Smith Replication: Primary Data Analysis

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2022-11-07

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 19044)
##
## 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_1.2.0           rlang_1.0.4            cowplot_1.1.1
##  [9] readxl_1.4.0           reshape2_1.4.4         superb_0.95.0          psychReport_3.0.1
## [13] apaTables_2.0.8        psych_2.2.5            BayesFactor_0.9.12-4.4 coda_0.19-4
## [17] ez_4.4-0               afex_1.1-1             lme4_1.1-30            Matrix_1.4-1
## [21] forcats_0.5.1          stringr_1.4.0          dplyr_1.0.9            purrr_0.3.4
## [25] readr_2.1.2            tidyr_1.2.0            tibble_3.1.8           ggplot2_3.3.6
## [29] tidyverse_1.3.2        plyr_1.8.7             rmarkdown_2.14         knitr_1.39
## [33] pacman_0.5.1
##
## loaded via a namespace (and not attached):
##  [1] TH.data_1.1-1       googledrive_2.0.0   minqa_1.2.4         colorspace_2.0-3
```

```
##  [5] ellipsis_0.3.2      estimability_1.4    fs_1.5.2            rstudioapi_0.13
##  [9] MatrixModels_0.5-0  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_2.1.0
## [17] jsonlite_1.8.0      lsr_0.5.2           nloptr_2.0.3        broom_1.0.0
## [21] dbplyr_2.2.1        shiny_1.7.2         compiler_4.2.1      httr_1.4.3
## [25] emmeans_1.7.5       backports_1.4.1     assertthat_0.2.1    fastmap_1.1.0
## [29] gargle_1.2.0        cli_3.3.0           later_1.3.0         htmltools_0.5.3
## [33] tools_4.2.1         lmerTest_3.1-3      gtable_0.3.0        glue_1.6.2
## [37] Rcpp_1.0.9          carData_3.0-5       cellranger_1.1.0    vctrs_0.4.1
## [41] nlme_3.1-157        xfun_0.31           rbibutils_2.2.8     rvest_1.0.2
## [45] mime_0.12           lifecycle_1.0.1     googlesheets4_1.0.0 MASS_7.3-57
## [49] zoo_1.8-11          shinyBS_0.61.1      promises_1.2.0.1    hms_1.1.1
## [53] parallel_4.2.1      sandwich_3.0-2      yaml_2.3.5          pbapply_1.5-0
## [57] stringi_1.7.8       boot_1.3-28         Rdpack_2.4          pkgconfig_2.0.3
## [61] evaluate_0.15       lattice_0.20-45     tidyselect_1.1.2    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_1.8.0        haven_2.5.0         withr_2.5.0
## [73] mgcv_1.8-40         survival_3.3-1      abind_1.4-5         modelr_0.1.8
## [77] crayon_1.5.1        car_3.1-0           utf8_1.2.2          tzdb_0.3.0
## [81] grid_4.2.1          reprex_2.0.1        digest_0.6.29       xtable_1.8-4
## [85] httpuv_1.6.5        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. Near the end we also present a *Conventional* Analysis which drops the time-outs for Percent Error (PE) results.

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"
```

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

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
```

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

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

```
##################################
#...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
```

```
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[star
## 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[sittin
## 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

```
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.
```

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

exp1_ANOVA_acc_uncon <-
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="")
exp1_ANOVA_acc_uncon
```

```
## [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"
```

```
write.csv(exp1_ANOVA_acc_uncon, "results/exp1_ANOVA_PE_uncon.csv")

#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[star
## 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)
```

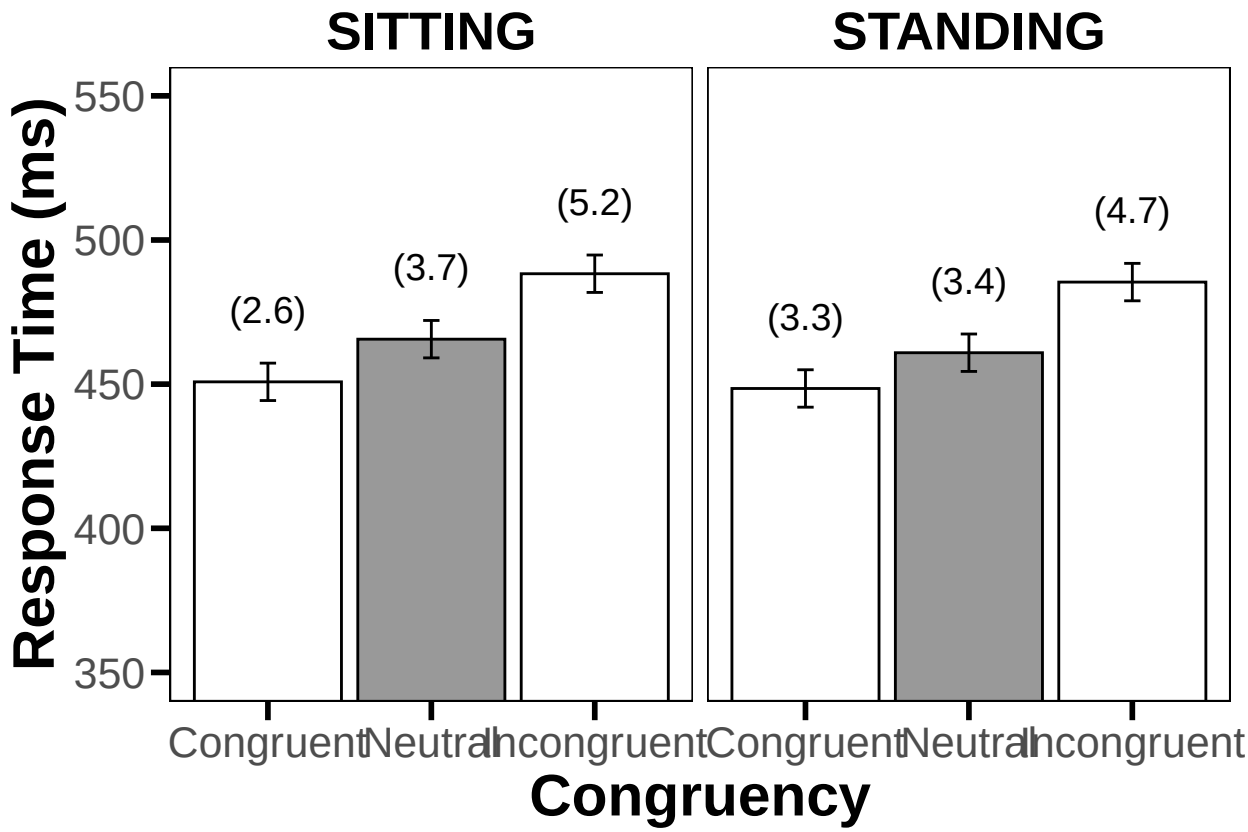
```
##     item   group1      group2 vars  n  mean    sd median trimmed  mad   min   max range skew
## X11    1  SITTING   congruent    1 50 450.8  56.3  443.0   446.5 45.5 348.3 598.3 250.0  0.7
## X12    2 STANDING   congruent    1 50 448.5  60.6  440.3   442.2 48.6 341.3 624.4 283.0  1.0
## X13    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)
```

```r
all(ntrials_sub == 392)
```

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

```r
#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.
```

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

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

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

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

```r
### 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
```

