Power analysis for Smith replication experiments

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```r
knitr::opts_chunk$set(echo = TRUE, tidy = FALSE)
options(width = 100)

#Get the working directory
  workingdir <- getwd()



if(!require("pacman")) install.packages("pacman")
```

```
## Loading required package: pacman
```

```r
pacman::p_load(knitr, rmarkdown, yaml, tidyverse, Superpower,
               parallel, optimParallel, ez, psychReport, sjstats, rstatix,
               corrplot)

#Save renv lock file
#renv::snapshot()

#Superpower isn't multithreaded, but mkl likely still provides a boost
#Set number of cpus to the number of cores
  #num.cpus <- parallel::detectCores(logical = T)
  #options(boot.ncpus = num.cpus)

#Number of cores R is using
  #getOption("boot.ncpus", 1L)

sessionInfo()
```

```
## R version 4.1.1 (2021-08-10)
## Platform: x86_64-w64-mingw32/x64 (64-bit)
## Running under: Windows 10 x64 (build 19043)
##
## Matrix products: default
##
## locale:
## [1] LC_COLLATE=English_United States.1252  LC_CTYPE=English_United States.1252
## [3] LC_MONETARY=English_United States.1252 LC_NUMERIC=C
## [5] LC_TIME=English_United States.1252
##
## attached base packages:
## [1] parallel  stats     graphics  grDevices utils     datasets  methods   base
```

```
## 
## other attached packages:
##  [1] corrplot_0.90       rstatix_0.7.0       sjstats_0.18.1      psychReport_3.0.1
##  [5] ez_4.4-0            optimParallel_1.0-2 Superpower_0.1.2    forcats_0.5.1
##  [9] stringr_1.4.0       dplyr_1.0.7         purrr_0.3.4         readr_2.0.1
## [13] tidyr_1.1.3         tibble_3.1.4        ggplot2_3.3.5       tidyverse_1.3.1
## [17] yaml_2.2.1          rmarkdown_2.10      knitr_1.33          pacman_0.5.1
## 
## loaded via a namespace (and not attached):
##    [1] TH.data_1.0-10     minqa_1.2.4         colorspace_2.0-2    ellipsis_0.3.2
##    [5] rio_0.5.27          sjlabelled_1.1.8    estimability_1.3    htmlTable_2.2.1
##    [9] parameters_0.14.0   base64enc_0.1-3     fs_1.5.0            rstudioapi_0.13
##   [13] fansi_0.5.0         mvtnorm_1.1-2       lubridate_1.7.10    xml2_1.3.2
##   [17] codetools_0.2-18    splines_4.1.1       sjmisc_2.8.7        afex_1.0-1
##   [21] Formula_1.2-4       jsonlite_1.7.2      nloptr_1.2.2.2      broom_0.7.9
##   [25] cluster_2.1.2       dbplyr_2.1.1        png_0.1-7           effectsize_0.4.5
##   [29] compiler_4.1.1      httr_1.4.2          emmeans_1.6.3       backports_1.2.1
##   [33] assertthat_0.2.1    Matrix_1.3-4        fastmap_1.1.0       cli_3.0.1
##   [37] htmltools_0.5.2     tools_4.1.1         lmerTest_3.1-3      coda_0.19-4
##   [41] gtable_0.3.0        glue_1.4.2          reshape2_1.4.4      Rcpp_1.0.7
##   [45] carData_3.0-4       cellranger_1.1.0    vctrs_0.3.8         nlme_3.1-152
##   [49] insight_0.14.3      xfun_0.25           openxlsx_4.2.4      lme4_1.1-27.1
##   [53] rvest_1.0.1         lifecycle_1.0.0     MASS_7.3-54         zoo_1.8-9
##   [57] scales_1.1.1        hms_1.1.0           sandwich_3.0-1      RColorBrewer_1.1-2
##   [61] curl_4.3.2          gridExtra_2.3       rpart_4.1-15        latticeExtra_0.6-29
##   [65] stringi_1.7.4       bayestestR_0.10.5   checkmate_2.0.0     boot_1.3-28
##   [69] zip_2.2.0           rlang_0.4.11        pkgconfig_2.0.3     evaluate_0.14
##   [73] lattice_0.20-44     htmlwidgets_1.5.3   tidyselect_1.1.1    plyr_1.8.6
##   [77] magrittr_2.0.1      R6_2.5.1            generics_0.1.0      Hmisc_4.5-0
##   [81] multcomp_1.4-17     DBI_1.1.1           mgcv_1.8-36         pillar_1.6.2
##   [85] haven_2.4.3         foreign_0.8-81      withr_2.4.2         datawizard_0.2.0
##   [89] survival_3.2-11     abind_1.4-5         nnet_7.3-16         performance_0.7.3
##   [93] modelr_0.1.8        crayon_1.4.1        car_3.0-11          utf8_1.2.2
##   [97] tzdb_0.1.2          jpeg_0.1-9          grid_4.1.1          readxl_1.3.1
##  [101] data.table_1.14.0   reprex_2.0.1        digest_0.6.27       xtable_1.8-4
##  [105] numDeriv_2016.8-1.1 munsell_0.5.0
```

Effective sample size with replicated measures

Goulet, M.-A., & Cousineau, D. (2019). The Power of Replicated Measures to Increase Statistical Power. Advances in Methods and Practices in Psychological Science, 2(3), 199–213. https://doi.org/10/gf5swn

```r
r.from.alpha <- function(alpha.val, # Cronbach's alpha
                         m.val)# Number of replications per participant, per cell
  {
  r.val <-  1/(1 + (m.val*(1/alpha.val - 1)))
  return(r.val)
  }


