Smith Replication: Primary Data Analysis

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Session Information

```
# References for R packages
# install.packages(devtools)
# require(devtools)
# devtools::install_github("crsh/papaja")
# require(papaja)
#
# papaja::r_refs(file = "results/r-package-refs.bib") #<-- writes bib file w/refs

#Save package versions
#renv::snapshot()

sessionInfo()
```

```
## R version 4.2.1 (2022-06-23 ucrt)
## Platform: x86_64-w64-mingw32/x64 (64-bit)
## Running under: Windows 10 x64 (build 19045)
##
## Matrix products: default
##
## locale:
## [1] LC_COLLATE=English_United States.utf8  LC_CTYPE=English_United States.utf8
## [3] LC_MONETARY=English_United States.utf8 LC_NUMERIC=C
## [5] LC_TIME=English_United States.utf8
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
##  [1] labeling_0.4.2         MBESS_4.9.2            highr_0.9              farver_2.1.1
##  [5] ggstance_0.3.5         scales_1.2.1           rlang_1.0.6            cowplot_1.1.1
##  [9] readxl_1.4.1           reshape2_1.4.4         superb_0.95.0          psychReport_3.0.2
## [13] apaTables_2.0.8        psych_2.2.9            BayesFactor_0.9.12-4.4 coda_0.19-4
## [17] ez_4.4-0               afex_1.2-0             lme4_1.1-30            Matrix_1.5-1
## [21] forcats_0.5.2          stringr_1.4.1          dplyr_1.0.10           purrr_0.3.5
## [25] readr_2.1.3            tidyr_1.2.1            tibble_3.1.8           ggplot2_3.3.6
## [29] tidyverse_1.3.2        plyr_1.8.7             rmarkdown_2.17         knitr_1.40
## [33] pacman_0.5.1
##
```

```
## loaded via a namespace (and not attached):
##  [1] TH.data_1.1-1       googledrive_2.0.0   minqa_1.2.5         colorspace_2.0-3
##  [5] ellipsis_0.3.2      estimability_1.4.1  fs_1.5.2            rstudioapi_0.14
##  [9] MatrixModels_0.5-1  fansi_1.0.3         mvtnorm_1.1-3       lubridate_1.8.0
## [13] xml2_1.3.3          codetools_0.2-18    splines_4.2.1       mnormt_2.1.1
## [17] jsonlite_1.8.3      lsr_0.5.2           nloptr_2.0.3        broom_1.0.1
## [21] dbplyr_2.2.1        shiny_1.7.3         compiler_4.2.1      httr_1.4.4
## [25] emmeans_1.8.2       backports_1.4.1     assertthat_0.2.1    fastmap_1.1.0
## [29] gargle_1.2.1        cli_3.4.1           later_1.3.0         htmltools_0.5.3
## [33] tools_4.2.1         lmerTest_3.1-3      gtable_0.3.1        glue_1.6.2
## [37] Rcpp_1.0.9          carData_3.0-5       cellranger_1.1.0    vctrs_0.4.2
## [41] nlme_3.1-160        xfun_0.34           rbibutils_2.2.9     rvest_1.0.3
## [45] mime_0.12           lifecycle_1.0.3     googlesheets4_1.0.1 MASS_7.3-58.1
## [49] zoo_1.8-11          shinyBS_0.61.1      promises_1.2.0.1    hms_1.1.2
## [53] parallel_4.2.1      sandwich_3.0-2      yaml_2.3.6          pbapply_1.5-0
## [57] stringi_1.7.8       boot_1.3-28         Rdpack_2.4          pkgconfig_2.0.3
## [61] evaluate_0.17       lattice_0.20-45     tidyselect_1.2.0    magrittr_2.0.3
## [65] R6_2.5.1            generics_0.1.3      multcomp_1.4-20     DBI_1.1.3
## [69] foreign_0.8-82      pillar_1.8.1        haven_2.5.1         withr_2.5.0
## [73] mgcv_1.8-40         survival_3.4-0      abind_1.4-5         modelr_0.1.9
## [77] crayon_1.5.2        car_3.1-1           utf8_1.2.2          tzdb_0.3.0
## [81] grid_4.2.1          reprex_2.0.2        digest_0.6.29       xtable_1.8-4
## [85] httpuv_1.6.6        numDeriv_2016.8-1.1 munsell_0.5.0
```

***Unconventional* Analysis: Time-Outs (>=1500 ms to respond) are treated as errors. The primary results are reported using this atypical approach to be to be consistent with the original paper by Smith et al.**

In the Appendix, we perform a *Conventional* Analysis which drops the time-outs.

Experiment 1 - Stroop

Import and clean data

```
stroop_files = list.files(path = "data/Experiment 1 Data/", full.names = T)
stroop_files = stroop_files[str_detect(stroop_files,pattern="(?=.*SJ)(?=.*.txt)")]

mergedStroopData <- ldply(stroop_files,
                          read.delim,
                          header=FALSE,
                          stringsAsFactors = FALSE,
                          sep = "")  #for each item in the list apply the function read.delim

names(mergedStroopData) = c("sj",
                          "cb",
                          "blockNumber",
                          "blockType",
                          "trialNum",
                          "congruency",
                          "posture",
                          "wordStim",
                          "inkColour",
                          "rt",
                          "cResp",
                          "resp",
                          "ac")
#...remove problem subjects
#.. No subjects pre-identified as needing to be removed (see ethics protocol)

#...check number of observations per condition
ftable(posture+congruency~sj, mergedStroopData)
```

```
##    posture      SITTING                      STANDING
##    congruency congruent incongruent neutral congruent incongruent neutral
## sj
## 1                    60          60      60        60          60      60
## 2                    60          60      60        60          60      60
## 3                    60          60      60        60          60      60
## 4                    60          60      60        60          60      60
## 5                    60          60      60        60          60      60
## 6                    60          60      60        60          60      60
## 7                    60          60      60        60          60      60
## 8                    60          60      60        60          60      60
## 9                    60          60      60        60          60      60
## 10                   60          60      60        60          60      60
## 11                   60          60      60        60          60      60
## 12                   60          60      60        60          60      60
## 13                   60          60      60        60          60      60
## 14                   60          60      60        60          60      60
## 15                   60          60      60        60          60      60
## 16                   60          60      60        60          60      60
## 17                   60          60      60        60          60      60
## 18                   60          60      60        60          60      60
## 19                   60          60      60        60          60      60
## 20                   60          60      60        60          60      60
## 21                   60          60      60        60          60      60
## 22                  120         120     120       120         120     120
## 24                   60          60      60        60          60      60
## 25                   60          60      60        60          60      60
## 26                   60          60      60        60          60      60
## 27                   60          60      60        60          60      60
## 28                   60          60      60        60          60      60
## 29                   60          60      60        60          60      60
## 30                   60          60      60        60          60      60
## 31                   60          60      60        60          60      60
## 32                   60          60      60        60          60      60
## 33                   60          60      60        60          60      60
## 34                   60          60      60        60          60      60
## 35                   60          60      60        60          60      60
## 36                   60          60      60        60          60      60
## 37                   60          60      60        60          60      60
## 38                   60          60      60        60          60      60
## 39                   60          60      60        60          60      60
## 40                   60          60      60        60          60      60
## 41                   60          60      60        60          60      60
## 42                   60          60      60        60          60      60
## 43                   60          60      60        60          60      60
## 44                   60          60      60        60          60      60
## 45                   60          60      60        60          60      60
## 46                   60          60      60        60          60      60
## 47                   60          60      60        60          60      60
## 48                   60          60      60        60          60      60
## 49                   60          60      60        60          60      60
## 50                   60          60      60        60          60      60
```

```
ftable(blockType~sj, mergedStroopData)
```

```
##    blockType experimental practice
## sj
## 1                     288       72
## 2                     288       72
## 3                     288       72
## 4                     288       72
## 5                     288       72
## 6                     288       72
## 7                     288       72
## 8                     288       72
## 9                     288       72
## 10                    288       72
## 11                    288       72
## 12                    288       72
## 13                    288       72
## 14                    288       72
## 15                    288       72
## 16                    288       72
## 17                    288       72
## 18                    288       72
## 19                    288       72
## 20                    288       72
## 21                    288       72
## 22                    576      144
## 24                    288       72
## 25                    288       72
## 26                    288       72
## 27                    288       72
## 28                    288       72
## 29                    288       72
## 30                    288       72
## 31                    288       72
## 32                    288       72
## 33                    288       72
## 34                    288       72
## 35                    288       72
## 36                    288       72
## 37                    288       72
## 38                    288       72
## 39                    288       72
## 40                    288       72
## 41                    288       72
## 42                    288       72
## 43                    288       72
## 44                    288       72
## 45                    288       72
## 46                    288       72
## 47                    288       72
## 48                    288       72
## 49                    288       72
## 50                    288       72
```

```
#...need to fix SJ - same one was used with two counterbalances
mergedStroopData$sj = paste(mergedStroopData$sj,"_",mergedStroopData$cb,sep="")

#...check for missing data
mergedStroopData[!complete.cases(mergedStroopData),]
```

```
##          sj cb blockNumber    blockType trialNum  congruency  posture wordStim inkColour rt cResp
## 646   10_2  2           8 experimental       34 incongruent STANDING      RED     green  0     2
## 1081  12_2  2           1     practice        1     neutral  SITTING    XXXXX     green  0     2
## 1117  12_2  2           2 experimental        1 incongruent  SITTING    GREEN       red  0     1
## 1445  13_1  1           1     practice        5 incongruent STANDING    GREEN       red  0     1
## 1801  14_2  2           1     practice        1     neutral  SITTING      XXX     green  0     2
## 2162  15_1  1           1     practice        2   congruent STANDING    GREEN     green  0     2
## 2163  15_1  1           1     practice        3     neutral STANDING    XXXXX     green  0     2
## 2615  16_2  2           3 experimental       23 incongruent  SITTING      RED     green  0     2
## 2720  16_2  2           6     practice       20     neutral STANDING      XXX       red  0     1
## 2737  16_2  2           7 experimental        1 incongruent STANDING    GREEN       red  0     1
## 2885  17_1  1           1     practice        5 incongruent STANDING      RED     green  0     2
## 3360  18_2  2           4 experimental       12 incongruent  SITTING    GREEN       red  0     1
## 3457  18_2  2           7 experimental        1 incongruent STANDING      RED     green  0     2
## 3601  19_1  1           1     practice        1   congruent STANDING      RED       red  0     1
## 4370  20_2  2           2 experimental       14     neutral  SITTING    XXXXX       red  0     1
## 4505  20_2  2           6     practice        5 incongruent STANDING    GREEN       red  0     1
## 4681  21_1  1           1     practice        1   congruent STANDING      RED       red  0     1
## 4682  21_1  1           1     practice        2     neutral STANDING      XXX       red  0     1
## 4692  21_1  1           1     practice       12 incongruent STANDING      RED     green  0     2
## 5041  22_1  1           1     practice        1 incongruent STANDING    GREEN       red  0     1
## 5042  22_1  1           1     practice        2 incongruent STANDING      RED     green  0     2
## 5043  22_1  1           1     practice        3     neutral STANDING      XXX       red  0     1
## 5422  22_2  2           1     practice       22 incongruent  SITTING    GREEN       red  0     1
## 5428  22_2  2           1     practice       28 incongruent  SITTING      RED     green  0     2
## 5501  22_2  2           3 experimental       29     neutral  SITTING    XXXXX       red  0     1
## 5530  22_2  2           4 experimental       22 incongruent  SITTING      RED     green  0     2
## 5533  22_2  2           4 experimental       25 incongruent  SITTING      RED     green  0     2
## 5608  22_2  2           6     practice       28 incongruent STANDING    GREEN       red  0     1
## 5621  22_2  2           7 experimental        5     neutral STANDING    XXXXX     green  0     2
## 5644  22_2  2           7 experimental       28     neutral STANDING      XXX     green  0     2
## 5668  22_2  2           8 experimental       16 incongruent STANDING    GREEN       red  0     1
## 5684  22_2  2           8 experimental       32     neutral STANDING    XXXXX        red  0      1
## 5741  22_2  2          10 experimental       17     neutral STANDING      XXX      green  0      2
## 5761  24_2  2           1     practice        1   congruent  SITTING      RED        red  0      1
## 5763  24_2  2           1     practice        3   congruent  SITTING    GREEN      green  0      2
## 5768  24_2  2           1     practice        8     neutral  SITTING      XXX      green  0      2
## 5770  24_2  2           1     practice       10 incongruent  SITTING      RED      green  0      2
## 5772  24_2  2           1     practice       12   congruent  SITTING    GREEN      green  0      2
## 5773  24_2  2           1     practice       13     neutral  SITTING      XXX        red  0      1
## 5775  24_2  2           1     practice       15 incongruent  SITTING    GREEN        red  0      1
## 5776  24_2  2           1     practice       16     neutral  SITTING    XXXXX      green  0      2
## 5797  24_2  2           2 experimental        1     neutral  SITTING    XXXXX      green  0      2
## 5798  24_2  2           2 experimental        2 incongruent  SITTING      RED      green  0      2
## 6018  24_2  2           8 experimental        6   congruent STANDING      RED        red  0      1
## 6121  25_1  1           1     practice        1     neutral STANDING      XXX        red  0      1
## 6482  26_2  2           1     practice        2     neutral  SITTING    XXXXX        red  0      1
## 6518  26_2  2           2 experimental        2 incongruent  SITTING      RED      green  0      2
## 6841  27_1  1           1     practice        1   congruent STANDING      RED        red  0      1
## 6842  27_1  1           1     practice        2     neutral STANDING    XXXXX      green  0      2
## 6843  27_1  1           1     practice        3     neutral STANDING    XXXXX        red  0      1
## 7202  28_2  2           1     practice        2 incongruent  SITTING    GREEN        red  0      1
## 7921   3_1  1           1     practice        1   congruent STANDING    GREEN      green  0      2
## 7957   3_1  1           2 experimental        1     neutral STANDING    XXXXX        red  0      1
## 8858  31_1  1           7 experimental        2   congruent  SITTING      RED        red  0      1
## 9253  32_2  2           8 experimental        1     neutral STANDING      XXX      green  0      2
## 9361  33_1  1           1     practice        1   congruent STANDING      RED        red  0      1
## 9364  33_1  1           1     practice        4 incongruent STANDING    GREEN        red  0      1
## 9386  33_1  1           1     practice       26   congruent STANDING    GREEN      green  0      2
## 9390  33_1  1           1     practice       30     neutral STANDING      XXX        red  0      1
## 9505  33_1  1           5 experimental        1     neutral STANDING    XXXXX        red  0      1
## 10441 36_2  2           1     practice        1   congruent  SITTING    GREEN      green  0      2
## 10444 36_2  2           1     practice        4 incongruent  SITTING    GREEN        red  0      1
## 10447 36_2  2           1     practice        7 incongruent  SITTING      RED      green  0      2
## 10448 36_2  2           1     practice        8     neutral  SITTING      XXX      green  0      2
## 10535 36_2  2           3 experimental       23 incongruent  SITTING    GREEN        red  0      1
## 10639 36_2  2           6     practice       19     neutral STANDING    XXXXX      green  0      2
## 10785 36_2  2          10 experimental       21   congruent STANDING    GREEN      green  0      2
## 11294 38_2  2           4 experimental       26 incongruent  SITTING      RED      green  0      2
## 11387 38_2  2           7 experimental       11     neutral STANDING      XXX      green  0      2
## 11418 38_2  2           8 experimental        6 incongruent STANDING      RED      green  0      2
## 11421 38_2  2           8 experimental        9 incongruent STANDING    GREEN        red  0      1
## 12202  4_2  2           9 experimental       34 incongruent STANDING    GREEN        red  0      1
## 12241 40_2  2           1     practice        1 incongruent  SITTING      RED      green  0      2
## 13603 43_1  1           8 experimental       31 incongruent  SITTING      RED      green  0      2
## 13688 44_2  2           1     practice        8 incongruent  SITTING      RED      green  0      2
## 13689 44_2  2           1     practice        9 incongruent  SITTING    GREEN        red  0      1
## 13694 44_2  2           1     practice       14 incongruent  SITTING    GREEN        red  0      1
## 13695 44_2  2           1     practice       15     neutral  SITTING    XXXXX        red  0      1
## 13696 44_2  2           1     practice       16 incongruent  SITTING      RED      green  0      2
## 13702 44_2  2           1     practice       22   congruent  SITTING    GREEN      green  0      2
## 13709 44_2  2           1     practice       29 incongruent  SITTING    GREEN        red  0      1
## 13713 44_2  2           1     practice       33 incongruent  SITTING      RED      green  0      2
## 13715 44_2  2           1     practice       35 incongruent  SITTING    GREEN        red  0      1
## 13716 44_2  2           1     practice       36   congruent  SITTING    GREEN      green  0      2
## 13717 44_2  2           2 experimental        1   congruent  SITTING      RED        red  0      1
## 13721 44_2  2           2 experimental        5 incongruent  SITTING    GREEN       red  0     1
## 14041 45_1  1           1     practice        1   congruent STANDING    GREEN     green  0     2
## 14379 45_1  1          10 experimental       15     neutral  SITTING    XXXXX     green  0     2
## 14864 47_1  1           3 experimental       32   congruent STANDING      RED       red  0     1
## 14901 47_1  1           4 experimental       33     neutral STANDING      XXX     green  0     2
## 14958 47_1  1           6     practice       18 incongruent  SITTING      RED     green  0     2
## 15121 48_2  2           1     practice        1   congruent  SITTING    GREEN     green  0     2
## 15842  5_1  1           1     practice        2 incongruent STANDING    GREEN       red  0     1
## 15843  5_1  1           1     practice        3   congruent STANDING      RED       red  0     1
## 15845  5_1  1           1     practice        5   congruent STANDING    GREEN     green  0     2
## 15846  5_1  1           1     practice        6 incongruent STANDING      RED     green  0     2
## 15847  5_1  1           1     practice        7     neutral STANDING      XXX     green  0     2
## 16107  5_1  1           8 experimental       15     neutral  SITTING      XXX       red  0     1
## 16201 50_2  2           1     practice        1 incongruent  SITTING    GREEN       red  0     1
## 16565  6_2  2           1     practice        5   congruent  SITTING      RED       red  0     1
## 16957  7_1  1           2 experimental        1     neutral STANDING      XXX     green  0     2
## 17282  8_2  2           1     practice        2 incongruent  SITTING    GREEN       red  0     1
## 17643  9_1  1           1     practice        3   congruent STANDING    GREEN     green  0     2
## 17644  9_1  1           1     practice        4 incongruent STANDING      RED     green  0     2
##       resp ac
## 646       0 NA
## 1081      0 NA
## 1117      0 NA
## 1445      0 NA
## 1801      0 NA
## 2162      0 NA
## 2163      0 NA
## 2615      0 NA
## 2720      0 NA
## 2737      0 NA
## 2885      0 NA
## 3360      0 NA
## 3457      0 NA
## 3601      0 NA
## 4370      0 NA
## 4505      0 NA
## 4681      0 NA
## 4682      0 NA
## 4692      0 NA
## 5041      0 NA
## 5042      0 NA
## 5043      0 NA
## 5422      0 NA
## 5428      0 NA
## 5501      0 NA
## 5530      0 NA
## 5533      0 NA
## 5608      0 NA
## 5621      0 NA
## 5644      0 NA
## 5668      0 NA
## 5684      0 NA
## 5741      0 NA
## 5761      0 NA
## 5763     0 NA
## 5768     0 NA
## 5770     0 NA
## 5772     0 NA
## 5773     0 NA
## 5775     0 NA
## 5776     0 NA
## 5797     0 NA
## 5798     0 NA
## 6018     0 NA
## 6121     0 NA
## 6482     0 NA
## 6518     0 NA
## 6841     0 NA
## 6842     0 NA
## 6843     0 NA
## 7202     0 NA
## 7921     0 NA
## 7957     0 NA
## 8858     0 NA
## 9253     0 NA
## 9361     0 NA
## 9364     0 NA
## 9386     0 NA
## 9390     0 NA
## 9505     0 NA
## 10441    0 NA
## 10444    0 NA
## 10447    0 NA
## 10448    0 NA
## 10535    0 NA
## 10639    0 NA
## 10785    0 NA
## 11294    0 NA
## 11387    0 NA
## 11418    0 NA
## 11421    0 NA
## 12202    0 NA
## 12241    0 NA
## 13603    0 NA
## 13688    0 NA
## 13689    0 NA
## 13694    0 NA
## 13695    0 NA
## 13696    0 NA
## 13702    0 NA
## 13709    0 NA
## 13713    0 NA
## 13715    0 NA
## 13716    0 NA
## 13717    0 NA
## 13721    0 NA
## 14041    0 NA
## 14379    0 NA
## 14864    0 NA
## 14901    0 NA
## 14958    0 NA
## 15121    0 NA
## 15842    0 NA
## 15843    0 NA
## 15845    0 NA
## 15846    0 NA
## 15847    0 NA
## 16107    0 NA
## 16201    0 NA
## 16565    0 NA
## 16957    0 NA
## 17282    0 NA
## 17643    0 NA
## 17644    0 NA
```

```
#...THERE IS MISSING DATA, BUT IT IS EXPECTED:
#...There are trials where the the experiment times out
#...can be identified as RT == 0
#...trials where a response was not made have an RT =0, resp=0 and ac = NA

#...get the number of time outs
dim(mergedStroopData[!complete.cases(mergedStroopData),])[1]
```

```
## [1] 104
```

```
#...how are the missing trials distributed???
timeOutStroopData = mergedStroopData[!complete.cases(mergedStroopData),]

ftable(posture~congruency, timeOutStroopData)
```

```
##             posture SITTING STANDING
## congruency
## congruent                10       14
## incongruent              29       18
## neutral                  13       20
```

```
ftable(blockType~sj, timeOutStroopData)
```

```
##      blockType experimental practice
## sj
## 10_2                      1        0
## 12_2                      1        1
## 13_1                      0        1
## 14_2                      0        1
## 15_1                      0        2
## 16_2                      2        1
## 17_1                      0        1
## 18_2                      2        0
## 19_1                      0        1
## 20_2                      1        1
## 21_1                      0        3
## 22_1                      0        3
## 22_2                      8        3
## 24_2                      3        8
## 25_1                      0        1
## 26_2                      1        1
## 27_1                      0        3
## 28_2                      0        1
## 3_1                       1        1
## 31_1                      1        0
## 32_2                      1        0
## 33_1                      1        4
## 36_2                      2        5
## 38_2                      4        0
## 4_2                       1        0
## 40_2                      0        1
## 43_1                      1        0
## 44_2                      2       10
## 45_1                      1        1
## 47_1                      2        1
## 48_2                      0        1
## 5_1                       1        5
## 50_2                      0        1
## 6_2                       0        1
## 7_1                       1        0
## 8_2                       0        1
## 9_1                       0        2
```

```
#...this code changes the "time-out" trials as errors
#...see Davoli et al.
mergedStroopData$ac[mergedStroopData$rt==0] = 0

#...remove practice trials
mergedStroopData <- mergedStroopData[!mergedStroopData$blockType=="practice",]

#...check that only experimental trials are left
unique(mergedStroopData$blockType)
```

```
## [1] "experimental"
```

```
totalStroopTrials = dim(mergedStroopData)[1]
observationDataStroop = data.frame(ftable(blockType~sj, mergedStroopData))[,c(1,3)]

#...remove trials faster than 100ms
# mergedStroopData= mergedStroopData[!mergedStroopData$rt==0,]  #...greater that 1500ms
mergedStroopData= mergedStroopData[!(mergedStroopData$rt<=100 & mergedStroopData$rt > 0),]
validStroopRTTrials = dim(mergedStroopData)[1]
observationDataStroop$validTrials = data.frame(ftable(blockType~sj, mergedStroopData))[,c(3)]

print(paste("percent invalid trials = ",
            ((totalStroopTrials-validStroopRTTrials)/totalStroopTrials)*100))
```

```
## [1] "percent invalid trials =  0.00694444444444444"
```

```r
#Drops "time-out" trials
mergedStroopData.conventional <- mergedStroopData %>%
                                  filter(rt != 0 & !is.na(ac))

write.csv(mergedStroopData, file = "results/exp1_merged_stroop_data.csv",
            row.names = F)

#Conventional analysis drops the time out trials, rather than treating as errors
write.table(mergedStroopData.conventional, file = "results/exp1_merged_stroop_data_conv.txt",
            row.names = F)

stroopCorrect = mergedStroopData[mergedStroopData$ac == 1, ]

# mergedDataSet = mergedDataSet[mergedDataSet$ac ==1,]
errorsRemoved = dim(stroopCorrect)[1] #...total remaining trials
observationDataStroop$correctTrials = data.frame(ftable(blockType~sj, stroopCorrect))[,c(3)]
trimInfo = data.frame(totalStroopTrials, validStroopRTTrials,errorsRemoved)
head(trimInfo)
```

```
##   totalStroopTrials validStroopRTTrials errorsRemoved
## 1             14400               14399         13852
```

```r
#...percent of error trials lost
print(paste("percent errors removed = ",
            (((validStroopRTTrials-errorsRemoved)/totalStroopTrials)*100)))
```

```
## [1] "percent errors removed =  3.79861111111111"
```

```r
##################################
#...CHECK 20% CRITERION
##################################
observationDataStroop$percentLoss =
  ((observationDataStroop$Freq-observationDataStroop$correctTrials)/
     observationDataStroop$Freq)*100

observationDataStroop$percentLoss
```

```
##  [1]  3.4722222  1.7361111  0.3472222  6.9444444  1.7361111  4.1666667  4.5138889  1.7361111
##  [9]  1.0416667  1.7361111  1.7361111  3.1250000  2.0833333  4.5138889  1.7361111 10.0694444
## [17]  8.6805556  0.3472222  2.0833333  4.5138889  4.8611111  1.3888889  1.3888889  3.4722222
## [25] 16.6666667  1.7361111 15.9722222  1.0416667  0.0000000  5.5555556  2.0833333  8.6805556
## [33]  0.3472222  3.1250000  1.7361111  2.0833333  4.1666667  2.7777778  2.4305556  7.6388889
## [41]  1.0416667  4.1666667  2.7777778  1.0416667  5.5555556  3.1250000 10.0694444  1.7361111
## [49]  3.4722222  3.8194444
```

```r
sum(observationDataStroop$percentLoss>20)
```

```
## [1] 0
```

```
#...None!

#...RUN TRIMMING PROCEDURE
tempList = pjRecursiveTrim2(stroopCorrect, #...dataset
                            "rt", #...dependent variables
                            c("sj",
                              "cb",
                              "congruency",
                              "posture")) #.independent variables

trimmedStroopData=tempList[[1]]
totalStroopN = tempList[[2]]
rejectedStroop = tempList[[3]]
percentTrimmedStroop = tempList[[4]]
NcellsStroop = tempList[[5]]


#...get the trimming info
trimOutputStroop= data.frame(totalStroopN, rejectedStroop,percentTrimmedStroop,NcellsStroop)
head(trimOutputStroop)
```

```
##   totalStroopN rejectedStroop percentTrimmedStroop NcellsStroop
## 1        13852            292             2.107999          300
```

```
stroopRT = plyr::ddply(trimmedStroopData,
                 .(sj, cb,congruency,posture),
                 summarise,
                 meanRT = mean(rt))

head(stroopRT)
```

```
##    sj cb  congruency  posture   meanRT
## 1 1_1  1   congruent  SITTING 471.6458
## 2 1_1  1   congruent STANDING 400.0638
## 3 1_1  1 incongruent  SITTING 430.0455
## 4 1_1  1 incongruent STANDING 439.8444
## 5 1_1  1     neutral  SITTING 454.5455
## 6 1_1  1     neutral STANDING 408.4565
```

```
#...get error data
stroopPE = plyr::ddply(mergedStroopData,
                     .(sj, cb,congruency,posture),
                     summarise,
                     meanPE = 100 - (mean(ac)*100))

head(stroopPE)
```

```
##    sj cb  congruency  posture   meanPE
## 1 1_1  1   congruent  SITTING 0.000000
## 2 1_1  1   congruent STANDING 0.000000
## 3 1_1  1 incongruent  SITTING 4.166667
## 4 1_1  1 incongruent STANDING 6.250000
## 5 1_1  1     neutral  SITTING 6.250000
## 6 1_1  1     neutral STANDING 4.166667
```

```
#...combine the RT and error data
stroopCombined = cbind(stroopRT,meanPE =stroopPE$meanPE)

head(stroopCombined)
```

```
##    sj cb  congruency  posture   meanRT   meanPE
## 1 1_1  1   congruent  SITTING 471.6458 0.000000
## 2 1_1  1   congruent STANDING 400.0638 0.000000
## 3 1_1  1 incongruent  SITTING 430.0455 4.166667
## 4 1_1  1 incongruent STANDING 439.8444 6.250000
## 5 1_1  1     neutral  SITTING 454.5455 6.250000
## 6 1_1  1     neutral STANDING 408.4565 4.166667
```

```
#...set as factors
stroopCombined$sj = factor(stroopCombined$sj)
stroopCombined$cb = factor(stroopCombined$cb)
```