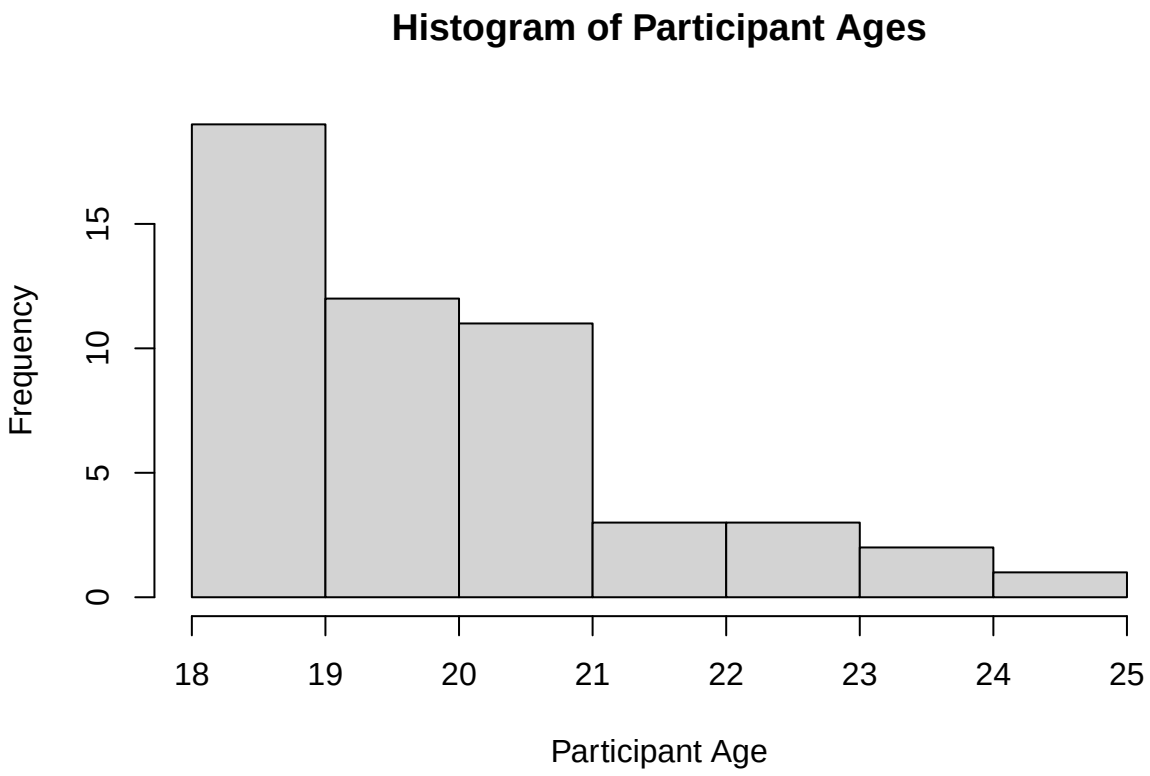
```
#59 records
#first two are test data
# need to match up the 6 dropped participants from behavioral data
demo_df <- demo_raw %>%
  filter(!(X %in% c("test", low_acc_subs)))
dim(demo_df)
```

```
## [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
```

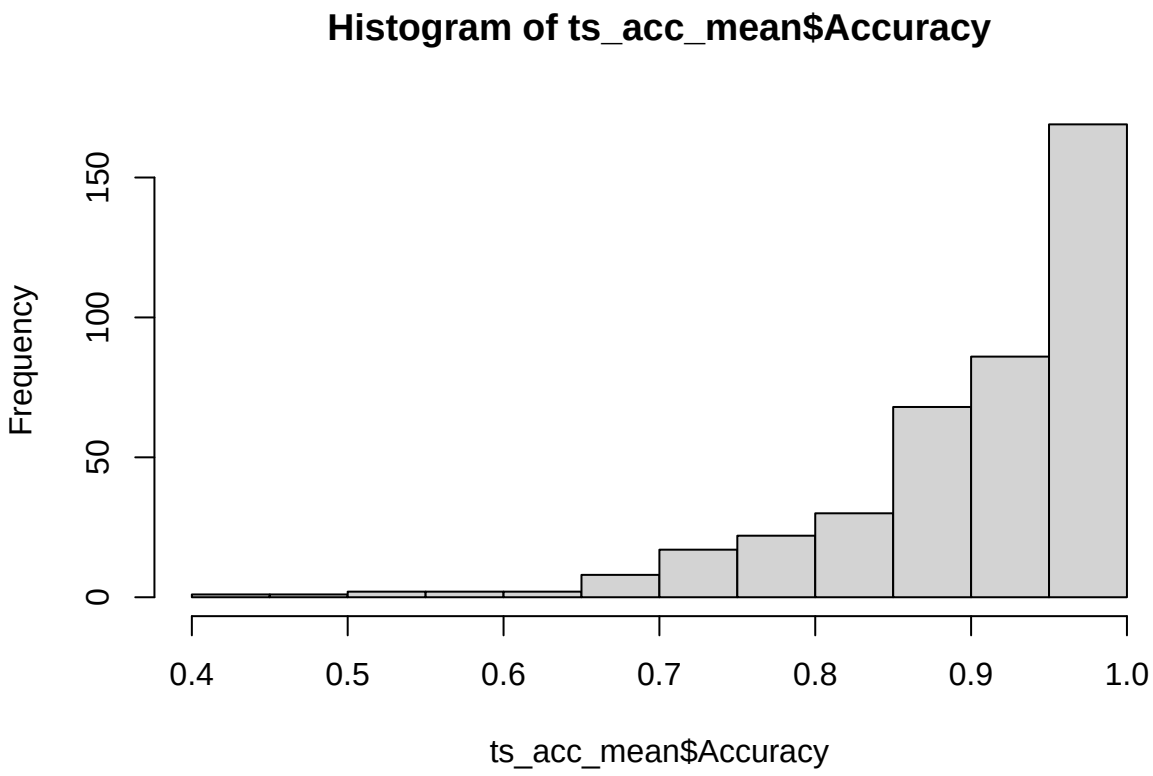
```
## # A tibble: 6 x 2
##   Race.Pick                              n
##   <chr>                              <int>
## 1 White /European American              22
## 2 Black / African American              11
## 3 Hispanic/Latino/Latina/Latinx         11
## 4 Asian /South Pacific Islander          3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

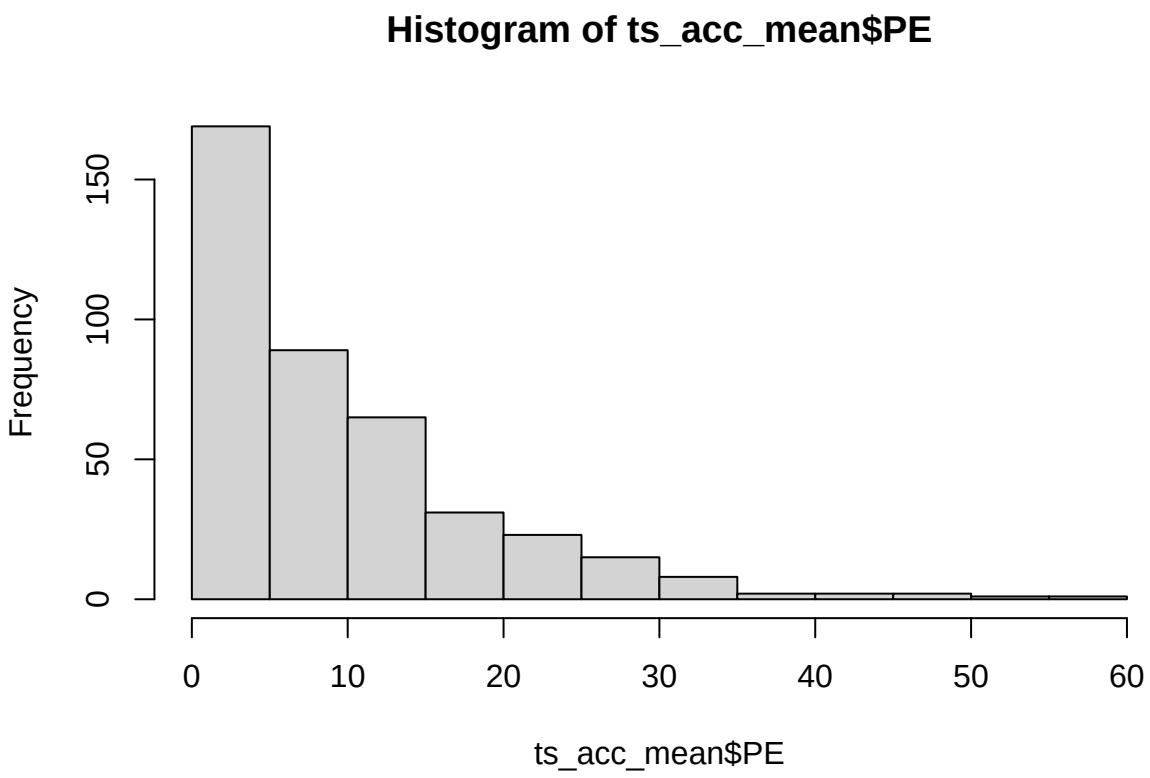
```
## # A tibble: 2 x 2
##   Eng.First     n
##   <chr>     <int>
## 1 NO            8
## 2 YES          43
```

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_PE_uncon.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
```