#Assuming a high Cronbach's alpha, conservative estimate for sample size gain
 exp1.r <- r.from.alpha(0.85, 48) #288 total trials, 6 cells = 48 trials per cell
 exp2.r <- r.from.alpha(0.85, 48) #48 test trials per block, 8 block, and 8 cells
 exp3.r <- r.from.alpha(0.85, 64) #64 trials per block, 4 blocks, and 4 cells
```

2

```r
n1.eff.sample <- function(nm,   #Total sample size
                              m.val,
                              r.val
                              )
  {
  n1 <- ((nm - 1)*m.val)/(1 + (m.val - 1)*r.val) + 1
  return(n1)
  }

#Effective sample sizes
#N = 50 for each experiment
exp1.eff.N <- n1.eff.sample(50, 48, exp1.r)
exp1.eff.N
```

```
## [1] 395.45
```

```r
exp2.eff.N <- n1.eff.sample(50, 48, exp2.r)
exp2.eff.N
```

```
## [1] 395.45
```

```r
exp3.eff.N <- n1.eff.sample(50, 64, exp1.r)
exp3.eff.N
```

```
## [1] 410.8182
```

```r
#Sample size gain multiplier with replicated trials
  exp1.eff.N/50
```

```
## [1] 7.909
```

```r
  exp2.eff.N/50
```

```
## [1] 7.909
```

```r
  exp3.eff.N/50
```

```
## [1] 8.216364
```

```r
#Rounded (whole number) effective sample sizes
  exp1.reff.N <- round(exp1.eff.N, digits = 0)
  exp1.reff.N
```

```
## [1] 395
```

```r
  exp2.reff.N <- round(exp2.eff.N, digits = 0)
  exp2.reff.N
```

```
## [1] 395
```

```
exp3.reff.N <- round(exp3.eff.N, digits = 0)
exp3.reff.N
```
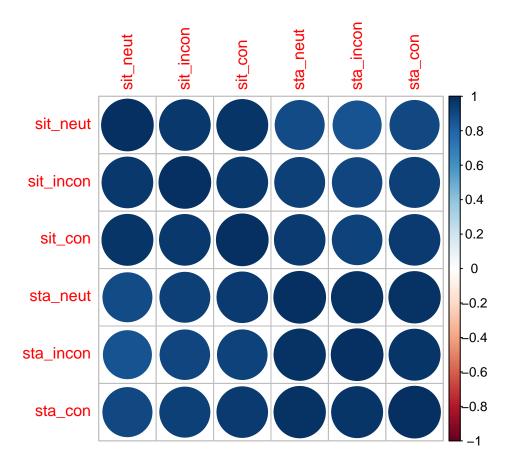
```
## [1] 411
```

Power analysis for effect sizes of interest
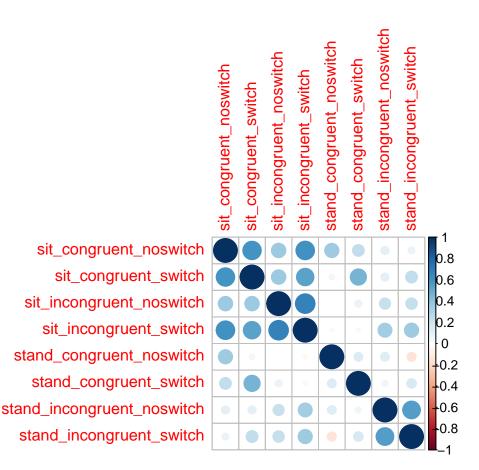
```
#From Smith Excel sheet
#Exp 1: RT
exp1.means <- c(376.005, 391.367857, 375.726428, 383.347857, 382.5107143,
                382.8871429)

exp1.SDs   <- c(62.01257388,   73.28657807,   69.71743768,   65.24234116,
                62.97572102,   61.65609988)

exp1.labels <- c("posture", "sit", "stand",
                 "congruency", "neut", "incon", "con")

#Check to see if neutral dropped for the Posture x Congruency interaction?
  #F(2, 26)
  #Source: Howell, Fundamental Statistics for Behavioral Science 4th Edition
  # Numerator
  # (A - 1) x (B - 1)
  # (2 - 1)*(3 - 1)

  # Denominator
  # (A - 1) x (B - 1) x (N - 1)
  # A = Posture, 2 levels
  # B = Congruency, 3 levels?
  # N = Sample size, 14 participants

  #(Posture: 2 - 1) x (Congruency: 3 - 1) x (Sample Size: 14 - 1)
  # (2 - 1)*(3 - 1)*(14 - 1)
  # Appears to includes neutral, based on df in the interaction

#Load means from 3 Smith experiments
Smith_exp1_RT <- read.csv(paste0(workingdir, "/Smith_exp1_RT.csv"))
  head(Smith_exp1_RT)
```

```
##   subj sit_neut sit_incon sit_con sta_neut sta_incon sta_con
## 1    1   413.68    407.30  392.91   374.53    363.64  400.34
## 2    2   417.23    419.72  416.75   404.30    393.59  398.15
## 3    3   497.14    522.09  486.00   475.33    466.08  459.80
## 4    4   309.86    305.80  307.17   323.66    310.23  320.95
## 5    5   405.38    440.57  429.27   430.56    407.42  428.71
## 6    6   369.40    390.23  357.30   370.88    379.78  361.52
```