Reaction time results

```
rtModelStroop <- ezANOVA(stroopCombined,
                  dv = .(meanRT),
                  wid=.(sj),
                  within=.(posture,congruency),
                  detailed=TRUE,
                  type=3,
                  return_aov=TRUE)
```

```
## Warning: Converting "posture" to factor for ANOVA.

## Warning: Converting "congruency" to factor for ANOVA.
```

```
rtModelStroop$ANOVA
```

```
##               Effect DFn DFd          SSn        SSd            F            p p<.05          ges
## 1        (Intercept)   1  49 6.530862e+07 1322013.63 2.420643e+03 2.233955e-43     * 0.9748634585
## 2            posture   1  49 8.221421e+02  156217.37 2.578776e-01 6.138604e-01       0.0004879807
## 3         congruency   2  98 7.093105e+04  154676.49 2.247026e+01 9.278220e-09     * 0.0404190166
## 4 posture:congruency   2  98 8.430066e+01   51054.35 8.090852e-02 9.223396e-01       0.0000500584
```

```
rtStroopMSE = rtModelStroop$ANOVA$SSd/rtModelStroop$ANOVA$DFd

#...print ANOVA in nice format
paste(rtModelStroop$ANOVA$Effect,":  F(",
      rtModelStroop$ANOVA$DFn,
      ", ",
      rtModelStroop$ANOVA$DFd,
      ") = ",
      round(rtModelStroop$ANOVA$F,3),
      ", MSE = ",
      round(rtStroopMSE,3),
      ", p = ",
      round(rtModelStroop$ANOVA$p,3),
      ", partialEtaSq = ",
      round(rtModelStroop$ANOVA$SSn/(rtModelStroop$ANOVA$SSn+rtModelStroop$ANOVA$SSd),4),
      sep="")
```

```
## [1] "(Intercept):  F(1, 49) = 2420.643, MSE = 26979.87, p = 0, partialEtaSq = 0.9802"
## [2] "posture:  F(1, 49) = 0.258, MSE = 3188.11, p = 0.614, partialEtaSq = 0.0052"
## [3] "congruency:  F(2, 98) = 22.47, MSE = 1578.332, p = 0, partialEtaSq = 0.3144"
## [4] "posture:congruency:  F(2, 98) = 0.081, MSE = 520.963, p = 0.922, partialEtaSq = 0.0016"
```

```
#...CALCULATE THE BAYES FACTORS FOR THE RT ANALYSIS
stroopBF = stroopCombined
stroopBF$posture = factor(stroopBF$posture)
stroopBF$congruency = factor(stroopBF$congruency)
bfValues1 = anovaBF(meanRT~congruency*posture+sj,
                   data = stroopBF,
                   whichRandom = "sj",
                   method="laplace")
bfValues1
```

```
## Bayes factor analysis
## --------------
## [1] congruency + sj                                 : 35335703  ±NA%
## [2] posture + sj                                    : 0.1461731 ±NA%
## [3] congruency + posture + sj                       : 5410998   ±NA%
## [4] congruency + posture + congruency:posture + sj : 346149.8  ±NA%
##
## Against denominator:
##   meanRT ~ sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
#...get the Bayes factor for the Null Interaction
bfValues1[3]/bfValues1[4]
```

```
## Bayes factor analysis
## --------------
## [1] congruency + posture + sj : 15.63195 ±NA%
##
## Against denominator:
##   meanRT ~ congruency + posture + congruency:posture + sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
1/(bfValues1[3]/bfValues1[4])
```

```
## Bayes factor analysis
## --------------
## [1] congruency + posture + congruency:posture + sj : 0.06397154 ±NA%
##
## Against denominator:
##   meanRT ~ congruency + posture + sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
# Difference scores and paired t-tests
#... stroop effect (incongruent - congruent) FOR Standing
standingStroop = stroopCombined[stroopCombined$posture=="STANDING", ]
standingStroop = standingStroop[standingStroop$congruency!="neutral", ]
t.test(standingStroop$meanRT[standingStroop$congruency=="congruent"],
       standingStroop$meanRT[standingStroop$congruency=="incongruent"],
       paired=TRUE )
```

```
##
##  Paired t-test
##
## data:  standingStroop$meanRT[standingStroop$congruency == "congruent"] and standingStroop$meanRT[stan
## t = -4.3805, df = 49, p-value = 6.226e-05
## alternative hypothesis: true mean difference is not equal to 0
## 95 percent confidence interval:
##  -53.81756 -19.96796
## sample estimates:
## mean difference
##       -36.89276
```

```
#... stroop effect (incongruent - congruent) FOR SITTING
sittingStroop = stroopCombined[stroopCombined$posture=="SITTING", ]
sittingStroop = sittingStroop[sittingStroop$congruency!="neutral", ]
t.test(sittingStroop$meanRT[sittingStroop$congruency=="congruent"],
       sittingStroop$meanRT[sittingStroop$congruency=="incongruent"],
       paired=TRUE )
```

```
##
##  Paired t-test
##
## data:  sittingStroop$meanRT[sittingStroop$congruency == "congruent"] and sittingStroop$meanRT[sitting
## t = -5.1209, df = 49, p-value = 5.104e-06
## alternative hypothesis: true mean difference is not equal to 0
## 95 percent confidence interval:
##  -52.27703 -22.81052
## sample estimates:
## mean difference
##       -37.54377
```

Percent error results

```r
errModelStroop <- ezANOVA(stroopCombined,
                   dv = .(meanPE),
                   wid=.(sj),
                   within=.(posture,congruency),
                   detailed=TRUE,
                   type=3,
                   return_aov = TRUE)
```

```
## Warning: Converting "posture" to factor for ANOVA.

## Warning: Converting "congruency" to factor for ANOVA.
```

```r
errStroopMSE = errModelStroop$ANOVA$SSd/errModelStroop$ANOVA$DFd

paste(errModelStroop$ANOVA$Effect,":  F(",
      errModelStroop$ANOVA$DFn,
      ", ",
      errModelStroop$ANOVA$DFd,
      ") = ",
      round(errModelStroop$ANOVA$F,3),
      ", MSE = ",
      round(errStroopMSE,3),
      ", p = ",
      round(errModelStroop$ANOVA$p,3),
      ", partialEtaSq = ",
      round(errModelStroop$ANOVA$SSn/(errModelStroop$ANOVA$SSn+errModelStroop$ANOVA$SSd),4),
      sep="")
```

```
## [1] "(Intercept):  F(1, 49) = 57.526, MSE = 75.297, p = 0, partialEtaSq = 0.54"
## [2] "posture:  F(1, 49) = 0.007, MSE = 16.562, p = 0.934, partialEtaSq = 1e-04"
## [3] "congruency:  F(2, 98) = 11.598, MSE = 9.222, p = 0, partialEtaSq = 0.1914"
## [4] "posture:congruency:  F(2, 98) = 1.59, MSE = 6.228, p = 0.209, partialEtaSq = 0.0314"
```

```r
#BF for errors
bfValues1.error = anovaBF(meanPE~congruency*posture+sj,
                          data = stroopBF,
                          whichRandom = "sj",
                          method="laplace")

bfValues1.error
```

```
## Bayes factor analysis
## --------------
## [1] congruency + sj                                 : 776.6647  ±NA%
## [2] posture + sj                                    : 0.1172445 ±NA%
## [3] congruency + posture + sj                       : 91.51836  ±NA%
## [4] congruency + posture + congruency:posture + sj : 13.90884  ±NA%
##
## Against denominator:
##   meanPE ~ sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
#...get the Bayes factor for the Null Interaction
bfValues1.error[3]/bfValues1.error[4]
```

```
## Bayes factor analysis
## --------------
## [1] congruency + posture + sj : 6.579869 ±NA%
##
## Against denominator:
##   meanPE ~ congruency + posture + congruency:posture + sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
1/(bfValues1.error[3]/bfValues1.error[4])
```

```
## Bayes factor analysis
## --------------
## [1] congruency + posture + congruency:posture + sj : 0.1519787 ±NA%
##
## Against denominator:
##   meanPE ~ congruency + posture + sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
#...ERRORs
#... stroop effect (incongruent - congruent) FOR Standing
t.test(standingStroop$meanPE[standingStroop$congruency=="congruent"],
       standingStroop$meanPE[standingStroop$congruency=="incongruent"],
       paired=TRUE )
```

```
##
##  Paired t-test
##
## data:  standingStroop$meanPE[standingStroop$congruency == "congruent"] and standingStroop$meanPE[stan
## t = -2.0681, df = 49, p-value = 0.04393
## alternative hypothesis: true mean difference is not equal to 0
## 95 percent confidence interval:
##  -2.79325655 -0.04007678
## sample estimates:
## mean difference
##       -1.416667
```

```
#... stroop effect (incongruent - congruent) FOR SITTING
t.test(sittingStroop$meanPE[sittingStroop$congruency=="congruent"],
       sittingStroop$meanPE[sittingStroop$congruency=="incongruent"],
       paired=TRUE )
```

```
##
##  Paired t-test
##
## data:  sittingStroop$meanPE[sittingStroop$congruency == "congruent"] and sittingStroop$meanPE[sitting
## t = -4.6535, df = 49, p-value = 2.51e-05
## alternative hypothesis: true mean difference is not equal to 0
## 95 percent confidence interval:
##  -3.758593 -1.491407
## sample estimates:
## mean difference 
##          -2.625
```

