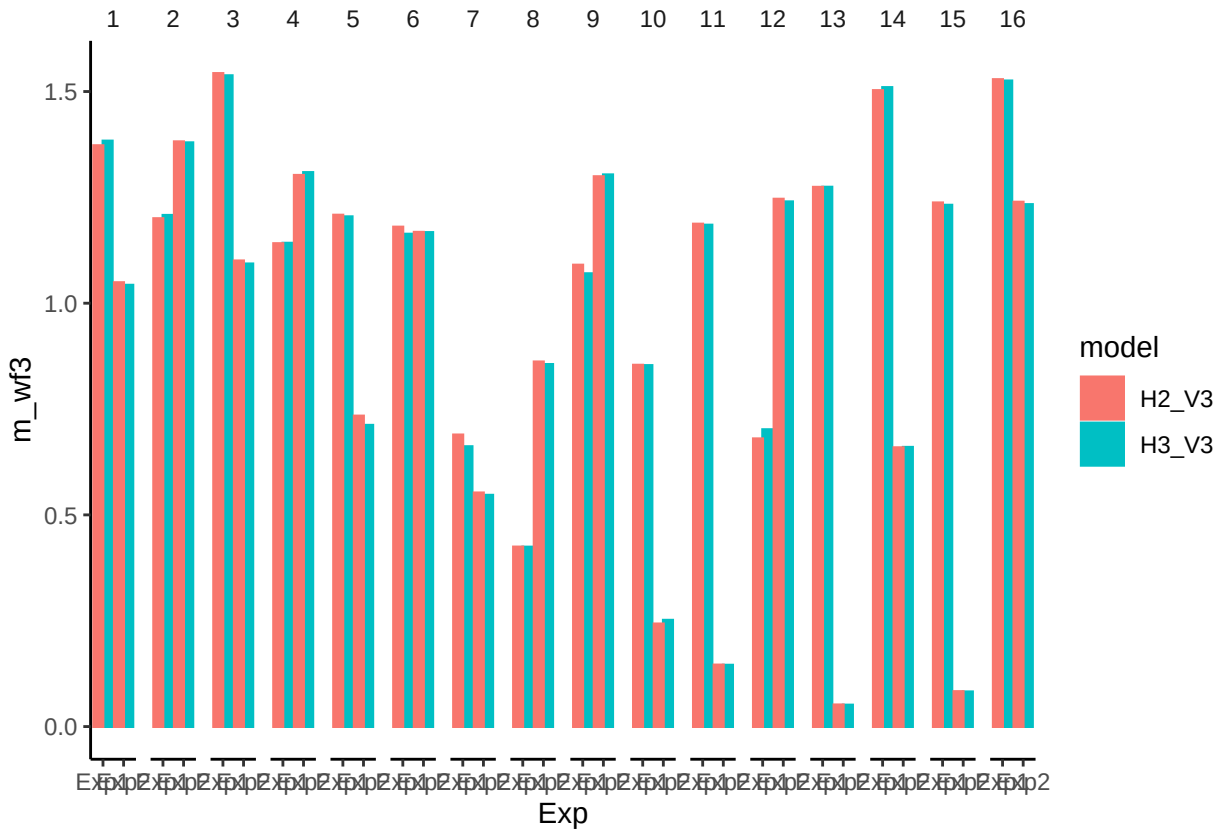
```
ggplot(m_Baypar, aes(x = Exp, y = m_wf1, color = model, fill = model, group = model)) +
  geom_bar(stat = "identity",
           position = position_dodge()) +
  facet_grid(~Nsub)+
  theme_new
```



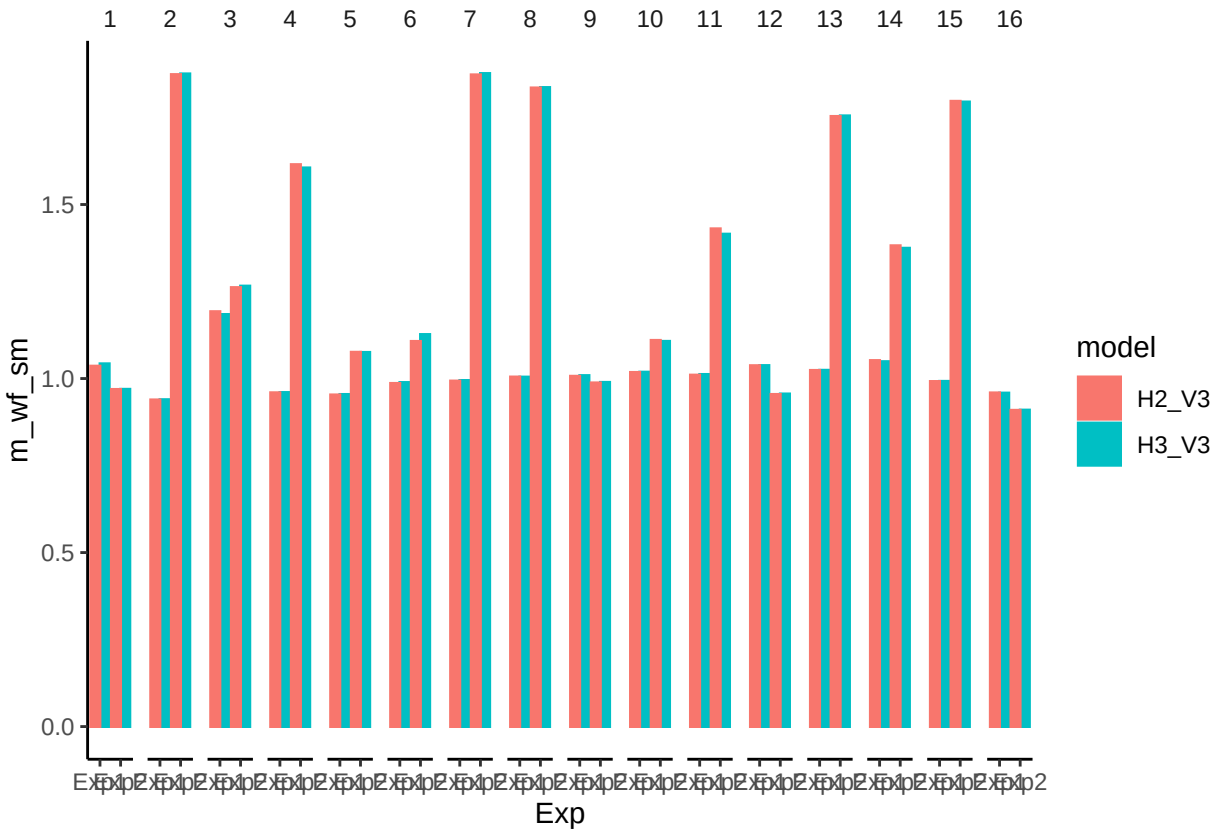

```
ggplot(m_Baypar, aes(x = Exp, y = m_wf2, color = model, fill = model, group = model)) +
  geom_bar(stat = "identity",
           position = position_dodge()) +
  facet_grid(~Nsub)+
  theme_new
```




```
ggplot(m_Baypar, aes(x = Exp, y = m_wf3, color = model, fill = model, group = model)) +
  geom_bar(stat = "identity",
           position = position_dodge()) +
