Supplement 1 with subjects omitted as suggested by the HCP

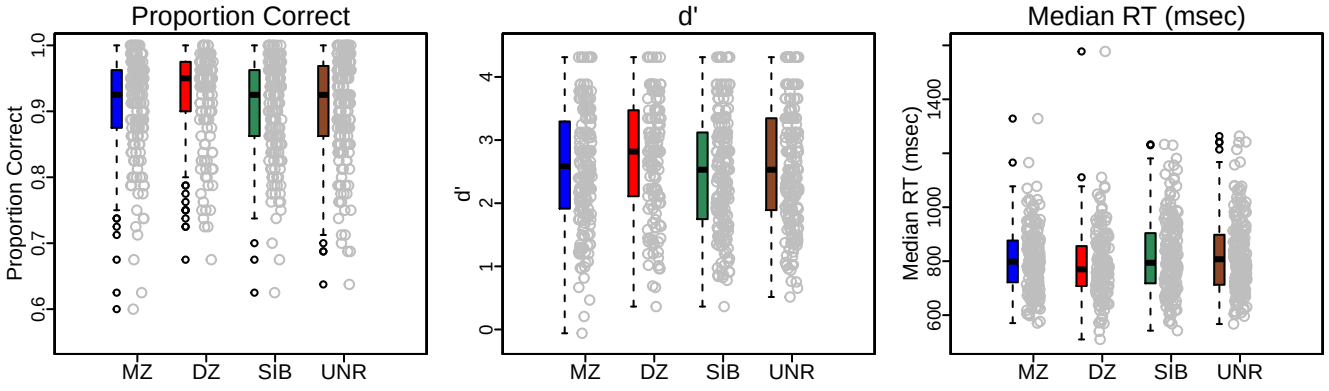
source and input files available at `https://osf.io/p6msu/`
compiled May 11, 2020
Supplement 1 for "Pattern similarity analyses of frontoparietal task coding: Individual variation and genetic influences" by Joset A. Etzel, Ya'el Courtney, Caitlin E. Carey, Maria Z. Gehred, Arpana Agrawal, and Todd S. Braver.
Cerebral Cortex, Volume 30, Issue 5, May 2020, `doi:10.1093/cercor/bhz301`

This is a `knitr` file (`https://yihui.name/knitr/`); see the `.rnw` file with the same name as this `.pdf` for the R code to generate all figures and results. To compile, change the `in.path` variable to the location of the `input` directory downloaded from **https://osf.io/p6msu/**.

NOTE: This knitr was compiled using a subset of the participants in the published paper: 20 (as of 11 May 2020) people included in the original analysis were later flagged by the HCP as having problematic WM task fMRI data (11 MZ, 3 DZ, 2 SIB, 4 UNR). Omitting pairs in which at least one member was flagged by the HCP leaves 94 MZ pairs, 75 DZ pairs, 97 SIB pairs, and 96 UNR pairs for these analyses.

S1.1a Behavioral Performance: Face, Place, 0-back, 2-back

These are not expected to vary by subject group (MZ, DZ, SIB, UNR), since the statistics are calculated on each person by themselves. However, the results are calculated for each group separately as well as ALL for completeness, and to ensure that there aren't unexpected group differences.



Mean and standard error of the mean of the behavioral measures plotted above. Robust statistics, trimmed at 0.1. ALL is all subjects combined and listed in Table 1 of the main text.

	ALL	MZ	DZ	SIB	UNR
Proportion Correct	.919 {.003}	.918 {.006}	.932 {.006}	.913 {.006}	.917 {.006}
d prime	2.59 {.04}	2.58 {.07}	2.75 {.08}	2.5 {.07}	2.57 {.07}
Median RT	800.1 {4.8}	799.3 {8.6}	779.7 {9.7}	807.9 {9.8}	811.2 {10.1}

Below is the code testing for a group effect on each behavioral measure separately, using `t1way` (a robust anova). There isn't a significant group effect with d' or RT, but there is one for Proportion Correct: DZ larger than the other three groups.

```
## [1] "Proportion Correct"
## Call:
## t1way(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
## Test statistic: F = 3.5795
## Degrees of freedom 1: 3
## Degrees of freedom 2: 239.6
## p-value: 0.01458
```