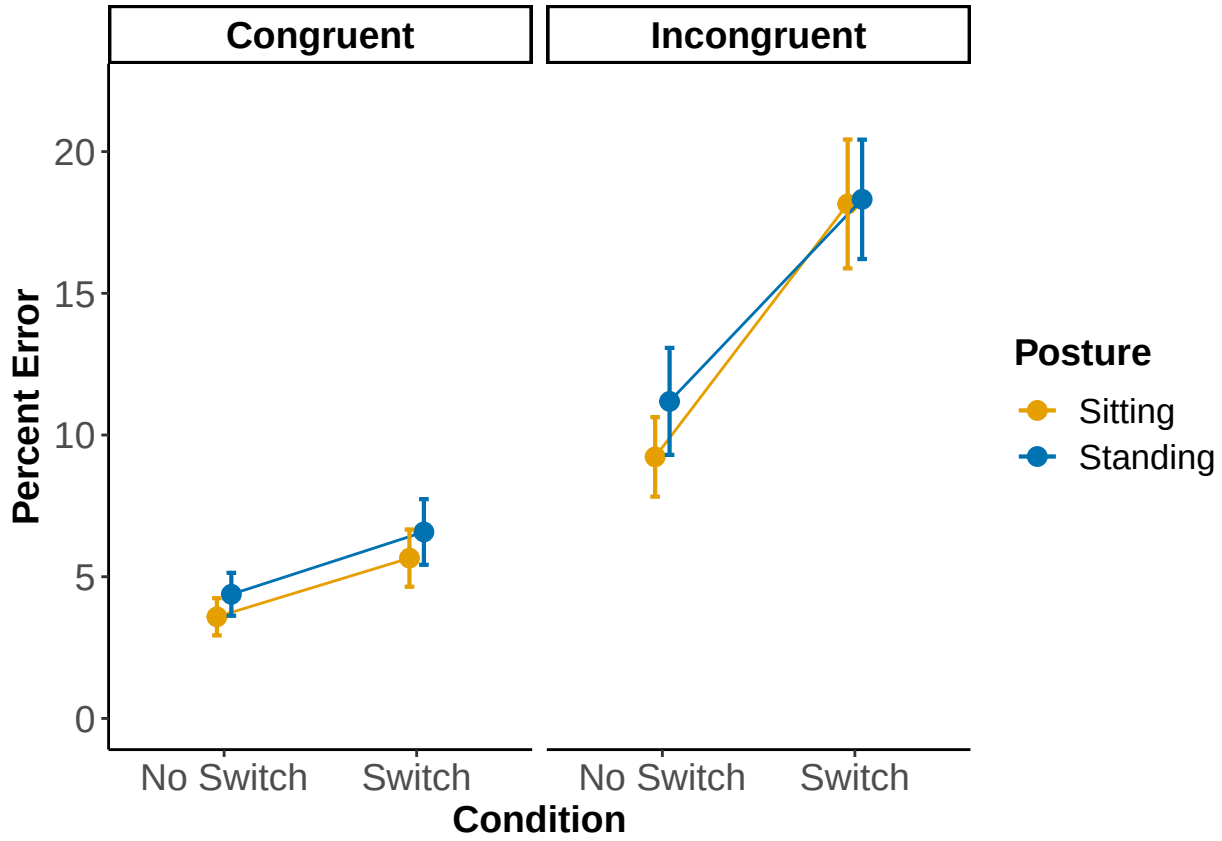
```
congruent.labs <- c("Congruent", "Incongruent")
names(congruent.labs) <- c("1", "2")

#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() +
 theme(axis.text=element_text(size=14),
       panel.background = element_rect(fill = "white", colour = "white", size = 1),
       axis.title = element_text(size=14, face="bold"),
       strip.text = element_text(size = 14, face = "bold",colour = "black", angle = 0),
       legend.text = element_text(size = 13),
       legend.title = element_text(size= 14, face = "bold")) +
  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
```

```r
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
```

```r
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
```