  facet_grid(~Nsub)+
  theme_new
```

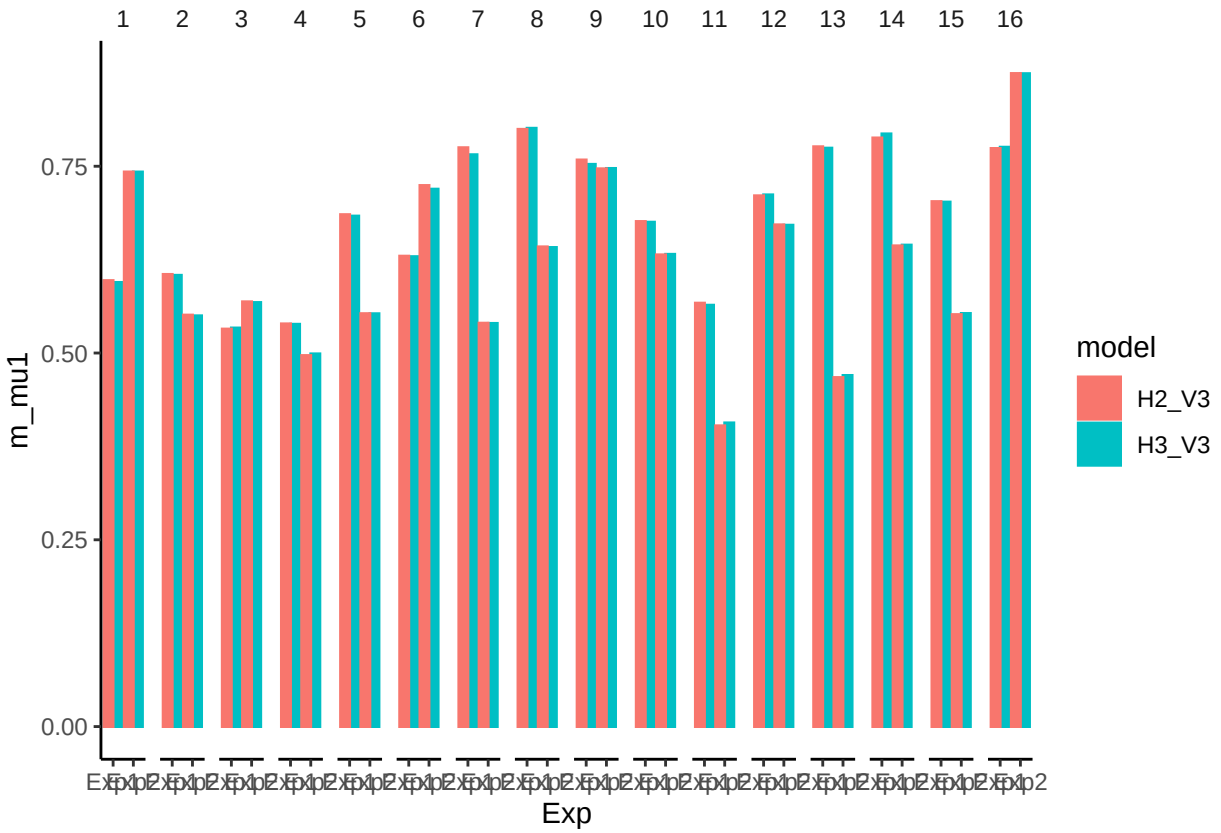



```
ggplot(m_Baypar, aes(x = Exp, y = m_wf_sm, color = model, fill = model, group = model)) +
  geom_bar(stat = "identity",
           position = position_dodge()) +
  facet_grid(~Nsub)+
  theme_new
```

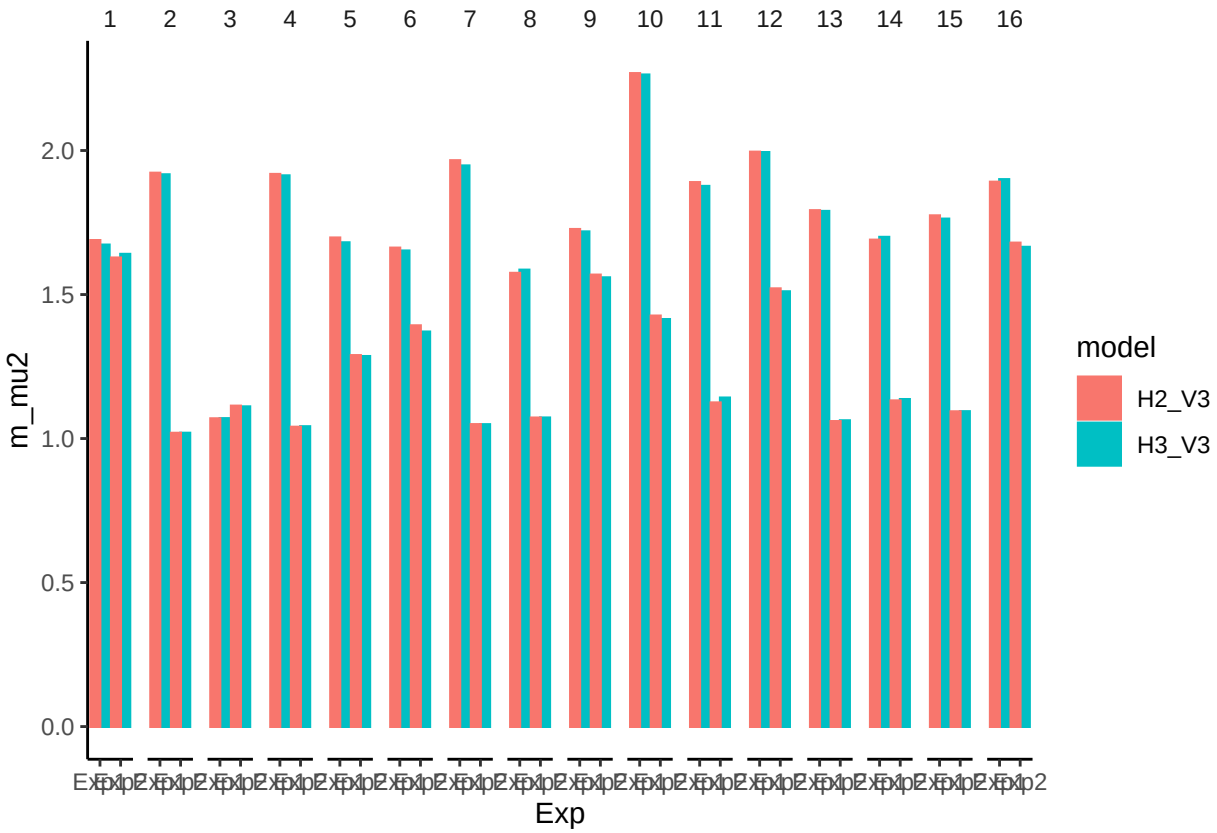


means of the prior

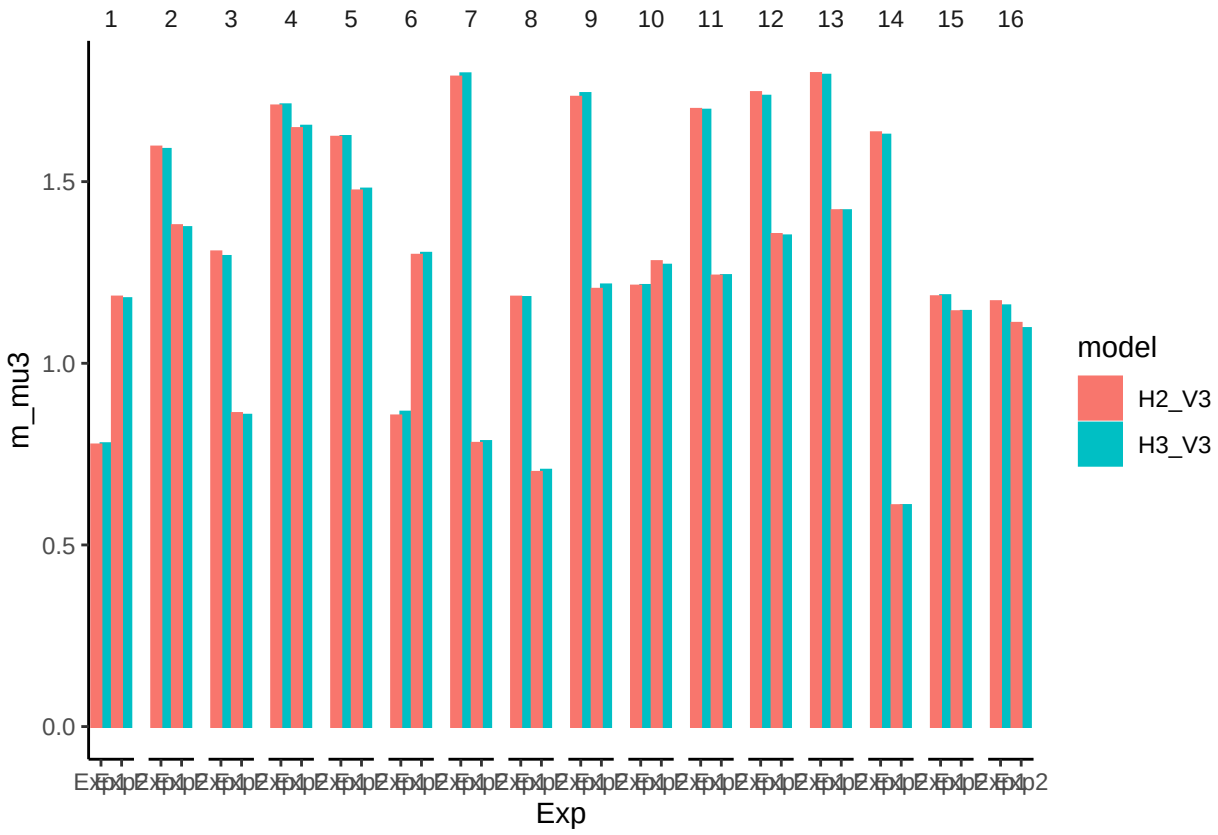
```
ggplot(m_Baypar, aes(x = Exp, y = m_mu1, color = model, fill = model, group = model)) +
  geom_bar(stat = "identity",
           position = position_dodge()) +
  facet_grid(~Nsub)+
  theme_new
```




```
