

Neurocognitive and Functional Heterogeneity in Depressed Youth

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This is the master document containing the final analyses for the project: Neurocognitive and Functional Heterogeneity in Depressed Youth

Steps:

1) Sample construction

- We started with the CNB sample (9498 youths aged 8-22)
- Youths were excluded if they did not have age, sex, gender or maternal education documented
- Youths were also excluded if they had missing data for any of the 26 cognitive measures (12 accuracy, 14 speed)
- 712 depressed youths and 2310 remained ($n = 3022$)

2) Matching

- Using the R package Matchit, depressed youths were age and sex matched with typically developing youth
- Match was performed in 2 steps to allow us to enrich our TD group with children who had imaging
- Step 1: Depressed youth with imaging(200) were matched with youths with imaging. Results: 187 depressed and 187 TDs matched
- Step 2: People who were matched in Step 1 were removed from the original groups (unmatched: Depressed 525, TD 2123)
- Step 3: Subjects from TD group that did not have imaging were removed
- Step 4: Match was rerun for depressed without imaging with TDs WITH imaging
- Step 5: Groups were combined and demographics were checked to ensure that the groups were still matched
- Of note: Matchit does depend on random seeding, so each iteration generates VERY SLIGHT differences between groups
- Our Matchit was run 6/11/2018
- Final TD ($n = 712$) and Depressed ($n = 712$), for a total $n = 1424$

3) HYDRA

- Final matched groups were output to csv and sent to HYDRA for subtyping
- The HYDRA code can be found at <https://github.com/evaryl/HYDRA>

4) Cognitive analysis

- Results from HYDRA revealed highest ARI (0.39) for 3 subtype solution
- CNB Factor Summary Scores (Accuracy, Speed, Efficiency) were evaluated
- Results:
- Subtype 1: Cognition Preserved
- Subtype 2: Cognition Impaired
- Subtype 3: Impulsive

5) Clinical bifactor analysis

- Bifactor scores were calculated (excluding measures that were used to classify depression in initial sample construction)

- Subtypes were evaluated on 5 bifactor scores (anxious-misery, psychosis, externalizing, fear, and overall psychopathology)
- Results:
- All subtypes had higher psychopathology than TDs ($P(\text{FDR}) < 0.05$)
- Subtypes 1 and 3 were indistinguishable on clinical factor scores ($P(\text{FDR}) = \text{NS}$)
- Subtype 1 had higher anxious-misery scores than Subtype 2 ($P=0.030$)
- Subtype 2 had higher fear scores than Subtypes 1 and 3 ($P(\text{FDR}) < 0.0001$)

6) Anxious-misery analysis

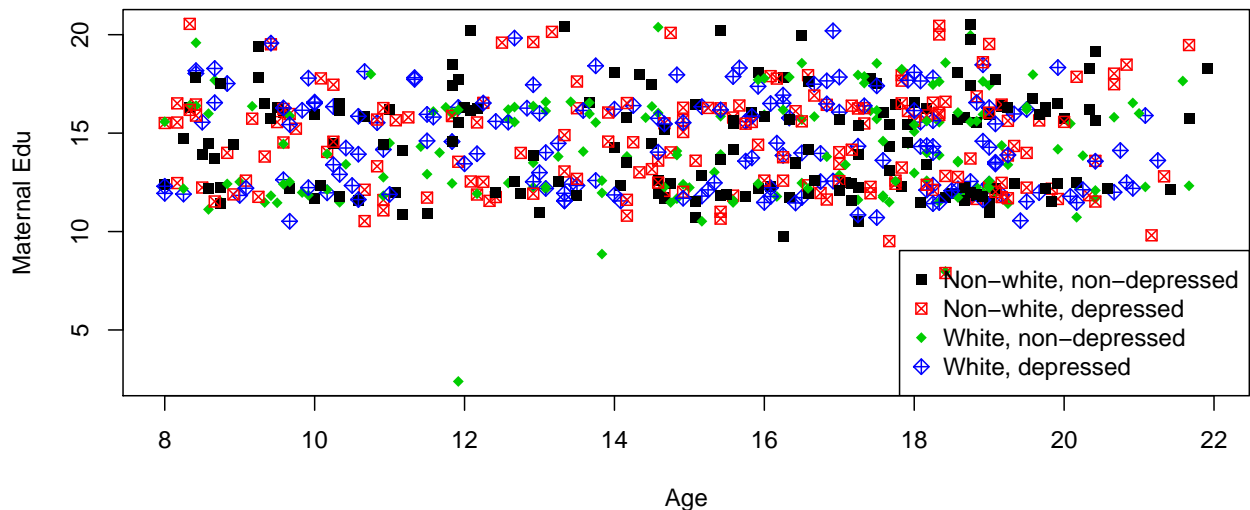
- Anxious-misery factor scores were calculated separately from the State-Trait Anxiety Inventory (STAI)
- Subtypes were evaluated on state and trait factors to verify cognitive differences were not due to current or lifetime anxious-misery
- Results:
- All subtypes had significantly higher state ($P(\text{FDR}) = 0.001$) and trait ($P(\text{FDR}) < 0.001$) anxiety
 - State Pairwise:
 - Subtype 1 vs TD ($P=0.03$)
 - Subtype 2 vs TD ($P=0.02$)
 - Subtype 3 vs TD ($P=0.08$, NS)
 - Trait Pairwise: All Subtypes vs TD ($P < 0.001$)
- Subtypes 1-3 did NOT differ on EITHER state or trait anxiety ($P=\text{NS}$)

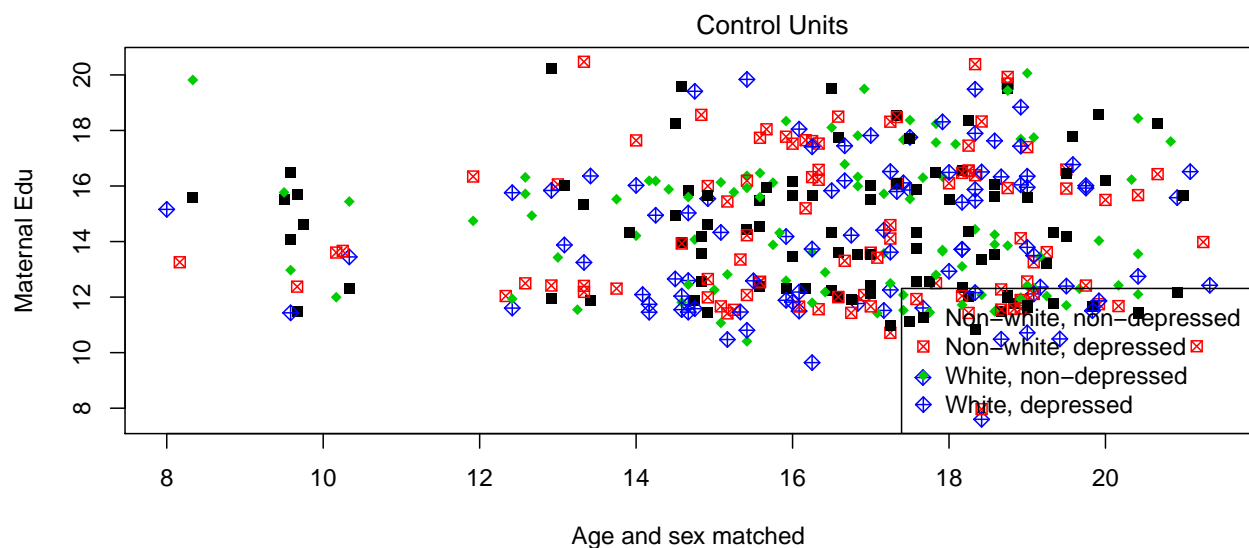
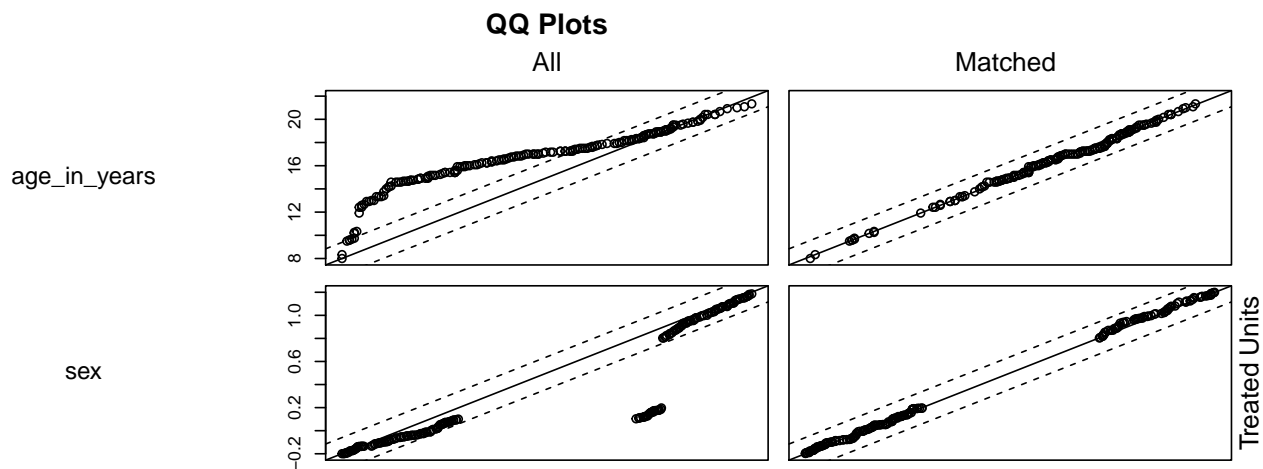
7) Nback

- Using 21 functionally defined regions of interest from Satterthwaite et al, 2013, percent signal change between 2bk and 0bk was evaluated by subtype
- Results:
- 6 areas showed significant differences ($P(\text{FDR}) < 0.05$) by subtype including
 - right crus II
 - right precuneus
 - left precuneus
 - dorsal anterior cingulate
 - left dorsal frontal/mfg
 - left dorsolateral prefrontal cortex