Make plots for Stroop

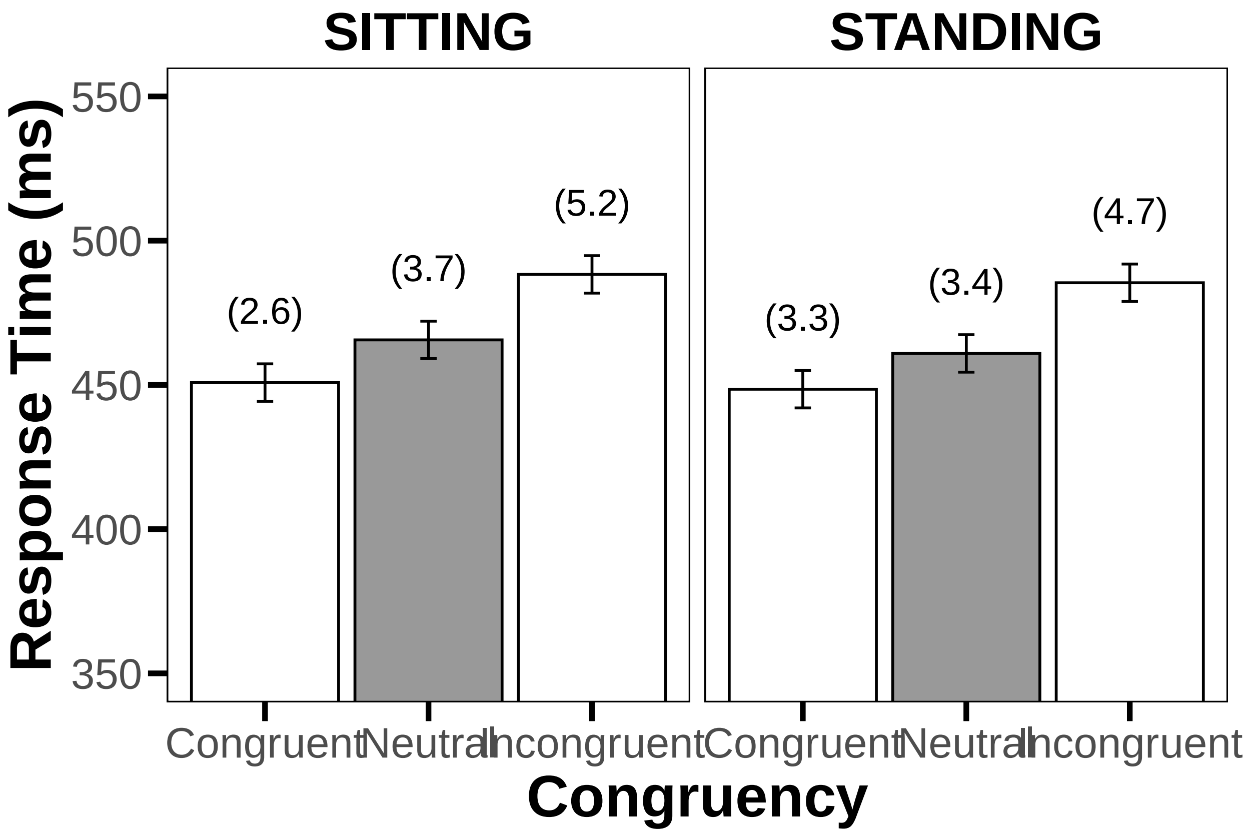
```
#...pull out summary statistics per condition averaged across subjects for graph
graphRT = describeBy(stroopCombined$meanRT,
                     list(stroopCombined$posture,stroopCombined$congruency),
                     mat=TRUE,
                     digits = 1)

graphPE = describeBy(stroopCombined$meanPE,
                     list(stroopCombined$posture,stroopCombined$congruency),
                     mat=TRUE,
                     digits = 1)
head(graphRT)
```

```
##     item   group1      group2 vars  n  mean    sd median trimmed  mad   min   max range skew
## X11    1  SITTING   congruent    1 50 450.8  56.3  443.0   446.5 45.5 348.3 598.3 250.0  0.7
## X12    2 STANDING   congruent    1 50 448.5  60.6  440.3   442.2 48.6 341.3 624.4 283.0  1.0
## X13    3  SITTING incongruent    1 50 488.3  91.9  471.8   476.7 74.4 351.1 803.1 452.0  1.2
## X14    4 STANDING incongruent    1 50 485.4 100.6  458.7   470.5 79.0 358.3 861.5 503.2  1.8
## X15    5  SITTING     neutral    1 50 465.6  66.3  456.6   460.1 49.7 357.8 702.6 344.7  1.0
## X16    6 STANDING     neutral    1 50 460.9  67.6  452.7   453.6 51.5 346.2 695.4 349.2  1.4
##     kurtosis   se
## X11      0.2  8.0
## X12      0.9  8.6
## X13      1.7 13.0
## X14      3.8 14.2
## X15      1.9  9.4
## X16      2.7  9.6
```

```
#...get rid of irrelevant columns
graphRT = graphRT[,c("group1","group2","mean","se")]
graphPE = graphPE[,c("group1","group2","mean","se")]

#...rename the variables
names(graphRT) = c("posture","congruency","mean","se")
names(graphPE) = c("posture","congruency","mean","se")

#...make sure posture is in UPPERCASE
graphRT$posture = str_to_upper(graphRT$posture)

#..calculate the within subjects confidence intervals based on loftus and masson
#..the confidence intervals are based on the interaction term.

inxn.rt.MSE = rtStroopMSE[4]
inxn.err.MSE = errStroopMSE[4]

graphRT$se = sqrt((inxn.rt.MSE)/length(unique(stroopCombined$sj)))
graphPE$se= sqrt((inxn.err.MSE)/length(unique(stroopCombined$sj)))

critT = qt(p=.025,df=length(unique(stroopCombined$sj))-2,lower.tail =FALSE)

#---add the min and max for the confidence intervals
graphRT$min = graphRT$mean - (graphRT$se*critT)
graphRT$max = graphRT$mean + (graphRT$se*critT)

####GET AC DATA FROM twoAnimalWordsPRPac.R
graphRT$ac = paste("(",format(round(graphPE$mean,digits=1),nsmall = 1),")",sep="")
head(graphRT)
```

```
##      posture  congruency  mean       se      min      max    ac
## X11  SITTING   congruent 450.8 3.227887 444.3099 457.2901 (2.6)
## X12 STANDING   congruent 448.5 3.227887 442.0099 454.9901 (3.3)
## X13  SITTING incongruent 488.3 3.227887 481.8099 494.7901 (5.2)
## X14 STANDING incongruent 485.4 3.227887 478.9099 491.8901 (4.7)
## X15  SITTING     neutral 465.6 3.227887 459.1099 472.0901 (3.7)
## X16 STANDING     neutral 460.9 3.227887 454.4099 467.3901 (3.4)
```

```
#...used for positioning the accuracy data on the graph
graphRT$vAdj = 25 #down
graphRT$vAdj[graphRT$congruency=="incongruent"]=25 #up
graphRT$hAdj = 0 #right
#graphRT$hAdj[graphRT$posture=="SITTING"]=-60 #left
graphRT$congruency = factor(graphRT$congruency,labels = c("Congruent","Incongruent","Neutral"))
graphRT$congruency = factor(graphRT$congruency,levels=c("Congruent","Neutral","Incongruent"))

interactionPlot <- ggplot(graphRT, aes(congruency, mean, group=posture)) +
  theme(legend.position = "none")+
  scale_fill_manual(values=c("#FFFFFF","#999999","#FFFFFF","#999999")) +
  coord_cartesian(ylim=c(350,550),expand=TRUE) +
  scale_y_continuous(breaks = round(seq(350, 550, by = 50),0)) +
  geom_text(aes(label=ac),nudge_x=graphRT$hAdj,nudge_y =graphRT$vAdj, size=5) +
  geom_bar(stat="identity", aes(fill=interaction(congruency)),colour="black")+
  geom_errorbar(aes(ymin=min,ymax=max,group=interaction(posture,congruency)), width=.1)+
  labs(x = "Congruency", y = "Response Time (ms)") +
  theme(axis.ticks = element_line(size = 1, colour = "black", linetype = "solid"),
        axis.ticks.length = unit(.25,"cm"),
       #axis.line = element_line(size = 1, colour = "black", linetype = "solid"),
        panel.background = element_rect(fill = "white", colour = "white", size = 1),
        axis.text=element_text(size=16),
        axis.title=element_text(size=22,face="bold"),
        strip.text = element_text(size = 20, face = "bold",colour = "black", angle = 0),
        panel.border = element_rect(colour = "black", fill = NA, size = 0.50),
        strip.background = element_rect(fill=NA,colour="NA",size = 2))+
  facet_grid(~posture)

interactionPlot
```



```
ggsave(interactionPlot,
       file = "results/plots/fig1_exp1_stroop_interaction_plot.pdf",
       units = "in",
       width = 8.5,
       height = 5,
       dpi = 600)



exp1.table <-
apa.2way.table(congruency,
               posture,
               meanRT,
               stroopCombined,
               show.conf.interval = TRUE,
               landscape=TRUE,
               filename = "results/plots/exp1_table.doc")
exp1.table
```

```
##
##
## Means and standard deviations for meanRT as a function of a 3(congruency) X 2(posture) design
##
##                         M         M_95%_CI     SD
##   posture:SITTING
##        congruency
##         congruent 450.77 [434.78, 466.76]  56.26
##       incongruent 488.31 [462.20, 514.42]  91.87
##           neutral 465.62 [446.78, 484.47]  66.31
##
##  posture:STANDING
##        congruency
##         congruent 448.51 [431.30, 465.72]  60.56
##       incongruent 485.40 [456.81, 513.99] 100.61
##           neutral 460.86 [441.64, 480.08]  67.64
##
## Note. M and SD represent mean and standard deviation, respectively.
## LL and UL indicate the lower and upper limits of the
## 95% confidence interval for the mean, respectively.
## The confidence interval is a plausible range of population means
## that could have created a sample mean (Cumming, 2014).
```

Experiment 2 - Task-switching

Import and clean data

```
###read in data
ts_path <- "/data/Experiment 2 Data/task-switching-replication-recoded-2.csv"
task_switching_raw <- read.csv(paste0(workingdir, ts_path))
head(task_switching_raw)
```

```
##   participant session condition  trialType  posture blockNum trialNum switchTrialType
## 1           1       1         1 experiment standing        1        1          buffer
## 2           1       1         1 experiment standing        1        2        noswitch
## 3           1       1         1 experiment standing        1        3          switch
## 4           1       1         1 experiment standing        1        4        noswitch
## 5           1       1         1 experiment standing        1        5        noswitch
## 6           1       1         1 experiment standing        1        6        noswitch
##   congruentTrialType cueType shapeType shapeColor response correctResponse correct reactionTime
## 1        incongruent   solid    square       blue    right            left      no    0.9088130
## 2        incongruent   solid    square       blue     left            left     yes    0.5947349
## 3        incongruent  dashed    square       blue    right           right     yes    0.7084870
## 4        incongruent  dashed    square       blue    right           right     yes    0.5995200
## 5          congruent  dashed    square     yellow    right           right     yes    0.4399409
## 6          congruent  dashed    square     yellow    right           right     yes    0.3847258
##                  date    utcTime
## 1 2021-11-10 10:22:00 1636561737
## 2 2021-11-10 10:22:00 1636561744
## 3 2021-11-10 10:22:00 1636561746
## 4 2021-11-10 10:22:00 1636561748
## 5 2021-11-10 10:22:00 1636561750
## 6 2021-11-10 10:22:00 1636561752
```

```
### check data
```

```
#does every person have 392 trials?
ntrials_sub <- task_switching_raw %>%
  group_by(participant) %>%
  summarize(ntrials = n()) %>%
  pull(ntrials)

all(ntrials_sub == 392)
```

```
## [1] TRUE
```

```
#does every block start with a buffer and have 49 trials?
task_switching_raw <- task_switching_raw %>%
  mutate(condblock = paste0(posture, blockNum))

blocktrials <- task_switching_raw %>%
  group_by(participant, condblock) %>%
  summarize(ntrials = n(), firsttrial = first(switchTrialType))
```

```
## ‘summarise()‘ has grouped output by ’participant’. You can override using the ‘.groups‘ argument.
```

```
all(blocktrials$ntrials == 49)
```

```
## [1] TRUE
```

```
all(blocktrials$firsttrial == "buffer")
```

```
## [1] TRUE
```

```
### clean data

#Drop buffer trials
task_switching_raw2 <- task_switching_raw %>%
  filter(switchTrialType != "buffer")

#Recode Correct to 1 and Incorrect to 0
task_switching_raw2$correct_bin <- recode(task_switching_raw2$correct,
                                          "no"  = 0,
                                          "yes" = 1)
#Change RTs from seconds to milliseconds
task_switching_raw2 <-  task_switching_raw2 %>%
  mutate(reactionTime = reactionTime * 1000)


#Calc overall acc by participant
ts_overall_acc <- task_switching_raw2 %>%
  group_by(participant)  %>%
  summarize(Accuracy = mean(correct_bin))

#find participants with less than 80% accuracy
#2, 8, 15, 44, 49, 51
#First exclusion criteria
```

```
low_acc_subs <- ts_overall_acc %>% filter(Accuracy < 0.80) %>%
  pull(participant)

task_switching_raw3 <- task_switching_raw2 %>%
  filter(!(participant %in% low_acc_subs))

#Summary of time-out trials
timeOutTaskSwitch = task_switching_raw3 %>%
                                    filter(is.na(reactionTime))

ftable(posture~congruentTrialType, timeOutTaskSwitch)
```

```
##                     posture sitting standing
## congruentTrialType
## congruent                        82       92
## incongruent                      98      117
```

```
ftable(posture~congruentTrialType~switchTrialType, timeOutTaskSwitch)
```

```
##                  congruentTrialType congruent incongruent
## switchTrialType
## noswitch                                  76          88
## switch                                    98         127
```

```
ftable(congruentTrialType ~ participant, timeOutTaskSwitch)
```

```
##              congruentTrialType congruent incongruent
## participant
## 1                                      8           7
## 3                                      2           3
## 4                                      3           8
## 7                                      1           2
## 9                                      2           0
## 10                                     1           1
## 11                                     0           1
## 12                                     1           2
## 13                                     4           2
## 14                                     3           0
## 16                                     3           4
## 17                                     1           1
## 18                                     3           2
## 19                                    14          21
## 20                                     1           2
## 21                                     3          10
## 22                                     1           1
## 23                                     6           5
## 24                                     5           3
## 25                                     2           3
## 26                                     1           2
## 27                                     3           5
## 28                                     4           4
## 29                                     4           6
## 30                                     5           6
## 31                                    11          13
## 32                                     7           2
## 33                                     1           4
## 34                                     3           1
## 35                                     2           2
## 36                                     2           2
## 37                                     1           4
## 38                                     6           3
## 39                                     2           5
## 41                                     3           3
## 42                                     5          12
## 43                                     4           5
## 45                                     0           8
## 46                                     5           5
## 47                                     2           0
## 48                                    10           7
## 50                                     2           3
## 52                                     1           0
## 53                                     1           1
## 54                                     3           3
## 55                                    13          27
## 56                                     6           2
## 57                                     3           2
```

```
ftable(switchTrialType ~ participant, timeOutTaskSwitch)
```

```
##             switchTrialType noswitch switch
## participant
## 1                                  6      9
## 3                                  4      1
## 4                                  7      4
## 7                                  2      1
## 9                                  0      2
## 10                                 1      1
## 11                                 1      0
## 12                                 0      3
## 13                                 1      5
## 14                                 0      3
## 16                                 1      6
## 17                                 1      1
## 18                                 3      2
## 19                                19     16
## 20                                 2      1
## 21                                 6      7
## 22                                 1      1
## 23                                 4      7
## 24                                 1      7
## 25                                 3      2
## 26                                 1      2
## 27                                 5      3
## 28                                 3      5
## 29                                 6      4
## 30                                  5      6
## 31                                 13     11
## 32                                  5      4
## 33                                  1      4
## 34                                  2      2
## 35                                  1      3
## 36                                  2      2
## 37                                  1      4
## 38                                  4      5
## 39                                  3      4
## 41                                  3      3
## 42                                  6     11
## 43                                  5      4
## 45                                  3      5
## 46                                  5      5
## 47                                  0      2
## 48                                  8      9
## 50                                  0      5
## 52                                  1      0
## 53                                  0      2
## 54                                  2      4
## 55                                 11     29
## 56                                  4      4
## 57                                  1      4
```

```
#Drop "time-out" trials
task_switching_raw.conventional <- task_switching_raw3 %>%
                                    filter(!is.na(reactionTime))

write.csv(task_switching_raw.conventional, file = "results/exp2_merged_ts_conv.csv",
            row.names = F)

#Calc mean Acc by participant and conditions (posture, con, switch)
#Narrow format
ts_acc_mean <- task_switching_raw3 %>%
  group_by(participant,
           posture,
           congruentTrialType,
           switchTrialType) %>%
  summarize(Accuracy    = mean(correct_bin),
            PE = (1 - Accuracy) * 100)
```

```
## `summarise()` has grouped output by 'participant', 'posture', 'congruentTrialType'. You can
## override using the `.groups` argument.
```

```
#Convert data to wide format (for statview/SPSS/etc)
ts_acc_mean_wide <- ts_acc_mean %>%
  select(-Accuracy) %>%
  pivot_wider(names_from = c(posture,
                             congruentTrialType,
                             switchTrialType),
              values_from =   PE)
```

```
ts_acc_mean <- ts_acc_mean %>%
  ungroup() %>%
  mutate(across(posture:switchTrialType, as.factor))

str(ts_acc_mean)
```

```
## tibble [408 x 6] (S3: tbl_df/tbl/data.frame)
##  $ participant       : int [1:408] 1 1 1 1 1 1 1 1 3 3 ...
##  $ posture           : Factor w/ 2 levels "sitting","standing": 1 1 1 1 2 2 2 2 1 1 ...
##  $ congruentTrialType: Factor w/ 2 levels "congruent","incongruent": 1 1 2 2 1 1 2 2 1 1 ...
##  $ switchTrialType   : Factor w/ 2 levels "noswitch","switch": 1 2 1 2 1 2 1 2 1 2 ...
##  $ Accuracy          : num [1:408] 0.96 0.978 0.957 0.88 0.981 ...
##  $ PE                : num [1:408] 4 2.17 4.35 12 1.89 ...
```

```
#Total N = 51 (6 dropped for total acc < 80%)
length(unique(ts_acc_mean$participant))
```

```
## [1] 51
```