ggplot(m_Baypar, aes(x = Exp, y = m_mu2, color = model, fill = model, group = model)) +
  geom_bar(stat = "identity",
           position = position_dodge()) +
  facet_grid(~Nsub)+
  theme_new
```

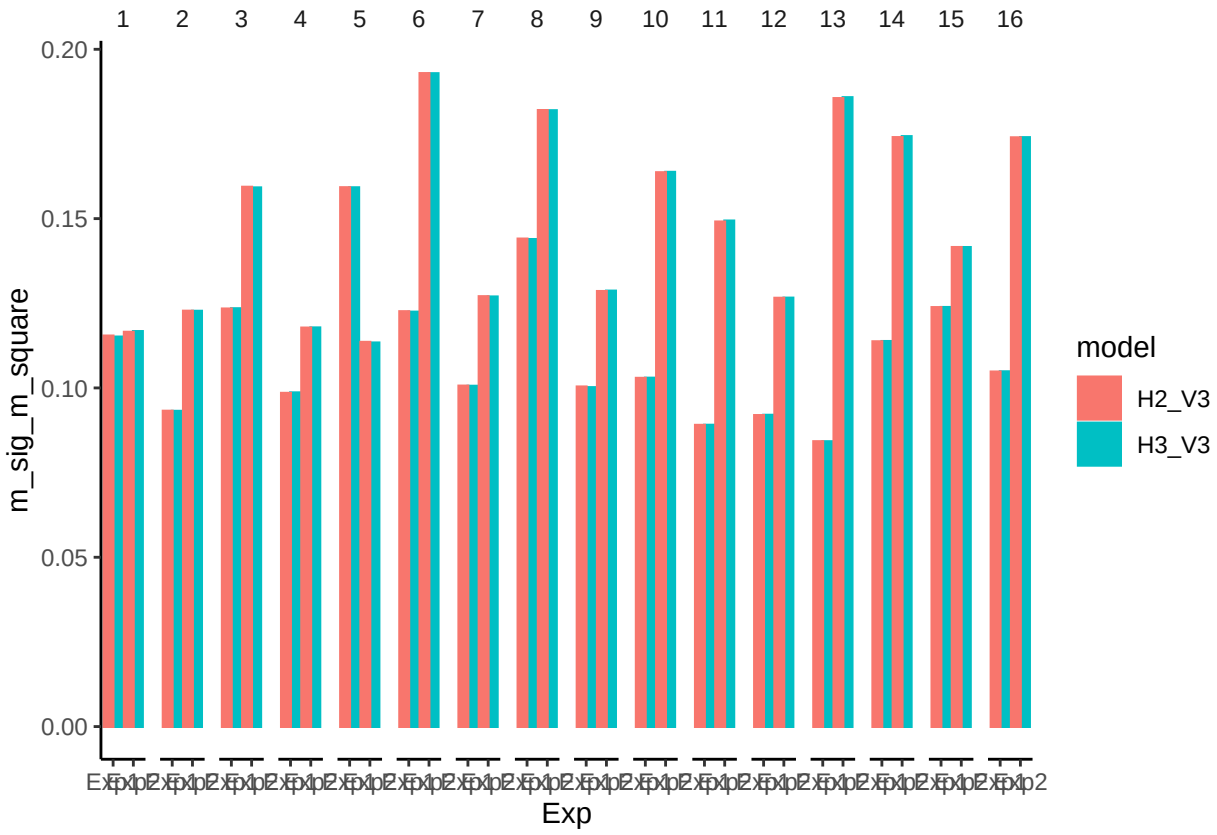



```
ggplot(m_Baypar, aes(x = Exp, y = m_mu3, color = model, fill = model, group = model)) +
  geom_bar(stat = "identity",
           position = position_dodge()) +
  facet_grid(~Nsub)+
  theme_new
```



motor noise

```
ggplot(m_Baypar, aes(x = Exp, y = m_sig_m_square, color = model, fill = model, group = model)) +
    geom_bar(stat = "identity",
             position = position_dodge()) +
  facet_grid(~Nsub)+
  theme_new
```

