Power Simulation

Jose Ossandon

2/12/2018

Paired comparisons

To evaluate how many subjects and trials per would be necessary to have a powered experiment replication, I first evaluated the experiment's paired-comparisons between the main conditions. These correspond to the crossing of the factors response mode (2 leves, external 'Re' and anatomical), crossing of the legs (2 levels, uncrossed 'Lu' and crossed 'Lc') and crossing of the hands (2 levels, uncrossed 'Hu' and crossed 'Hc').

p-values

```
##
##  Pairwise comparisons using paired t tests
##
## data:  auxres$RT and auxres$cond
##
##        ReLuHu  ReLuHc  ReLcHu  ReLcHc  RaLuHu  RaLuHc  RaLcHu
## ReLuHc 9.6e-07 -       -       -       -       -       -
## ReLcHu 5.4e-11 2.9e-09 -       -       -       -       -
## ReLcHc 1.2e-09 3.5e-08 8.5e-06 -       -       -       -
## RaLuHu 1.00000 4.2e-06 2.3e-10 3.1e-09 -       -       -
## RaLuHc 9.6e-08 0.00043 0.00029 0.77783 1.1e-09 -       -
## RaLcHu 8.0e-09 2.6e-05 2.9e-05 0.31408 2.5e-10 1.00000 -
## RaLcHc 4.4e-09 6.1e-07 0.00050 0.23700 1.5e-09 0.02555 0.01323
##
## P value adjustment method: holm
```

Significant comparison (alpha<.05 corrected)

```
##        ReLuHu ReLuHc ReLcHu ReLcHc RaLuHu RaLuHc RaLcHu
## ReLuHc   TRUE     NA     NA     NA     NA     NA     NA
## ReLcHu   TRUE   TRUE     NA     NA     NA     NA     NA
## ReLcHc   TRUE   TRUE   TRUE     NA     NA     NA     NA
## RaLuHu  FALSE   TRUE   TRUE   TRUE     NA     NA     NA
## RaLuHc   TRUE   TRUE   TRUE  FALSE   TRUE     NA     NA
## RaLcHu   TRUE   TRUE   TRUE  FALSE   TRUE  FALSE     NA
## RaLcHc   TRUE   TRUE   TRUE  FALSE   TRUE   TRUE   TRUE
```

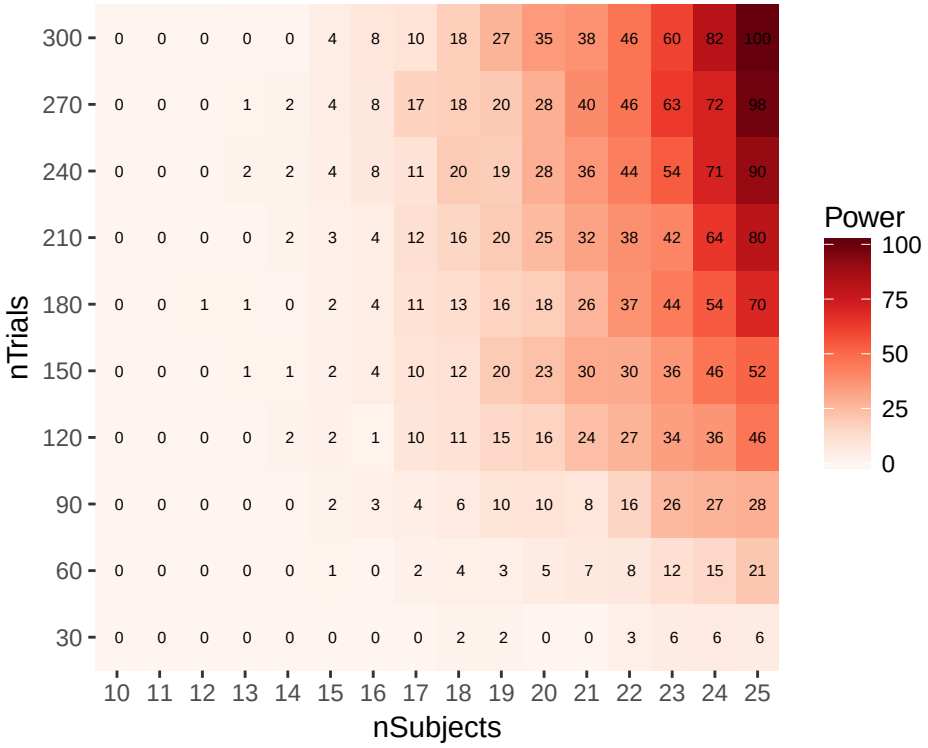
As it can be seen from this result, most of the comparisons between conditions are signficant and with very low p-values, reflecting the fact that they were large and strongly consistent across subjects.