8) Nback age-by-sex

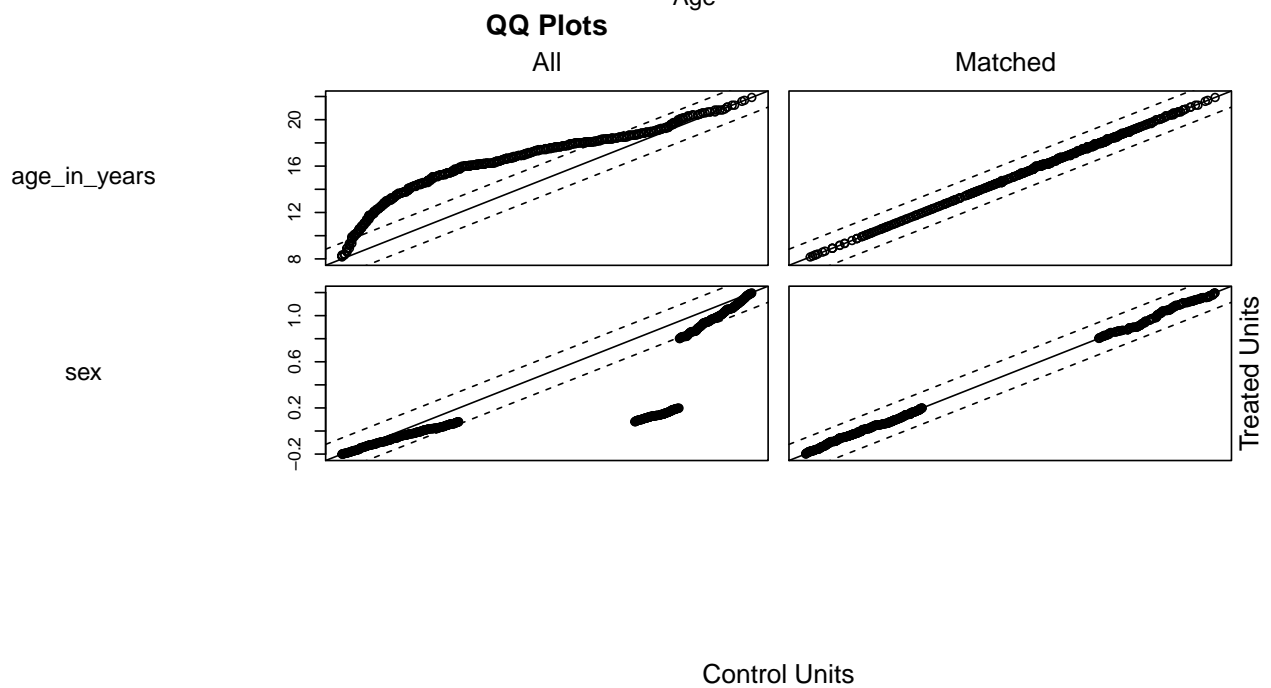
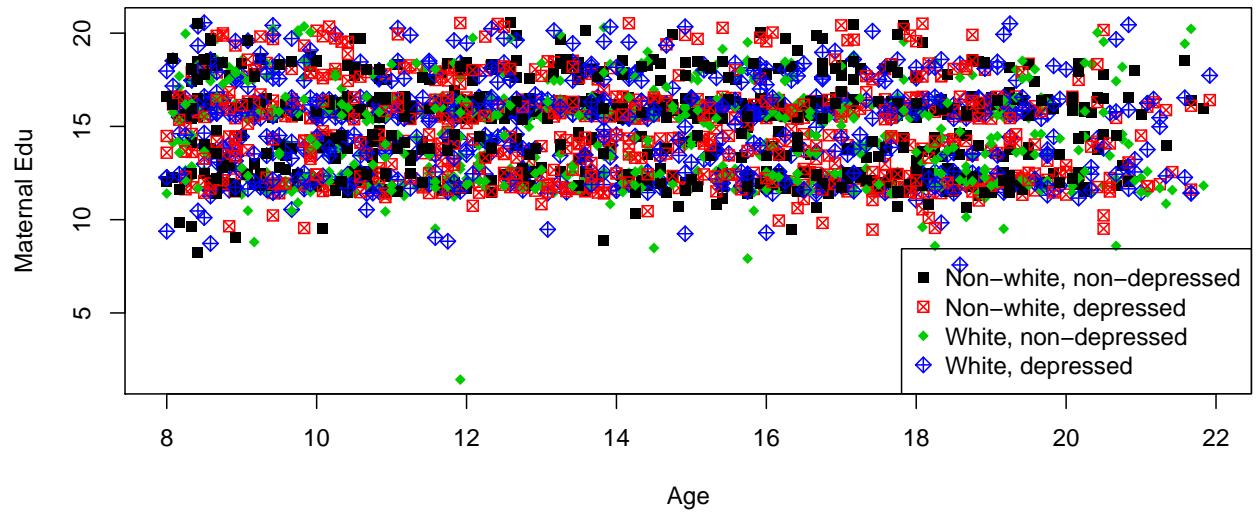
- For each of the 6 regions that showed between group differences that survived FDR correction ($P(\text{FDR}) < 0.05$), age by sex interactions were evaluated
- Results: -For all areas, age by sex interactions were found to be non-significant ($P(\text{FDR}) > 0.05$)

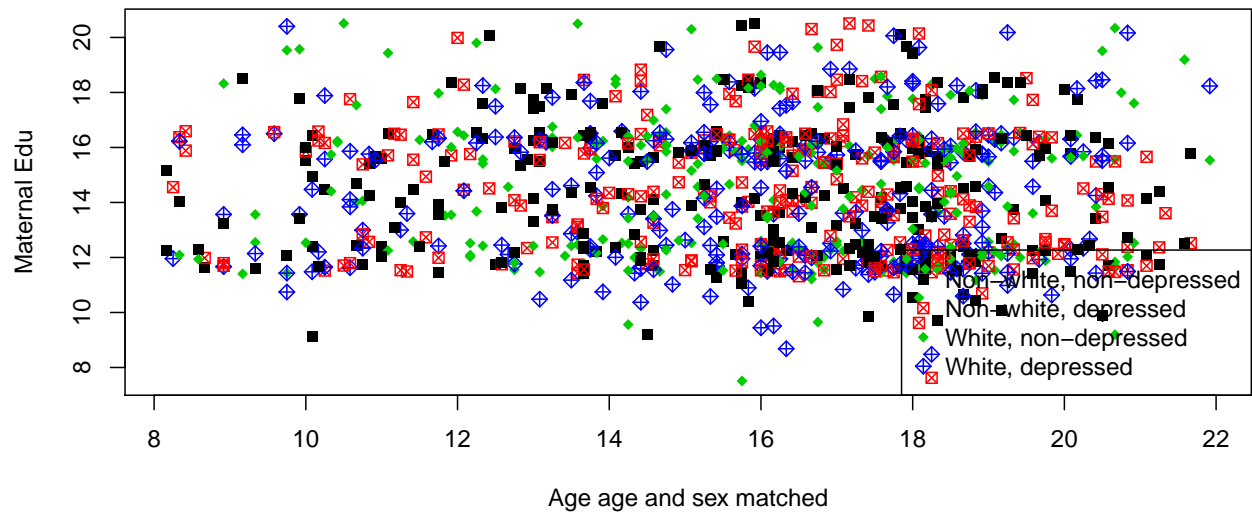




```
## [1] "Version matching on data_age_and_sex"
##
##           Stratified by Depression
##           level      Depressed      Non-depressed
## n
## Race_binarized (mean (sd))      0.44 (0.50)      0.53 (0.50)
## Sex (%)
##           Female      117 ( 62.6)      117 ( 62.6)
##           Male       70 ( 37.4)       70 ( 37.4)
## Maternal Ed (mean (sd))      13.91 (2.35)      14.88 (2.57)
## Age (mean (sd))      16.57 (2.63)      16.61 (2.67)
## Depression (%)
##           Depressed      187 (100.0)      0 ( 0.0)
##           Non-depressed      0 ( 0.0)      187 (100.0)
##
##           Stratified by Depression
##           p      test
## n
## Race_binarized (mean (sd)) 0.098
## Sex (%)      1.000
```

```
##
## Maternal Ed (mean (sd))    <0.001
## Age (mean (sd))           0.891
## Depression (%)             <0.001
##
```





```
## [1] "Version matching on data_age_and_sex"
##
##           Stratified by Depression
##           level      Depressed      Non-depressed
## n
## Race_binarized (mean (sd))      0.59 (0.49)      0.65 (0.48)
## Sex (%)
##           Female      360 ( 68.6)      360 ( 68.6)
##           Male      165 ( 31.4)      165 ( 31.4)
## Maternal Ed (mean (sd))      14.19 (2.26)      14.73 (2.46)
## Age (mean (sd))      15.97 (2.97)      15.97 (2.97)
## Depression (%)
##           Depressed      525 (100.0)      0 ( 0.0)
##           Non-depressed      0 ( 0.0)      525 (100.0)
##
##           Stratified by Depression
##           p      test
## n
## Race_binarized (mean (sd)) 0.049
## Sex (%)      1.000
##
## Maternal Ed (mean (sd)) <0.001
## Age (mean (sd))      0.996
## Depression (%) <0.001
##

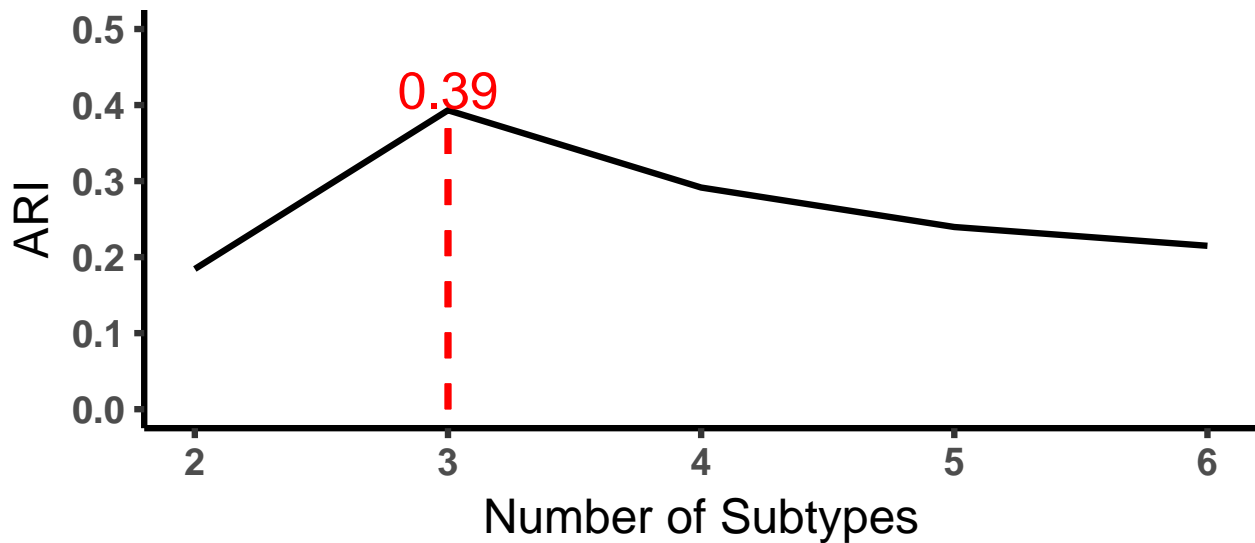
## [1] "Version matching on data_age_and_sex"
##
##           Stratified by Depression
##           level      Depressed      Non-depressed
## n
## Race_binarized (mean (sd))      0.55 (0.50)      0.62 (0.49)
## Sex (%)
##           Female      477 ( 67.0)      477 ( 67.0)
##           Male      235 ( 33.0)      235 ( 33.0)
## Maternal Ed (mean (sd))      14.12 (2.29)      14.77 (2.49)
## Age (mean (sd))      16.13 (2.90)      16.14 (2.91)
## Depression (%)
##           Depressed      712 (100.0)      0 ( 0.0)
##           Non-depressed      0 ( 0.0)      712 (100.0)
##
##           Stratified by Depression
##           p      test
## n
## Race_binarized (mean (sd)) 0.011
## Sex (%)      1.000
```