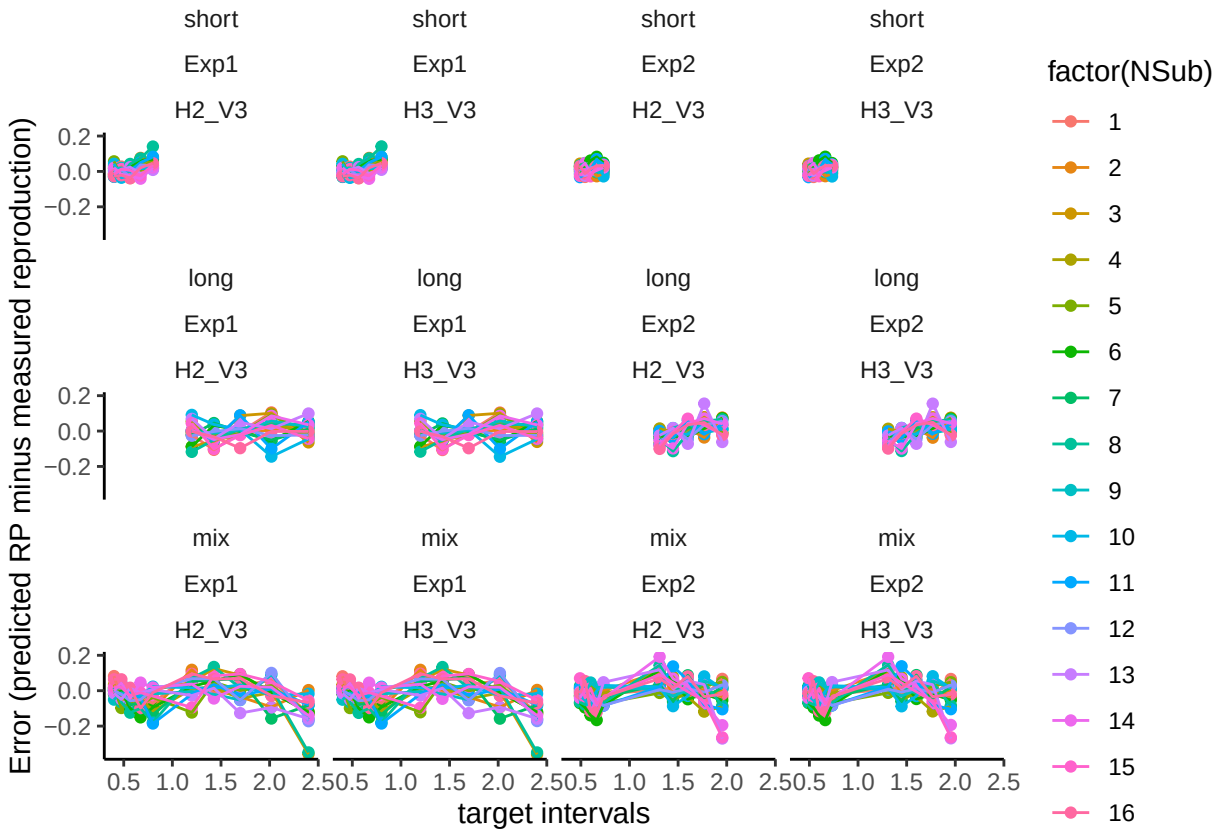


Prediction results

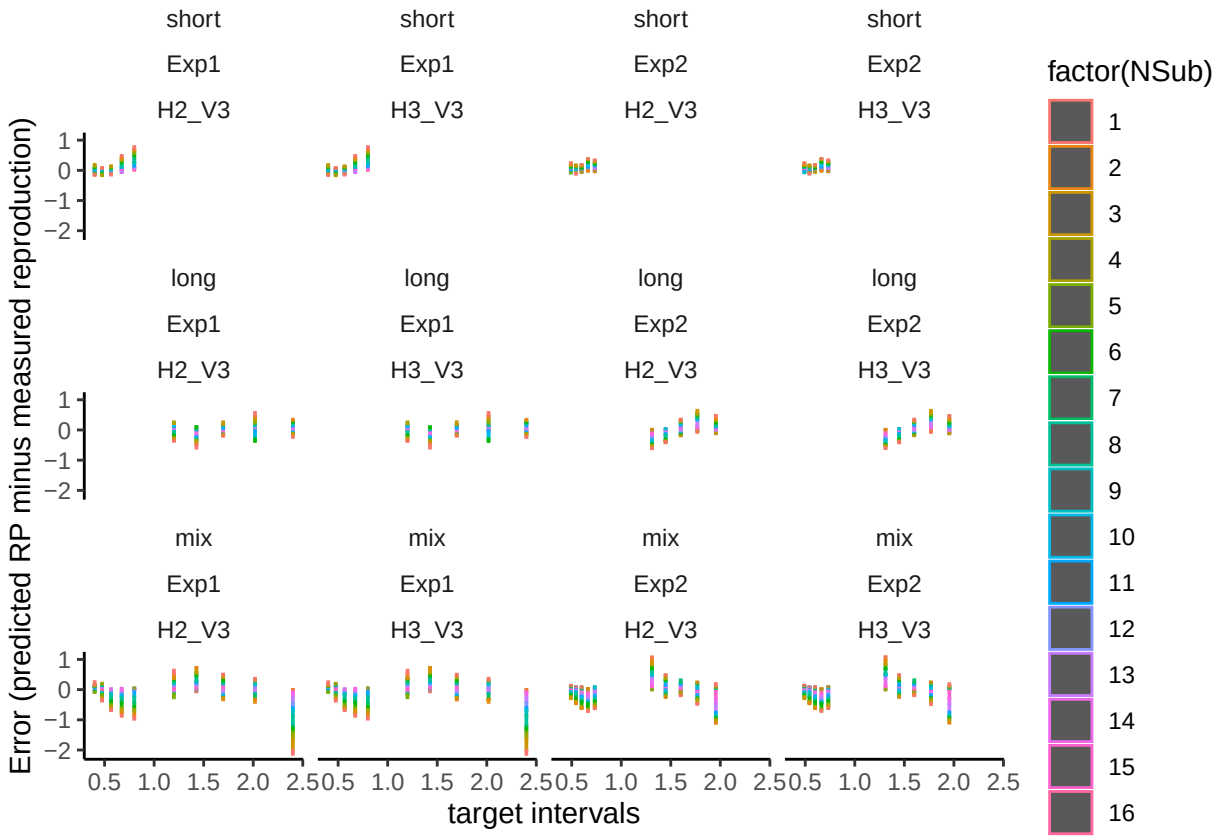
```
predY <- group_by(AllDat_predY, targetDur, Exp, NSub, model, group) %>%
  summarize(m_RP = mean(RP), n = n(),
            sd_RP = sd(RP)/ sqrt(n-1),
            m_predY = mean(predY),
            sd_predY = sd(predY)/ sqrt(n-1))

predY$m_rpErr = predY$m_predY - predY$m_RP
predY$m_relativeErr = predY$m_rpErr / predY$targetDur
```

```
m_predY <- predY%>%
 group_by(targetDur, Exp, model, group)%>%
  summarize(
    n = n(),
    m_m_predY = mean(m_predY),
    se_m_predY = sd(m_predY) / sqrt(n - 1),
    m_m_RP = mean(m_RP),
    se_m_RP = sd(m_RP) / sqrt(n-1)