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

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

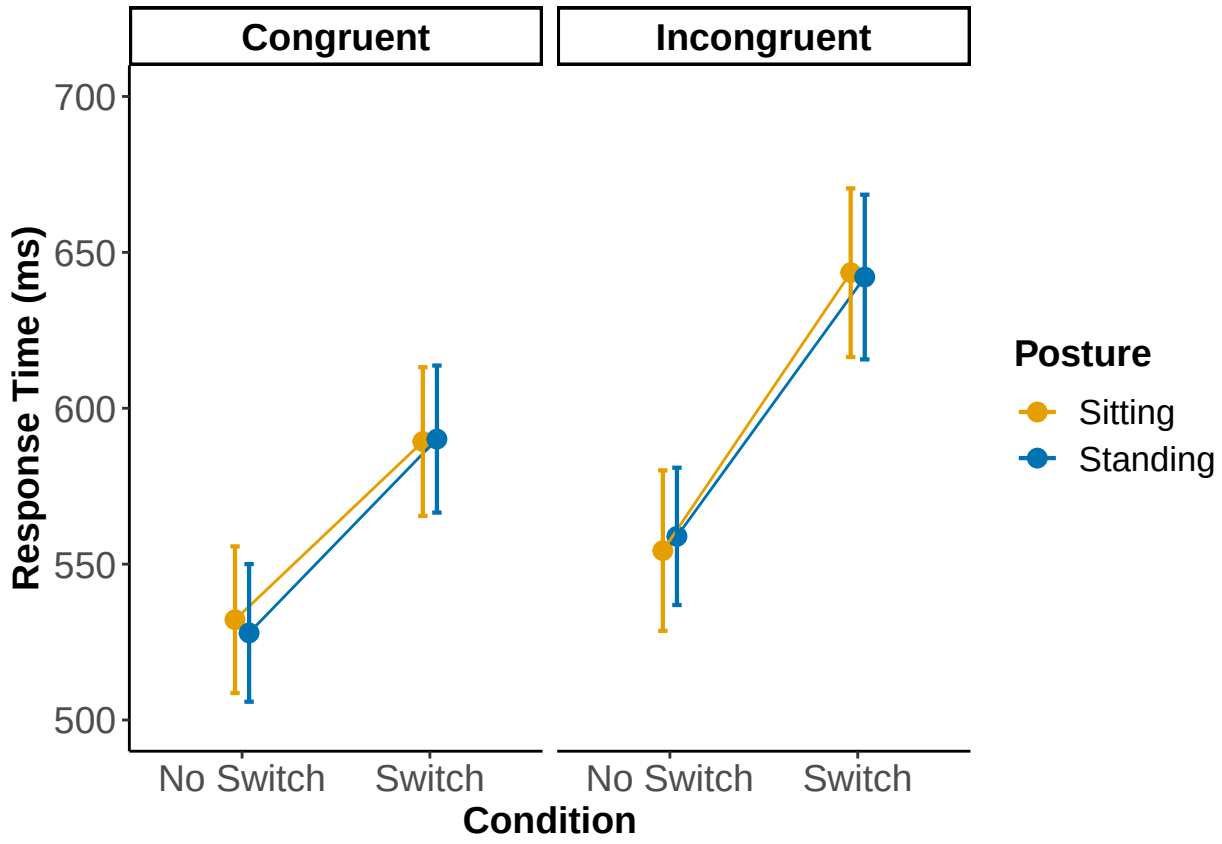
```
## `summarise()` has grouped output by 'participant', 'posture', 'congruentTrialType'. You can
## override using the `.groups` argument.
```

```r
#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() +
 theme(axis.text=element_text(size=14),
       panel.background = element_rect(fill = "white", colour = "white", size = 1),
       axis.title = element_text(size=14, face="bold"),
       strip.text = element_text(size = 14, face = "bold",colour = "black", angle = 0),
       legend.text = element_text(size = 13),
       legend.title = element_text(size= 14, face = "bold")) +
  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.conventional <- merged.VS.data %>% filter(rt < 1500)
write.csv(merged.VS.data.conventional,
          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$correctTrials)/observationDa
sum(observationDataVS$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

exp3_ANOVA_PE_uncon <-
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="")

write.csv(exp3_ANOVA_PE_uncon, "results/exp3_ANOVA_PE_uncon.csv")

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])
```

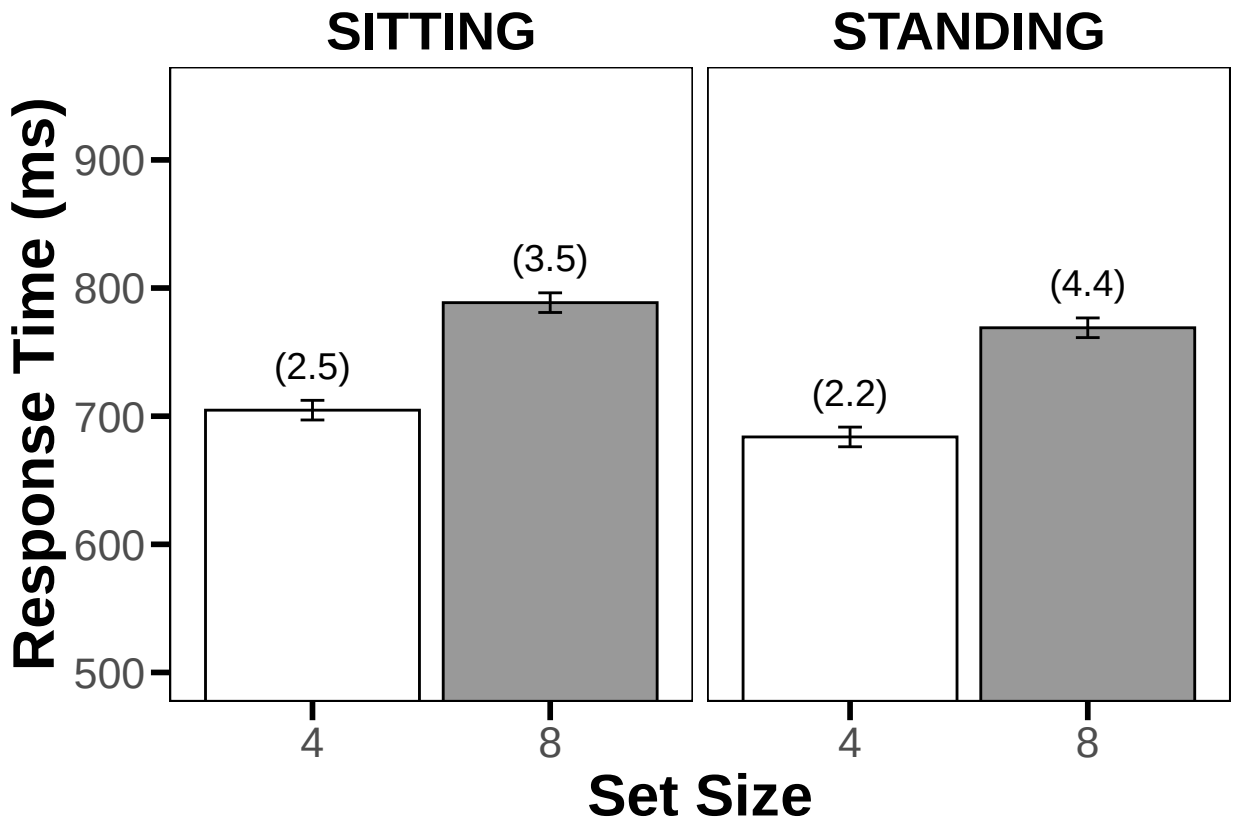
```
## Bayes factor analysis
## --------------
## [1] setSize + postureFactor + setSize:postureFactor + sj : 1.063539 ±NA%
##
## Against denominator:
##   meanPE ~ setSize + postureFactor + sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

Make plots for visual search

```
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)
```

```
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)
```

```r
#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

```r
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

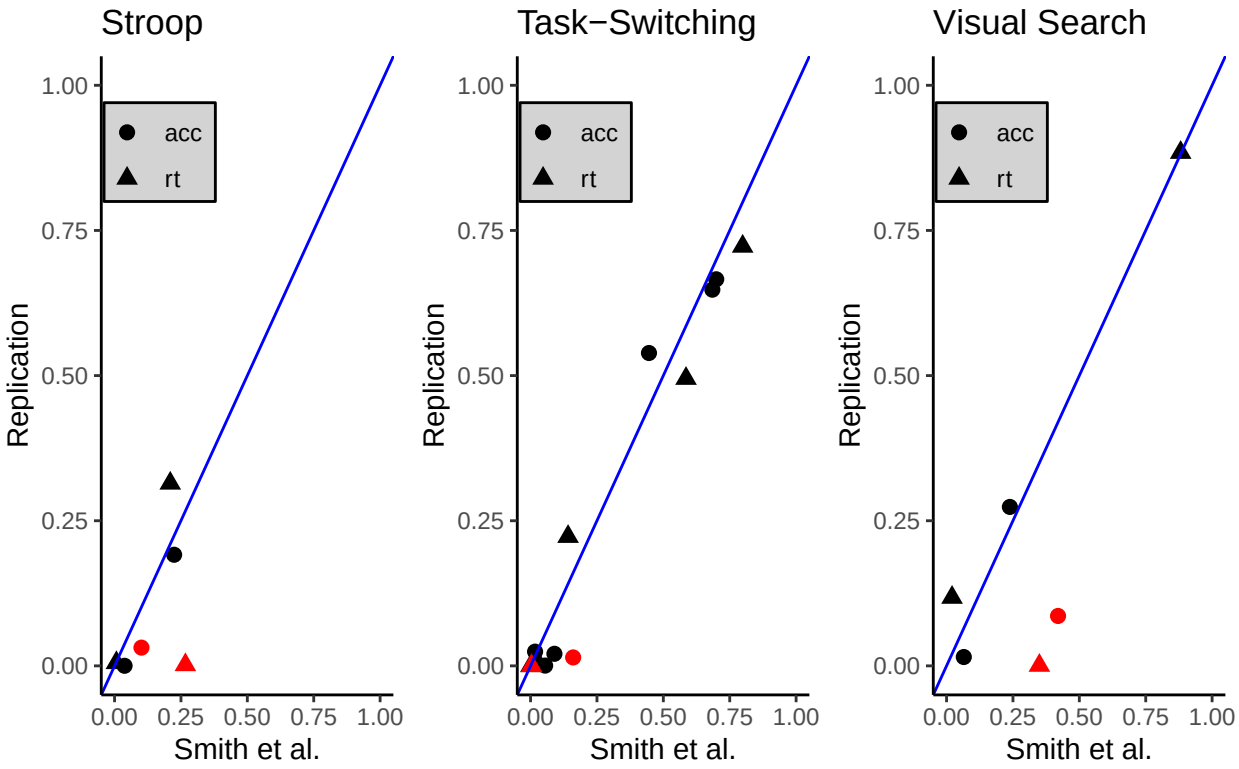
```
smith_anovas <- lst(Smith_exp1_anova_acc$anova_table,
                    Smith_exp1_anova_rt$anova_table,
                    Smith_exp2_anova_acc$anova_table,
                    Smith_exp2_anova_rt$anova_table,
                    Smith_exp3_anova_acc$anova_table,
                    Smith_exp3_anova_rt$anova_table)