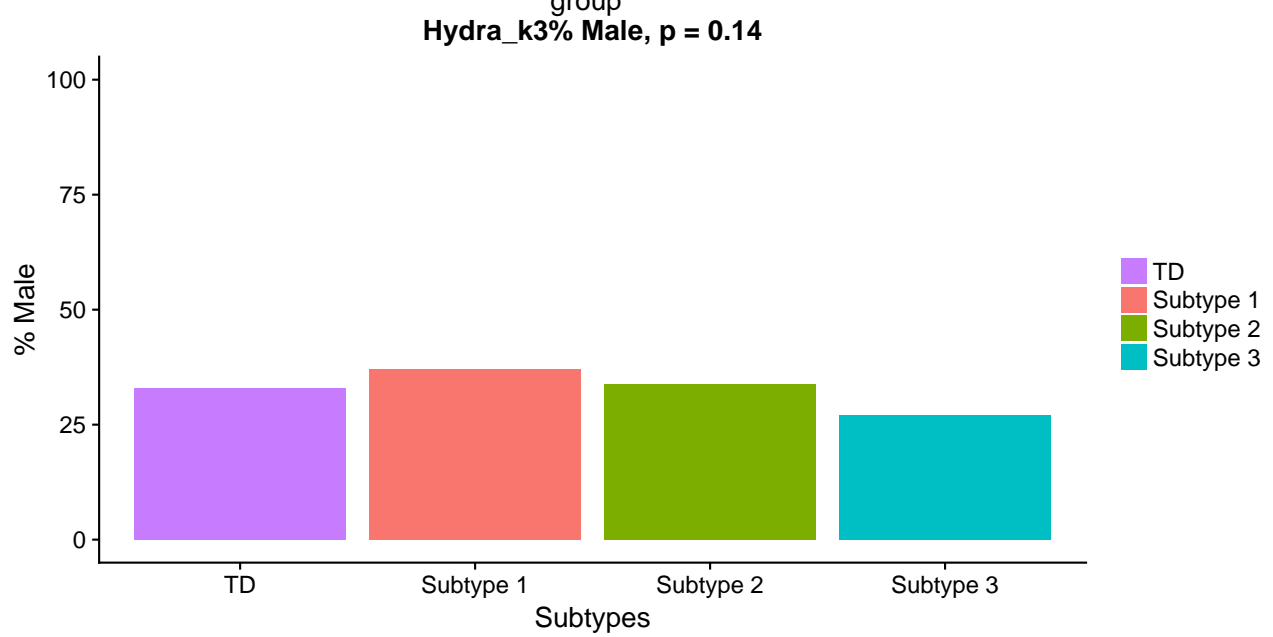
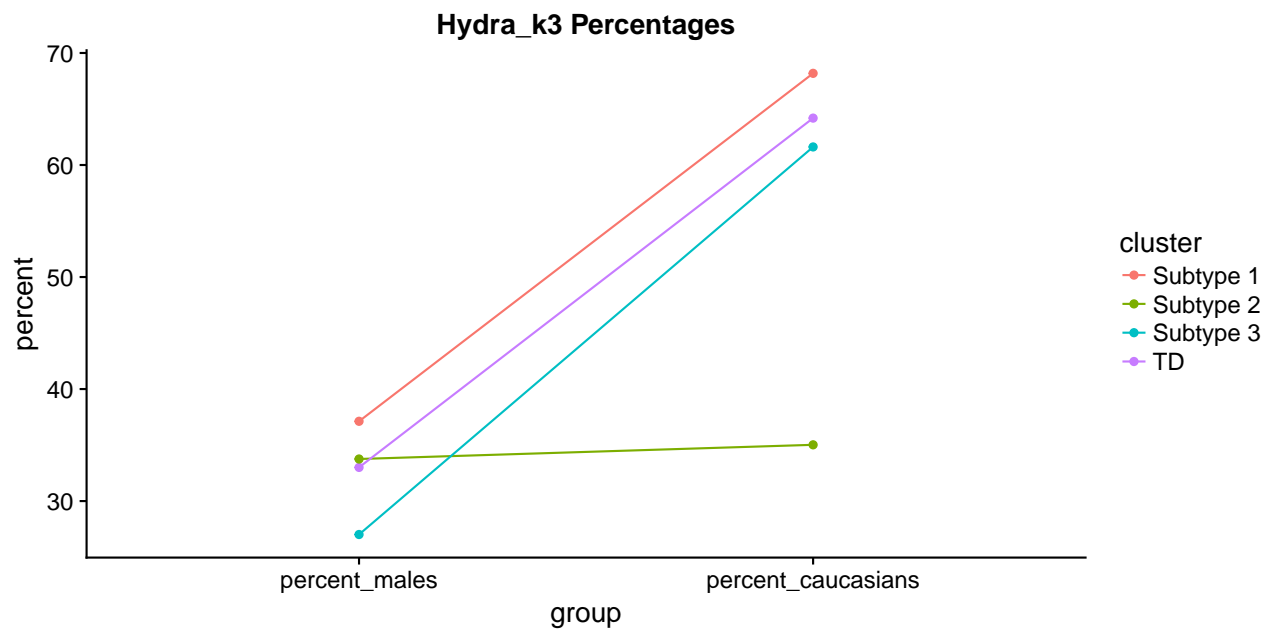
```

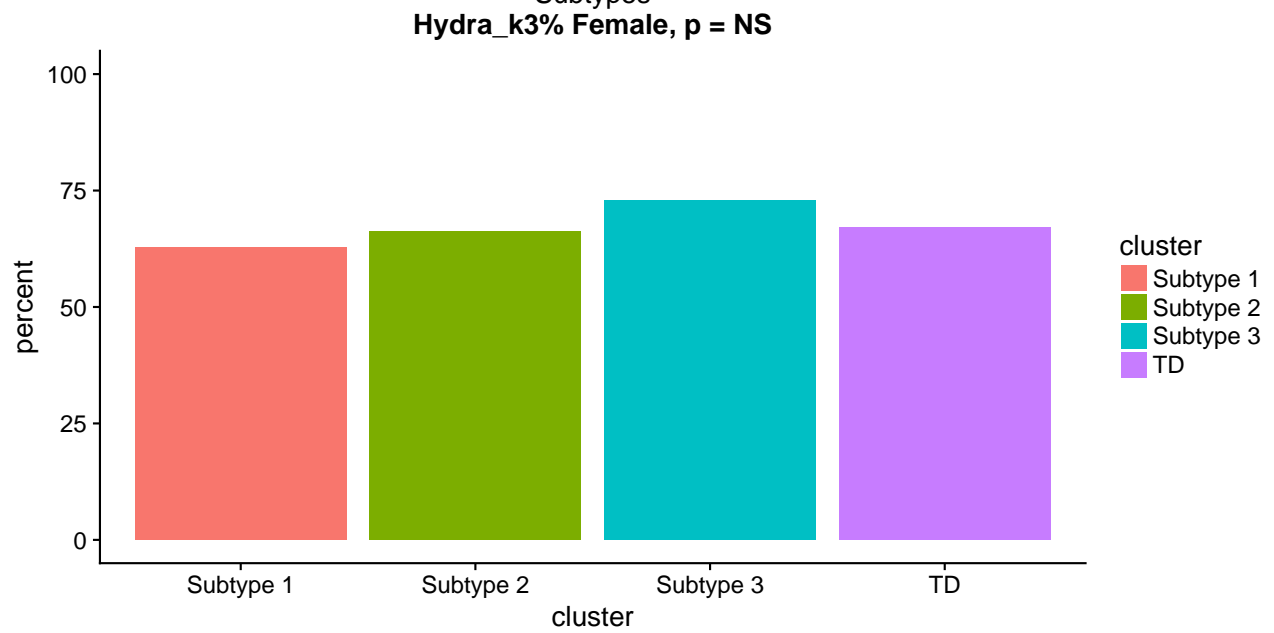
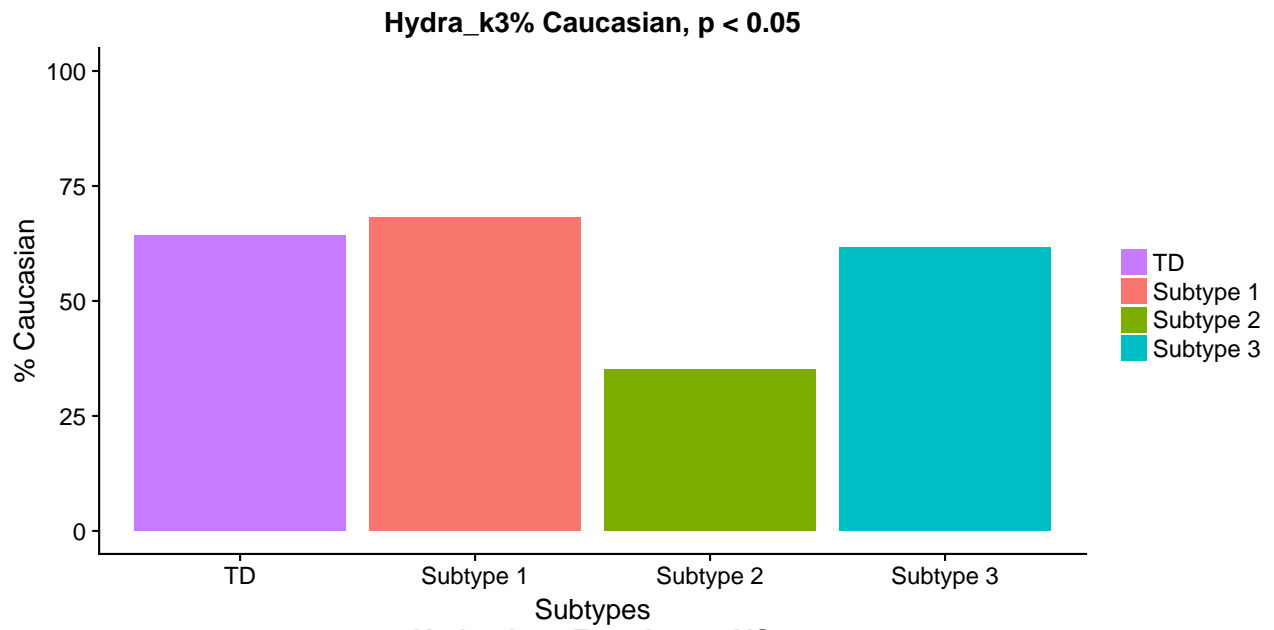
##
## Maternal Ed (mean (sd)) <0.001
## Age (mean (sd)) 0.953
## Depression (%) <0.001
##
##
## Stratified by Depression
## level Depressed Non-depressed
## n 712 712
## Race (%) Caucasian 393 ( 55.2) 457 ( 64.2)
## Non-caucasian 319 ( 44.8) 255 ( 35.8)
## Sex (%) Female 477 ( 67.0) 477 ( 67.0)
## Male 235 ( 33.0) 235 ( 33.0)
## Maternal Ed (mean (sd)) 14.12 (2.29) 14.93 (2.52)
## Age (mean (sd)) 16.13 (2.90) 16.14 (2.91)
## Depression (%) Depressed 712 (100.0) 0 ( 0.0)
## Non-depressed 0 ( 0.0) 712 (100.0)
##
## Stratified by Depression
## p test
## n
## Race (%) 0.001
##
## Sex (%) 1.000
##
## Maternal Ed (mean (sd)) <0.001
## Age (mean (sd)) 0.944
## Depression (%) <0.001
##

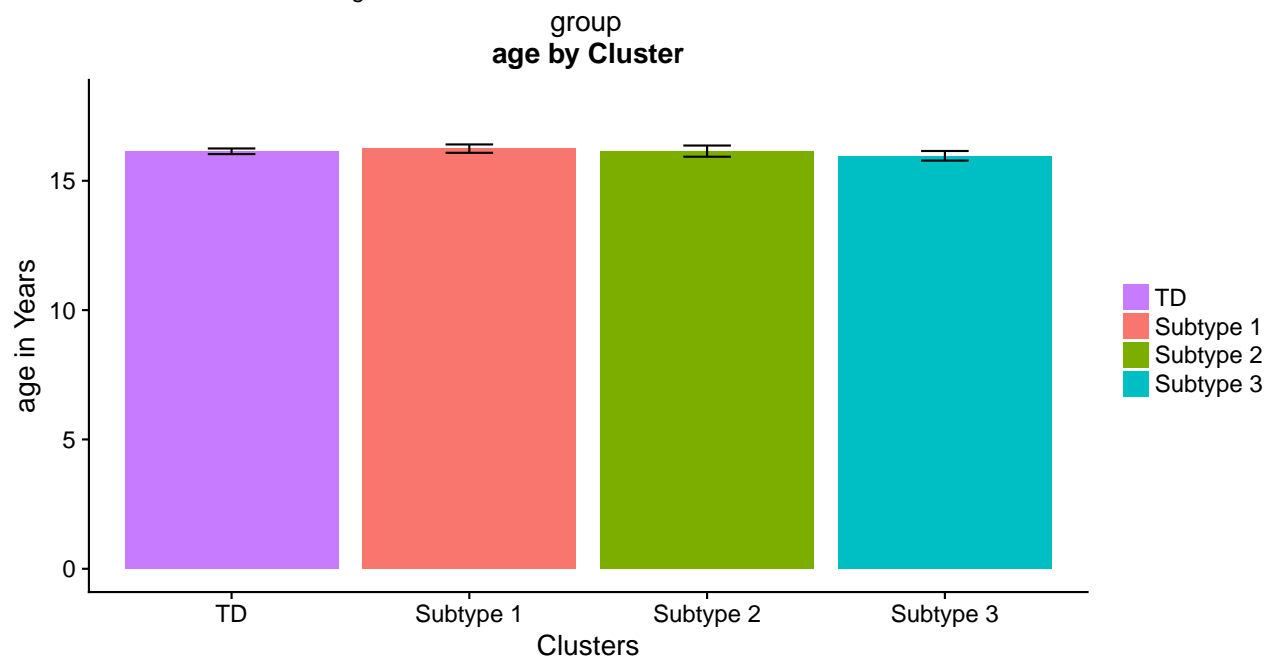
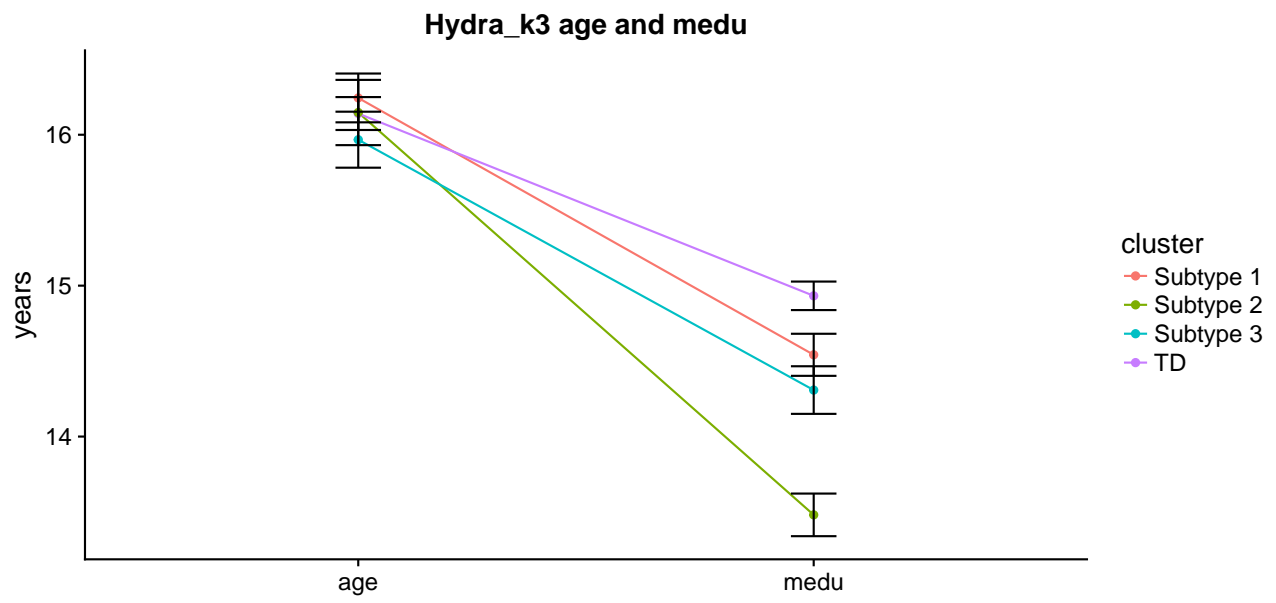
```