  )
```

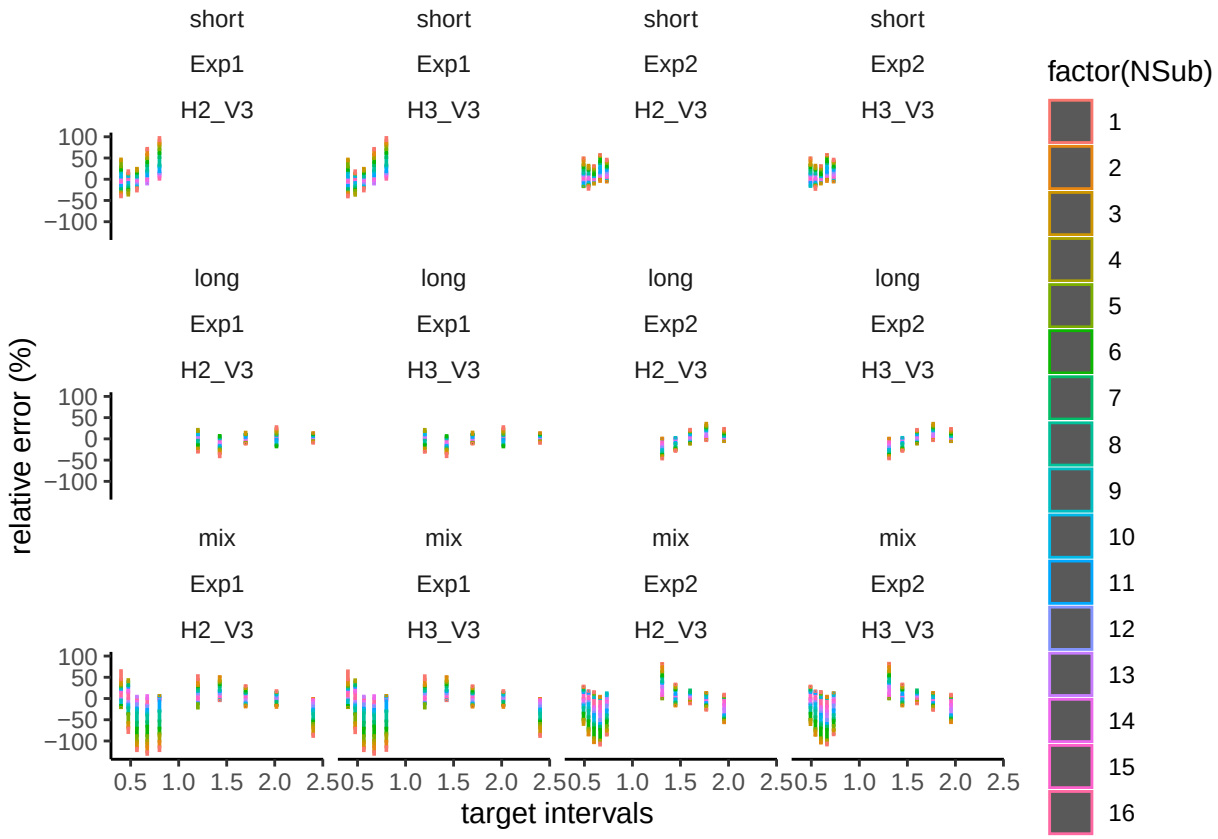
```
#plot Error in mixed blocks
ggplot(data=predY, aes(x= targetDur, y=m_rpErr, group = factor(NSub), color= factor(NSub))) +
  geom_point()+
  geom_line()+
labs(x="target intervals", y="Error (predicted RP minus measured reproduction)")+
facet_wrap(group+Exp~ model)+
  theme_new
```




```
#plot Error in mixed blocks
ggplot(data=predY, aes(x= targetDur, y=m_rpErr, group = factor(NSub), color= factor(NSub))) +
  geom_bar(stat="identity")+
  labs(x="target intervals", y="Error (predicted RP minus measured reproduction)")+
  facet_wrap(group+Exp~model) +
  theme_new
```