```
Smith_exp2_acc <- read.csv(paste0(workingdir, "/Smith_exp2_acc.csv"))
  head(Smith_exp2_acc)
```
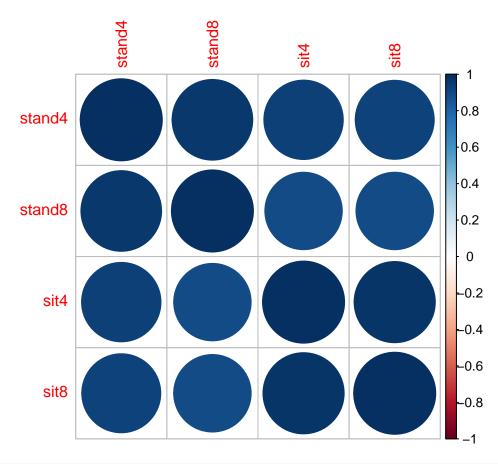
```
##   subj sit_congruent_noswitch sit_congruent_switch sit_incongruent_noswitch sit_incongruent_switch
## 1    1              1.0000000            1.0000000                0.9574468              0.9512195
## 2    2              0.9761905            0.9777778                0.9807692              0.7959184
## 3    3              0.9772727            0.9791667                0.9800000              0.9347826
## 4    4              0.8928571            0.8837209                0.8157895              0.5490196
## 5    5              1.0000000            0.9800000                0.9250000              0.9333333
## 6    6              1.0000000            0.9500000                0.9565217              0.8679245
##   stand_congruent_noswitch stand_congruent_switch stand_incongruent_noswitch
## 1                0.9800000              1.0000000                  0.9318182
## 2                0.9800000              0.9818182                  0.9069767
## 3                0.9803922              0.9318182                  0.9534884
## 4                0.9803922              1.0000000                  0.9523810
## 5                0.9777778              0.9791667                  0.9591837
## 6                1.0000000              1.0000000                  0.8867925
##   stand_incongruent_switch
## 1                0.8936170
## 2                0.8000000
## 3                0.9000000
## 4                0.9523810
## 5                0.9565217
## 6                0.8372093
```

```r
Smith_exp3_RT <- read.csv(paste0(workingdir, "/Smith_exp3_RT.csv"))
  head(Smith_exp3_RT)
```

```
##   subj stand4 stand8   sit4   sit8 stand_slope sit_slope
## 1    1 622.19 684.75 614.75 696.74     15.6400   20.4975
## 2    2 494.39 593.68 535.98 589.20     24.8225   13.3050
## 3    3 515.93 611.02 574.73 619.38     23.7725   11.1625
## 4    4 524.85 619.06 527.89 568.29     23.5525   10.1000
## 5    5 439.89 454.93 477.14 546.17      3.7600   17.2575
## 6    6 760.26 833.17 872.06 936.10     18.2275   16.0100
```

```r
#Create correlation matrices for design_fct
#Exp 1
  M1 <- cor(Smith_exp1_RT[,2:7])
  corrplot(M1)
```

```
#Exp 2
  M2 <- cor(Smith_exp2_acc[,2:9])
   corrplot(M2)
```

```
#Exp 3
  M3 <- cor(Smith_exp3_RT[,2:5]) #Not using slopes (last two columns)
  corrplot(M3)
```

stand4   stand8   sit4   sit8

stand4

stand8

sit4

sit8

```
# Smith_exp1_RT_narrow <- gather(Smith_exp1_RT,
#                                subj,
#                                RT,
#                                sit_neut:sit_con,
#                                sta_neut:sta_con)
#
# Smith_exp1_RT_narrow$condition<- rep(
#                                   c(rep("neut", times = 14),
#                                     rep("incon", times = 14),
#                                     rep("con", times = 14)
#                                     ),
#                                   times = 2
#                                   )
#
# Smith_exp1_RT_narrow$posture <- c(rep("Sit", times = 42),
#                                   rep("Stand", times = 42))
# Smith_exp1_RT_narrow$subj <- as.factor(Smith_exp1_RT_narrow$subj)
# Smith_exp1_RT_narrow$condition <- as.factor(Smith_exp1_RT_narrow$condition)
# Smith_exp1_RT_narrow$posture <- as.factor(Smith_exp1_RT_narrow$posture)
# Smith_exp1_RT_narrow$subj = rep(Smith_exp1_RT$subj, times = 6)
#
# head(Smith_exp1_RT_narrow)
#
# exp1_anova <- ezANOVA(Smith_exp1_RT_narrow,
#                       dv = RT,
#                       wid = subj,
```

```
#                        within = .(posture, condition),
#                        type = 3,
#                        detailed = TRUE,
#                        return_aov=F
#                        )
#
# exp1_anova
# exp1_anova$ANOVA
#
# # Partial eta-squared    #Effect                Error
# exp1_anova$ANOVA$SSn[4]/(exp1_anova$ANOVA$SSd[4] + exp1_anova$ANOVA$SSn[4])
#
# # Generalized eta-squared  #Sum squares all effects, NO error
# exp1_anova$ANOVA$SSn[4]/sum(exp1_anova$ANOVA$SSd[1:4])
#
# # Eta-squared                #Total sum squares
# sum(exp1_anova$ANOVA$SSn[1])/sum(exp1_anova$ANOVA$SSd[1:4])
#
# #Partial eta-squared is 0.27, same as reported
# aovEffectSize(exp1_anova, effectSize = "pes")
# #0.266663800
#
# aovEffectSize(exp1_anova, effectSize = "ges")
# #* 0.0035565930
#
# my.aov1 <- anova_test(
#                        Smith_exp1_RT_narrow,
#                        dv = RT,
#                        wid = subj,
#                        within = c(condition, posture)
#                        )
#
# #3-way rm ANOVA in R using aov()
# my.aov <- aov(RT ~  posture * condition + Error((subj)/(posture*condition)),
#               Smith_exp1_RT_narrow)
#
# summary(my.aov)
# anova_stats(my.aov)