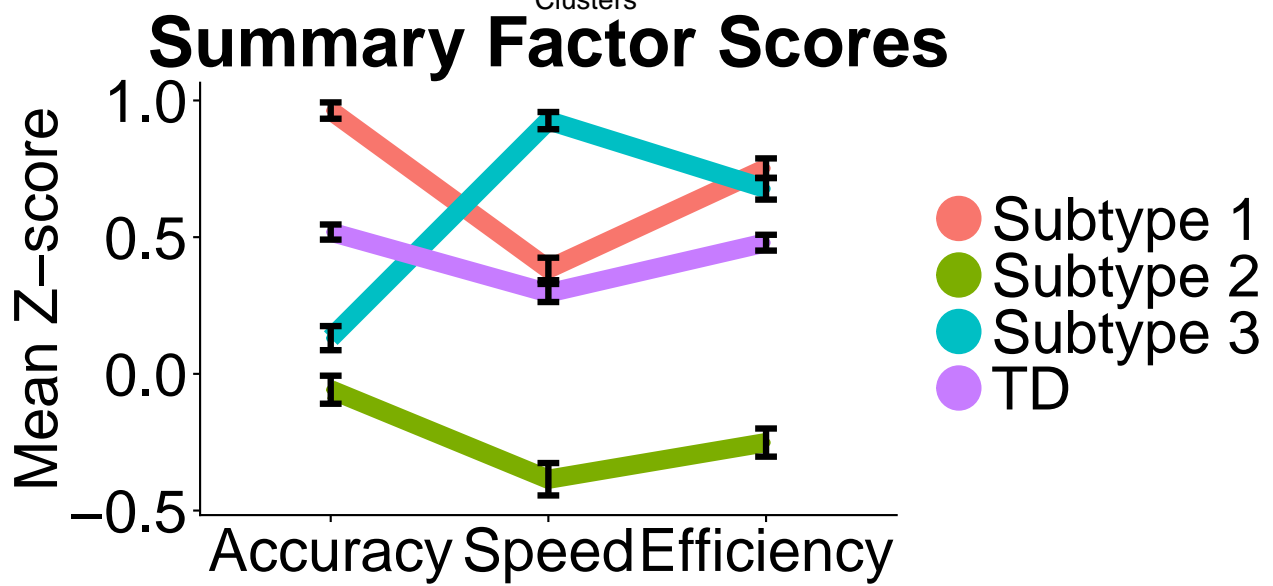
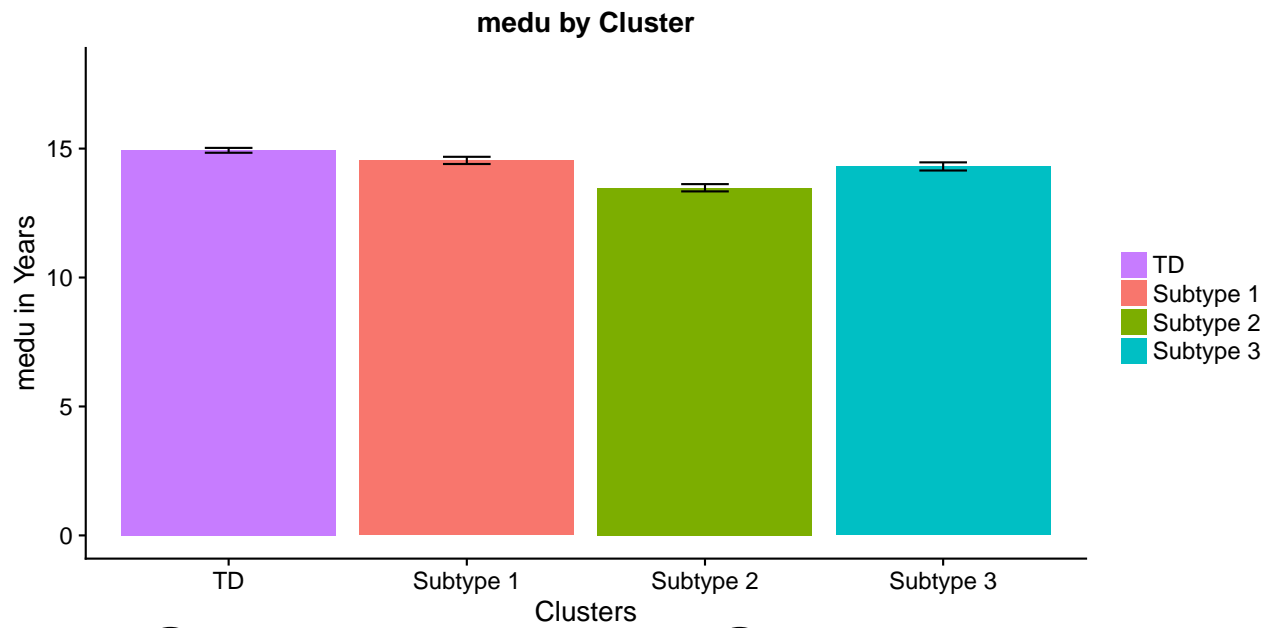
HYDRA