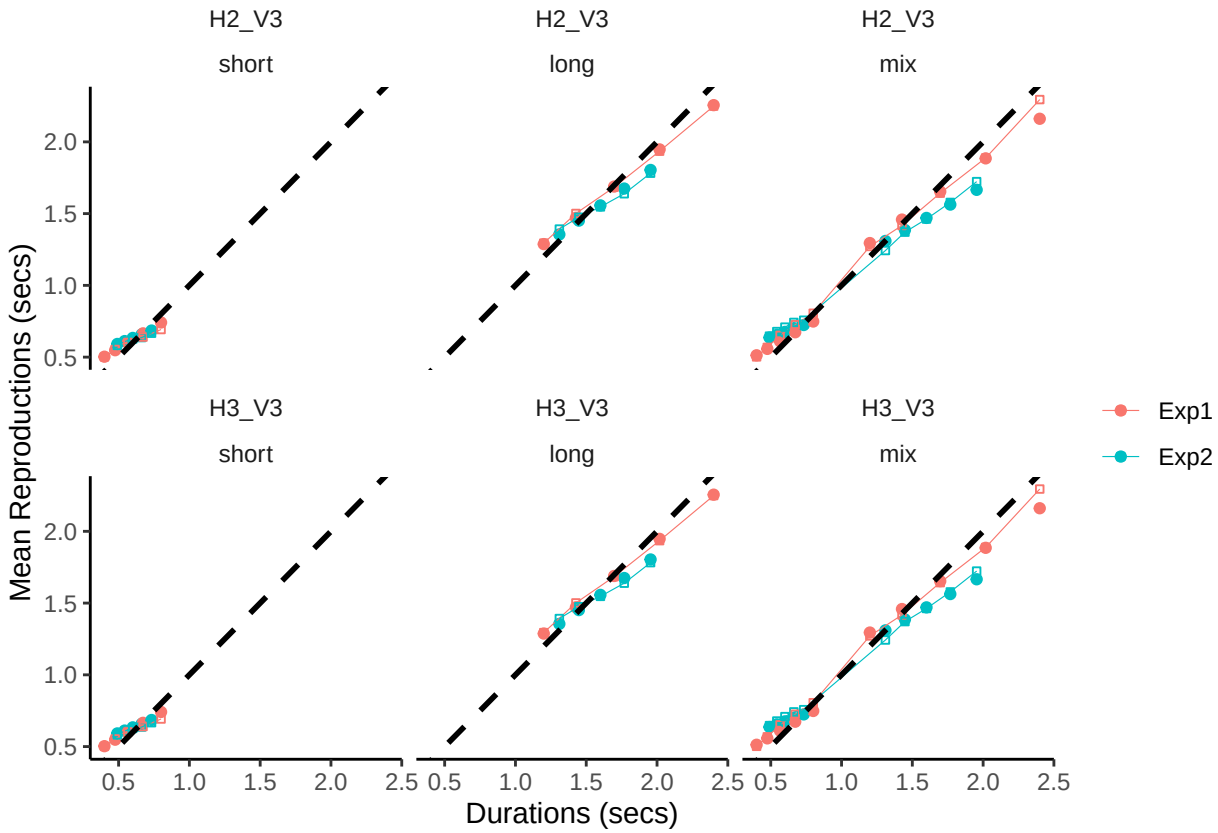



```
#plot relative Error for mixed blocks
fig_rerr_model <-  ggplot(data=predY, aes(x= targetDur, y=m_relativeErr*100, group = factor(NSub), colo
  geom_bar(stat="identity")+
  labs(x="target intervals", y="relative error (%)")+
  facet_wrap(group+Exp~model) +
  theme_new
fig_rerr_model
```



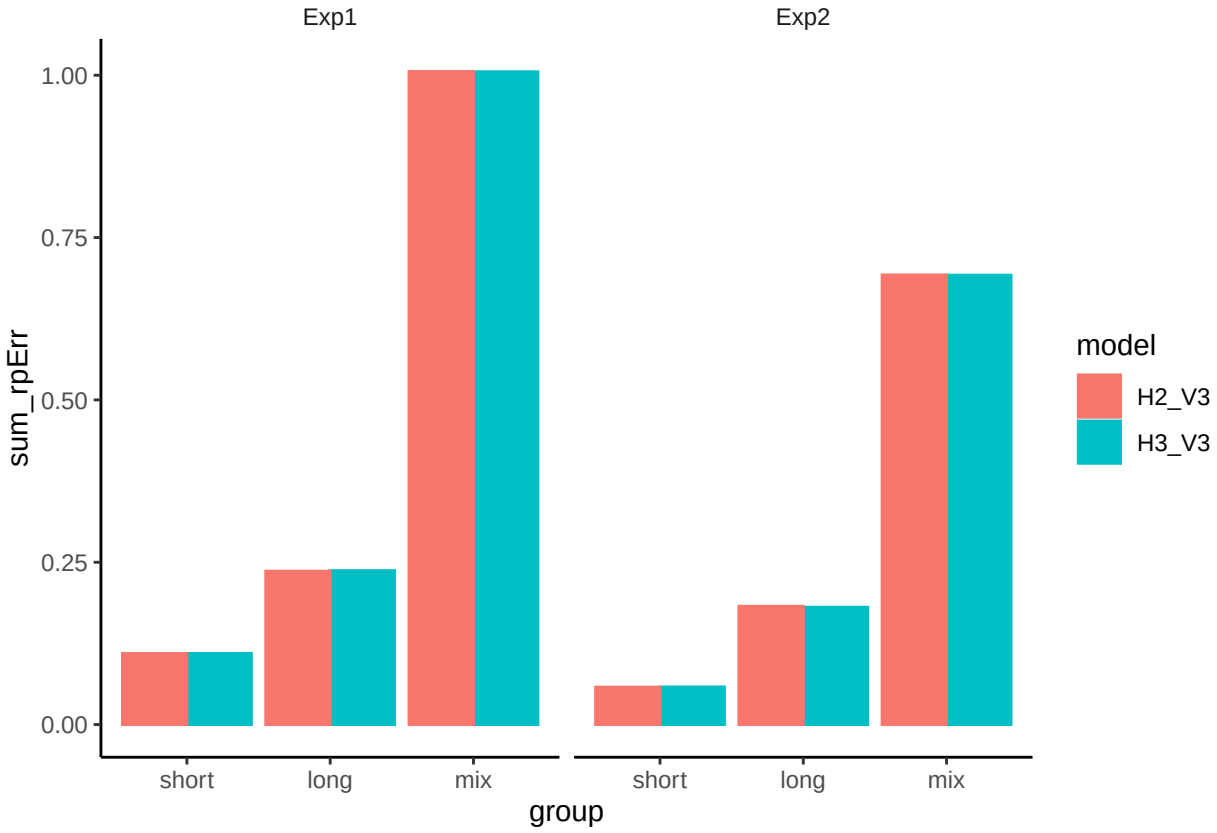

```
ggsave(file.path('figures','fig_rerr_model.png'), fig_rerr_model, width = 7, height = 5)
```

```
#plot the average of the predicted Y under the mixed condition
fig_mpredY = ggplot(m_predY) +
  geom_point(aes(targetDur, m_m_predY, group = Exp, color = Exp)) +