#3 posture:congruency 2, 788 2188.35 7.81 *** .019   <.001
#         anova_posture:congruency  95.4    0.021165


#
#
# exp1.anova <- aov_ez("subj", "RT", Smith_exp1_RT_narrow,
#                      within = c("condition", "posture"),
#                      type = 3)


#Exp 2: Accuracy
exp2.means <- c(0.97039395, 0.93738492, 0.92253851, 0.83707885,
                0.96995475, 0.95278776, 0.92968805, 0.87189628)
```

```r
exp2.SDs    <- c(0.03458640, 0.05457752, 0.05131776, 0.09717051, 0.02519055,
                 0.03545601, 0.04419698, 0.06410994)

exp2.labels <- c("posture", "sit", "stand",
                 "congruency", "con", "incon",
                 "condition", "no_switch", "switch")
#Exp 3: RT
exp3.means <- c(548.905,    617.8666667,    567.75, 612.4383333)
exp3.SDs    <- c(99.22788982,    109.5684515,    119.3201426,    127.286163)

exp3.labels <- c("posture", "stand", "sit",
                 "setsize", "four_items", "eight_items")



#Sensitivity analysis for power: Effect sizes of interest, including the min
  #Increasing SDs is more noise, thus lower effect sizes
  SD.mulitplier <- c(1, 1.5, 2, 2.5, 3)

#Design output from ANOVA_design()
  design.exp1 <- list()
  design.exp2 <- list()
  design.exp3 <- list()

#Setup design for ANOVA_design, loop the length of the SD.multiplier
design_fct <- function(factors, n, mu, sd, labelnames, corr.matrix, design.name)
  {
    for (i in 1:length(SD.mulitplier)) {
      design.name[[i]] <- ANOVA_design(design = factors,
                                       n = n, #Effective sample size
                                       mu = mu,
                                       sd = sd*SD.mulitplier[i],
                                       r <- corr.matrix,
                                       labelnames = labelnames,
                                       plot = FALSE)
                  }
return(design.name)
  }


#Exp 1
  exp1.design <- design_fct("2w*3w",
                            exp1.reff.N,
                            exp1.means,
                            exp1.SDs,
                            exp1.labels,
                            M1,
                            design.exp1)
```

```
## Warning in if (class(cors) == "numeric" & length(cors) == 1) {: the condition has length > 1 and
## only the first element will be used
```

```
## Warning in if (class(cors) == "matrix") {: the condition has length > 1 and only the first element
```

```
## will be used

## Warning in if (class(cors) == "numeric" & length(cors) == 1) {: the condition has length > 1 and
## only the first element will be used

## Warning in if (class(cors) == "matrix") {: the condition has length > 1 and only the first element
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## Warning in if (class(cors) == "matrix") {: the condition has length > 1 and only the first element
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## Warning in if (class(cors) == "matrix") {: the condition has length > 1 and only the first element
## will be used

## Warning in if (class(cors) == "numeric" & length(cors) == 1) {: the condition has length > 1 and
## only the first element will be used

## Warning in if (class(cors) == "matrix") {: the condition has length > 1 and only the first element
## will be used
```

```
#Exp 2
  exp2.design <- design_fct("2w*2w*2w",
                            exp2.reff.N,
                            exp2.means,
                            exp2.SDs,
                            exp2.labels,
                            M2,
                            design.exp2)
```

```
## Warning in if (class(cors) == "numeric" & length(cors) == 1) {: the condition has length > 1 and
## only the first element will be used

## Warning in if (class(cors) == "numeric" & length(cors) == 1) {: the condition has length > 1 and
## only the first element will be used