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(),
        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
```

Effect Size Comparisons

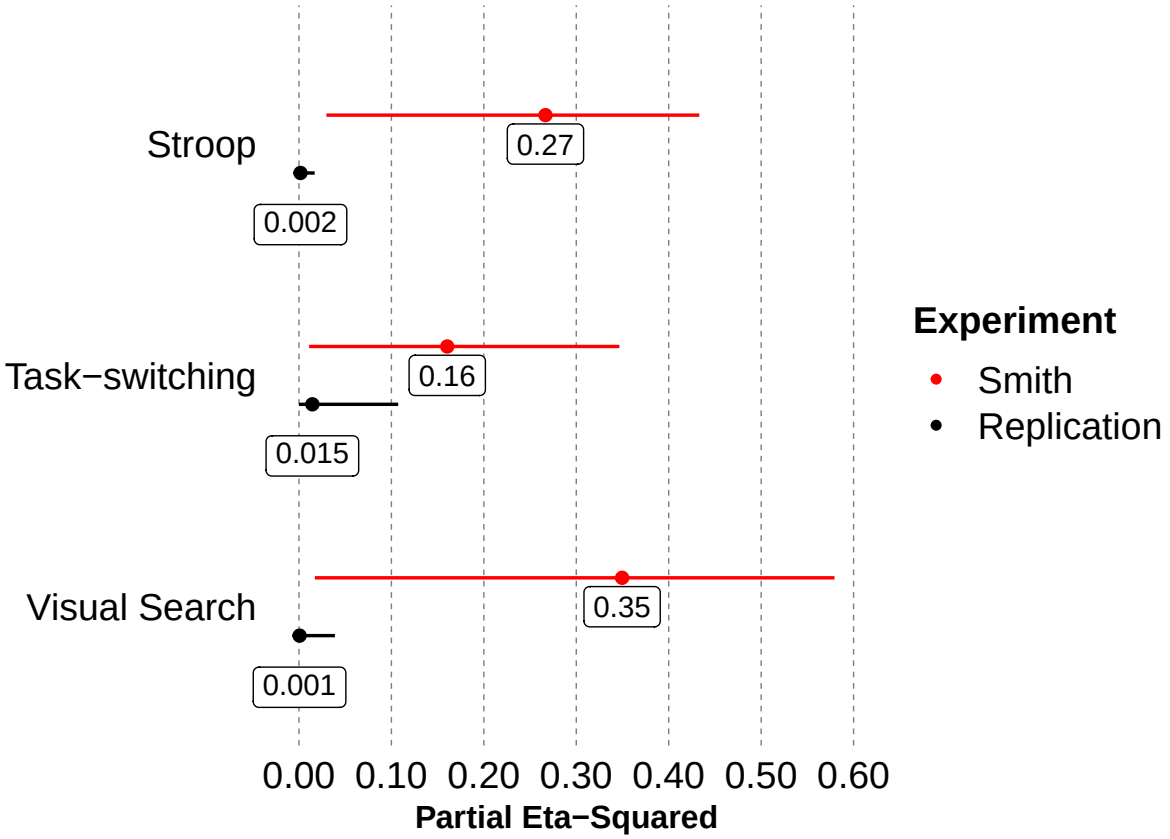



```
ggsave(all.plot,
       file = "results/plots/supp_all_effects_plot.pdf",
       units = "in",
       width = 9.5,
       height = 4.50,
       dpi = 600)


### 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)  +
   theme(axis.text=element_text(size=14),
       panel.background = element_rect(fill = "white", colour = "white", size = 1),
       axis.title = element_text(size=12, face="bold"),
       strip.text = element_text(size = 12, face = "bold",colour = "black", angle = 0),
       legend.text = element_text(size = 14),
       legend.title = element_text(size= 14, face = "bold")) +
  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 = 7,
       height = 5,
       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
```

Appendix: Analysis with conventional dropping of timeout trials (only affects PE analysis)

Experiment 1: Stroop

```
e1.conv.PE = plyr::ddply(mergedStroopData.conventional,
                     .(sj, cb,congruency,posture),
                     summarise,
                     meanPE = 100 - (mean(ac)*100)) %>%
  ungroup() %>%
  mutate(across(sj:posture, factor))

e1.conv.errmodel <- ezANOVA(e1.conv.PE,
                    dv = .(meanPE),
                    wid=.(sj),
                    within=.(posture,congruency),
                    detailed=TRUE,
                    type=3,
                    return_aov = TRUE)

e1.conv.MSE = e1.conv.errmodel$ANOVA$SSd/e1.conv.errmodel$ANOVA$DFd

exp1_ANOVA_PE_con <-
paste(e1.conv.errmodel$ANOVA$Effect,":  F(",
      e1.conv.errmodel$ANOVA$DFn,
      ", ",
      e1.conv.errmodel$ANOVA$DFd,
      ") = ",
      round(e1.conv.errmodel$ANOVA$F,3),
      ", MSE = ",
      round(e1.conv.MSE,3),
      ", p = ",
      round(e1.conv.errmodel$ANOVA$p,3),
      ", partialEtaSq = ",
      round(e1.conv.errmodel$ANOVA$SSn/(e1.conv.errmodel$ANOVA$SSn+e1.conv.errmodel$ANOVA$SSd),4),
      sep="")
exp1_ANOVA_PE_con
```

```
## [1] "(Intercept):  F(1, 49) = 54.682, MSE = 69.145, p = 0, partialEtaSq = 0.5274"
## [2] "posture:  F(1, 49) = 0.028, MSE = 14.823, p = 0.868, partialEtaSq = 6e-04"
## [3] "congruency:  F(2, 98) = 8.813, MSE = 9.641, p = 0, partialEtaSq = 0.1524"
## [4] "posture:congruency:  F(2, 98) = 1.533, MSE = 5.865, p = 0.221, partialEtaSq = 0.0303"
```

```
write.csv(exp1_ANOVA_PE_con, "results/exp1_ANOVA_PE_con.csv")