  geom_line(aes(targetDur, m_m_RP, group = Exp, color = factor(Exp)),  size = 0.2) +
  geom_point(aes(targetDur, m_m_RP, group = Exp, color = factor(Exp)),  size = 1, shape = 0) +
  geom_abline(slope = 1, linetype = 2, size = 1) + # add diagonal line
  facet_wrap(model~group) +
  guides(color = guide_legend(title = element_blank())) + # remove legend title
  theme_classic() +
  theme(strip.background = element_blank()) + # remove subtitle background
  labs(x = "Durations (secs)", y = "Mean Reproductions (secs)", size =15) + theme(legend.position="bott
  theme_new

fig_mpredY
```




```
ggsave(file.path('figures','fig_mpredY_V3.png'), fig_mpredY, width = 7, height = 5)
```

```
predY$rpErr_squared <- predY$m_rpErr^2
m_predY_Err <- dplyr::group_by(predY, Exp, model, group) %>%
  dplyr::summarize(sum_rpErr = sum(rpErr_squared),
                   n = n())

fig_rpErr_model <- ggplot(m_predY_Err, aes(x = group, y = sum_rpErr, color = model, fill = model, group
  geom_bar(stat = "identity",
           position = position_dodge()) + theme(legend.position="bottom")+
  facet_wrap(Exp~.) +
  theme_new

ggsave(file.path('figures','fig_rpErr_model.png'), fig_rpErr_model, width = 7, height = 5)

fig_rpErr_model
```


Exp1
Exp2
sum_rpErr
1.00
0.75
0.50
0.25
0.00
short
long
mix
group
model
H2_V3
H3_V3