## Warning in if (class(cors) == "numeric" & length(cors) == 1) {: the condition has length > 1 and
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## Warning in if (class(cors) == "matrix") {: the condition has length > 1 and only the first element
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## Warning in if (class(cors) == "numeric" & length(cors) == 1) {: the condition has length > 1 and
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```

```
## Warning in if (class(cors) == "matrix") {: the condition has length > 1 and only the first element
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## Warning in if (class(cors) == "matrix") {: the condition has length > 1 and only the first element
## will be used

## Warning in if (class(cors) == "numeric" & length(cors) == 1) {: the condition has length > 1 and
## only the first element will be used

## Warning in if (class(cors) == "matrix") {: the condition has length > 1 and only the first element
## will be used
```

```r
#Exp 3
  exp3.design <- design_fct("2w*2w",
                            exp3.reff.N,
                            exp3.means,
                            exp3.SDs,
                            exp3.labels,
                            M3,
                            design.exp3)
```

```
## Warning in if (class(cors) == "numeric" & length(cors) == 1) {: the condition has length > 1 and
## only the first element will be used

## Warning in if (class(cors) == "numeric" & length(cors) == 1) {: the condition has length > 1 and
## only the first element will be used

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## Warning in if (class(cors) == "matrix") {: the condition has length > 1 and only the first element
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## Warning in if (class(cors) == "numeric" & length(cors) == 1) {: the condition has length > 1 and
## only the first element will be used

## Warning in if (class(cors) == "matrix") {: the condition has length > 1 and only the first element
## will be used
```

```r
#Setup for ANOVA_power() fct
#Seeds for reproducibility
  set.seed(432)
  exp1.seeds <- sample.int(1000, length(SD.mulitplier))

  set.seed(653)
  exp2.seeds <- sample.int(1000, length(SD.mulitplier))

  set.seed(797)
  exp3.seeds <- sample.int(1000, length(SD.mulitplier))

#Number of simulations
  nsims = 1000


power_result_exp1 <- list() #Row 3
power_result_exp2 <- list() #Row 5
power_result_exp3 <- list() #Row 2

#Code for testing
#
# power_result_vig1 <- ANOVA_exact(exp2.design[[1]],
#                                  alpha = 0.05,
#                                  verbose = TRUE)
# power_result_vig1$aov_result
#
# power_result_vig2 <- ANOVA_power(exp2.design[[1]],
#                                  alpha = 0.05,
#                                  nsims = nsims,
#                                  verbose = TRUE)
#   power_result_vig2


 #power_result_vig$aov_result
 #power_result_vig$main_results

# plot(exp1.design[[1]])

power_exp <- function(design,
                      seed,
                      row.to.extract,
                      output)
  {
  for (i in 1:length(SD.mulitplier)) {
          power_result_vig <- ANOVA_power(design[[i]],
                                          alpha = 0.05,
                                          nsims = nsims,
                                          seed = seed[i])
          output[[i]] <- power_result_vig$main_results[row.to.extract,]
                }
      return(output)
  }
```

```r
exp1.power <- power_exp(exp1.design, exp1.seeds, 3, power_result_exp1)
```

```
## Power and Effect sizes for ANOVA tests
##                          power effect_size
## anova_posture             38.6    0.009564
## anova_congruency         100.0    0.200740
## anova_posture:congruency 100.0    0.253809
##
## Power and Effect sizes for pairwise comparisons (t-tests)
##                                                            power effect_size
## p_posture_sit_congruency_neut_posture_sit_congruency_incon 100.0     0.70811
## p_posture_sit_congruency_neut_posture_sit_congruency_con     6.3    -0.01580
## p_posture_sit_congruency_neut_posture_stand_congruency_neut 100.0     0.25647
## p_posture_sit_congruency_neut_posture_stand_congruency_incon 96.8    0.20233
## p_posture_sit_congruency_neut_posture_stand_congruency_con  100.0     0.25323
## p_posture_sit_congruency_incon_posture_sit_congruency_con   100.0    -0.78129
## p_posture_sit_congruency_incon_posture_stand_congruency_neut 100.0   -0.30012
## p_posture_sit_congruency_incon_posture_stand_congruency_incon 99.9   -0.29834
## p_posture_sit_congruency_incon_posture_stand_congruency_con 100.0    -0.31827
## p_posture_sit_congruency_con_posture_stand_congruency_neut  100.0     0.37303
## p_posture_sit_congruency_con_posture_stand_congruency_incon  99.8     0.25279
## p_posture_sit_congruency_con_posture_stand_congruency_con   100.0     0.34763
## p_posture_stand_congruency_neut_posture_stand_congruency_incon 26.5  -0.06968
## p_posture_stand_congruency_neut_posture_stand_congruency_con  14.0   -0.04155
## p_posture_stand_congruency_incon_posture_stand_congruency_con  8.4    0.02228
##
##
## Within-Subject Factors Included: Check MANOVA Results
##
## Power and Effect sizes for ANOVA tests
##                          power effect_size
## anova_posture             20.2    0.005681
## anova_congruency         100.0    0.100860
## anova_posture:congruency 100.0    0.132196
##
## Power and Effect sizes for pairwise comparisons (t-tests)
##                                                            power effect_size
## p_posture_sit_congruency_neut_posture_sit_congruency_incon 100.0    0.471418
## p_posture_sit_congruency_neut_posture_sit_congruency_con     5.0   -0.008724
## p_posture_sit_congruency_neut_posture_stand_congruency_neut  92.1    0.171159
## p_posture_sit_congruency_neut_posture_stand_congruency_incon 76.7   0.134904
## p_posture_sit_congruency_neut_posture_stand_congruency_con   91.9    0.170129
## p_posture_sit_congruency_incon_posture_sit_congruency_con   100.0   -0.518784
## p_posture_sit_congruency_incon_posture_stand_congruency_neut 97.3   -0.199169
## p_posture_sit_congruency_incon_posture_stand_congruency_incon 96.9  -0.198504
## p_posture_sit_congruency_incon_posture_stand_congruency_con  98.7   -0.210601
## p_posture_sit_congruency_con_posture_stand_congruency_neut   99.8    0.247845
## p_posture_sit_congruency_con_posture_stand_congruency_incon  90.9    0.167812
## p_posture_sit_congruency_con_posture_stand_congruency_con    99.8    0.232529
## p_posture_stand_congruency_neut_posture_stand_congruency_incon 14.8 -0.047375
## p_posture_stand_congruency_neut_posture_stand_congruency_con   9.1  -0.025522
## p_posture_stand_congruency_incon_posture_stand_congruency_con  6.6   0.017111
##
```