Summarize Demographics

```
demo_raw <- read.csv(paste0(workingdir, "/data",
                            "/Experiment 2 Data/Task Switching_February 24, 2022_13.05.csv"),
                     skip = 1) %>%
  slice(-1) %>%
  select(-c(Response.Type,IP.Address, Recipient.Last.Name:Distribution.Channel))
colnames(demo_raw)[10:15] <- c("Gender.Pick", "Gender.Text","Age","Race.Pick","Race.Text","Eng.First")

dim(demo_raw)
```

```
## [1] 59 15
```

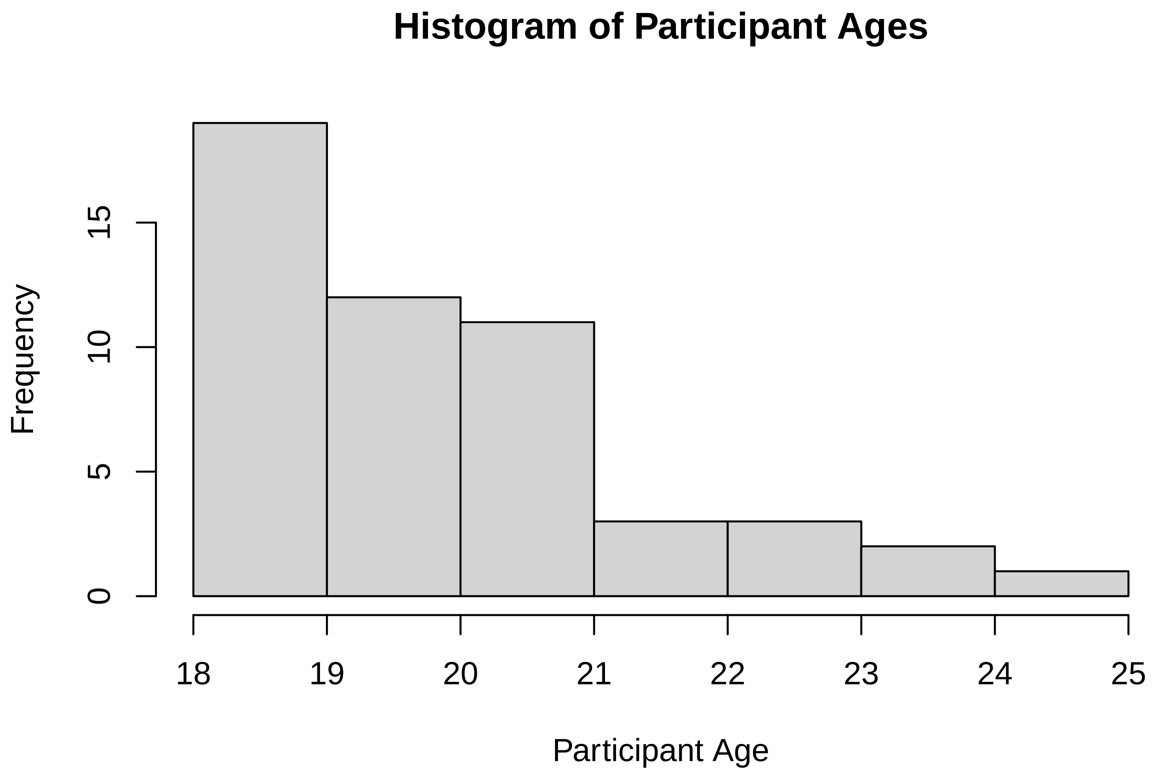
```
#59 records
#first two are test data
# need to match up the 6 dropped participants from behavioral data
demo_df <- demo_raw %>%
  filter(!(X %in% c("test", low_acc_subs)))
dim(demo_df)
```

```
## [1] 51 15
```

```
demo_df <- demo_df %>%
  mutate(Gender.New = ifelse(Gender.Pick %in% c("Man","Woman"), Gender.Pick, Gender.Text),
         Eng.First = toupper(Eng.First))

#gender breakdown
gender_table <- demo_df %>%
  group_by(Gender.New) %>%
  summarize(n = n())
gender_table
```

```
## # A tibble: 3 x 2
##   Gender.New       n
##   <chr>        <int>
## 1 Man             23
## 2 non binaary      1
## 3 Woman           27
```

```
#age breakdown
hist(as.numeric(demo_df$Age),
     main = "Histogram of Participant Ages",
     xlab = "Participant Age")
```



```
age_table <- demo_df %>%
  group_by(Age) %>%
  summarize(n = n())
age_table
```

```
## # A tibble: 8 x 2
##   Age       n
##   <chr> <int>
## 1 18        9
## 2 19       10
## 3 20       12
## 4 21       11
## 5 22        3
## 6 23        3
## 7 24        2
## 8 25        1
```

```
#age mean and sd
mean_age <- mean(as.numeric(demo_df$Age))
sd_age <- sd(as.numeric(demo_df$Age))

kable(matrix(c(mean_age, sd_age), nrow = 1), col.names = c("Mean of Age", "SD of Age"))
```

Mean of Age	SD of Age
20.21569	1.73567

```
#race breakdown
race_table <- demo_df %>%
  group_by(Race.Pick) %>%
  summarize(n = n()) %>%
  arrange(desc(n))
race_table
```

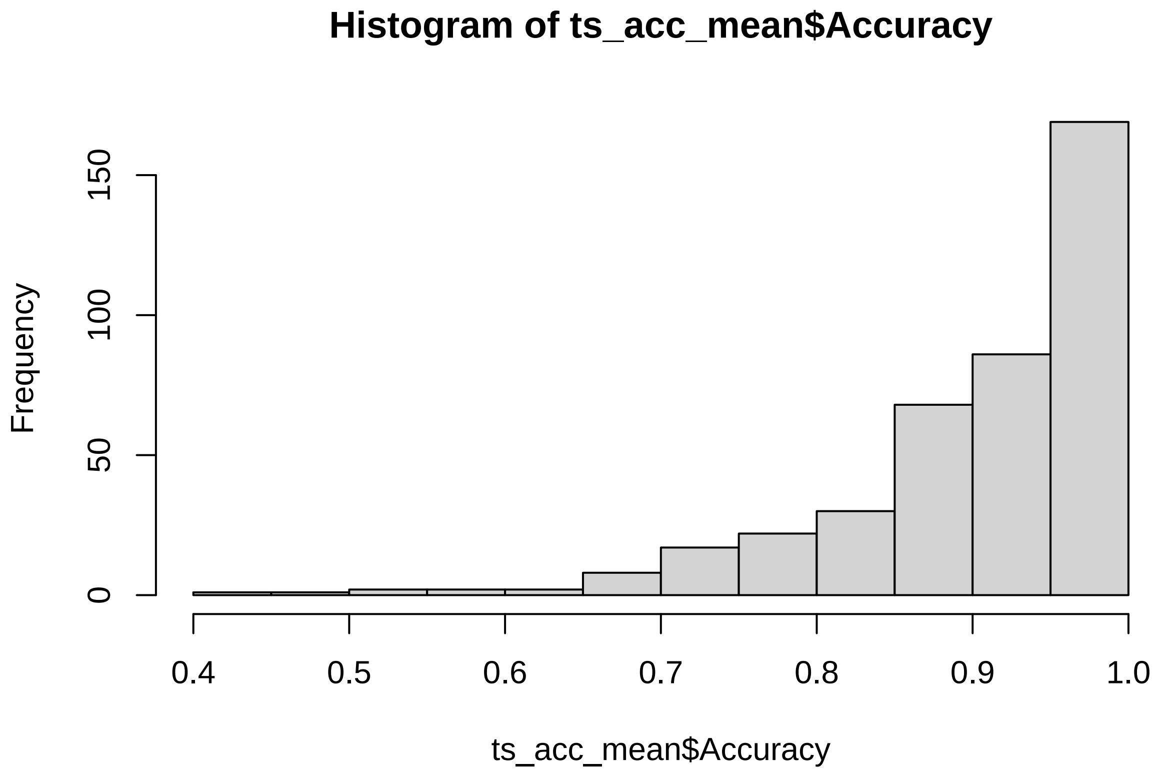
```
## # A tibble: 6 x 2
##   Race.Pick                               n
##   <chr>                               <int>
## 1 White /European American               22
## 2 Black / African American               11
## 3 Hispanic/Latino/Latina/Latinx          11
## 4 Asian /South Pacific Islander           3
## 5 Central Asian /Indian /Pakistani        3
## 6 Native American / American Indian       1
```

```
#language breakdown
lang_table <- demo_df %>%
  group_by(Eng.First) %>%
  summarize(n=n())
lang_table
```

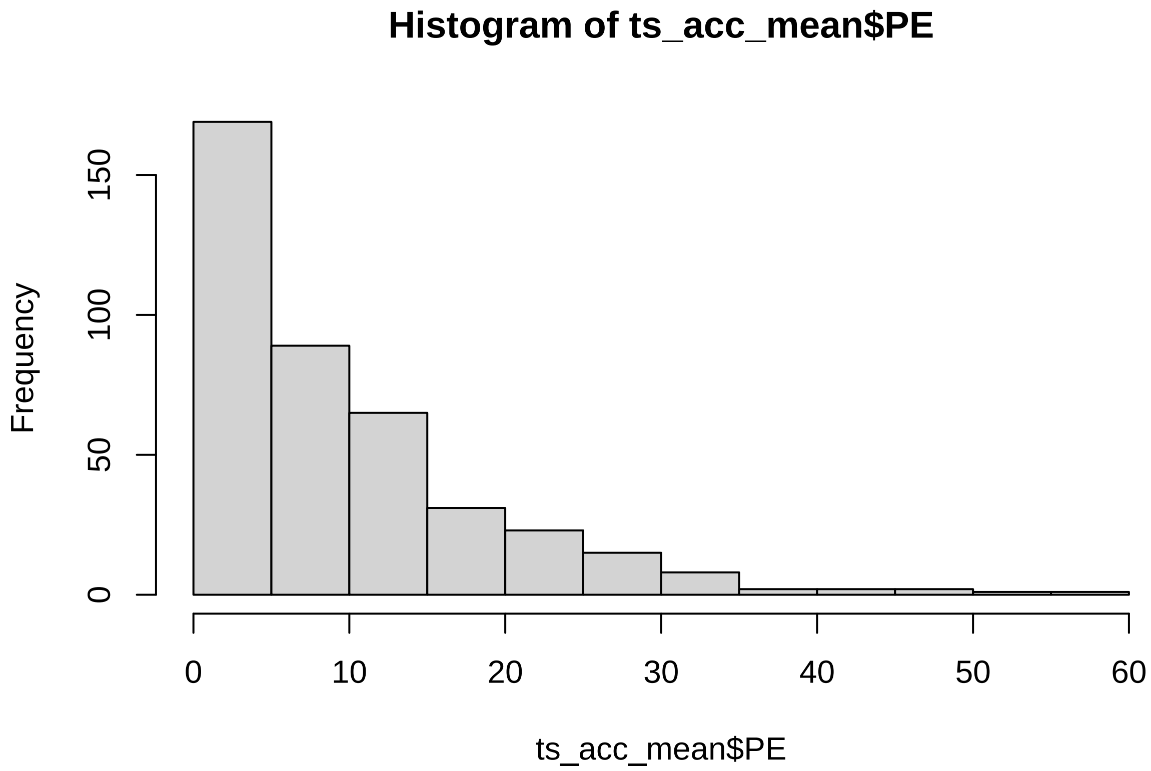
```
## # A tibble: 2 x 2
##   Eng.First     n
##   <chr>     <int>
## 1 NO            8
## 2 YES          43
```

Accuracy results

```
#Accuracy for all cells
hist(ts_acc_mean$Accuracy)
```



```
hist(ts_acc_mean$PE)
```



```
accModelTS <- aov_ez(data = ts_acc_mean,
                     dv = "PE",
                     id = "participant",
                     within = c("posture", "congruentTrialType", "switchTrialType"),
                     type = 3,
                     anova_table = list(es = "pes")
)

acc.stats.TS <- ezStats(ts_acc_mean,
                     dv = PE,
                     wid = participant,
                     within = .(posture, congruentTrialType, switchTrialType),
                     type = 3
)
```

```
## Warning: Converting "participant" to factor for ANOVA.
```

```
write.csv(acc.stats.TS[ ,-7], file = "results/exp2_Descriptives_ACC.csv",
          row.names = F)


write.csv(accModelTS$anova_table, "results/exp2_ANOVA_acc.csv")
accModelTS
```

```
## Anova Table (Type 3 tests)
```

```
##
## Response: PE
##                                       Effect    df   MSE         F   pes p.value
## 1                                    posture 1, 50 88.41      1.06  .021    .308
## 2                         congruentTrialType 1, 50 86.07 99.66 ***  .666   <.001
## 3                            switchTrialType 1, 50 28.61 92.04 ***  .648   <.001
## 4                 posture:congruentTrialType 1, 50 41.84      0.02 <.001    .875
## 5                    posture:switchTrialType 1, 50 24.00      0.74  .015    .395
## 6         congruentTrialType:switchTrialType 1, 50 15.15 58.43 ***  .539   <.001
## 7 posture:congruentTrialType:switchTrialType 1, 50 18.80      1.26  .024    .268
## ---
## Signif. codes:  0 ’***’ 0.001 ’**’ 0.01 ’*’ 0.05 ’+’ 0.1 ’ ’ 1
```

```
#Calculate confidence interval: PES for posture x switch/condition interaction
#using ANOVA results            (partial eta-squared)
interaction_effect_CI <-  get.ci.partial.eta.squared(accModelTS$anova_table$F[5],
                                                     accModelTS$anova_table$`num Df`[5],
                                                     accModelTS$anova_table$`den Df`[5],
                                                     conf.level = 0.90)
                                                    #90% CI is the  convention for PES
interaction_effect_CI
```

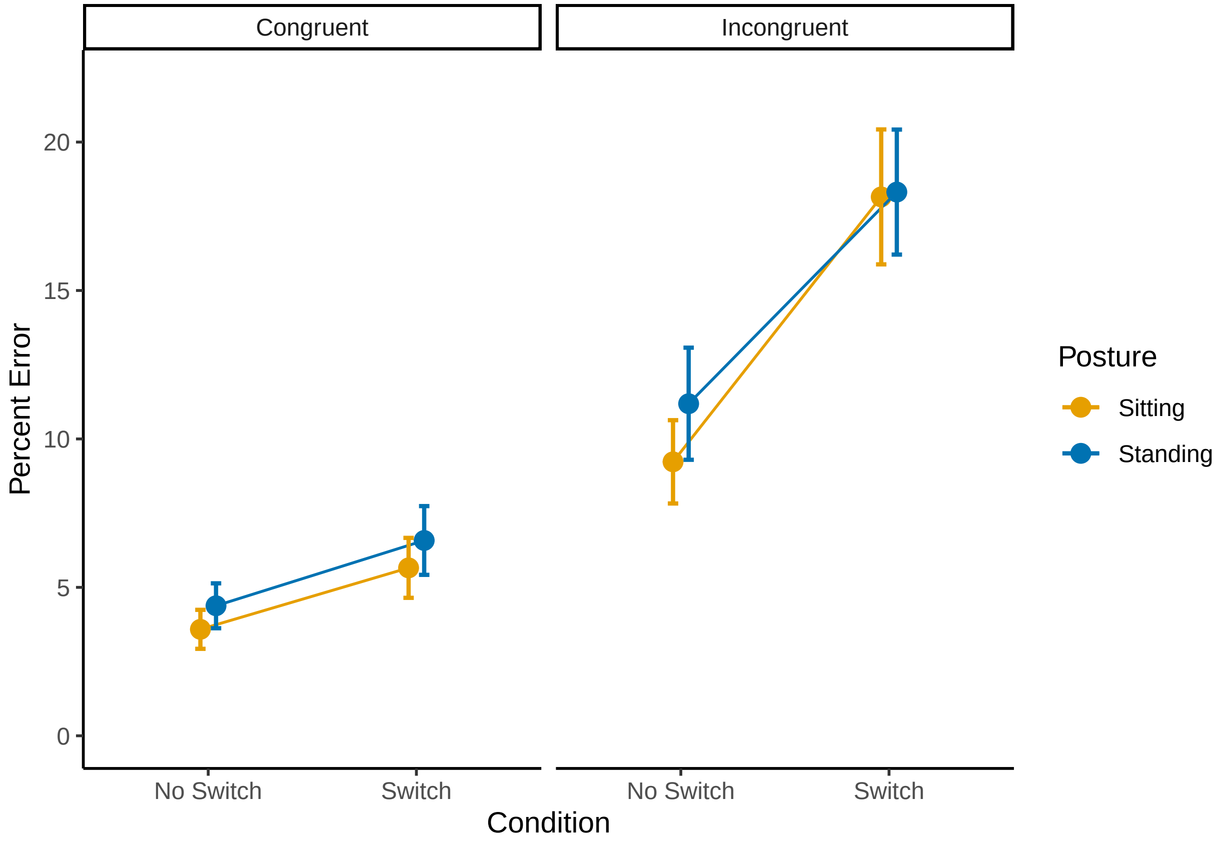
```
## $LL
## [1] 0
##
## $UL
## [1] 0.1073579
```

```
congruent.labs <- c("Congruent", "Incongruent")
names(congruent.labs) <- c("1", "2")

#make plot like Smith et al's
acc_plot <-
  superbPlot(ts_acc_mean_wide,
             WSFactors = c("Condition(2)", "Congruent(2)", "Posture(2)"),
             variables = colnames(ts_acc_mean_wide)[2:9],
             errorbar = "SE", #Tempted to change to CI, should stay SE to be consistent with SMith
             plotStyle = "line",
             factorOrder = c("Condition","Posture","Congruent"),
             adjustments = list(purpose = "difference"))+
  theme_classic() +
  ylim(0, 22) + #Trying to make ylim same as the Smith w/o cutting off error bars
  facet_wrap(vars(Congruent), labeller = labeller(Congruent = congruent.labs)) +
  scale_x_discrete(labels=c("1" = "No Switch", "2" = "Switch"))+
  scale_color_manual(values=c("#E69F00", "#0072B2"),
                     labels = c("Sitting", "Standing")) +
  labs(y = "Percent Error")
```

```
## superb::FYI: Here is how the within-subject variables are understood:
```

```
##  Condition Congruent Posture                      variable
##          1         1       1    sitting_congruent_noswitch
##          2         1       1      sitting_congruent_switch
##          1         2       1  sitting_incongruent_noswitch
##          2         2       1    sitting_incongruent_switch
##          1         1       2   standing_congruent_noswitch
##          2         1       2     standing_congruent_switch
##          1         2       2 standing_incongruent_noswitch
##          2         2       2   standing_incongruent_switch
```

```
#Note this is Figure 3, not figure 2 (drawn below)
ggsave(acc_plot,
       file = "results/plots/fig3_exp2_ts_acc_plot.pdf",
       units = "in",
       width = 6.62,
       height = 5.50,
       dpi = 600)

acc_plot
```



```
#...CALCULATE THE BAYES FACTORS FOR THE ACC ANALYSIS
taskswitchBF = data.frame(ts_acc_mean)

taskswitchBF$participant = factor(ts_acc_mean$participant)
taskswitchBF$posture = factor(ts_acc_mean$posture)
taskswitchBF$congruentTrialType = factor(taskswitchBF$congruentTrialType)
taskswitchBF$switchTrialType  = factor(taskswitchBF$switchTrialType)
```

```
#str(taskswitchBF)


bfValues2 = anovaBF(Accuracy~ posture*switchTrialType+participant,
                   data = taskswitchBF,
                   whichRandom = "participant",
                   method="laplace")
bfValues2
```

```
## Bayes factor analysis
## --------------
## [1] posture + participant                                             : 0.1836549 ±NA%
## [2] switchTrialType + participant                                     : 5429475   ±NA%
## [3] posture + switchTrialType + participant                           : 1064550   ±NA%
## [4] posture + switchTrialType + posture:switchTrialType + participant : 168897.1  ±NA%
##
## Against denominator:
##   Accuracy ~ participant
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
#...get the Bayes factor for the Null Interaction (vs. model w/no interaction)
bfValues2[3]/bfValues2[4]
```

```
## Bayes factor analysis
## --------------
## [1] posture + switchTrialType + participant : 6.302952 ±NA%
##
## Against denominator:
##   Accuracy ~ posture + switchTrialType + posture:switchTrialType + participant
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
1/(bfValues2[3]/bfValues2[4])
```

```
## Bayes factor analysis
## --------------
## [1] posture + switchTrialType + posture:switchTrialType + participant : 0.1586558 ±NA%
##
## Against denominator:
##   Accuracy ~ posture + switchTrialType + participant
## ---
## Bayes factor type: BFlinearModel, JZS
```