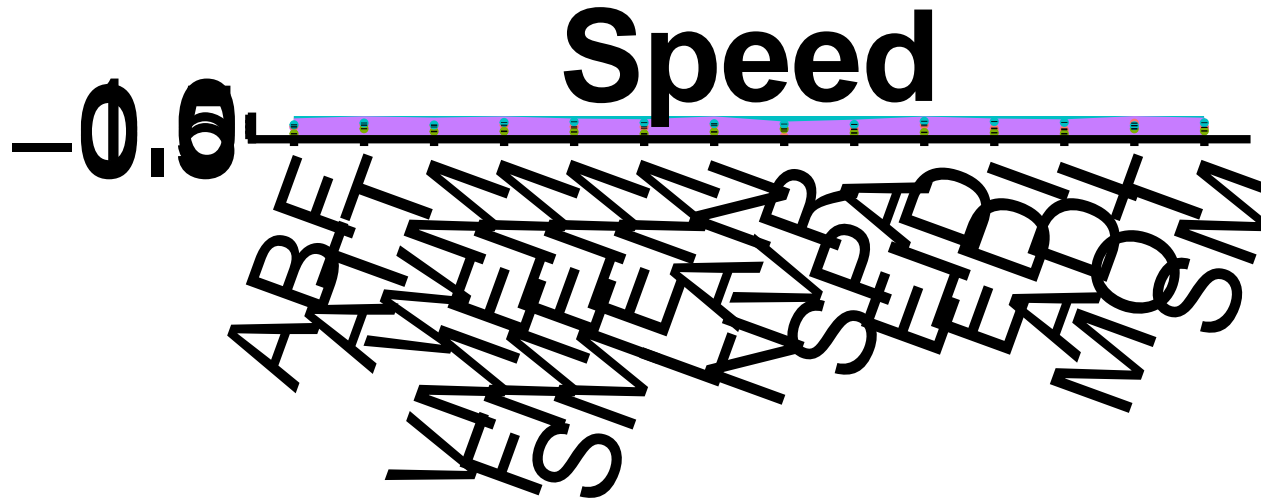
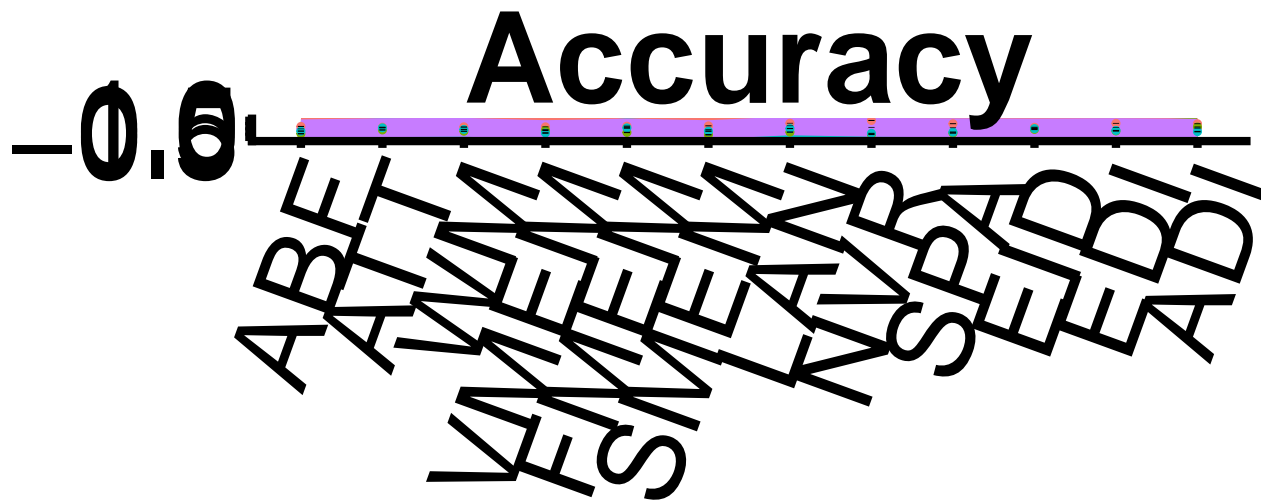












```
## [1] "Linear model- Mean centered age that was then squared"
##      cnb_measure p_FDR_corr
## 1      abf_z      0
## 2      att_z      0.001
## 3      wm_z      0
## 4      vmem_z     0
## 5      fmem_z     0
## 6      smem_z     0
## 7      lan_z      0
## 8      nvr_z      0
## 9      spa_z      0
## 10     eid_z      0.033
## 11     edi_z      0
## 12     adi_z      0
## 13     abf_s_z     0
```

```

## 14      att_s_z          0
## 15      wm_s_z          0
## 16      vmem_s_z        0
## 17      fmem_s_z        0
## 18      smem_s_z        0
## 19      lan_s_z         0
## 20      nvr_s_z         0
## 21      spa_s_z         0
## 22      eid_s_z         0
## 23      edi_s_z         0
## 24      adi_s_z         0
## 25      mot_s_z         0
## 26      sm_s_z          0

## [1] "LM pairwise contrasts with FDR corrected values, CNB scores"

##      -1 - 1 -1 - 2 -1 - 3 1 - 2 1 - 3 2 - 3 p_FDR_corr
## abf_z    0.002  0.000  0.015 0.000 0.000 0.020          0
## att_z    0.863  0.001  0.995 0.001 0.847 0.032        0.001
## wm_z     0.862  0.000  0.002 0.000 0.001 0.057          0
## vmem_z   0.000  0.722  0.000 0.000 0.000 0.013          0
## fmem_z   0.054  0.000  0.999 0.000 0.250 0.000          0
## smem_z   0.000  0.000  0.240 0.000 0.000 0.001          0
## lan_z    0.000  0.000  0.000 0.000 0.000 0.000          0
## nvr_z    0.000  0.000  0.000 0.000 0.000 0.554          0
## spa_z    0.000  0.000  0.000 0.000 0.000 0.727          0
## eid_z    0.627  0.122  0.837 0.025 0.353 0.716        0.033
## edi_z    0.000  0.000  0.000 0.000 0.000 0.919          0
## adi_z    0.000  0.279  0.000 0.000 0.000 0.000          0
## abf_s_z  0.101  0.000  0.000 0.000 0.296 0.000          0
## att_s_z  0.554  0.000  0.000 0.000 0.038 0.000          0
## wm_s_z   0.159  0.000  0.014 0.000 0.787 0.000          0
## vmem_s_z 0.554  0.000  0.000 0.000 0.003 0.000          0
## fmem_s_z 0.318  0.000  0.000 0.000 0.000 0.000          0
## smem_s_z 0.077  0.000  0.000 0.000 0.000 0.000          0
## lan_s_z  0.456  0.000  0.003 0.000 0.285 0.000          0
## nvr_s_z  0.000  0.071  0.000 0.000 0.000 0.000          0
## spa_s_z  0.971  0.000  0.000 0.001 0.000 0.000          0
## eid_s_z  0.440  0.000  0.000 0.000 0.000 0.000          0
## edi_s_z  0.762  0.000  0.000 0.000 0.000 0.000          0
## adi_s_z  0.672  0.000  0.000 0.000 0.000 0.000          0
## mot_s_z  0.003  0.000  0.991 0.000 0.015 0.003          0
## sm_s_z   0.954  0.000  0.000 0.000 0.000 0.000          0

## contrast estimate      SE    df t.ratio p.value
## -1 - 1    -0.2264986 0.06407130 1420  -3.535  0.0024
## -1 - 2     0.4523014 0.06668061 1420   6.783 <.0001
## -1 - 3     0.2089367 0.06969478 1420   2.998  0.0147
## 1 - 2      0.6788000 0.07956523 1420   8.531 <.0001
## 1 - 3      0.4354353 0.08210776 1420   5.303 <.0001
## 2 - 3     -0.2433648 0.08415971 1420  -2.892  0.0203
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast estimate      SE    df t.ratio p.value
## -1 - 1    -0.04312068 0.05521656 1420  -0.781  0.8631

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```

## -1 - 2    0.21305590 0.05746525 1420    3.708 0.0012
## -1 - 3    0.01466661 0.06006286 1420    0.244 0.9949
## 1 - 2     0.25617658 0.06856920 1420    3.736 0.0011
## 1 - 3     0.05778729 0.07076035 1420    0.817 0.8466
## 2 - 3    -0.19838929 0.07252871 1420   -2.735 0.0320
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1    -0.0404608 0.05162219 1420   -0.784 0.8618
## -1 - 2     0.3728930 0.05372451 1420    6.941 <.0001
## -1 - 3     0.2017588 0.05615302 1420    3.593 0.0019
## 1 - 2     0.4133538 0.06410564 1420    6.448 <.0001
## 1 - 3     0.2422196 0.06615415 1420    3.661 0.0015
## 2 - 3    -0.1711343 0.06780740 1420   -2.524 0.0567
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1    -0.26502990 0.06131852 1420   -4.322 0.0001
## -1 - 2     0.06679999 0.06381572 1420    1.047 0.7219
## -1 - 3     0.31049760 0.06670039 1420    4.655 <.0001
## 1 - 2     0.33182989 0.07614677 1420    4.358 0.0001
## 1 - 3     0.57552750 0.07858006 1420    7.324 <.0001
## 2 - 3     0.24369760 0.08054384 1420    3.026 0.0135
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1    -0.16837995 0.06629148 1420   -2.540 0.0544
## -1 - 2     0.41554090 0.06899120 1420    6.023 <.0001
## -1 - 3    -0.01116918 0.07210982 1420   -0.155 0.9987
## 1 - 2     0.58392085 0.08232230 1420    7.093 <.0001
## 1 - 3     0.15721077 0.08495294 1420    1.851 0.2502
## 2 - 3    -0.42671008 0.08707598 1420   -4.900 <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1    -0.3607104 0.06736337 1420   -5.355 <.0001
## -1 - 2     0.4714814 0.07010674 1420    6.725 <.0001
## -1 - 3     0.1373127 0.07327578 1420    1.874 0.2398
## 1 - 2     0.8321918 0.08365340 1420    9.948 <.0001
## 1 - 3     0.4980231 0.08632657 1420    5.769 <.0001
## 2 - 3    -0.3341687 0.08848394 1420   -3.777 0.0010
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1    -0.2414072 0.05407307 1420   -4.464 0.0001
## -1 - 2     0.5901804 0.05627519 1420   10.487 <.0001
## -1 - 3     0.2561681 0.05881901 1420    4.355 0.0001
## 1 - 2     0.8315876 0.06714919 1420   12.384 <.0001
## 1 - 3     0.4975753 0.06929497 1420    7.181 <.0001
## 2 - 3    -0.3340123 0.07102671 1420   -4.703 <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1    -0.6404344 0.06239211 1420  -10.265 <.0001

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## -1 - 2    0.6724267 0.06493303 1420 10.356 <.0001
## -1 - 3    0.5647885 0.06786821 1420  8.322 <.0001
##  1 - 2    1.3128611 0.07747998 1420 16.945 <.0001
##  1 - 3    1.2052228 0.07995587 1420 15.074 <.0001
##  2 - 3   -0.1076383 0.08195404 1420 -1.313 0.5545
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1   -0.3822279 0.06315518 1420  -6.052 <.0001
## -1 - 2    0.4957128 0.06572717 1420   7.542 <.0001
## -1 - 3    0.4095527 0.06869824 1420   5.962 <.0001
##  1 - 2    0.8779407 0.07842756 1420  11.194 <.0001
##  1 - 3    0.7917806 0.08093374 1420   9.783 <.0001
##  2 - 3   -0.0861601 0.08295634 1420  -1.039 0.7267
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1   -0.06914252 0.05765594 1420  -1.199 0.6274
## -1 - 2    0.13245521 0.06000398 1420   2.207 0.1217
## -1 - 3    0.05249643 0.06271634 1420   0.837 0.8368
##  1 - 2    0.20159773 0.07159849 1420   2.816 0.0254
##  1 - 3    0.12163895 0.07388644 1420   1.646 0.3530
##  2 - 3   -0.07995878 0.07573292 1420  -1.056 0.7165
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1   -0.40062763 0.05701688 1420  -7.026 <.0001
## -1 - 2    0.31591078 0.05933890 1420   5.324 <.0001
## -1 - 3    0.26791531 0.06202120 1420   4.320 0.0001
##  1 - 2    0.71653841 0.07080489 1420  10.120 <.0001
##  1 - 3    0.66854293 0.07306748 1420   9.150 <.0001
##  2 - 3   -0.04799548 0.07489350 1420  -0.641 0.9187
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1   -0.4184966 0.05890991 1420  -7.104 <.0001
## -1 - 2   -0.1096468 0.06130902 1420  -1.788 0.2793
## -1 - 3    0.3188571 0.06408037 1420   4.976 <.0001
##  1 - 2    0.3088497 0.07315569 1420   4.222 0.0002
##  1 - 3    0.7373537 0.07549341 1420   9.767 <.0001
##  2 - 3    0.4285039 0.07738005 1420   5.538 <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1   -0.1438771 0.06283771 1420  -2.290 0.1009
## -1 - 2    0.5493754 0.06539678 1420   8.401 <.0001
## -1 - 3   -0.2852104 0.06835291 1420  -4.173 0.0002
##  1 - 2    0.6932524 0.07803333 1420   8.884 <.0001
##  1 - 3   -0.1413334 0.08052691 1420  -1.755 0.2957
##  2 - 3   -0.8345858 0.08253935 1420 -10.111 <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1   -0.07003723 0.05329324 1420  -1.314 0.5540