#BF for errors
e1.conv.BF = anovaBF(meanPE~congruency*posture+sj,
                           data = e1.conv.PE,
                           whichRandom = "sj",
                           method="laplace")
e1.conv.BF
```

```
## Bayes factor analysis
```

```
## --------------
## [1] congruency + sj                                : 136.8983  ±NA%
## [2] posture + sj                                   : 0.1188895 ±NA%
## [3] congruency + posture + sj                      : 16.39088  ±NA%
## [4] congruency + posture + congruency:posture + sj : 2.363896  ±NA%
##
## Against denominator:
##   meanPE ~ sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
#...get the Bayes factor for the Null Interaction
e1.conv.BF[3]/e1.conv.BF[4]
```

```
## Bayes factor analysis
## --------------
## [1] congruency + posture + sj : 6.933838 ±NA%
##
## Against denominator:
##   meanPE ~ congruency + posture + congruency:posture + sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
1/(e1.conv.BF[3]/e1.conv.BF[4])
```

```
## Bayes factor analysis
## --------------
## [1] congruency + posture + congruency:posture + sj : 0.1442203 ±NA%
##
## Against denominator:
##   meanPE ~ congruency + posture + sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

Experiment 2: Task-Switching

```
e2.conv.PE <- task_switching_raw.conventional %>%
  group_by(participant,
           posture,
           congruentTrialType,
           switchTrialType) %>%
  summarize(meanPE = mean((1 - correct_bin) * 100)) %>%
  ungroup() %>%
  mutate(across(participant:switchTrialType, factor))
```

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

```
e2.accModel.conv <- aov_ez(data = e2.conv.PE,
                      dv = "meanPE",
                      id = "participant",
                      within = c("posture", "congruentTrialType", "switchTrialType"),
                      type = 3,
                      anova_table = list(es = "pes")
)
```

```
e2.accModel.conv
```

```
## Anova Table (Type 3 tests)
##
## Response: meanPE
##                                       Effect    df   MSE          F   pes p.value
## 1                                   posture 1, 50 77.65       0.65  .013    .425
## 2                       congruentTrialType 1, 50 76.69 108.95 ***  .685   <.001
## 3                          switchTrialType 1, 50 21.86  99.91 ***  .666   <.001
## 4                posture:congruentTrialType 1, 50 38.81       0.01 <.001    .939
## 5                   posture:switchTrialType 1, 50 18.61       1.40  .027    .243
## 6         congruentTrialType:switchTrialType 1, 50 13.78  63.78 ***  .561   <.001
## 7 posture:congruentTrialType:switchTrialType 1, 50 13.56       0.48  .010    .491
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '+' 0.1 ' ' 1
```

```
write.csv(e2.accModel.conv$anova_table, "results/exp2_ANOVA_PE_con.csv")


#...CALCULATE THE BAYES FACTORS FOR THE ACC ANALYSIS
tsBF.conv = data.frame(e2.conv.PE)

bfValues2 = anovaBF(meanPE~ posture*switchTrialType+participant,
                    data = tsBF.conv,
                    whichRandom = "participant",
                    method="laplace")
bfValues2
```

```
## Bayes factor analysis
## --------------
## [1] posture + participant                                                : 0.1450097 ±NA%
## [2] switchTrialType + participant                                        : 1499134   ±NA%
## [3] posture + switchTrialType + participant                              : 225089.5  ±NA%
## [4] posture + switchTrialType + posture:switchTrialType + participant : 38577.89  ±NA%
##
## Against denominator:
##   meanPE ~ 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 : 5.834676 ±NA%
##
## Against denominator:
##   meanPE ~ posture + switchTrialType + posture:switchTrialType + participant
## ---
## Bayes factor type: BFlinearModel, JZS
```

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

```
## Bayes factor analysis
## --------------
```

```
## [1] posture + switchTrialType + posture:switchTrialType + participant : 0.1713891 ±NA%
##
## Against denominator:
##   meanPE ~ posture + switchTrialType + participant
## ---
## Bayes factor type: BFlinearModel, JZS
```

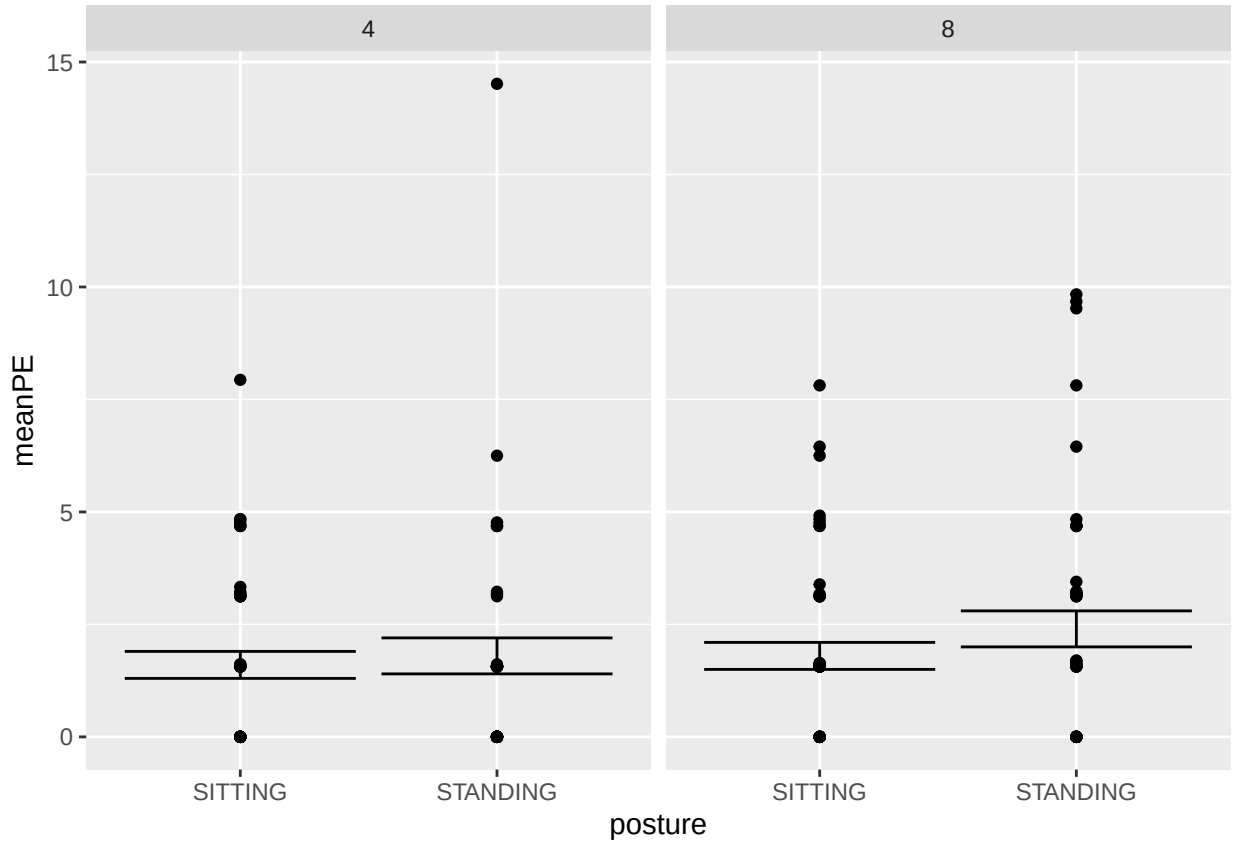
Experiment 3: Visual Search

```
e3.conv.PE = plyr::ddply(merged.VS.data.conventional,
                     .(sj, setSize, posture),
                     summarise,
                     meanPE = 100 - (mean(ac)*100)) %>%
  ungroup() %>%
  mutate(across(sj:posture, factor))

e3.conv.errmodel <- ezANOVA(e3.conv.PE,
                    dv = .(meanPE),
                    wid=.(sj),
                    within=.(posture, setSize),
                    detailed=TRUE,
                    type=3,
                    return_aov = TRUE)

e3.conv.MSE = e3.conv.errmodel$ANOVA$SSd/e3.conv.errmodel$ANOVA$DFd

exp3_ANOVA_PE_con <-
paste(e3.conv.errmodel$ANOVA$Effect,":  F(",
      e3.conv.errmodel$ANOVA$DFn,
      ", ",
      e3.conv.errmodel$ANOVA$DFd,
      ") = ",
      round(e3.conv.errmodel$ANOVA$F,3),
      ", MSE = ",
      round(e3.conv.MSE,3),
      ", p = ",
      round(e3.conv.errmodel$ANOVA$p,3),
      ", partialEtaSq = ",
      round(e3.conv.errmodel$ANOVA$SSn/(e3.conv.errmodel$ANOVA$SSn+e3.conv.errmodel$ANOVA$SSd),4),
      sep="")

exp3_ANOVA_PE_con
```