```
## 
## Within-Subject Factors Included: Check MANOVA Results
## 
## Power and Effect sizes for ANOVA tests
##                         power effect_size
## anova_posture            11.9    0.003944
## anova_congruency        100.0    0.059290
## anova_posture:congruency 100.0    0.079727
## 
## Power and Effect sizes for pairwise comparisons (t-tests)
##                                                            power effect_size
## p_posture_sit_congruency_neut_posture_sit_congruency_incon 100.0    0.351060
## p_posture_sit_congruency_neut_posture_sit_congruency_con     5.0   -0.009361
## p_posture_sit_congruency_neut_posture_stand_congruency_neut  67.1    0.123683
## p_posture_sit_congruency_neut_posture_stand_congruency_incon 47.7    0.095908
## p_posture_sit_congruency_neut_posture_stand_congruency_con   65.9    0.122236
## p_posture_sit_congruency_incon_posture_sit_congruency_con   100.0   -0.388383
## p_posture_sit_congruency_incon_posture_stand_congruency_neut 85.0   -0.151837
## p_posture_sit_congruency_incon_posture_stand_congruency_incon 85.7  -0.152307
## p_posture_sit_congruency_incon_posture_stand_congruency_con  89.2   -0.160731
## p_posture_sit_congruency_con_posture_stand_congruency_neut   95.1    0.181526
## p_posture_sit_congruency_con_posture_stand_congruency_incon  67.3    0.121212
## p_posture_sit_congruency_con_posture_stand_congruency_con    92.0    0.169519
## p_posture_stand_congruency_neut_posture_stand_congruency_incon 11.7 -0.038566
## p_posture_stand_congruency_neut_posture_stand_congruency_con  7.1   -0.019957
## p_posture_stand_congruency_incon_posture_stand_congruency_con 6.0    0.014737
## 
## 
## Within-Subject Factors Included: Check MANOVA Results
## 
## Power and Effect sizes for ANOVA tests
##                         power effect_size
## anova_posture            11.1    0.003642
## anova_congruency         99.6    0.040551
## anova_posture:congruency 100.0    0.053326
## 
## Power and Effect sizes for pairwise comparisons (t-tests)
##                                                            power effect_size
## p_posture_sit_congruency_neut_posture_sit_congruency_incon 100.0    0.281933
## p_posture_sit_congruency_neut_posture_sit_congruency_con     5.3   -0.008235
## p_posture_sit_congruency_neut_posture_stand_congruency_neut  51.3    0.101867
## p_posture_sit_congruency_neut_posture_stand_congruency_incon 34.7    0.080760
## p_posture_sit_congruency_neut_posture_stand_congruency_con   51.3    0.100894
## p_posture_sit_congruency_incon_posture_sit_congruency_con   100.0   -0.312754
## p_posture_sit_congruency_incon_posture_stand_congruency_neut 65.7   -0.119158
## p_posture_sit_congruency_incon_posture_stand_congruency_incon 66.2  -0.118225
## p_posture_sit_congruency_incon_posture_stand_congruency_con  70.8   -0.126227
## p_posture_sit_congruency_con_posture_stand_congruency_neut   84.7    0.150013
## p_posture_sit_congruency_con_posture_stand_congruency_incon  53.8    0.102305
## p_posture_sit_congruency_con_posture_stand_congruency_con    79.0    0.140461
## p_posture_stand_congruency_neut_posture_stand_congruency_incon 9.0  -0.026790
## p_posture_stand_congruency_neut_posture_stand_congruency_con  6.1   -0.015809
## p_posture_stand_congruency_incon_posture_stand_congruency_con 5.4    0.008727
## 
```

```
## 
## Within-Subject Factors Included: Check MANOVA Results
## 
## Power and Effect sizes for ANOVA tests
##                         power effect_size
## anova_posture              6.4     0.00310
## anova_congruency          96.9     0.02884
## anova_posture:congruency 100.0     0.03797
## 
## Power and Effect sizes for pairwise comparisons (t-tests)
##                                                            power effect_size
## p_posture_sit_congruency_neut_posture_sit_congruency_incon  99.8    0.235267
## p_posture_sit_congruency_neut_posture_sit_congruency_con     4.9   -0.002324
## p_posture_sit_congruency_neut_posture_stand_congruency_neut 39.3    0.085807
## p_posture_sit_congruency_neut_posture_stand_congruency_incon 26.8   0.067489
## p_posture_sit_congruency_neut_posture_stand_congruency_con  40.7    0.084872
## p_posture_sit_congruency_incon_posture_sit_congruency_con  100.0   -0.257435
## p_posture_sit_congruency_incon_posture_stand_congruency_neut 48.1  -0.098892
## p_posture_sit_congruency_incon_posture_stand_congruency_incon 50.1 -0.098893
## p_posture_sit_congruency_incon_posture_stand_congruency_con 53.9   -0.105028
## p_posture_sit_congruency_con_posture_stand_congruency_neut  67.9    0.122455
## p_posture_sit_congruency_con_posture_stand_congruency_incon 38.5    0.082618
## p_posture_sit_congruency_con_posture_stand_congruency_con   63.5    0.114151
## p_posture_stand_congruency_neut_posture_stand_congruency_incon 8.1 -0.024232
## p_posture_stand_congruency_neut_posture_stand_congruency_con  5.7  -0.013832
## p_posture_stand_congruency_incon_posture_stand_congruency_con 5.3   0.008111
## 
## 
## Within-Subject Factors Included: Check MANOVA Results
```

```r
exp2.power <- power_exp(exp2.design, exp2.seeds, 5, power_result_exp2)
```

```
## Power and Effect sizes for ANOVA tests
##                                power effect_size
## anova_posture                  100.0     0.08594
## anova_congruency               100.0     0.69577
## anova_condition                100.0     0.61347
## anova_posture:congruency        98.0     0.04122
## anova_posture:condition        100.0     0.17335
## anova_congruency:condition     100.0     0.42904
## anova_posture:congruency:condition  98.1  0.04171
## 
## Power and Effect sizes for pairwise comparisons (t-tests)
## 
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_no_switch
```

```
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
##
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
##
##
## Within-Subject Factors Included: Check MANOVA Results
##
## Power and Effect sizes for ANOVA tests
##                                      power effect_size
## anova_posture                        98.6     0.04304
```