Reaction time results

```
#look at reaction time for correct trials
ts_correct_only <- task_switching_raw3 %>%
  filter(correct_bin == 1)
```

```
#Second exclusion criteria
#How many trials faster than 100 ms? Only a single one
sum(ts_correct_only$reactionTime < 100)
```

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

```
dim(ts_correct_only)
```

```
## [1] 17699    20
```

```
ts_correct_only2 <- ts_correct_only %>% filter(reactionTime >= 100)
#Sanity check, one trial is dropped. Now have 17,698 trials
dim(ts_correct_only2)
```

```
## [1] 17698    20
```

```
trimOutputTS = pjRecursiveTrim2(dataSet = ts_correct_only2,
                                  dv = "reactionTime",
                                  splitvars = c("participant",
                                                "posture",
                                                "switchTrialType",
                                                "congruentTrialType"))
trimmedTSData=trimOutputTS[[1]]
totalN.TS = trimOutputTS[[2]]
rejectedTS = trimOutputTS[[3]]
percentTrimmedTS = trimOutputTS[[4]] #this is very close to the percentage trimmed for stroop
#2.14% of trials
percentTrimmedTS
```

```
## [1] 2.141485
```

```
NcellsTS = trimOutputTS[[5]] # 51 participants * 8 conditions

trimmed_rt_mean_TS <- trimmedTSData %>%
  group_by(participant,
           posture,
           congruentTrialType,
           switchTrialType) %>%
  summarize(mean_rt    = mean(reactionTime))
```

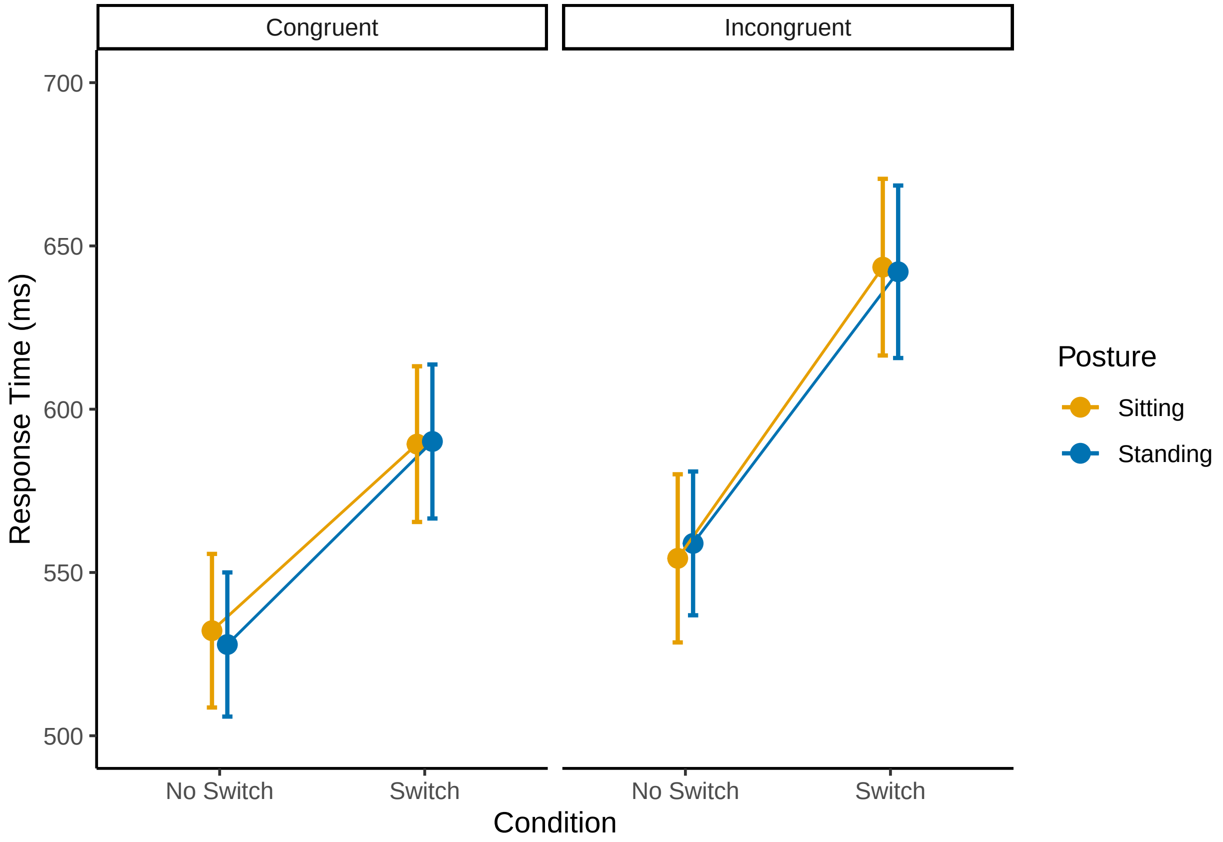
```
## ‘summarise()‘ has grouped output by ’participant’, ’posture’, ’congruentTrialType’. You can
## override using the ‘.groups‘ argument.
```

```
#Convert data to wide format
trimmed_rt_mean_TS_wide <- trimmed_rt_mean_TS %>%
  pivot_wider(names_from = c(posture,
                             congruentTrialType,
                             switchTrialType),
              values_from =   mean_rt)
```

```
trimmed_RT_plot <-
  superbPlot(trimmed_rt_mean_TS_wide,
             WSFactors = c("Condition(2)", "Congruent(2)", "Posture(2)"),
             variables = colnames(trimmed_rt_mean_TS_wide)[2:9],
             errorbar = "SE",
             plotStyle = "line",
             factorOrder = c("Condition","Posture","Congruent"),
             adjustments = list(purpose = "difference"))+
  theme_classic()+
  facet_wrap(vars(Congruent), labeller = labeller(Congruent = congruent.labs)) +
  scale_x_discrete(labels=c("1" = "No Switch", "2" = "Switch"))+
  scale_color_manual(values=c("#E69F00", "#0072B2"), labels = c("Sitting", "Standing")) +
  ylim(500, 700) +
  labs(y = "Response Time (ms)")
```

```
## superb::FYI: Here is how the within-subject variables are understood:
##  Condition Congruent Posture                      variable
##          1         1       1    sitting_congruent_noswitch
##          2         1       1      sitting_congruent_switch
##          1         2       1  sitting_incongruent_noswitch
##          2         2       1    sitting_incongruent_switch
##          1         1       2   standing_congruent_noswitch
##          2         1       2     standing_congruent_switch
##          1         2       2 standing_incongruent_noswitch
##          2         2       2   standing_incongruent_switch
```

```
ggsave(trimmed_RT_plot,
       file = "results/plots/fig2_exp2_ts_trimmed_RT_plot.pdf",
       units = "in",
       width = 6.62,
       height = 5.50,
       dpi = 600)

trimmed_RT_plot
```



```
rtModelTS <- aov_ez(data = trimmed_rt_mean_TS,
                    dv = 'mean_rt',
                    id = 'participant',
                    within = c('posture',
                               'congruentTrialType',
                               'switchTrialType'),
                    type = 3,
                    anova_table = list(es = "pes"))

rt.stats.TS <- ezStats(trimmed_rt_mean_TS,
                                   dv = mean_rt,
                                   wid = participant,
                                   within = .(posture, congruentTrialType, switchTrialType),
                                   type = 3
)
```

```
## Warning: Converting "participant" to factor for ANOVA.
```

```
## Warning: Converting "posture" to factor for ANOVA.
```

```
## Warning: Converting "congruentTrialType" to factor for ANOVA.
```

```
## Warning: Converting "switchTrialType" to factor for ANOVA.
```

```
write.csv(rt.stats.TS[ ,-7],
          file = "results/exp2_Descriptives_trimmed_RT.csv",
          row.names = F)

write.csv(rtModelTS$anova_table, file = "results/exp2_ANOVA_trimmed_RT.csv")
rtModelTS
```

```
## Anova Table (Type 3 tests)
##
## Response: mean_rt
##                                       Effect    df     MSE          F   pes p.value
## 1                                    posture 1, 50 9922.05       0.00 <.001    .995
## 2                         congruentTrialType 1, 50 3302.21  48.98 ***  .495   <.001
## 3                            switchTrialType 1, 50 4166.22 130.17 ***  .722   <.001
## 4                 posture:congruentTrialType 1, 50 1592.27       0.17  .003    .679
## 5                    posture:switchTrialType 1, 50 1519.08       0.00 <.001    .951
## 6         congruentTrialType:switchTrialType 1, 50 1252.33  14.32 ***  .223   <.001
## 7 posture:congruentTrialType:switchTrialType 1, 50 1552.36       0.50  .010    .483
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '+' 0.1 ' ' 1
```

```
trimmed_rt_mean_TS2 <- data.frame(trimmed_rt_mean_TS)
trimmed_rt_mean_TS2$participant = factor(trimmed_rt_mean_TS2$participant)
trimmed_rt_mean_TS2$posture = factor(trimmed_rt_mean_TS2$posture)
trimmed_rt_mean_TS2$congruentTrialType = factor(trimmed_rt_mean_TS2$congruentTrialType)
trimmed_rt_mean_TS2$switchTrialType  = factor(trimmed_rt_mean_TS2$switchTrialType)

bfValues2.RT = anovaBF(mean_rt ~ posture*switchTrialType+participant,
                   data = trimmed_rt_mean_TS2,
                   whichRandom = "participant",
                   method="laplace")
bfValues2.RT
```

```
## Bayes factor analysis
## --------------
## [1] posture + participant                                            : 0.1007388    ±NA%
## [2] switchTrialType + participant                                    : 4.227658e+24 ±NA%
## [3] posture + switchTrialType + participant                          : 4.265145e+23 ±NA%
## [4] posture + switchTrialType + posture:switchTrialType + participant : 6.012989e+22 ±NA%
##
## Against denominator:
##   mean_rt ~ participant
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
#...get the Bayes factor for the Null Interaction (vs. model w/no interaction)
bfValues2.RT[3]/bfValues2.RT[4]
```

```
## Bayes factor analysis
## --------------
## [1] posture + switchTrialType + participant : 7.093219 ±NA%
##
```

```
## Against denominator:
##   mean_rt ~ posture + switchTrialType + posture:switchTrialType + participant
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
1/(bfValues2.RT[3]/bfValues2.RT[4])
```

```
## Bayes factor analysis
## --------------
## [1] posture + switchTrialType + posture:switchTrialType + participant : 0.1409797 ±NA%
##
## Against denominator:
##   mean_rt ~ posture + switchTrialType + participant
## ---
## Bayes factor type: BFlinearModel, JZS
```