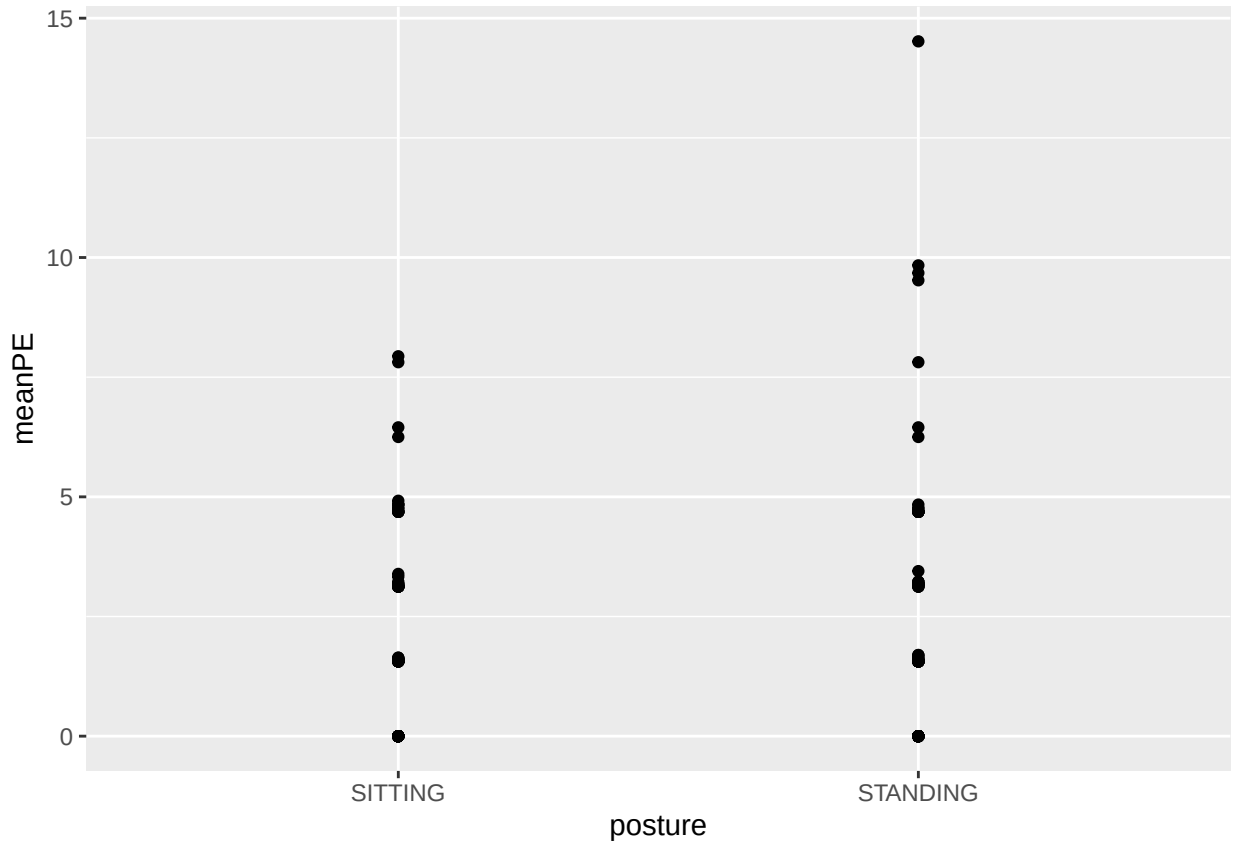
```
## [1] "(Intercept):  F(1, 49) = 55.236, MSE = 12.588, p = 0, partialEtaSq = 0.5299"
## [2] "posture:  F(1, 49) = 3.311, MSE = 2.43, p = 0.075, partialEtaSq = 0.0633"
## [3] "setSize:  F(1, 49) = 2.312, MSE = 3.628, p = 0.135, partialEtaSq = 0.0451"
## [4] "posture:setSize:  F(1, 49) = 0.623, MSE = 2.794, p = 0.434, partialEtaSq = 0.0125"
```

```
write.csv(exp3_ANOVA_PE_con, "results/exp3_ANOVA_PE_con.csv")

graphPE3.con = describeBy(e3.conv.PE$meanPE,
                     list(e3.conv.PE$posture, e3.conv.PE$setSize),
                     mat=TRUE,
                     digits = 1)
```

```
graphPE3.con = graphPE3.con[,c("group1","group2","mean", "sd", "se")]

names(graphPE3.con) = c("posture","setSize","meanPE", "sd", "se")

e3.PE.conv.plot <-
ggplot(data = e3.conv.PE, aes(x = posture,
                              y = meanPE)) +
  geom_point() +
  facet_wrap(~setSize) +
  geom_errorbar(data = graphPE3.con, aes(ymin = meanPE   - se, ymax = meanPE   + se))

e3.PE.conv.plot
```




```
#Standing has a single cell mean, set size = 4, nearly 15 percent error
e3.PE.conv.plot2 <-
ggplot(data = e3.conv.PE, aes(x = posture,
                              y = meanPE)) +
  geom_point()

e3.PE.conv.plot2
```




```
#hist(e3.conv.PE$meanPE)

#BF for errors
e3.conv.BF = anovaBF(meanPE~setSize*posture+sj,
                          data = e3.conv.PE,
                          whichRandom = "sj",
                          method="laplace")
e3.conv.BF
```

```
## Bayes factor analysis
## --------------
## [1] setSize + sj                              : 0.5212586  ±NA%
## [2] posture + sj                              : 0.4937759  ±NA%
## [3] setSize + posture + sj                    : 0.2659863  ±NA%
## [4] setSize + posture + setSize:posture + sj : 0.06740099 ±NA%
##
## Against denominator:
##   meanPE ~ sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
#...get the Bayes factor for the Null Interaction
e3.conv.BF[3]/e3.conv.BF[4]
```

```
## Bayes factor analysis
## --------------
## [1] setSize + posture + sj : 3.946327 ±NA%
```

```
##
## Against denominator:
##   meanPE ~ setSize + posture + setSize:posture + sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
1/(e3.conv.BF[3]/e3.conv.BF[4])
```

```
## Bayes factor analysis
## --------------
## [1] setSize + posture + setSize:posture + sj : 0.2534002 ±NA%
##
## Against denominator:
##   meanPE ~ setSize + posture + sj
## ---
## Bayes factor type: BFlinearModel, JZS
```