```

```

## -1 - 2    0.27951462 0.05546361 1420    5.040 <.0001
## -1 - 3   -0.25266145 0.05797073 1420   -4.358 0.0001
##  1 - 2    0.34955186 0.06618078 1420    5.282 <.0001
##  1 - 3   -0.18262422 0.06829561 1420   -2.674 0.0380
##  2 - 3   -0.53217607 0.07000238 1420   -7.602 <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1   -0.12340003 0.05922036 1420   -2.084 0.1589
## -1 - 2    0.41363589 0.06163211 1420    6.711 <.0001
## -1 - 3   -0.19420788 0.06441807 1420   -3.015 0.0139
##  1 - 2    0.53703592 0.07354122 1420    7.303 <.0001
##  1 - 3   -0.07080785 0.07589125 1420   -0.933 0.7871
##  2 - 3   -0.60784377 0.07778784 1420   -7.814 <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1   -0.07404698 0.05632668 1420   -1.315 0.5537
## -1 - 2    0.50137204 0.05862058 1420    8.553 <.0001
## -1 - 3   -0.32524194 0.06127042 1420   -5.308 <.0001
##  1 - 2    0.57541902 0.06994778 1420    8.226 <.0001
##  1 - 3   -0.25119496 0.07218298 1420   -3.480 0.0029
##  2 - 3   -0.82661397 0.07398690 1420  -11.172 <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1   -0.1084012 0.06332059 1420   -1.712 0.3177
## -1 - 2    0.3678585 0.06589932 1420    5.582 <.0001
## -1 - 3   -0.5748044 0.06887817 1420   -8.345 <.0001
##  1 - 2    0.4762598 0.07863298 1420    6.057 <.0001
##  1 - 3   -0.4664032 0.08114572 1420   -5.748 <.0001
##  2 - 3   -0.9426630 0.08317362 1420  -11.334 <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1   -0.1630010 0.06790699 1420   -2.400 0.0774
## -1 - 2    0.4779579 0.07067251 1420    6.763 <.0001
## -1 - 3   -0.5593285 0.07386712 1420   -7.572 <.0001
##  1 - 2    0.6409589 0.08432848 1420    7.601 <.0001
##  1 - 3   -0.3963275 0.08702322 1420   -4.554 <.0001
##  2 - 3   -1.0372864 0.08919801 1420  -11.629 <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1   -0.07902212 0.05373803 1420   -1.471 0.4557
## -1 - 2    0.56466061 0.05592651 1420   10.096 <.0001
## -1 - 3   -0.20133677 0.05845457 1420   -3.444 0.0033
##  1 - 2    0.64368273 0.06673314 1420    9.646 <.0001
##  1 - 3   -0.12231465 0.06886561 1420   -1.776 0.2853
##  2 - 3   -0.76599738 0.07058663 1420  -10.852 <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate          SE    df t.ratio p.value
## -1 - 1    0.5393300 0.07638485 1420    7.061 <.0001

```

```

## -1 - 2 -0.1934495 0.07949563 1420 -2.433 0.0714
## -1 - 3 -0.6450656 0.08308908 1420 -7.764 <.0001
## 1 - 2 -0.7327795 0.09485648 1420 -7.725 <.0001
## 1 - 3 -1.1843956 0.09788765 1420 -12.100 <.0001
## 2 - 3 -0.4516161 0.10033395 1420 -4.501 <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast estimate SE df t.ratio p.value
## -1 - 1 0.02963254 0.06727858 1420 0.440 0.9714
## -1 - 2 0.35758553 0.07001850 1420 5.107 <.0001
## -1 - 3 -0.43475550 0.07318356 1420 -5.941 <.0001
## 1 - 2 0.32795299 0.08354811 1420 3.925 0.0005
## 1 - 3 -0.46438803 0.08621791 1420 -5.386 <.0001
## 2 - 3 -0.79234102 0.08837257 1420 -8.966 <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast estimate SE df t.ratio p.value
## -1 - 1 -0.08812999 0.05893232 1420 -1.495 0.4405
## -1 - 2 0.59826312 0.06133234 1420 9.754 <.0001
## -1 - 3 -0.43402642 0.06410475 1420 -6.771 <.0001
## 1 - 2 0.68639311 0.07318353 1420 9.379 <.0001
## 1 - 3 -0.34589643 0.07552213 1420 -4.580 <.0001
## 2 - 3 -1.03228954 0.07740949 1420 -13.335 <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast estimate SE df t.ratio p.value
## -1 - 1 0.06217608 0.06356753 1420 0.978 0.7620
## -1 - 2 0.44591292 0.06615632 1420 6.740 <.0001
## -1 - 3 -0.59186922 0.06914679 1420 -8.560 <.0001
## 1 - 2 0.38373684 0.07893964 1420 4.861 <.0001
## 1 - 3 -0.65404530 0.08146218 1420 -8.029 <.0001
## 2 - 3 -1.03778214 0.08349799 1420 -12.429 <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast estimate SE df t.ratio p.value
## -1 - 1 0.08167459 0.07233600 1420 1.129 0.6716
## -1 - 2 0.46187266 0.07528188 1420 6.135 <.0001
## -1 - 3 -0.59117438 0.07868485 1420 -7.513 <.0001
## 1 - 2 0.38019807 0.08982852 1420 4.232 0.0001
## 1 - 3 -0.67284897 0.09269902 1420 -7.258 <.0001
## 2 - 3 -1.05304704 0.09501564 1420 -11.083 <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast estimate SE df t.ratio p.value
## -1 - 1 -0.22218338 0.06337607 1420 -3.506 0.0026
## -1 - 2 0.30663331 0.06595706 1420 4.649 <.0001
## -1 - 3 0.02005391 0.06893852 1420 0.291 0.9914
## 1 - 2 0.52881669 0.07870187 1420 6.719 <.0001
## 1 - 3 0.24223729 0.08121682 1420 2.983 0.0154
## 2 - 3 -0.28657940 0.08324649 1420 -3.443 0.0033
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast estimate SE df t.ratio p.value
## -1 - 1 0.03048762 0.05850695 1420 0.521 0.9540

```

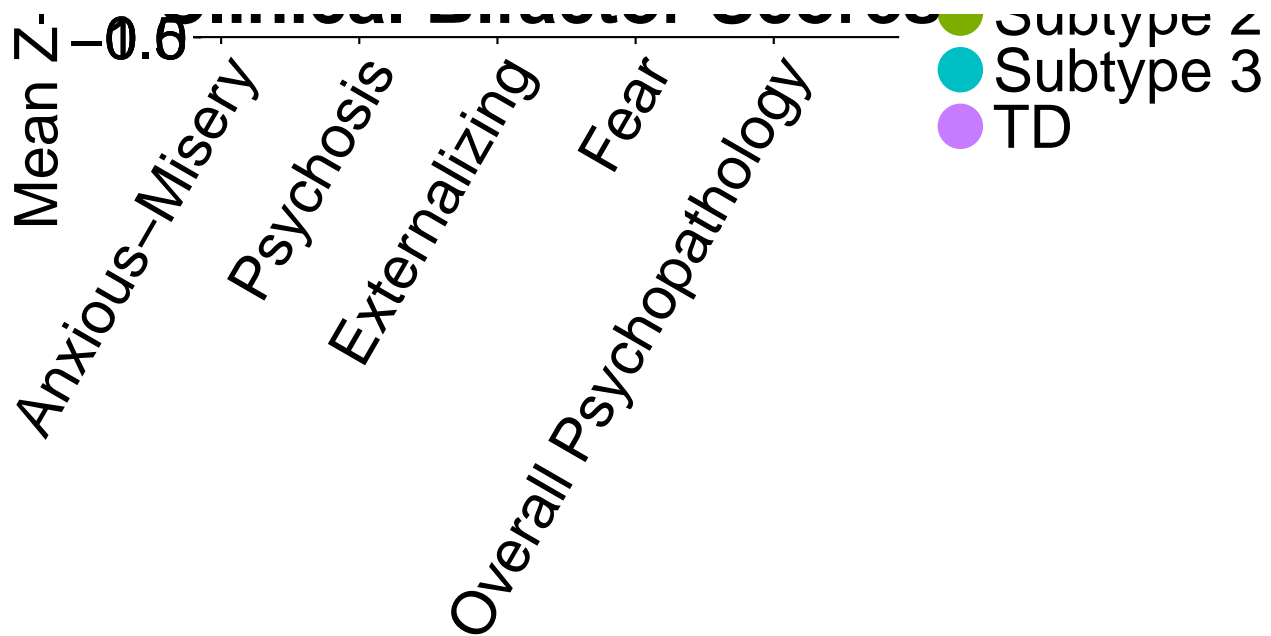


```

## -1 - 2      0.34791107 0.06088965 1420      5.714 <.0001
## -1 - 3     -0.41389316 0.06364205 1420     -6.503 <.0001
## 1 - 2       0.31742345 0.07265529 1420      4.369 0.0001
## 1 - 3     -0.44438078 0.07497701 1420     -5.927 <.0001
## 2 - 3     -0.76180423 0.07685075 1420     -9.913 <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates

##          abf_z      att_z      wm_z      vmem_z      fmem_z      smem_z
## contrast factor,6 factor,6 factor,6 factor,6 factor,6 factor,6
## estimate Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
## SE        Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
## df        Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
## t.ratio   Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
## p.value   Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
##          lan_z      nvr_z      spa_z      eid_z      edi_z      adi_z
## contrast factor,6 factor,6 factor,6 factor,6 factor,6 factor,6
## estimate Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
## SE        Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
## df        Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
## t.ratio   Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
## p.value   Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
##          abf_s_z      att_s_z      wm_s_z      vmem_s_z      fmem_s_z      smem_s_z
## contrast factor,6 factor,6 factor,6 factor,6 factor,6 factor,6
## estimate Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
## SE        Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
## df        Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
## t.ratio   Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
## p.value   Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
##          lan_s_z      nvr_s_z      spa_s_z      eid_s_z      edi_s_z      adi_s_z
## contrast factor,6 factor,6 factor,6 factor,6 factor,6 factor,6
## estimate Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
## SE        Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
## df        Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
## t.ratio   Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
## p.value   Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6 Numeric,6
##          mot_s_z      sm_s_z
## contrast factor,6 factor,6
## estimate Numeric,6 Numeric,6
## SE        Numeric,6 Numeric,6
## df        Numeric,6 Numeric,6
## t.ratio   Numeric,6 Numeric,6
## p.value   Numeric,6 Numeric,6