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```
## anova_congruency                    100.0    0.50403
## anova_condition                      100.0    0.41456
## anova_posture:congruency              76.8    0.02060
## anova_posture:condition              100.0    0.08889
## anova_congruency:condition           100.0    0.25137
## anova_posture:congruency:condition    76.5    0.02133
##
## Power and Effect sizes for pairwise comparisons (t-tests)
##
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
##
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_switch
```

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```
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_no_switcl
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switcl
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
##
##
## Within-Subject Factors Included: Check MANOVA Results
##
## Power and Effect sizes for ANOVA tests
##                                      power effect_size
## anova_posture                         85.2     0.02548
## anova_congruency                     100.0     0.36312
## anova_condition                      100.0     0.28622
## anova_posture:congruency              51.2     0.01280
## anova_posture:condition               99.2     0.05272
## anova_congruency:condition           100.0     0.15980
## anova_posture:congruency:condition    51.7     0.01301
##
## Power and Effect sizes for pairwise comparisons (t-tests)
##
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_no_switcl
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switcl
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
```

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```
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
##
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
##
##
## Within-Subject Factors Included: Check MANOVA Results
##
## Power and Effect sizes for ANOVA tests
##                                  power effect_size
## anova_posture                     68.1    0.016450
## anova_congruency                 100.0    0.266443
## anova_condition                  100.0    0.202839
## anova_posture:congruency          35.0    0.008608
## anova_posture:condition           95.1    0.034607
## anova_congruency:condition       100.0    0.109006
## anova_posture:congruency:condition  35.0  0.008573
##
## Power and Effect sizes for pairwise comparisons (t-tests)
##
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
```

```
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
##
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
##
##
## Within-Subject Factors Included: Check MANOVA Results
##
```

```
## Power and Effect sizes for ANOVA tests
##                                    power effect_size
## anova_posture                       53.5    0.013043
## anova_congruency                   100.0    0.205175
## anova_condition                    100.0    0.152192
## anova_posture:congruency            28.1    0.007236
## anova_posture:condition             86.2    0.025266
## anova_congruency:condition          99.9    0.078098
## anova_posture:congruency:condition  28.4    0.007405
##
## Power and Effect sizes for pairwise comparisons (t-tests)
##
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
##
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
```

```
## p_posture_sit_congruency_incon_condition_no_switch_posture_sit_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_no_switcl
## p_posture_sit_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_con_condition_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_sit_congruency_incon_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_con_condition_switch
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_no_switcl
## p_posture_stand_congruency_con_condition_no_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_no_switch
## p_posture_stand_congruency_con_condition_switch_posture_stand_congruency_incon_condition_switch
## p_posture_stand_congruency_incon_condition_no_switch_posture_stand_congruency_incon_condition_switch
##
##
## Within-Subject Factors Included: Check MANOVA Results

exp3.power <- power_exp(exp3.design, exp3.seeds, 3, power_result_exp3)


## Power and Effect sizes for ANOVA tests
##                      power effect_size
## anova_posture         79.7    0.02125
## anova_setsize        100.0    0.87245
## anova_posture:setsize 100.0    0.33051
##
## Power and Effect sizes for pairwise comparisons (t-tests)
##                                                               power effect_size
## p_posture_stand_setsize_four_items_posture_stand_setsize_eight_items 100.0    2.3906
## p_posture_stand_setsize_four_items_posture_sit_setsize_four_items    100.0    0.4317
## p_posture_stand_setsize_four_items_posture_sit_setsize_eight_items   100.0    1.2404
## p_posture_stand_setsize_eight_items_posture_sit_setsize_four_items   100.0   -0.9220
## p_posture_stand_setsize_eight_items_posture_sit_setsize_eight_items   47.2   -0.0945
## p_posture_sit_setsize_four_items_posture_sit_setsize_eight_items     100.0    1.6798
##
##
## Within-Subject Factors Included: Check MANOVA Results
##
## Power and Effect sizes for ANOVA tests
##                      power effect_size
## anova_posture         46.5    0.01125
## anova_setsize        100.0    0.75243
## anova_posture:setsize 100.0    0.18047
##
## Power and Effect sizes for pairwise comparisons (t-tests)
##                                                               power effect_size
## p_posture_stand_setsize_four_items_posture_stand_setsize_eight_items 100.0   1.59054
## p_posture_stand_setsize_four_items_posture_sit_setsize_four_items    100.0   0.28940
## p_posture_stand_setsize_four_items_posture_sit_setsize_eight_items   100.0   0.82839
## p_posture_stand_setsize_eight_items_posture_sit_setsize_four_items   100.0  -0.61329
## p_posture_stand_setsize_eight_items_posture_sit_setsize_eight_items   25.2  -0.06177
## p_posture_sit_setsize_four_items_posture_sit_setsize_eight_items     100.0   1.12143
##
```