Experiment 3 - Visual search

Import and clean data

```
vs_files = list.files(path = "data/Experiment 3 Data/", full.names = T)
vs_files = vs_files[str_detect(vs_files,pattern="(?=.*SJ)(?=.*.txt)")]

merged.VS.data <- ldply(vs_files,
                        read.delim,
                        header=FALSE,
                        stringsAsFactors = FALSE,
                        sep = "")  #for each item in the list apply the function read.delim

#..ADD HEADERS
names(merged.VS.data) = c("sj",
                        "cb",
                        "blockNumber",
                        "blockType",
                        "trialNum",
                        "target",
                        "targetImage",
                        "distractor",
                        "distractorImage",
                        "posture",
                        "setSize",
                        "rt",
                        "resp",
                        "cresp",
                        "ac")

#...look at unique values from both columns
unique(merged.VS.data[c('sj')])
```

```
##       sj
## 1       1
## 265    10
## 529    11
## 793    12
## 1057   13
## 1321   14
## 1585   15
## 1849   16
## 2113   17
## 2377   18
## 2641   19
## 2905    2
## 3169   20
## 3433   21
## 3697   22
## 3961   23
## 4225   24
## 4489   25
## 4753   26
## 5017   27
## 5281   28
## 5545   29
## 5809    3
## 6073   30
## 6337   31
## 6601   32
## 6865   33
## 7129   34
## 7393   35
## 7657   36
## 7921   37
## 8185   38
## 8449   39
## 8713    4
## 8977   40
## 9241   41
## 9505   42
## 9769   43
## 10033 44
## 10297 45
## 10561 46
## 10825 47
## 11089 48
## 11353 49
## 11617  5
## 11881 50
## 12145  6
## 12409  7
## 12673  8
## 12937  9
```

```
unique(merged.VS.data[c('blockType')])
```

```
##      blockType
## 1     practice
## 9 experimental
```

```
#..DOES EACH SUBJECT HAVE THE SAME NUMBER OF TRIALS
ftable(blockType~sj, merged.VS.data)
```

```
##    blockType experimental practice
## sj
## 1                     256        8
## 2                     256        8
## 3                     256        8
## 4                     256        8
## 5                     256        8
## 6                     256        8
## 7                     256        8
## 8                     256        8
## 9                     256        8
## 10                    256        8
## 11                    256        8
## 12                    256        8
## 13                    256        8
## 14                    256        8
## 15                    256        8
## 16                    256        8
## 17                    256        8
## 18                    256        8
## 19                    256        8
## 20                    256        8
## 21                    256        8
## 22                    256        8
## 23                    256        8
## 24                    256        8
## 25                    256        8
## 26                    256        8
## 27                    256        8
## 28                    256        8
## 29                    256        8
## 30                    256        8
## 31                    256        8
## 32                    256        8
## 33                    256        8
## 34                    256        8
## 35                    256        8
## 36                    256        8
## 37                    256        8
## 38                    256        8
## 39                    256        8
## 40                    256        8
## 41                    256        8
## 42                    256        8
## 43                    256        8
## 44                    256        8
## 45                    256        8
## 46                    256        8
## 47                    256        8
## 48                    256        8
## 49                    256        8
## 50                    256        8
```

```
#...DO WE HAVE EQUAL OBSERVATIONS FOR EACH COUNTERBALANCE
ftable(blockType~cb, merged.VS.data)
```

```
##    blockType experimental practice
## cb
## 1                    6400      200
## 2                    6400      200
```

```
#...LOOK FOR MISSING DATA
merged.VS.data[!complete.cases(merged.VS.data),]
```

```
##  [1] sj              cb              blockNumber     blockType       trialNum        target
##  [7] targetImage     distractor      distractorImage posture         setSize         rt
## [13] resp            cresp           ac
## <0 rows> (or 0-length row.names)
```

```
#... GET RID OF PRACTICE TRIALS
merged.VS.data <- merged.VS.data[!merged.VS.data$blockType=="practice",]

#.... CHECK TRIALS PER CONDITION
ftable(posture+target+distractor+setSize~sj, merged.VS.data)
```

```
##    posture    SITTING                      STANDING
##    target           h           s                 h           s
##    distractor       e     u     e     u           e     u     e     u
##    setSize          4  8  4  8  4  8  4  8        4  8  4  8  4  8  4  8
## sj
## 1                  16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 2                  16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 3                  16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 4                  16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 5                  16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 6                  16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 7                  16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 8                  16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 9                  16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 10                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 11                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 12                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 13                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 14                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 15                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 16                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 17                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 18                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 19                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 20                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 21                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 22                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 23                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 24                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 25                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 26                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 27                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 28                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 29                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 30                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 31                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 32                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 33                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 34                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 35                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 36                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 37                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 38                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 39                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 40                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 41                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 42                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 43                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 44                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 45                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 46                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 47                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 48                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 49                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
## 50                 16 16 16 16 16 16 16 16       16 16 16 16 16 16 16 16
```

```
#... UNLIKE THE STROOP, PARTICIPANTS WERE ALLOWED TO TAKE LONGER THAN 1500MS BUT WERE GIVEN A WARNING
#... TRIALS LONGER THAN 1500 MS will be considered errors (i.e., they will be dropped in RT but kept in
#... Set values in the ac column to 0 on trials where a response is > = 1500

#...check that only experimental trials are left
unique(merged.VS.data$blockType)
```

```
## [1] "experimental"
```

```
write.table(merged.VS.data, file = "results/exp3_merged_vs_data.txt", row.names = F)

#...count trials
totalTrialsVS = dim(merged.VS.data)[1]
observationDataVS = data.frame(ftable(blockType~sj, merged.VS.data))[,c(1,3)]

#...get the number of extreme trials <100 - anticipatory or fast responses
merged.VS.data= merged.VS.data[!merged.VS.data$rt<=100,]
validRTTrialsVS = dim(merged.VS.data)[1]
observationDataVS$validTrials = data.frame(ftable(blockType~sj, merged.VS.data))[,c(3)]

print(paste("percent invalid trials = ", ((totalTrialsVS-validRTTrialsVS)/totalTrialsVS)*100))
```

```
## [1] "percent invalid trials =  0"
```

```
#...get the number of time outs
timeOutVS = merged.VS.data %>% filter(rt >= 1500)
dim(timeOutVS)[1]
```

```
## [1] 168
```

```
ftable(posture~setSize, timeOutVS)
```

```
##         posture SITTING STANDING
## setSize
## 4                    32       13
## 8                    56       67
```

```
ftable(posture~sj, timeOutVS)
```

```
##    posture SITTING STANDING
## sj
## 2                9       12
## 3                2        0
## 4                6        2
## 5                3        1
## 6                0        1
## 7                1        2
## 9                4        6
## 10               7        3
## 11               3        2
## 12               2        7
## 13               4        1
## 15               1        2
## 17               2        0
## 18               0        1
## 19               3        2
## 20               1        2
## 22               2        2
## 24               0        2
## 25               2        4
## 27               0        2
## 28               0        1
## 29               5        6
## 30               2        0
## 31               3        0
## 33               0        1
## 35               3        2
## 36               0        1
## 37               0        1
## 39               2        3
## 40               3        3
## 41               0        2
## 42               2        1
## 44               4        2
## 45               3        0
## 46               3        0
## 47                0        1
## 48                1        0
## 49                3        2
## 50                2        0
```

```
ftable(blockType~setSize, timeOutVS)
```

```
##         blockType experimental
## setSize
## 4                           45
## 8                          123
```

```
merged.VS.data.convention <- merged.VS.data %>% filter(rt < 1500)
write.csv(merged.VS.data.convention,
          file = "results/exp3_merged_vs_data_conv.csv",
          row.names = F)


#...this code changes the 1550ms+ trials into errors
merged.VS.data.orig <- merged.VS.data
merged.VS.data$ac[merged.VS.data$rt>=1500] = 0

vsCorrect = merged.VS.data[merged.VS.data$ac ==1,]

errorsRemovedVS = dim(vsCorrect)[1]
observationDataVS$correctTrials = data.frame(ftable(blockType~sj, vsCorrect))[,c(3)]

trimInfo = data.frame(totalTrialsVS, validRTTrialsVS, errorsRemovedVS)
head(trimInfo)
```

```
##   totalTrialsVS validRTTrialsVS errorsRemovedVS
## 1         12800           12800           12397
```

```
#################################
#...CHECK 20% CRITERION
#################################
observationDataVS$percentLoss = ((observationDataVS$Freq-observationDataVS$correctTrials)/observationDat
sum(observationDataVS$percentLoss>20)
```

```
## [1] 0
```

```
#...None!

#...RUN TRIMMING PROCEDURE
tempList = pjRecursiveTrim2(vsCorrect, #...dataset
                            "rt", #...dependent variables
                            c("sj",
                              "cb",
                              "setSize",
                              "posture")) #.independent variables

trimmedData=tempList[[1]]
```

```
totalN = tempList[[2]]
rejected = tempList[[3]]
percentTrimmed = tempList[[4]]
Ncells = tempList[[5]]

print(paste("Percent of outliers removed: ",round(percentTrimmed,3)))
```

```
## [1] "Percent of outliers removed:  1.339"
```

```
#...get the trimming info
output.out= data.frame(totalN, rejected,percentTrimmed,Ncells)
head(output.out)
```

```
##   totalN rejected percentTrimmed Ncells
## 1  12397      166       1.339034    200
```

```
#...get mean error data
vsPE = plyr::ddply(merged.VS.data,
                 .(sj,cb,setSize, posture),
                 summarise,
                 meanPE = 100 - (mean(ac)*100))
head(vsPE)
```

```
##   sj cb setSize  posture meanPE
## 1  1  1       4  SITTING 0.0000
## 2  1  1       4 STANDING 0.0000
## 3  1  1       8  SITTING 0.0000
## 4  1  1       8 STANDING 0.0000
## 5  2  1       4  SITTING 4.6875
## 6  2  1       4 STANDING 4.6875
```

```
vsRT = plyr::ddply(trimmedData,
                 .(sj, cb, setSize,posture),
                 summarise,
                 meanRT = mean(rt))

#...combine the RT and error data
vsCombined = cbind(vsRT,meanPE =vsPE$meanPE)
str(vsCombined)
```

```
## 'data.frame':    200 obs. of  6 variables:
##  $ sj     : int  1 1 1 1 2 2 2 2 3 3 ...
##  $ cb     : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ setSize: int  4 4 8 8 4 4 8 8 4 4 ...
##  $ posture: chr  "SITTING" "STANDING" "SITTING" "STANDING" ...
##  $ meanRT : num  677 593 736 620 792 ...
##  $ meanPE : num  0 0 0 0 4.69 ...
```

```
#...set as factors
vsCombined$sj = factor(vsCombined$sj)
vsCombined$cb = factor(vsCombined$cb)
```

```
vsCombined$setSize = factor(vsCombined$setSize)
vsCombined$postureFactor = factor(vsCombined$posture)
summary(vsCombined$cb)
```

```
##   1   2
## 100 100
```

Reaction time results

```
rtModelVS <- ezANOVA(vsCombined,
                   dv = .(meanRT),
                   wid=.(sj),
                   within=.(postureFactor,setSize),
                   detailed=TRUE,
                   type=3,
                   return_aov=TRUE)

rtModelVS$ANOVA
```

```
##                  Effect DFn DFd          SSn        SSd            F            p p<.05
## 1           (Intercept)   1  49 1.084958e+08 1189588.17 4.469020e+03 8.326740e-50     *
## 2         postureFactor   1  49 2.052064e+04  153738.29 6.540411e+00 1.369090e-02     *
## 3               setSize   1  49 3.574624e+05   46863.03 3.737628e+02 1.414816e-24     *
## 4 postureFactor:setSize   1  49 2.246613e+01   35654.35 3.087534e-02 8.612429e-01
##            ges
## 1 9.870285e-01
## 2 1.418774e-02
## 3 2.004492e-01
## 4 1.575613e-05
```

```
rt.VS.MSE <- rtModelVS$ANOVA$SSd/rtModelVS$ANOVA$DFd

#...print ANOVA in nice format
paste(rtModelVS$ANOVA$Effect,":  F(",
      rtModelVS$ANOVA$DFn,
      ", ",
      rtModelVS$ANOVA$DFd,
      ") = ",
      round(rtModelVS$ANOVA$F,3),
      ", MSE = ",
      round(rt.VS.MSE,3),
      ", p = ",
      round(rtModelVS$ANOVA$p,3),
      ", partialEtaSq = ",
      round(rtModelVS$ANOVA$SSn/(rtModelVS$ANOVA$SSn+rtModelVS$ANOVA$SSd),4),sep="")
```

```
## [1] "(Intercept):  F(1, 49) = 4469.02, MSE = 24277.31, p = 0, partialEtaSq = 0.9892"
## [2] "postureFactor:  F(1, 49) = 6.54, MSE = 3137.516, p = 0.014, partialEtaSq = 0.1178"
## [3] "setSize:  F(1, 49) = 373.763, MSE = 956.388, p = 0, partialEtaSq = 0.8841"
## [4] "postureFactor:setSize:  F(1, 49) = 0.031, MSE = 727.64, p = 0.861, partialEtaSq = 6e-04"
```

```
#...CALCULATE THE BAYES FACTORS FOR THE RT ANALYSIS
bfValues3 = anovaBF(meanRT~setSize*postureFactor+sj,
                   data = vsCombined,
                   whichRandom = "sj",
                   method="laplace")
bfValues3
```

```
## Bayes factor analysis
## --------------
## [1] setSize + sj                                         : 2.916459e+26 ±NA%
## [2] postureFactor + sj                                   : 1.51507      ±NA%
## [3] setSize + postureFactor + sj                         : 1.321058e+28 ±NA%
## [4] setSize + postureFactor + setSize:postureFactor + sj : 2.585184e+27 ±NA%
##
## Against denominator:
##   meanRT ~ sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
#...get the Bayes factor for the Null Interaction
bfValues3[3]/bfValues3[4]
```

```
## Bayes factor analysis
## --------------
## [1] setSize + postureFactor + sj : 5.110113 ±NA%
##
## Against denominator:
##   meanRT ~ setSize + postureFactor + setSize:postureFactor + sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
1/(bfValues3[3]/bfValues3[4])
```

```
## Bayes factor analysis
## --------------
## [1] setSize + postureFactor + setSize:postureFactor + sj : 0.1956904 ±NA%
##
## Against denominator:
##   meanRT ~ setSize + postureFactor + sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
###############################################
# GET DIFFERENCE SCORES - SEARCH RATE
##############################################

wideData = dcast(vsCombined, #the name of the dataframe you want to reshape
                 sj+cb #row variables
                 ~posture+setSize, #row variables ~ column variables
                 value.var = "meanRT")
head(wideData)
```

```
##   sj cb SITTING_4 SITTING_8 STANDING_4 STANDING_8
## 1  1  1  676.5238  735.5397   593.1129   619.6406
## 2  2  1  792.4590  931.9474   815.7213   993.5000
## 3  3  1  721.2787  827.2222   654.1639   774.5238
## 4  4  1  695.7119  741.9298   660.2632   653.0172
## 5  5  1  693.6034  839.2903   705.1967   759.7419
## 6  6  1  625.3750  694.0484   592.4531   687.5645
```

```
wideData$sittingEffect = (wideData$SITTING_8-wideData$SITTING_4)/4
wideData$standingEffect = (wideData$STANDING_8-wideData$STANDING_4)/4
wideData$interaction = wideData$sittingEffect - wideData$standingEffect

searchratestand = mean(wideData$standingEffect)  #...search rate in standing condition
searchratesit = mean(wideData$sittingEffect)  #...search rate in the sitting condition

searchratestand
```

```
## [1] 21.30589
```

```
searchratesit
```

```
## [1] 20.97073
```

```
#One-sample t-tests
t.test(wideData$standingEffect)
```

```
##
##  One Sample t-test
##
## data:  wideData$standingEffect
## t = 16.69, df = 49, p-value < 2.2e-16
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  18.74050 23.87127
## sample estimates:
## mean of x
##  21.30589
```

```
t.test(wideData$sittingEffect)
```

```
##
##  One Sample t-test
##
## data:  wideData$sittingEffect
## t = 13.055, df = 49, p-value < 2.2e-16
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  17.74261 24.19884
## sample estimates:
## mean of x
##  20.97073
```

```
#...Exact Binomial SIGN TEST
binom.test(length(wideData$interaction[wideData$interaction>=0]),
           length(unique(vsCombined$sj)))
```

```
##
##  Exact binomial test
##
## data:  length(wideData$interaction[wideData$interaction >= 0]) and length(unique(vsCombined$sj))
## number of successes = 25, number of trials = 50, p-value = 1
## alternative hypothesis: true probability of success is not equal to 0.5
## 95 percent confidence interval:
##  0.355273 0.644727
## sample estimates:
## probability of success
##                    0.5
```

Percent error results

```
errModelVS <- ezANOVA(vsCombined,
                   dv = .(meanPE),
                   wid=.(sj),
                   within=.(postureFactor,setSize),
                   detailed=TRUE,
                   type=3,
                   return_aov = TRUE)

errModelVS
```

```
## $ANOVA
##                  Effect DFn DFd         SSn       SSd          F            p p<.05         ges
## 1           (Intercept)   1  49 1982.531738 1158.9478 83.8209098 3.463466e-12     * 0.504342884
## 2         postureFactor   1  49    3.527832  227.7954  0.7588554 3.879351e-01       0.001807368
## 3               setSize   1  49  129.504395  343.5181 18.4727266 8.162026e-05     * 0.062324860
## 4 postureFactor:setSize   1  49   20.520020  218.1274  4.6096032 3.676850e-02     * 0.010422027
##
## $aov
##
## Call:
## aov(formula = formula(aov_formula), data = data)
##
## Grand Mean: 3.148438
##
## Stratum 1: sj
##
## Terms:
##                 Residuals
## Sum of Squares   1158.948
## Deg. of Freedom        49
##
## Residual standard error: 4.863332
##
```

```
## Stratum 2: sj:postureFactor
##
## Terms:
##                 postureFactor Residuals
## Sum of Squares        3.52783 227.79541
## Deg. of Freedom             1        49
##
## Residual standard error: 2.156128
## 1 out of 2 effects not estimable
## Estimated effects are balanced
##
## Stratum 3: sj:setSize
##
## Terms:
##                  setSize Residuals
## Sum of Squares  129.5044  343.5181
## Deg. of Freedom        1        49
##
## Residual standard error: 2.647749
## 1 out of 2 effects not estimable
## Estimated effects are balanced
##
## Stratum 4: sj:postureFactor:setSize
##
## Terms:
##                 postureFactor:setSize Residuals
## Sum of Squares               20.52002 218.12744
## Deg. of Freedom                     1        49
##
## Residual standard error: 2.109877
## Estimated effects are balanced
```

```
err.VS.MSE <- errModelVS$ANOVA$SSd/errModelVS$ANOVA$DFd

paste(errModelVS$ANOVA$Effect,":  F(",
      errModelVS$ANOVA$DFn,
      ", ",
      errModelVS$ANOVA$DFd,
      ") = ",
      round(errModelVS$ANOVA$F,3),
      ", MSE = ",
      round(err.VS.MSE,3),
      ", p = ",
      round(errModelVS$ANOVA$p,3),
      ", partialEtaSq = ",
      round(errModelVS$ANOVA$SSn/(errModelVS$ANOVA$SSn+errModelVS$ANOVA$SSd),4),sep="")
```

```
## [1] "(Intercept):  F(1, 49) = 83.821, MSE = 23.652, p = 0, partialEtaSq = 0.6311"
## [2] "postureFactor:  F(1, 49) = 0.759, MSE = 4.649, p = 0.388, partialEtaSq = 0.0153"
## [3] "setSize:  F(1, 49) = 18.473, MSE = 7.011, p = 0, partialEtaSq = 0.2738"
## [4] "postureFactor:setSize:  F(1, 49) = 4.61, MSE = 4.452, p = 0.037, partialEtaSq = 0.086"
```

```
wideData = dcast(vsCombined, #the name of the dataframe you want to reshape
                 sj+cb #row variables
                 ~posture+setSize, #row variables ~ column variables
                 value.var = "meanPE")
head(wideData)
```

```
##   sj cb SITTING_4 SITTING_8 STANDING_4 STANDING_8
## 1  1  1    0.0000    0.0000     0.0000     0.0000
## 2  2  1    4.6875   10.9375     4.6875    15.6250
## 3  3  1    1.5625    1.5625     0.0000     0.0000
## 4  4  1    6.2500   10.9375     4.6875     6.2500
## 5  5  1    3.1250    3.1250     1.5625     1.5625
## 6  6  1    0.0000    1.5625     0.0000     1.5625
```

```
wideData$sittingEffect = (wideData$SITTING_8-wideData$SITTING_4)/4
wideData$standingEffect = (wideData$STANDING_8-wideData$STANDING_4)/4
wideData$interaction = wideData$sittingEffect - wideData$standingEffect

searchratestand = mean(wideData$standingEffect)  #...search rate in standing condition
searchratesit = mean(wideData$sittingEffect)  #...search rate in the sitting condition

searchratestand
```

```
## [1] 0.5625
```

```
searchratesit
```

```
## [1] 0.2421875
```

```
#One-sample t-tests
t.test(wideData$standingEffect)
```

```
##
##  One Sample t-test
##
## data:  wideData$standingEffect
## t = 4.0858, df = 49, p-value = 0.0001623
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  0.2858399 0.8391601
## sample estimates:
## mean of x
##    0.5625
```

```
t.test(wideData$sittingEffect)
```

```
##
##  One Sample t-test
##
## data:  wideData$sittingEffect
## t = 2.4588, df = 49, p-value = 0.01752
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  0.04424588 0.44012912
## sample estimates:
## mean of x
## 0.2421875
```

```
#...CALCULATE THE BAYES FACTORS FOR THE RT ANALYSIS
bfValues3.error = anovaBF(meanPE~setSize*postureFactor+sj,
                   data = vsCombined,
                   whichRandom = "sj",
                   method="laplace")
bfValues3.error
```

```
## Bayes factor analysis
## --------------
## [1] setSize + sj                                         : 4888.005  ±NA%
## [2] postureFactor + sj                                   : 0.1823325 ±NA%
## [3] setSize + postureFactor + sj                         : 937.7872  ±NA%
## [4] setSize + postureFactor + setSize:postureFactor + sj : 997.3734  ±NA%
##
## Against denominator:
##   meanPE ~ sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
#...get the Bayes factor for the Null Interaction
bfValues3.error[3]/bfValues3.error[4]
```

```
## Bayes factor analysis
## --------------
## [1] setSize + postureFactor + sj : 0.9402568 ±NA%
##
## Against denominator:
##   meanPE ~ setSize + postureFactor + setSize:postureFactor + sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
1/(bfValues3.error[3]/bfValues3.error[4])
```

```
## Bayes factor analysis
## --------------
## [1] setSize + postureFactor + setSize:postureFactor + sj : 1.063539 ±NA%
##
## Against denominator:
##   meanPE ~ setSize + postureFactor + sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

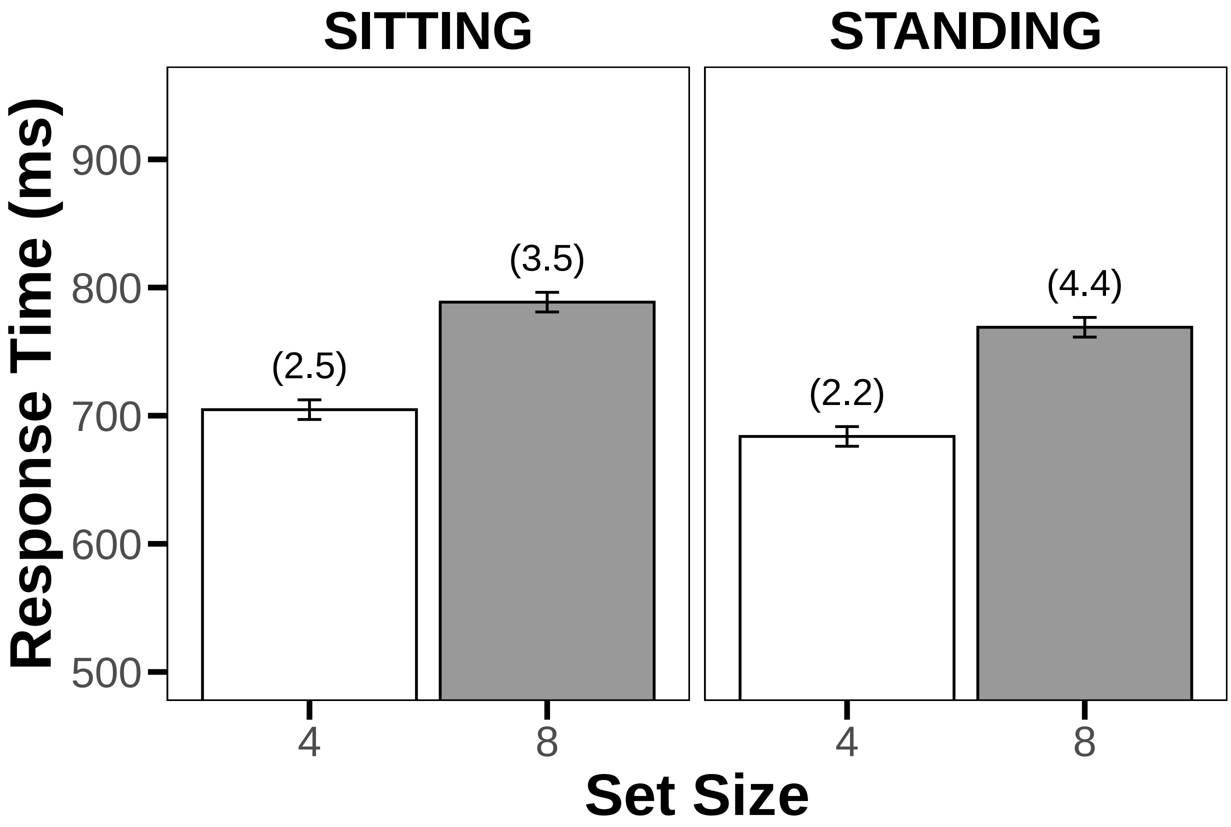
Make plots for visual search