Simulations

Each experiment simulation was performed by taking a random sample of subjects (total # of subjects: 25) and trials per condition (total # of trials per condition: 300). For every combination of #subjects and #trials *200* repetitions were done. The result of each simulation' significant-comparison table was compared to the actual result of the experiment (the table above).

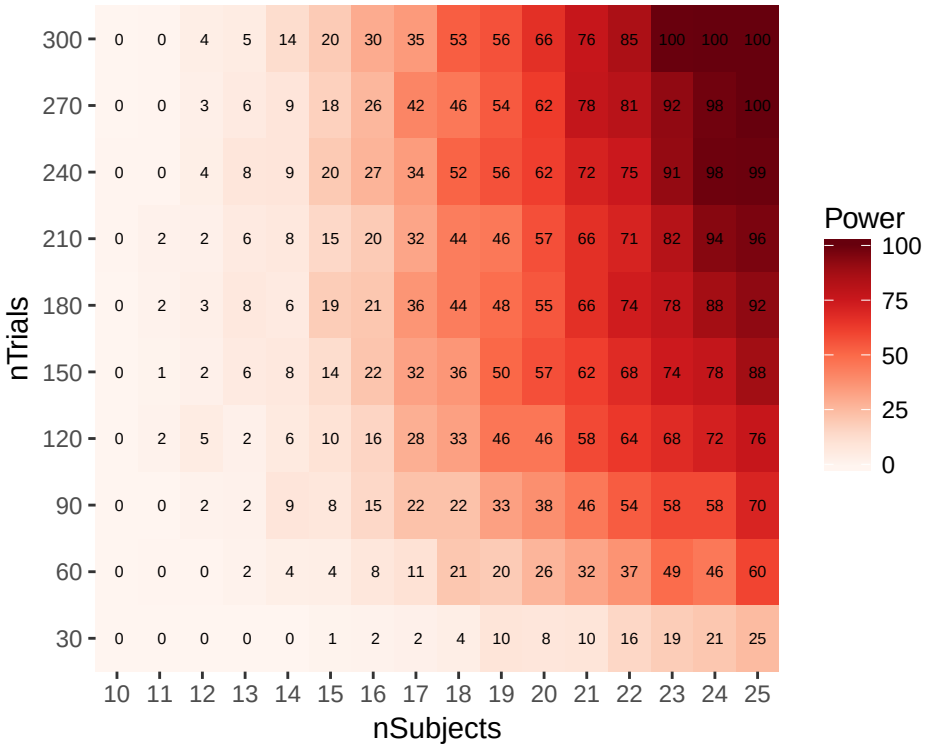
For the following plot, a simulation was considered a 'successful' experiment replication when the comparison-tables were exactly equal (i.e., the result of being significant or not of the 28 possible paired-comparisons was exactly the same between the actual results and the result in the simulated experiment). The 'power' value indicates the % of the *200* simulations that showed exactly the same result.