```



```
## [1] "LM"

##               clinical_measure p_FDR_corr
## 1      AnxiousMisery_Bifactor          0
## 2      Externalizing_Bifactor          0
## 3              Fear_Bifactor          0
## 4 Overall_Psychopathology_Bifactor      0

## [1] "LM pairwise contrasts with FDR corrected values, Bifactor scores"

##               -1 - 1 -1 - 2 -1 - 3 1 - 2 1 - 3 2 - 3
## AnxiousMisery_Bifactor      0.000      0 0.000 0.030 0.375 0.724
## Externalizing_Bifactor      0.000      0 0.000 0.701 0.776 0.207
## Fear_Bifactor               0.017      0 0.041 0.000 1.000 0.000
## Overall_Psychopathology_Bifactor 0.000      0 0.000 0.313 0.957 0.671
##               p_FDR_corr
## AnxiousMisery_Bifactor          0
## Externalizing_Bifactor          0
## Fear_Bifactor                   0
## Overall_Psychopathology_Bifactor 0

## contrast      estimate      SE    df t.ratio p.value
## -1 - 1      -0.42010128 0.03330872 1419 -12.612 <.0001
## -1 - 2      -0.30595077 0.03466471 1419 -8.826  <.0001
## -1 - 3      -0.35156073 0.03623112 1419 -9.703  <.0001
## 1 - 2       0.11415051 0.04135567 1419  2.760  0.0298
## 1 - 3       0.06854055 0.04267721 1419  1.606  0.3755
## 2 - 3      -0.04560995 0.04374375 1419 -1.043  0.7243
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate      SE    df t.ratio p.value
## -1 - 1      -0.6948367 0.09562916 1419 -7.266 <.0001
## -1 - 2      -0.8233024 0.09952220 1419 -8.273 <.0001
## -1 - 3      -0.5780063 0.10401937 1419 -5.557 <.0001
## 1 - 2      -0.1284657 0.11873193 1419 -1.082  0.7006
## 1 - 3       0.1168304 0.12252604 1419  0.954  0.7758
```

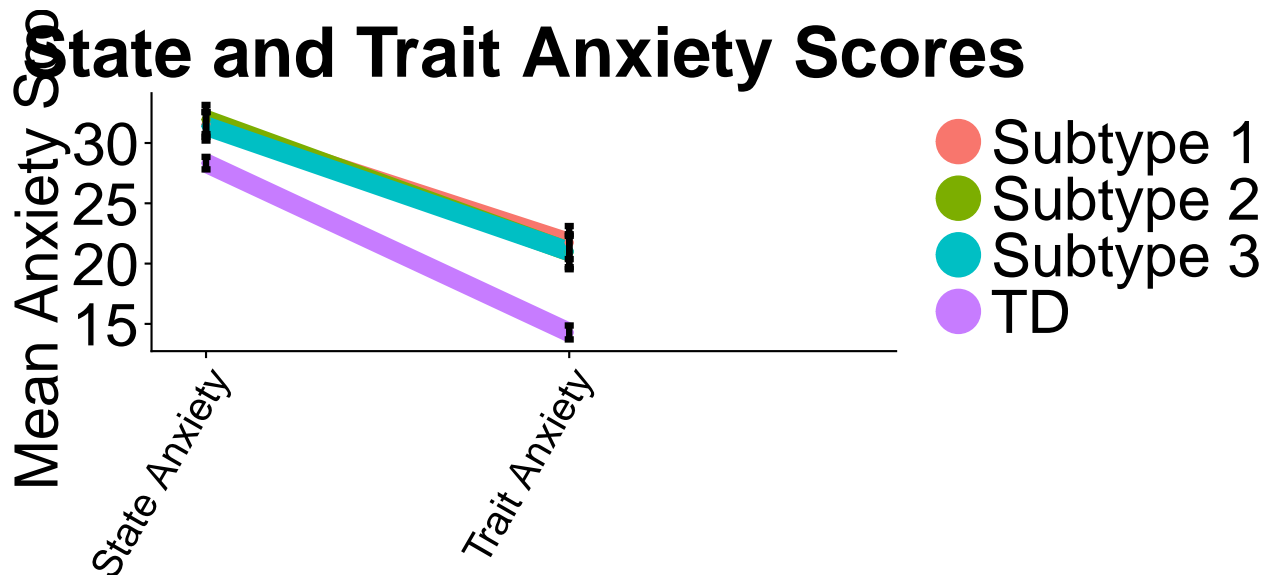
```

## 2 - 3      0.2452961 0.12558807 1419    1.953  0.2065
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate      SE    df t.ratio p.value
## -1 - 1      -0.146798987 0.04983303 1419   -2.946  0.0172
## -1 - 2      -0.436601969 0.05186172 1419   -8.419  <.0001
## -1 - 3      -0.143207844 0.05420523 1419   -2.642  0.0415
## 1 - 2       -0.289802982 0.06187204 1419   -4.684  <.0001
## 1 - 3        0.003591142 0.06384918 1419    0.056  0.9999
## 2 - 3        0.293394125 0.06544483 1419    4.483  <.0001
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast      estimate      SE    df t.ratio p.value
## -1 - 1      -0.89683717 0.03941806 1419  -22.752  <.0001
## -1 - 2      -0.98105063 0.04102276 1419  -23.915  <.0001
## -1 - 3      -0.92251267 0.04287648 1419  -21.516  <.0001
## 1 - 2       -0.08421346 0.04894095 1419   -1.721  0.3132
## 1 - 3       -0.02567550 0.05050487 1419   -0.508  0.9571
## 2 - 3        0.05853796 0.05176703 1419    1.131  0.6705
##
## P value adjustment: tukey method for comparing a family of 4 estimates
##           AnxiousMisery_Bifactor Externalizing_Bifactor Fear_Bifactor
## contrast factor,6              factor,6              factor,6
## estimate Numeric,6              Numeric,6              Numeric,6
## SE        Numeric,6              Numeric,6              Numeric,6
## df        Numeric,6              Numeric,6              Numeric,6
## t.ratio   Numeric,6              Numeric,6              Numeric,6
## p.value   Numeric,6              Numeric,6              Numeric,6
##           Overall_Psychopathology_Bifactor
## contrast factor,6
## estimate Numeric,6
## SE        Numeric,6
## df        Numeric,6
## t.ratio   Numeric,6
## p.value   Numeric,6

##           Stratified by Cluster
##           level      -1      1
## n              215      66
## Race (%)       Caucasian  123 ( 57.2)  43 ( 65.2)
##               Non-caucasian  92 ( 42.8)  23 ( 34.8)
## Sex (%)        Female     127 ( 59.1)  38 ( 57.6)
##               Male        88 ( 40.9)  28 ( 42.4)
## Maternal Ed (mean (sd))      14.80 (2.63)  14.65 (2.53)
## Age (mean (sd))              16.52 (2.82)  16.72 (2.20)
## Depression (%)   Depressed    0 ( 0.0)  66 (100.0)
##                 Non-depressed 215 (100.0)  0 ( 0.0)
## Cluster (%)     -1          215 (100.0)  0 ( 0.0)
##                 1           0 ( 0.0)  66 (100.0)
##                 2           0 ( 0.0)  0 ( 0.0)
##                 3           0 ( 0.0)  0 ( 0.0)
##           Stratified by Cluster
##           2      3      p      test
## n              55      48

```

```
## Race (%) 11 ( 20.0) 22 ( 45.8) <0.001
## 44 ( 80.0) 26 ( 54.2)
## Sex (%) 35 ( 63.6) 34 ( 70.8) 0.428
## 20 ( 36.4) 14 ( 29.2)
## Maternal Ed (mean (sd)) 13.22 (2.17) 13.40 (2.02) <0.001
## Age (mean (sd)) 17.26 (2.34) 16.68 (2.00) 0.309
## Depression (%) 55 (100.0) 48 (100.0) <0.001
## 0 ( 0.0) 0 ( 0.0)
## Cluster (%) 0 ( 0.0) 0 ( 0.0) <0.001
## 0 ( 0.0) 0 ( 0.0)
## 55 (100.0) 0 ( 0.0)
## 0 ( 0.0) 48 (100.0)
```



```
## [1] "LM Clinical"

## clinical_measure p_FDR_corr
## 1 staiPreState 0.001
## 2 staiPreTrait 0

## [1] "Pairwise contrasts with FDR corrected values, STAI"

## -1 - 1 -1 - 2 -1 - 3 1 - 2 1 - 3 2 - 3 p_FDR_corr
## staiPreState 0.025 0.016 0.079 0.992 1.000 0.986 0.001
## staiPreTrait 0.000 0.000 0.000 0.971 0.975 1.000 0

## contrast estimate SE df t.ratio p.value
## -1 - 1 -3.2000705 1.127587 380 -2.838 0.0246
## -1 - 2 -3.6152220 1.210792 380 -2.986 0.0159
## -1 - 3 -3.0656008 1.279164 380 -2.397 0.0794
## 1 - 2 -0.4151515 1.462943 380 -0.284 0.9920
## 1 - 3 0.1344697 1.520015 380 0.088 0.9998
## 2 - 3 0.5496212 1.582722 380 0.347 0.9856
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast estimate SE df t.ratio p.value
## -1 - 1 -7.45405215 1.319571 380 -5.649 <.0001
```

```

## -1 - 2 -6.69344609 1.416942 380 -4.724 <.0001
## -1 - 3 -6.71162791 1.496955 380 -4.484 0.0001
## 1 - 2 0.76060606 1.712025 380 0.444 0.9707
## 1 - 3 0.74242424 1.778814 380 0.417 0.9755
## 2 - 3 -0.01818182 1.852197 380 -0.010 1.0000
##
## P value adjustment: tukey method for comparing a family of 4 estimates

##          staiPreState staiPreTrait
## contrast factor,6      factor,6
## estimate Numeric,6      Numeric,6
## SE          Numeric,6      Numeric,6
## df          Numeric,6      Numeric,6
## t.ratio     Numeric,6      Numeric,6
## p.value     Numeric,6      Numeric,6

##          Stratified by Cluster
##          level          -1          1
## n          200          68
## Race (%)   Caucasian    122 ( 61.0)    45 ( 66.2)
##           Non-caucasian  78 ( 39.0)    23 ( 33.8)
## Sex (%)    Female       118 ( 59.0)    40 ( 58.8)
##           Male          82 ( 41.0)    28 ( 41.2)
## Maternal Ed (mean (sd)) 14.93 (2.58)    14.69 (2.50)
## Age (mean (sd))        16.49 (2.84)    16.84 (2.20)
## Depression (%) Depressed 0 ( 0.0)      68 (100.0)
##           Non-depressed 200 (100.0)    0 ( 0.0)
## Cluster (%) -1         200 (100.0)    0 ( 0.0)
##           1            0 ( 0.0)      68 (100.0)
##           2            0 ( 0.0)      0 ( 0.0)
##           3            0 ( 0.0)      0 ( 0.0)
##          Stratified by Cluster
##          2          3          p          test
## n          53          47
## Race (%)   12 ( 22.6)   21 ( 44.7) <0.001
##           41 ( 77.4)   26 ( 55.3)
## Sex (%)    34 ( 64.2)   34 ( 72.3) 0.359
##           19 ( 35.8)   13 ( 27.7)
## Maternal Ed (mean (sd)) 13.32 (2.09)   13.68 (2.19) <0.001
## Age (mean (sd))        16.91 (2.45)   16.86 (1.91) 0.574
## Depression (%) 53 (100.0)   47 (100.0) <0.001
##           0 ( 0.0)      0 ( 0.0)
## Cluster (%) 0 ( 0.0)      0 ( 0.0) <0.001
##           0 ( 0.0)      0 ( 0.0)
##           53 (100.0)   0 ( 0.0)
##           0 ( 0.0)      47 (100.0)

## [1] "LM N-back uncorrected"

##          p_anova
## nback_func_sc_crusI_r 0.020566198
## nback_func_sc_crusI_l 0.592177123
## nback_func_sc_crusII_r 0.010177645
## nback_func_sc_crusII_l 0.138542621
## nback_func_sc_insula_r 0.372442679
## nback_func_sc_insula_l 0.084128490