```r
graphRT3 = describeBy(vsCombined$meanRT,
                      list(vsCombined$posture,vsCombined$setSize),
                      mat=TRUE,
                      digits = 1)
graphPE3 = describeBy(vsCombined$meanPE,
                      list(vsCombined$posture,vsCombined$setSize),
                      mat=TRUE,
                      digits = 1)

graphRT3 = graphRT3[,c("group1","group2","mean","se")]
graphPE3 = graphPE3[,c("group1","group2","mean","se")]

names(graphRT3) = c("posture","setSize","mean","se")
names(graphPE3) = c("posture","setSize","mean","se")

graphRT3$posture = str_to_upper(graphRT3$posture)

#####################################################
#..calculate the within subjects confidence intervals based on loftus and masson
#..the confidence intervals are based on the interaction term.
#####################################################

graphRT3$se = sqrt((rt.VS.MSE[4])/length(unique(vsCombined$sj)))
graphPE3$se= sqrt((err.VS.MSE[4])/length(unique(vsCombined$sj)))

#####################################################
#..calculate the within subjects confidence intervals based on loftus and masson
#..the confidence intervals are based on the interaction term.
#####################################################


critT3 = qt(p=.025,df=length(unique(vsCombined$sj))-2,lower.tail =FALSE)

#---add the min and max for the confidence intervals
graphRT3$min = graphRT3$mean - (graphRT3$se*critT3)
graphRT3$max = graphRT3$mean + (graphRT3$se*critT3)

####GET AC DATA FROM twoAnimalWordsPRPac.R
graphRT3$ac = paste("(",format(round(graphPE3$mean,digits=1),nsmall = 1),")",sep="")
head(graphRT3)
```

```
##      posture setSize  mean       se      min      max    ac
## X11  SITTING       4 704.7 3.814813 697.0298 712.3702 (2.5)
## X12 STANDING       4 683.8 3.814813 676.1298 691.4702 (2.2)
## X13  SITTING       8 788.6 3.814813 780.9298 796.2702 (3.5)
## X14 STANDING       8 769.0 3.814813 761.3298 776.6702 (4.4)
```

```r
graphRT3$vAdj = 35 #down
graphRT3$vAdj[graphRT$setSize=="incongruent"]=35 #up
graphRT3$hAdj = 0 #right
```

```
#graphRT$hAdj[graphRT$posture=="SITTING"]=-60 #left

graphRT3$congruency = factor(graphRT3$setSize,labels = c("4","8"))

interactionPlot3 <- ggplot(graphRT3, aes(setSize, mean, group=posture)) +
  theme(legend.position = "none")+
  scale_fill_manual(values=c("#FFFFFF","#999999","#FFFFFF","#999999"))+
  coord_cartesian(ylim=c(500,950),expand=TRUE)+
  scale_y_continuous(breaks = round(seq(500, 950, by = 100),0))+
  geom_text(aes(label=ac),nudge_x=graphRT3$hAdj,nudge_y =graphRT3$vAdj,size=5)+
  geom_bar(stat="identity", aes(fill=interaction(setSize)),colour="black")+
  geom_errorbar(aes(ymin=min,ymax=max,group=interaction(posture,setSize)), width=.1)+
  labs(x = "Set Size", y = "Response Time (ms)") +
  theme(axis.ticks = element_line(size = 1, colour = "black", linetype = "solid"),
        axis.ticks.length = unit(.25,"cm"),
        #axis.line = element_line(size = 1, colour = "black", linetype = "solid"),
        panel.background = element_rect(fill = "white", colour = "white", size = 1),
        axis.text=element_text(size=16),
        axis.title=element_text(size=22,face="bold"),
        strip.text = element_text(size = 20, face = "bold",colour = "black", angle = 0),
        panel.border = element_rect(colour = "black", fill = NA, size = 0.50),
        strip.background = element_rect(fill=NA,colour="NA",size = 2))+
  facet_grid(~posture)

interactionPlot3
```



```
ggsave(interactionPlot3,
       file = "results/plots/fig4_exp3_visual_search_interaction_plot.pdf",
       units = "in",
       width = 8.5,
       height = 5,
       dpi = 600)
```

Reproduce results from Smith et al.

```
# Data source: The data from all the experiments are available at:
# http://rabrams.net under the Resources tab.

### Experiment 1 (Stroop)

#load acc data
Smith_Exp1_acc <- read_excel("data/smith_data.xlsx",
                             sheet = "Exp1Acc",
                             n_max = 14) #Sample size in Smith
#load rt data
Smith_Exp1_rt <- read_excel("data/smith_data.xlsx",
                            sheet = "Exp1RT",
                            n_max = 14)

#Restructure from wide to narrow, using tidyr
Smith_Exp1_acc_narrow <- Smith_Exp1_acc %>%
  pivot_longer(cols = sit_neut:sta_con, names_to = "condition", values_to = "acc") %>%
  separate(col = condition, into = c("posture", "con"))

Smith_Exp1_rt_narrow <- Smith_Exp1_rt %>%
  pivot_longer(cols = sit_neut:sta_con, names_to = "condition", values_to = "rt") %>%
  separate(col = condition, into = c("posture", "con"))

Smith_Exp1 <- merge(Smith_Exp1_acc_narrow, Smith_Exp1_rt_narrow)


Smith_exp1_anova_acc <- aov_ez(data = Smith_Exp1,
                               dv = 'acc',
                               id = 'subj',
                               within = c('posture', 'con'),
                               anova_table = list(es = "pes", correction = "none"),
                               type = 3)
kable(nice(Smith_exp1_anova_acc), caption = "ANOVA results for Smith Exp 1 - accuracy")
```

Table 2: ANOVA results for Smith Exp 1 - accuracy

Effect	df	MSE	F	pes	p.value
posture	1, 13	4.59	0.51	.038	.488
con	2, 26	3.19	3.76 *	.224	.037
posture:con	2, 26	2.18	1.47	.101	.250

```
Smith_exp1_anova_rt <- aov_ez(data = Smith_Exp1,
                              dv = 'rt',
                              id = 'subj',
                              within = c('posture', 'con'),
                              anova_table = list(es = "pes", correction = "none"),
                              type = 3)
kable(nice(Smith_exp1_anova_rt), caption = "ANOVA results for Smith Exp 1 - RT")
```

Table 3: ANOVA results for Smith Exp 1 - RT

Effect	df	MSE	F	pes	p.value
posture	1, 13	816.34	0.09	.007	.768
con	2, 26	150.32	3.45 *	.210	.047
posture:con	2, 26	128.10	4.73 *	.267	.018

```
### Experiment 2 (Task-switching)

#load acc data
Smith_Exp2_acc <- read_excel("data/smith_data.xlsx",
                             sheet = "Exp2Acc",
                             n_max = 30)
#load rt data
Smith_Exp2_rt <- read_excel("data/smith_data.xlsx",
                            sheet = "Exp2RT",
                            n_max = 30)

#Restructure from wide to narrow, using tidyr
Smith_Exp2_acc_narrow <- Smith_Exp2_acc %>%
  pivot_longer(cols = sit_congruent_noswitch:stand_incongruent_switch,
               names_to = "condition", values_to = "acc") %>%
  separate(col = condition, into = c("posture", "con", "switch"))

Smith_Exp2_rt_narrow <- Smith_Exp2_rt %>%
  pivot_longer(cols = sit_congruent_noswitch:stand_incongruent_switch,
               names_to = "condition", values_to = "rt") %>%
  separate(col = condition, into = c("posture", "con", "switch"))

Smith_Exp2 <- merge(Smith_Exp2_acc_narrow, Smith_Exp2_rt_narrow)


Smith_exp2_anova_acc <- aov_ez(data = Smith_Exp2,
                               dv = 'acc',
                               id = 'subj',
                               within = c('posture', 'con', 'switch'),
                               anova_table = list(es = "pes", correction = "none"),
                               type = 3)
kable(nice(Smith_exp2_anova_acc), caption = "ANOVA results for Smith Exp 2 - accuracy")
```

Table 4: ANOVA results for Smith Exp 2 - accuracy

Effect	df	MSE	F	pes	p.value
posture	1, 29	0.00	2.86	.090	.101
con	1, 29	0.00	67.40 ***	.699	<.001
switch	1, 29	0.00	62.94 ***	.685	<.001
posture:con	1, 29	0.00	1.68	.055	.205
posture:switch	1, 29	0.00	5.54 *	.160	.026
con:switch	1, 29	0.00	23.34 ***	.446	<.001
posture:con:switch	1, 29	0.00	0.50	.017	.484

```r
Smith_exp2_anova_rt <- aov_ez(data = Smith_Exp2,
                              dv = 'rt',
                              id = 'subj',
                              within = c('posture', 'con', 'switch'),
                              anova_table = list(es = "pes", correction = "none"),
                              type = 3)
kable(nice(Smith_exp2_anova_rt), caption = "ANOVA results for Smith Exp 2 - RT")
```

Table 5: ANOVA results for Smith Exp 2 - RT

Effect	df	MSE	F	pes	p.value
posture	1, 29	0.02	0.03	.001	.856
con	1, 29	0.00	40.95 ***	.585	<.001
switch	1, 29	0.00	115.10 ***	.799	<.001
posture:con	1, 29	0.00	0.49	.017	.489
posture:switch	1, 29	0.00	0.10	.004	.751
con:switch	1, 29	0.00	4.77 *	.141	.037
posture:con:switch	1, 29	0.00	0.67	.023	.420

```r
### Experiment 3 (Visual Search)

#load acc data
Smith_Exp3_acc <- read_excel("data/smith_data.xlsx",
                             sheet = "Exp3Acc",
                             n_max = 12) %>%
  select(subj:sit8)

#load rt data
Smith_Exp3_rt <- read_excel("data/smith_data.xlsx",
                            sheet = "Exp3RT",
                            n_max = 12)%>%
  select(subj:sit8)

#Restructure from wide to narrow, using tidyr
Smith_Exp3_acc_narrow <- Smith_Exp3_acc %>%
  pivot_longer(cols = stand4:sit8, names_to = "condition", values_to = "acc") %>%
  separate(col = condition, into = c("posture", "set.size"), sep = -1)

Smith_Exp3_rt_narrow <- Smith_Exp3_rt %>%
  pivot_longer(cols = stand4:sit8, names_to = "condition", values_to = "rt") %>%
  separate(col = condition, into = c("posture", "set.size"), sep = -1)

Smith_Exp3 <- merge(Smith_Exp3_acc_narrow, Smith_Exp3_rt_narrow)


Smith_exp3_anova_acc <- aov_ez(data = Smith_Exp3,
                               dv = 'acc',
                               id = 'subj',
                               within = c('posture', 'set.size'),
                               anova_table = list(es = "pes", correction = "none"),
                               type = 3)
kable(nice(Smith_exp3_anova_acc), caption = "ANOVA results for Smith Exp 3 - accuracy")
```

Table 6: ANOVA results for Smith Exp 3 - accuracy

Effect	df	MSE	F	pes	p.value
posture	1, 11	4.61	0.76	.065	.401
set.size	1, 11	1.75	3.44 +	.238	.090
posture:set.size	1, 11	1.38	7.96 *	.420	.017

```
Smith_exp3_anova_rt <- aov_ez(data = Smith_Exp3,
                              dv = 'rt',
                              id = 'subj',
                              within = c('posture', 'set.size'),
                              anova_table = list(es = "pes", correction = "none"),
                              type = 3)
kable(nice(Smith_exp3_anova_rt), caption = "ANOVA results for Smith Exp 3 - RT")
```

Table 7: ANOVA results for Smith Exp 3 - RT

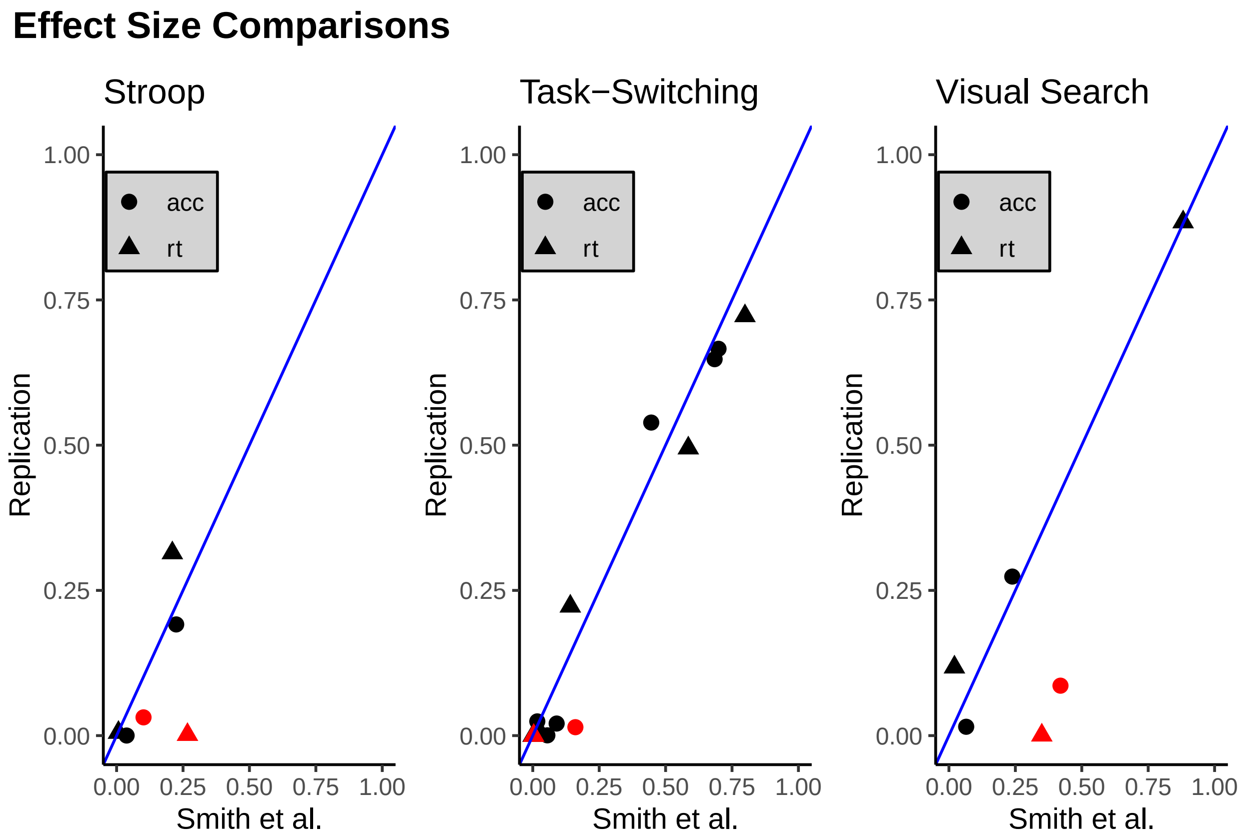
Effect	df	MSE	F	pes	p.value
posture	1, 11	2323.81	0.23	.021	.639
set.size	1, 11	473.24	81.88 ***	.882	<.001
posture:set.size	1, 11	298.96	5.91 *	.350	.033

Overall summary plots: Smith and replication