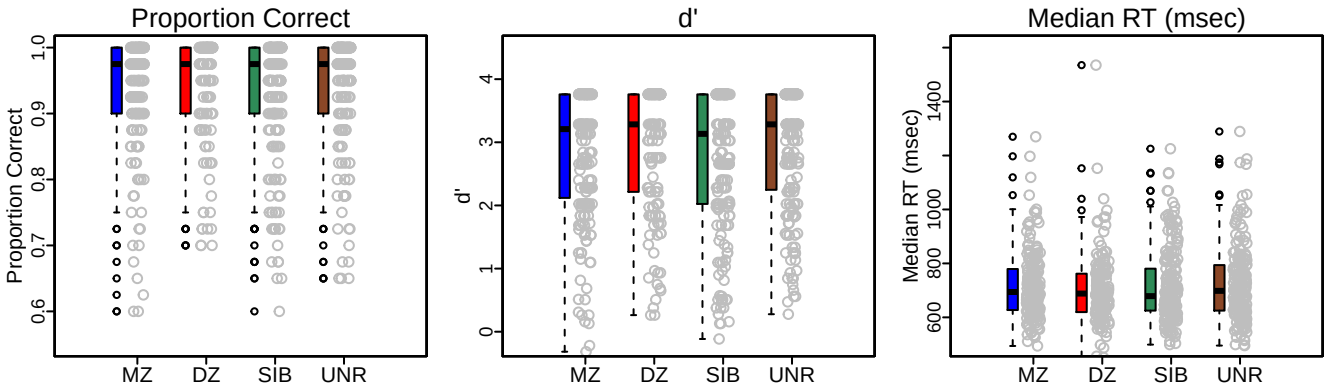
```
##
## Explanatory measure of effect size: 0.14
## Call:
## lincon(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
##               psihat ci.lower ci.upper p.value
## DZ vs. MZ    0.01755 -0.00284  0.03794 0.09857
## DZ vs. SIB   0.02330  0.00277  0.04382 0.01910
## DZ vs. UNR   0.01891 -0.00183  0.03965 0.08683
## MZ vs. SIB   0.00574 -0.01564  0.02713 0.86859
## MZ vs. UNR   0.00136 -0.02022  0.02294 0.86859
## SIB vs. UNR -0.00439 -0.02610  0.01733 0.86859
## [1] ""
## [1] "d'"
## Call:
## t1way(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
## Test statistic: F = 2.3608
## Degrees of freedom 1: 3
## Degrees of freedom 2: 236.94
## p-value: 0.07211
##
## Explanatory measure of effect size: 0.13
## [1] ""
## [1] "Median RT"
## Call:
## t1way(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
## Test statistic: F = 2.0016
## Degrees of freedom 1: 3
## Degrees of freedom 2: 238.77
## p-value: 0.11443
##
## Explanatory measure of effect size: 0.11
```