```

```

## nback_func_sc_dlpfc_ant_l 0.006097825
## nback_func_sc_dlpfc_ant_r 0.366464241
## nback_func_sc_dlpfc_post_l 0.045265130
## nback_func_sc_dlpfc_post_r 0.416186069
## nback_func_sc_dacc 0.014181529
## nback_func_sc_mfg_l 0.008944937
## nback_func_sc_mfg_r 0.129844195
## nback_func_sc_fp_r 0.076570570
## nback_func_sc_fp_l 0.308815633
## nback_func_sc_thal_r 0.462755211
## nback_func_sc_thal_l 0.412949344
## nback_func_sc_parietal_l 0.021300605
## nback_func_sc_precun_l 0.008365549
## nback_func_sc_precun_r 0.003328413
## nback_func_sc_parietal_r 0.327245394

## [1] "FDR corrected"

##           parcellation p_FDR_corr
## 1  nback_func_sc_crusII_r 0.0427
## 2 nback_func_sc_dlpfc_ant_l 0.0427
## 3      nback_func_sc_dacc 0.0496
## 4      nback_func_sc_mfg_l 0.0427
## 5      nback_func_sc_precun_l 0.0427
## 6      nback_func_sc_precun_r 0.0427

## [1] "LM pairwise contrasts and FDR corrected values"

##           -1 - 1 -1 - 2 -1 - 3 1 - 2 1 - 3 2 - 3
## nback_func_sc_crusII_r 0.490 0.195 0.215 0.031 0.036 1.000
## nback_func_sc_dlpfc_ant_l 0.633 0.070 0.213 0.017 0.056 0.989
## nback_func_sc_dacc 0.892 0.044 0.359 0.031 0.219 0.895
## nback_func_sc_mfg_l 0.346 0.225 0.281 0.022 0.031 1.000
## nback_func_sc_precun_l 0.998 0.009 0.472 0.028 0.523 0.581
## nback_func_sc_precun_r 0.978 0.032 0.051 0.045 0.062 1.000
##           p_FDR_corr
## nback_func_sc_crusII_r 0.0427
## nback_func_sc_dlpfc_ant_l 0.0427
## nback_func_sc_dacc 0.0496
## nback_func_sc_mfg_l 0.0427
## nback_func_sc_precun_l 0.0427
## nback_func_sc_precun_r 0.0427

## contrast estimate SE df t.ratio p.value
## -1 - 1 -4.7060176 3.321337 363 -1.417 0.4896
## -1 - 2 7.2602715 3.654505 363 1.987 0.1949
## -1 - 3 7.4221066 3.832165 363 1.937 0.2145
## 1 - 2 11.9662891 4.339656 363 2.757 0.0310
## 1 - 3 12.1281243 4.485887 363 2.704 0.0360
## 2 - 3 0.1618352 4.738866 363 0.034 1.0000
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast estimate SE df t.ratio p.value
## -1 - 1 -7.017476 5.895000 363 -1.190 0.6333
## -1 - 2 15.867504 6.486336 363 2.446 0.0704
## -1 - 3 13.199881 6.801663 363 1.941 0.2129

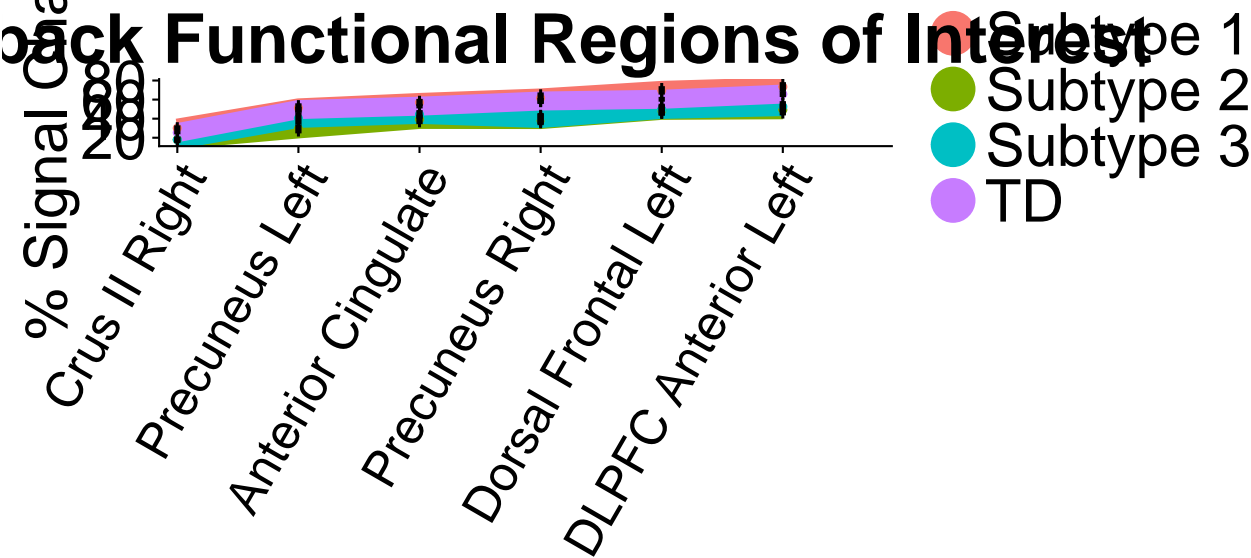
```

```

## 1 - 2    22.884980 7.702402 363    2.971  0.0166
## 1 - 3    20.217356 7.961946 363    2.539  0.0557
## 2 - 3    -2.667623 8.410955 363   -0.317  0.9889
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast estimate      SE df t.ratio p.value
## -1 - 1    -3.288923 4.609558 363   -0.714  0.8917
## -1 - 2    13.349527 5.071950 363    2.632  0.0437
## -1 - 3     8.704182 5.318517 363    1.637  0.3594
## 1 - 2     16.638450 6.022844 363    2.763  0.0306
## 1 - 3     11.993106 6.225793 363    1.926  0.2188
## 2 - 3     -4.645345 6.576893 363   -0.706  0.8946
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast estimate      SE df t.ratio p.value
## -1 - 1    -8.6463879 5.208043 363   -1.660  0.3464
## -1 - 2    10.9549248 5.730469 363    1.912  0.2249
## -1 - 3    10.7416769 6.009050 363    1.788  0.2810
## 1 - 2     19.6013127 6.804824 363    2.881  0.0218
## 1 - 3     19.3880648 7.034123 363    2.756  0.0311
## 2 - 3     -0.2132479 7.430808 363   -0.029  1.0000
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast estimate      SE df t.ratio p.value
## -1 - 1    -0.9781342 5.615490 363   -0.174  0.9981
## -1 - 2     19.5583353 6.178788 363    3.165  0.0091
## -1 - 3     9.3671445 6.479163 363    1.446  0.4717
## 1 - 2     20.5364695 7.337193 363    2.799  0.0276
## 1 - 3     10.3452787 7.584431 363    1.364  0.5228
## 2 - 3    -10.1911908 8.012151 363   -1.272  0.5814
##
## P value adjustment: tukey method for comparing a family of 4 estimates
## contrast estimate      SE df t.ratio p.value
## -1 - 1    -2.4913349 6.204687 363   -0.402  0.9781
## -1 - 2     18.7619780 6.827088 363    2.748  0.0318
## -1 - 3     18.4156023 7.158980 363    2.572  0.0511
## 1 - 2     21.2533129 8.107038 363    2.622  0.0449
## 1 - 3     20.9069372 8.380217 363    2.495  0.0624
## 2 - 3     -0.3463757 8.852814 363   -0.039  1.0000
##
## P value adjustment: tukey method for comparing a family of 4 estimates
##
##      nback_func_sc_crusII_r nback_func_sc_dlpfc_ant_1
## contrast factor,6          factor,6
## estimate Numeric,6         Numeric,6
## SE        Numeric,6         Numeric,6
## df         Numeric,6         Numeric,6
## t.ratio    Numeric,6         Numeric,6
## p.value    Numeric,6         Numeric,6
##
##      nback_func_sc_dacc nback_func_sc_mfg_l nback_func_sc_precun_l
## contrast factor,6          factor,6          factor,6
## estimate Numeric,6         Numeric,6         Numeric,6
## SE        Numeric,6         Numeric,6         Numeric,6
## df         Numeric,6         Numeric,6         Numeric,6

```

```
## t.ratio Numeric,6      Numeric,6      Numeric,6
## p.value Numeric,6      Numeric,6      Numeric,6
##      nback_func_sc_precun_r
## contrast factor,6
## estimate Numeric,6
## SE      Numeric,6
## df      Numeric,6
## t.ratio Numeric,6
## p.value Numeric,6
```



```
## [1] "Age by Sex interactions for Nback regions of interest all P=NS"
```