```
## 
## Within-Subject Factors Included: Check MANOVA Results
## 
## Power and Effect sizes for ANOVA tests
##                     power effect_size
## anova_posture          28    0.007142
## anova_setsize         100    0.630312
## anova_posture:setsize 100    0.112175
## 
## Power and Effect sizes for pairwise comparisons (t-tests)
##                                                                 power effect_size
## p_posture_stand_setsize_four_items_posture_stand_setsize_eight_items 100.0     1.19565
## p_posture_stand_setsize_four_items_posture_sit_setsize_four_items   99.6     0.21634
## p_posture_stand_setsize_four_items_posture_sit_setsize_eight_items 100.0     0.61945
## p_posture_stand_setsize_eight_items_posture_sit_setsize_four_items 100.0    -0.45988
## p_posture_stand_setsize_eight_items_posture_sit_setsize_eight_items  16.5    -0.04739
## p_posture_sit_setsize_four_items_posture_sit_setsize_eight_items   100.0     0.83774
## 
## 
## Within-Subject Factors Included: Check MANOVA Results
## 
## Power and Effect sizes for ANOVA tests
##                     power effect_size
## anova_posture          21.1   0.005643
## anova_setsize         100.0   0.523399
## anova_posture:setsize 100.0   0.075449
## 
## Power and Effect sizes for pairwise comparisons (t-tests)
##                                                                 power effect_size
## p_posture_stand_setsize_four_items_posture_stand_setsize_eight_items 100.0     0.95868
## p_posture_stand_setsize_four_items_posture_sit_setsize_four_items   93.8     0.17356
## p_posture_stand_setsize_four_items_posture_sit_setsize_eight_items 100.0     0.49805
## p_posture_stand_setsize_eight_items_posture_sit_setsize_four_items 100.0    -0.36961
## p_posture_stand_setsize_eight_items_posture_sit_setsize_eight_items  12.4    -0.03769
## p_posture_sit_setsize_four_items_posture_sit_setsize_eight_items   100.0     0.67401
## 
## 
## Within-Subject Factors Included: Check MANOVA Results
## 
## Power and Effect sizes for ANOVA tests
##                     power effect_size
## anova_posture          15.4   0.004507
## anova_setsize         100.0   0.431439
## anova_posture:setsize  99.5   0.053571
## 
## Power and Effect sizes for pairwise comparisons (t-tests)
##                                                                 power effect_size
## p_posture_stand_setsize_four_items_posture_stand_setsize_eight_items 100.0     0.79570
## p_posture_stand_setsize_four_items_posture_sit_setsize_four_items   81.9     0.14254
## p_posture_stand_setsize_four_items_posture_sit_setsize_eight_items 100.0     0.41281
## p_posture_stand_setsize_eight_items_posture_sit_setsize_four_items 100.0    -0.30766
## p_posture_stand_setsize_eight_items_posture_sit_setsize_eight_items   9.3    -0.03218
## p_posture_sit_setsize_four_items_posture_sit_setsize_eight_items   100.0     0.55996
## 
```

```
## 
## Within-Subject Factors Included: Check MANOVA Results

#Convert lists to data frames
exp1.df <- do.call(rbind.data.frame, exp1.power)
exp2.df <- do.call(rbind.data.frame, exp2.power)
exp3.df <- do.call(rbind.data.frame, exp3.power)

#Create experiment variables
exp1.rep <- rep("Exp1", times = dim(exp1.df)[1])
exp2.rep <- rep("Exp2", times = dim(exp2.df)[1])
exp3.rep <- rep("Exp3", times = dim(exp3.df)[1])

#Add column with exp to each data frame
exp1.df <- cbind(exp1.rep, exp1.df)
exp2.df <- cbind(exp2.rep, exp2.df)
exp3.df <- cbind(exp3.rep, exp3.df)

#Rename first column to Experiment
colnames(exp1.df)[1] <- "Experiment"
colnames(exp2.df)[1] <- "Experiment"
colnames(exp3.df)[1] <- "Experiment"

#Print the data frames
print(exp1.df, row.names = F)
```

```
##  Experiment power effect_size
##        Exp1   100  0.25380852
##        Exp1   100  0.13219633
##        Exp1   100  0.07972706
##        Exp1   100  0.05332561
##        Exp1   100  0.03797311
```

```
print(exp2.df, row.names = F)
```

```
##  Experiment power effect_size
##        Exp2 100.0  0.17335319
##        Exp2 100.0  0.08889169
##        Exp2  99.2  0.05271657
##        Exp2  95.1  0.03460735
##        Exp2  86.2  0.02526632
```

```
print(exp3.df, row.names = F)
```

```
##  Experiment power effect_size
##        Exp3 100.0  0.33051328
##        Exp3 100.0  0.18047165
##        Exp3 100.0  0.11217543
##        Exp3 100.0  0.07544901
##        Exp3  99.5  0.05357135
```

```r
#Write power analysis for each exp as csv files
#**Note power is rounded to 100%, since this is a finite sample size it's
#*effectively perfect power but actually ~99.99%
write.csv(exp1.df, "exp1.csv", row.names = F)
write.csv(exp2.df, "exp2.csv", row.names = F)
write.csv(exp3.df, "exp3.csv", row.names = F)

#Original effect sizes as-reported in Smith
  exp1.eta2p <- 0.27 #Posture x Congruency interaction for RT
  exp2.eta2p <- 0.16 #Condition x Posture interaction for acc
  exp3.eta2p <- 0.35 #Posture x Set size interaction for RT

#Percent of lowest effect in power given original effect
  #Exp 1: 14.06%
  exp1.df[5,3]/exp1.eta2p
```

```
## [1] 0.1406412
```

```r
  #Exp 2: 15.80%
  exp2.df[5,3]/exp2.eta2p
```

```
## [1] 0.1579145
```

```r
  #Exp 3: 15.31%
  exp3.df[5,3]/exp3.eta2p
```

```
## [1] 0.153061
```

```r
#Mean power for lowest effect
  #Exp 1-3
  sum(exp1.df[5,2],
      exp2.df[5,2],
      exp3.df[5,2])/3
```

```
## [1] 95.23333
```

```r
  #95.23% power for Exp 1-3

  #Exp 2-3
  sum(exp2.df[5,2],
      exp3.df[5,2])/2
```

```
## [1] 92.85
```

```r
  #92.85% power for Exp 2 and 3
```