Below are the tests for a group effect on the three behavioral measures together, using `t3way` (a robust anova). There were no significant interactions with any of the three behavioral measures. There were category and load significant main effects with all three; pair.group only significant for RT.

```
##### propcorrect: no sig interactions; load, cat, and pair.group sig
t3way(stats.tbl$propcorrect~stats.tbl$load*stats.tbl$cat*stats.tbl$pair.group);

## Call:
## t3way(formula = stats.tbl$propcorrect ~ stats.tbl$load * stats.tbl$cat *
##     stats.tbl$pair.group)
##
##                                                      value p.value
## stats.tbl$load                                 276.1290197  0.0001
## stats.tbl$cat                                    4.1913284  0.0410
## stats.tbl$pair.group                             9.1889035  0.0280
## stats.tbl$load:stats.tbl$cat                     2.5563353  0.1110
## stats.tbl$load:stats.tbl$pair.group              2.5707257  0.4640
## stats.tbl$cat:stats.tbl$pair.group               0.6224858  0.8920
## stats.tbl$load:stats.tbl$cat:stats.tbl$pair.group  0.8297383  0.8430

##### dprime: no sig interactions; load and cat sig
t3way(stats.tbl$dprime~stats.tbl$load*stats.tbl$cat*stats.tbl$pair.group);

## Call:
## t3way(formula = stats.tbl$dprime ~ stats.tbl$load * stats.tbl$cat *
##     stats.tbl$pair.group)
```

```
##
##                                                      value p.value
## stats.tbl$load                                   330.9567180  0.0001
## stats.tbl$cat                                     14.4969947  0.0002
## stats.tbl$pair.group                               7.0023113  0.0730
## stats.tbl$load:stats.tbl$cat                       0.6565292  0.4180
## stats.tbl$load:stats.tbl$pair.group                2.1991724  0.5340
## stats.tbl$cat:stats.tbl$pair.group                 1.3862104  0.7100
## stats.tbl$load:stats.tbl$cat:stats.tbl$pair.group  0.9328676  0.8180

##### RT: no sig interactions; load, cat, and pair.group sig
t3way(stats.tbl$RT~stats.tbl$load*stats.tbl$cat*stats.tbl$pair.group);

## Call:
## t3way(formula = stats.tbl$RT ~ stats.tbl$load * stats.tbl$cat *
##     stats.tbl$pair.group)
##
##                                                      value p.value
## stats.tbl$load                                  1506.9306720  0.0001
## stats.tbl$cat                                     20.6956119  0.0001
## stats.tbl$pair.group                              13.2129436  0.0050
## stats.tbl$load:stats.tbl$cat                       1.2924548  0.2560
## stats.tbl$load:stats.tbl$pair.group                4.5147529  0.2130
## stats.tbl$cat:stats.tbl$pair.group                 0.2989557  0.9610
## stats.tbl$load:stats.tbl$cat:stats.tbl$pair.group  4.8652727  0.1840
```

S1.1b Behavioral Performance: Face, Place, 0-back



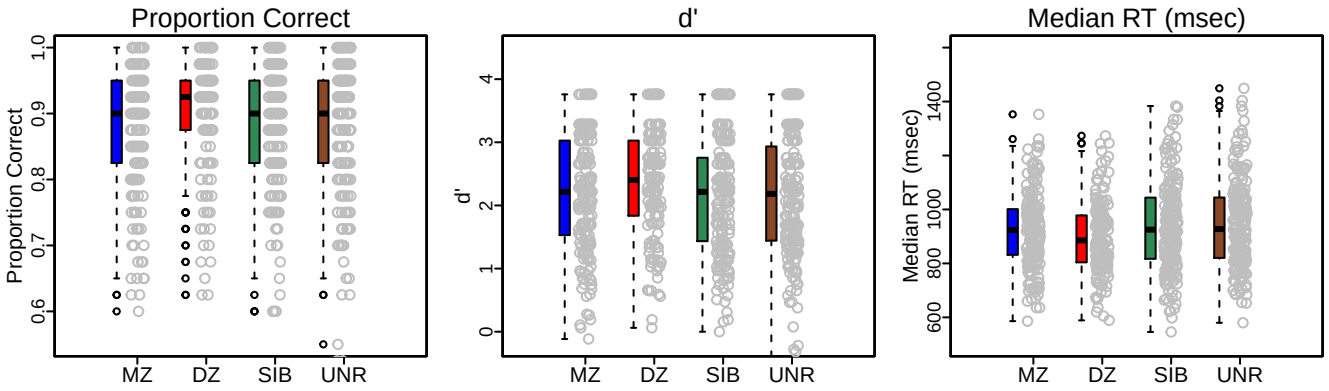
Mean and standard error of the measures plotted above. Robust statistics, trimmed at 0.1. ALL is all subjects combined.

	ALL	MZ	DZ	SIB	UNR
Proportion Correct	.954 {.003}	.952 {.005}	.96 {.006}	.947 {.007}	.956 {.006}
d prime	3 {.04}	2.95 {.08}	3.08 {.09}	2.91 {.09}	3.05 {.08}
Median RT	700.5 {4.5}	703.4 {8.3}	689.8 {8.5}	703 {10}	706.4 {9.3}

Below is the code testing for a group effect on each behavioral measure separately, using `t1way` (a robust anova).

```
## [1] "Proportion Correct"
## Call:
## t1way(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
## Test statistic: F = 0.7993
## Degrees of freedom 1: 3
## Degrees of freedom 2: 237.33
## p-value: 0.49532
##
## Explanatory measure of effect size: 0.08
## [1] ""
## [1] "d'"
## Call:
## t1way(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
## Test statistic: F = 0.9302
## Degrees of freedom 1: 3
## Degrees of freedom 2: 235.55
## p-value: 0.42677
##
## Explanatory measure of effect size: 0.08
## [1] ""
## [1] "Median RT"
## Call:
## t1way(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
## Test statistic: F = 0.519
## Degrees of freedom 1: 3
## Degrees of freedom 2: 238.54
## p-value: 0.66957
##
## Explanatory measure of effect size: 0.06
```