Simulations exactly equal

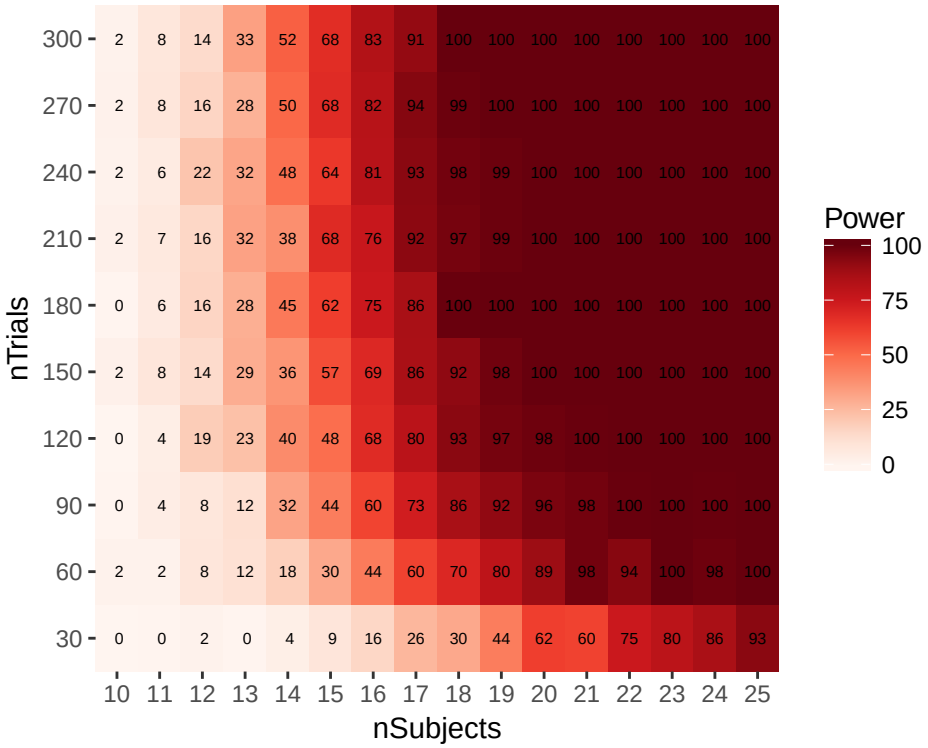


Considering a replication successful only when all the comparisons have the same result might be too strict, specially when considering the number of comparisons (28), that most comparisons were significant in the original experiment (23/28) but two of them had p-values that were only between 0.01 and 0.05 (adjusted). Furthermore these two barely significant comparisons represent differences that are numerically small (20-40 ms) when compared to the other mayor effects we see. Therefore the following three plots show the simulated power when considered a replication succesful when there is only one, two, or three comparisons that are different.

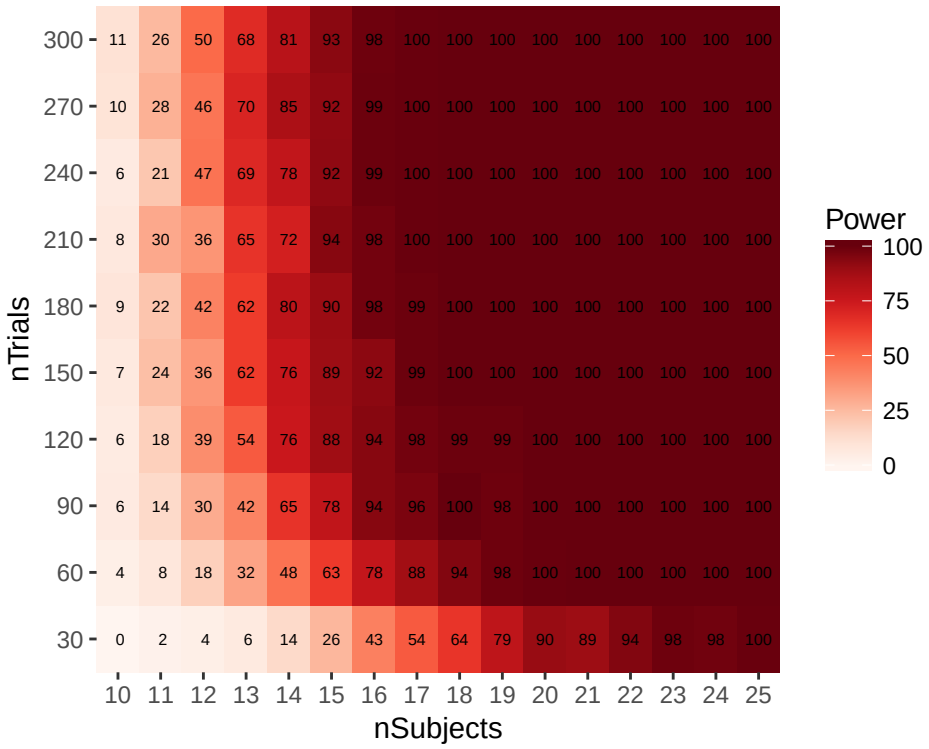
Different result in only one comparison



Different result in two comparisons



Different result in three comparisons


nTrials
300 11 26 50 68 81 93 98 100 100 100 100 100 100 100 100 100
270 10 28 46 70 85 92 99 100 100 100 100 100 100 100 100 100
240 6 21 47 69 78 92 99 100 100 100 100 100 100 100 100 100
210 8 30 36 65 72 94 98 100 100 100 100 100 100 100 100 100
180 9 22 42 62 80 90 98 99 100 100 100 100 100 100 100 100
150 7 24 36 62 76 89 92 99 100 100 100 100 100 100 100 100
120 6 18 39 54 76 88 94 98 99 99 100 100 100 100 100 100
90 6 14 30 42 65 78 94 96 100 98 100 100 100 100 100 100
60 4 8 18 32 48 63 78 88 94 98 100 100 100 100 100 100
30 0 2 4 6 14 26 43 54 64 79 90 89 94 98 98 100
10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
nSubjects
Power
100
75
50
25
0