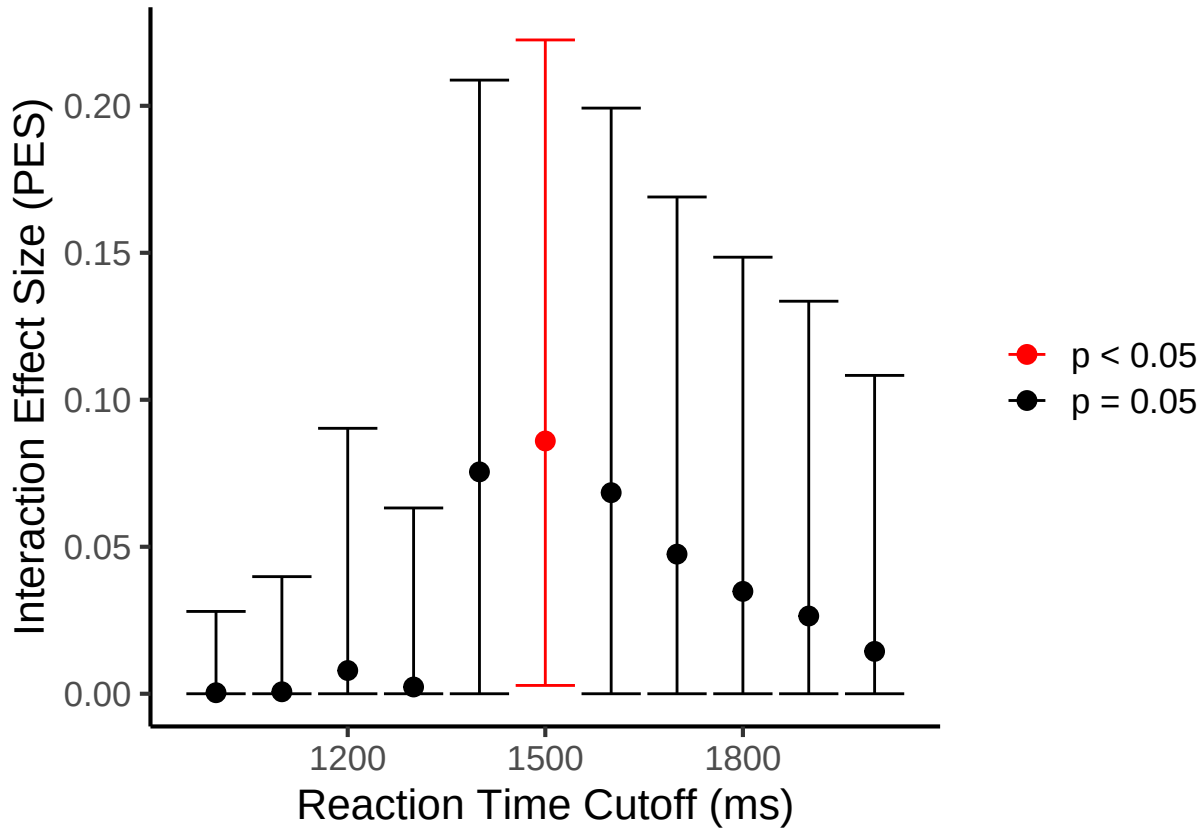
Effect of different RT cutoffs on PE interaction

```
#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)))
```

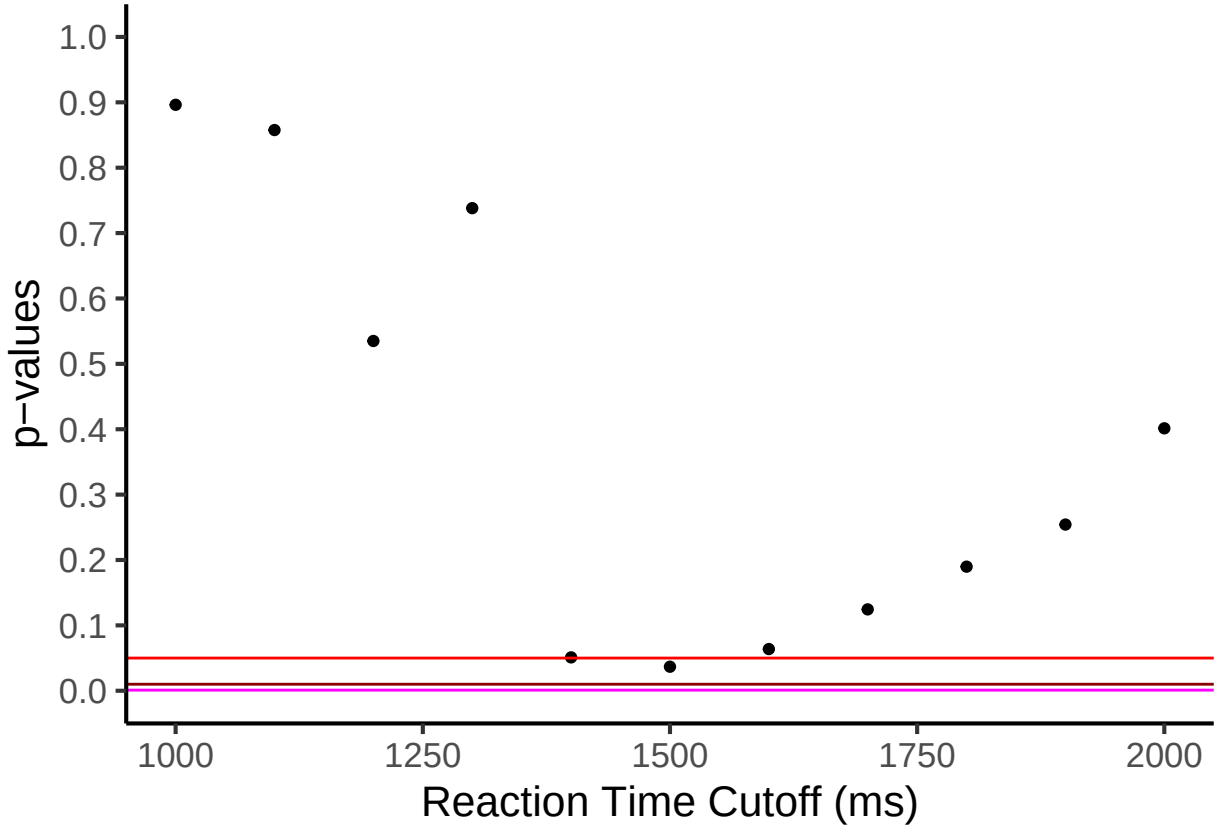
```
## `summarise()` has grouped output by 'sj', 'cb', 'setSize'. You can override using the `.groups`
## argument.
```

```
#...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

}

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
```




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

#Not in the supp: Distribution of p-values
exp3_rt_cutoff.pvals <-
ggplot(criteria.results, aes(criteria, p.vals)) +
  geom_point(size = 1.5) +
  scale_color_manual(values = c("red","black")) +
  theme_classic(base_size = 16) +
  theme(legend.title = element_blank()) +
  scale_y_continuous(limits = c(0, 1), breaks = seq(0, 1, 0.1)) +
  labs(y = "p-values", x = "Reaction Time Cutoff (ms)")

exp3_rt_cutoff.pvals + geom_hline(yintercept = 0.05, color = "red") +
                       geom_hline(yintercept = 0.01, color = "darkred") +
                       geom_hline(yintercept = 0.001, color = "magenta")
```




```
#plot(criteria.results$p.vals, criteria.results$es)
```