```
smith_anovas <- lst(Smith_exp1_anova_acc$anova_table,
                    Smith_exp1_anova_rt$anova_table,
                    Smith_exp2_anova_acc$anova_table,
                    Smith_exp2_anova_rt$anova_table,
                    Smith_exp3_anova_acc$anova_table,
                    Smith_exp3_anova_rt$anova_table)

repl_anovas <- lst(aov_ez(data = stroopCombined,
                          dv = "meanPE",
                          id = "sj",
                          within = c("posture", "congruency"),
                          type = 3,
                          anova_table = list(es = "pes")),
                   aov_ez(data = stroopCombined,
                          dv = "meanRT",
                          id = "sj",
                          within = c("posture", "congruency"),
                          type = 3,
                          anova_table = list(es = "pes")),
                   accModelTS,
                   rtModelTS,
                   aov_ez(data = vsCombined,
                          dv = "meanPE",
                          id = "sj",
                          within = c("postureFactor", "setSize"),
                          type = 3,
                          anova_table = list(es = "pes")),
                   aov_ez(data = vsCombined,
                          dv = "meanRT",
                          id = "sj",
                          within = c("postureFactor", "setSize"),
                          type = 3,
                          anova_table = list(es = "pes")))

for (i in 1:6){

  smith_anovas[[i]] <- smith_anovas[[i]] %>%
    rownames_to_column() %>%
    as.data.frame() %>%
    rowwise() %>%
    mutate(LL = get.ci.partial.eta.squared(F, `num Df`, `den Df`, conf.level = 0.9)$LL,
           UL = get.ci.partial.eta.squared(F, `num Df`, `den Df`, conf.level = 0.9)$UL)

  repl_anovas[[i]] <- repl_anovas[[i]]$anova_table %>%
    rownames_to_column() %>%
    as.data.frame() %>%
    rowwise() %>%
    mutate(LL = get.ci.partial.eta.squared(F, `num Df`, `den Df`, conf.level = 0.9)$LL,
           UL = get.ci.partial.eta.squared(F, `num Df`, `den Df`, conf.level = 0.9)$UL)
}

###Exp1 (Stroop)
smith.stroop <- smith_anovas[[1]] %>%
  ungroup() %>%
  bind_rows(smith_anovas[[2]]) %>%
  select(Effect = rowname, pes, LL, UL) %>%
  mutate(dv = rep(c("acc","rt"), each = 3), col = rep(c("black","black","red"),2))

repl.stroop <- repl_anovas[[1]] %>%
  ungroup() %>%
  bind_rows(repl_anovas[[2]]) %>%
  select(Effect = rowname, pes, LL, UL) %>%
  mutate(dv = rep(c("acc","rt"), each = 3), col = rep(c("black","black","red"),2),
         Effect = smith.stroop$Effect)


stroop.effects <- merge(smith.stroop, repl.stroop,
                        by = c("Effect","dv"), suffixes = c("Smith","Replication"))


stroop.plot <- ggplot(data = stroop.effects, aes(x = pesSmith, y = pesReplication, shape = dv)) +
  geom_point(size = 2.5, col = stroop.effects$colSmith) +
  xlim(0, 1.00) +
  ylim(0, 1.00) +
  geom_abline(slope = 1, intercept = 0, col = "blue") +
  theme_classic() +
  theme(legend.position = c(0.2, 0.85),
        legend.background = element_rect(colour = "black",
                                         linetype = "solid",
                                         fill = "lightgray"),
        legend.title = element_blank(),
        legend.margin=margin(-3,5,0,0)) +
  labs(y = "Replication", x = "Smith et al.", title = "Stroop")

###Exp2 (Task-switching)
smith.ts <- smith_anovas[[3]] %>%
  ungroup() %>%
  bind_rows(smith_anovas[[4]]) %>%
  select(Effect = rowname, pes, LL, UL) %>%
  mutate(dv = rep(c("acc","rt"), each = 7),
         col = rep(c("black","black","black","black","red","black","black"),2))

repl.ts <- repl_anovas[[3]] %>%
  ungroup() %>%
  bind_rows(repl_anovas[[4]]) %>%
  select(Effect = rowname, pes, LL, UL) %>%
  mutate(dv = rep(c("acc","rt"), each = 7),
         col = rep(c("black","black","black","black","red","black","black"),2),
         Effect = smith.ts$Effect)


ts.effects <- merge(smith.ts, repl.ts,
                        by = c("Effect","dv"), suffixes = c("Smith","Replication"))


ts.plot <- ggplot(data = ts.effects, aes(x = pesSmith, y = pesReplication, shape = dv)) +
  geom_point(size = 2.5, col = ts.effects$colSmith) +
  xlim(0, 1.00) +
  ylim(0, 1.00) +
  geom_abline(slope = 1, intercept = 0, col = "blue") +
  theme_classic() +
  theme(legend.position = c(0.2, 0.85),
        legend.background = element_rect(colour = "black",
                                         linetype = "solid",
                                         fill = "lightgray"),
        legend.title = element_blank(),
```

```r
        legend.margin=margin(-3,5,0,0)) +
  labs(y = "Replication", x = "Smith et al.", title = "Task-Switching")

###Exp3 (Visual Search)
smith.vs <- smith_anovas[[5]] %>%
  ungroup() %>%
  bind_rows(smith_anovas[[6]]) %>%
  select(Effect = rowname, pes, LL, UL) %>%
  mutate(dv = rep(c("acc","rt"), each = 3),
         col = rep(c("black","black","red"),2))

repl.vs <- repl_anovas[[5]] %>%
  ungroup() %>%
  bind_rows(repl_anovas[[6]]) %>%
  select(Effect = rowname, pes, LL, UL) %>%
  mutate(dv = rep(c("acc","rt"), each = 3),
         col = rep(c("black","black","red"),2),
         Effect = smith.vs$Effect)


vs.effects <- merge(smith.vs, repl.vs,
                        by = c("Effect","dv"), suffixes = c("Smith",
                                                            "Replication"))


vs.plot <- ggplot(data = vs.effects, aes(x = pesSmith, y = pesReplication, shape = dv)) +
  geom_point(size = 2.5, col = vs.effects$colSmith) +
  xlim(0, 1) +
  ylim(0, 1) +
  geom_abline(slope = 1, intercept = 0, col = "blue") +
  theme_classic() +
  theme(legend.position = c(0.2, 0.85),
        legend.background = element_rect(colour = "black",
                                         linetype = "solid",
                                         fill = "lightgray"),
        legend.title = element_blank(),
        legend.margin=margin(-3,5,0,0)) +
  labs(y = "Replication", x = "Smith et al.", title = "Visual Search")

all.plot <- plot_grid(stroop.plot, ts.plot, vs.plot, ncol = 3)

title <- ggdraw() +
  draw_label(
    "Effect Size Comparisons",
    fontface = 'bold',
    x = 0,
    hjust = 0
  ) +
  theme(
    # add margin on the left of the drawing canvas,
    # so title is aligned with left edge of first plot
    plot.margin = margin(0, 0, 0, 7)
  )
```

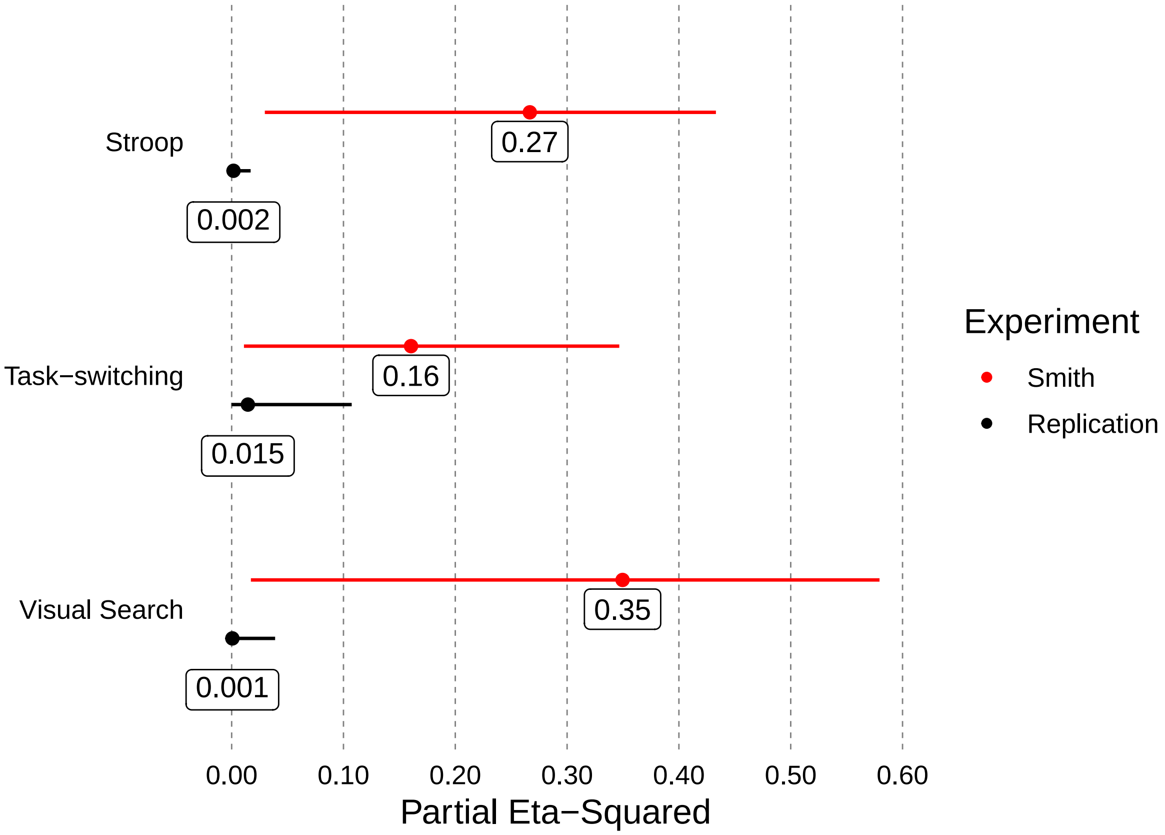
```
all.plot <- plot_grid(
  title, all.plot,
  ncol = 1,
  # rel_heights values control vertical title margins
  rel_heights = c(0.1, 1)
)

all.plot
```



```
ggsave(all.plot,
       file = "results/plots/supp_all_effects_plot.pdf",
       units = "in",
       width = 9.5,
       height = 4.50,
       dpi = 600)


### Forest plot
#Graph comparison of key effects for all three experiments
forest.colors <- c("black", "red")

forest.data <- data.frame(Experiment = rep(c("Smith", "Replication"), 3),
                          name = rep(c("Stroop", "Task-switching", "Visual Search"), each = 2),
                          dv = rep(c("rt","acc","rt"), each = 2),
                          pes = numeric(6),
                          LL = numeric(6),
                          UL = numeric(6))
forest.data[1,4:6] <- smith_anovas[[2]][3,c(6,8,9)]
forest.data[2,4:6] <- repl_anovas[[2]][3,c(6,8,9)]

forest.data[3,4:6] <- smith_anovas[[3]][5,c(6,8,9)]
forest.data[4,4:6] <- repl_anovas[[3]][5,c(6,8,9)]

forest.data[5,4:6] <- smith_anovas[[6]][3,c(6,8,9)]
forest.data[6,4:6] <- repl_anovas[[6]][3,c(6,8,9)]


forest.comp <- mod.forestplot(df = forest.data,
                              estimate = pes,
                              ci.lower = LL,
                              ci.upper = UL,
                              colour = Experiment,
                              xlab = "Partial Eta-Squared"
) +
  scale_color_manual(values = forest.colors) +
  scale_x_continuous(labels = label_number(accuracy = 0.01), breaks = seq(0.00, 0.60, 0.10)) +
  #Too busy w/numbers for effects?
  geom_label(data = subset(forest.data, Experiment == "Smith"),
                         aes(label = round(pes, digits = 2))) +
  geom_label(data = subset(forest.data, Experiment == "Replication"),
                         aes(label = round(pes, digits = 3)),
                        vjust = 2.50)  +
  coord_cartesian(clip="off") #Disable clipping to draw outside plot area
```

```
## Scale for 'colour' is already present. Adding another scale for 'colour', which will replace the
## existing scale.
```

```
forest.comp
```



```
ggsave(forest.comp,
       file = "results/plots/fig5_forest_plot.pdf",
       units = "in",
       width = 6,
       height = 6,
       dpi = 600)

#Compare proportions: replication divided by original effect sizes
replication.effects <- subset(forest.data, Experiment == "Replication")
original.effects    <- subset(forest.data, Experiment == "Smith")

#As a percentage
prop.effects <- (replication.effects$pes/original.effects$pes)*100
#< 1%, ~9%, and <1%
prop.effects
```

```
## [1] 0.6181838 9.0496059 0.1801278
```

```
#Average proportion is 3.28%
mean(prop.effects)
```

```
## [1] 3.282639
```

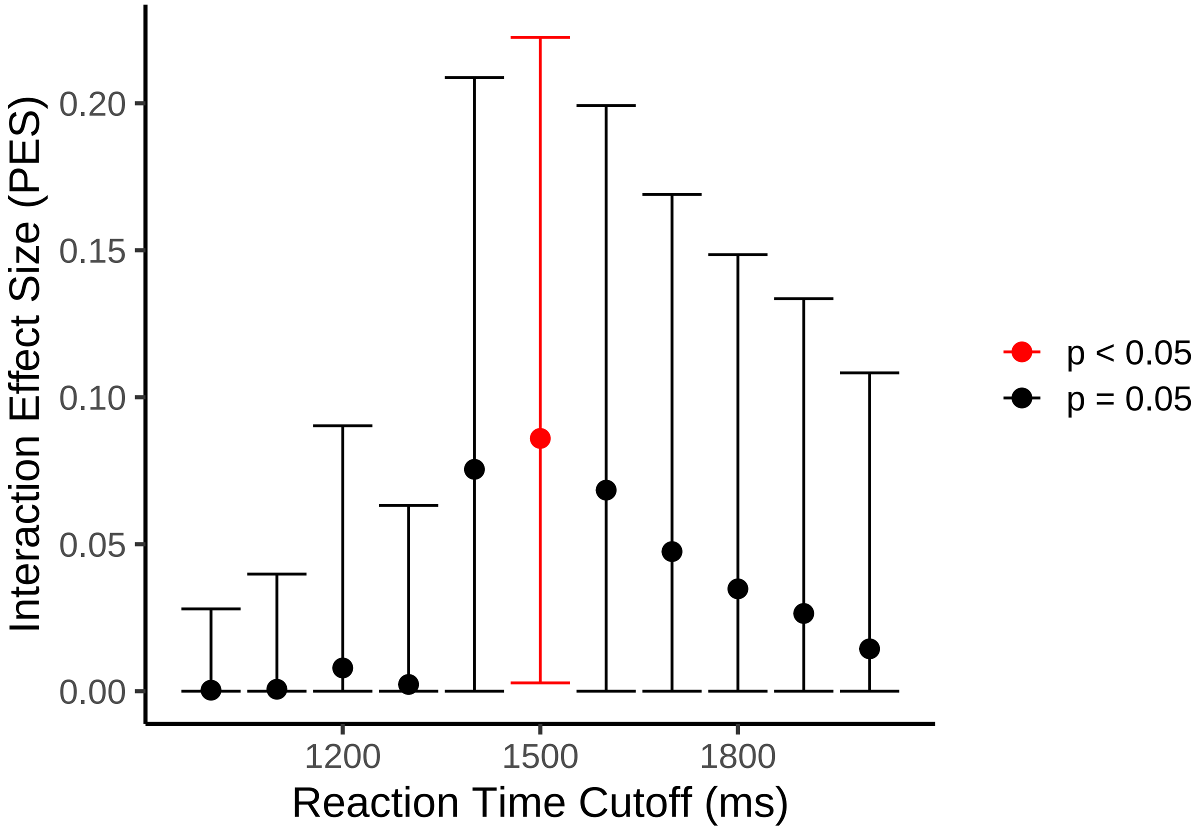
Exp 3: Effect of different RT cutoffs on PE interaction

```r
#compare different criteria for removing long trials
criteria <- seq(1000, 2000, by = 100)
ncriteria <- length(criteria)
criteria.dat <- merged.VS.data.orig

for (i in criteria){
  criteria.dat <- criteria.dat %>%
    mutate("drop{i}" := ifelse(rt >= i | ac == 0, 0, 1))
}

vsPEcriteria = criteria.dat %>%
  group_by(sj, cb, setSize, posture) %>%
  summarize(across(starts_with("drop"), ~ 100 - (mean(.x)*100)))
```

```
## ‘summarise()‘ has grouped output by ’sj’, ’cb’, ’setSize’. You can override using the ‘.groups‘
## argument.
```

```r
#...set as factors
vsPEcriteria$sj = factor(vsPEcriteria$sj)
vsPEcriteria$cb = factor(vsPEcriteria$cb)
vsPEcriteria$setSize = factor(vsPEcriteria$setSize)
vsPEcriteria$postureFactor = factor(vsPEcriteria$posture)

criteria.results <- data.frame(cutoff = criteria,
                               es = numeric(ncriteria),
                               p.vals = numeric(ncriteria),
                               ci.LL = numeric(ncriteria),
                               ci.UL = numeric(ncriteria))

for (i in 1:length(criteria)){

  tempcol <- paste0("drop",criteria[i])
  tempmod <- aov_ez(data = vsPEcriteria,
                               dv = tempcol,
                               id = 'sj',
                               within = c('posture', 'setSize'),
                               anova_table = list(es = "pes", correction = "none"),
                               type = 3)

  criteria.results$es[i] <- tempmod$anova_table$pes[3]
  criteria.results$p.vals[i] <- tempmod$anova_table$`Pr(>F)`[3]
  criteria.results$ci.LL[i] <- get.ci.partial.eta.squared(F.value=tempmod$anova_table$F[3],
                                                    df1=tempmod$anova_table$`num Df`[3],
                                                    df2 = tempmod$anova_table$`den Df`[3])$LL
  criteria.results$ci.UL[i] <- get.ci.partial.eta.squared(F.value=tempmod$anova_table$F[3],
                                                    df1=tempmod$anova_table$`num Df`[3],
                                                    df2 = tempmod$anova_table$`den Df`[3])$UL

}
```

```r
criteria.results$sig <- ifelse(criteria.results$p.vals < 0.05, "p < 0.05", "p \u2265 0.05")

exp3_rt_cutoff <-
ggplot(criteria.results, aes(criteria, es, col = sig)) +
  geom_point(size = 3) +
  geom_errorbar(aes(ymin = ci.LL, ymax = ci.UL)) +
  scale_color_manual(values = c("red","black")) +
  theme_classic(base_size = 16) +
  theme(legend.title = element_blank()) +
  labs(y = "Interaction Effect Size (PES)", x = "Reaction Time Cutoff (ms)")

exp3_rt_cutoff
```



```r
ggsave(exp3_rt_cutoff,
       file = "results/plots/supp_exp3_RT_cutoff.pdf",
       units = "in",
       width = 9,
       height = 6,
       dpi = 600)
```