S1.1c Behavioral Performance: Face, Place, 2-back



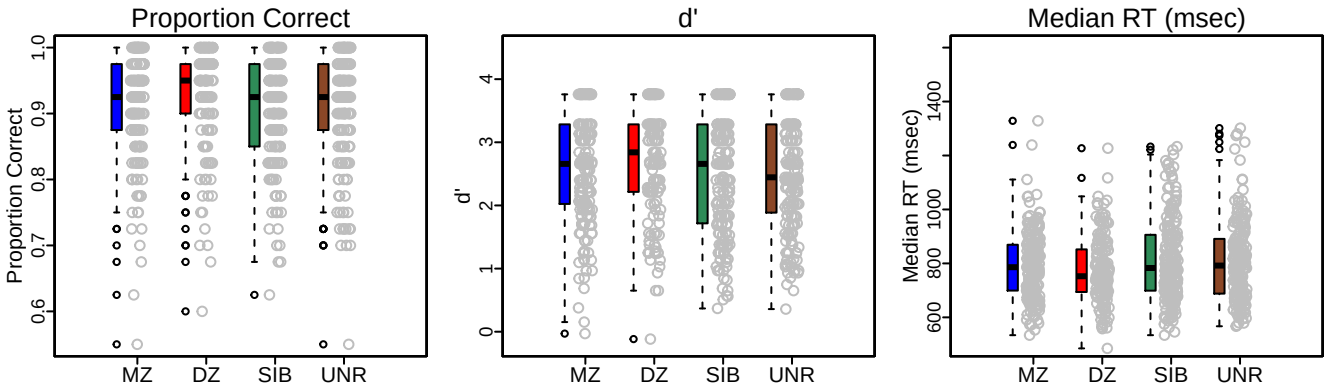
Mean and standard error of the measures plotted above. Robust statistics, trimmed at 0.1. ALL is all subjects combined.

	ALL	MZ	DZ	SIB	UNR
Proportion Correct	.895 {.004}	.894 {.007}	.912 {.007}	.892 {.007}	.887 {.008}
d prime	2.22 {.04}	2.22 {.07}	2.36 {.07}	2.16 {.07}	2.16 {.07}
Median RT	920.7 {5.8}	919.1 {10.6}	892.6 {11.1}	930.7 {12.3}	936.2 {12}

Below is the code testing for a group effect on each behavioral measure separately, using `t1way` (a robust anova).

```
## [1] "Proportion Correct"
## Call:
## t1way(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
## Test statistic: F = 3.053
## Degrees of freedom 1: 3
## Degrees of freedom 2: 240.07
## p-value: 0.02919
##
## Explanatory measure of effect size: 0.13
## [1] ""
## [1] "d'"
## Call:
## t1way(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
## Test statistic: F = 2.1654
## Degrees of freedom 1: 3
## Degrees of freedom 2: 237.99
## p-value: 0.09277
##
## Explanatory measure of effect size: 0.12
## [1] ""
## [1] "Median RT"
## Call:
## t1way(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
## Test statistic: F = 2.8497
## Degrees of freedom 1: 3
## Degrees of freedom 2: 237.78
## p-value: 0.03814
##
## Explanatory measure of effect size: 0.13
## Call:
## lincon(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
##               psihat  ci.lower ci.upper p.value
## DZ vs. MZ   -29.85175 -68.50782  8.80431 0.17399
## DZ vs. SIB  -38.57373 -81.54976  4.40230 0.09591
## DZ vs. UNR  -42.20172 -85.30674  0.90329 0.06441
## MZ vs. SIB   -8.72197 -49.57026 32.12631 0.83265
## MZ vs. UNR  -12.34997 -53.33394 28.63400 0.83265
## SIB vs. UNR  -3.62800 -48.73230 41.47631 0.83265
```

S1.1d Behavioral Performance: Face, 0-back, 2-back



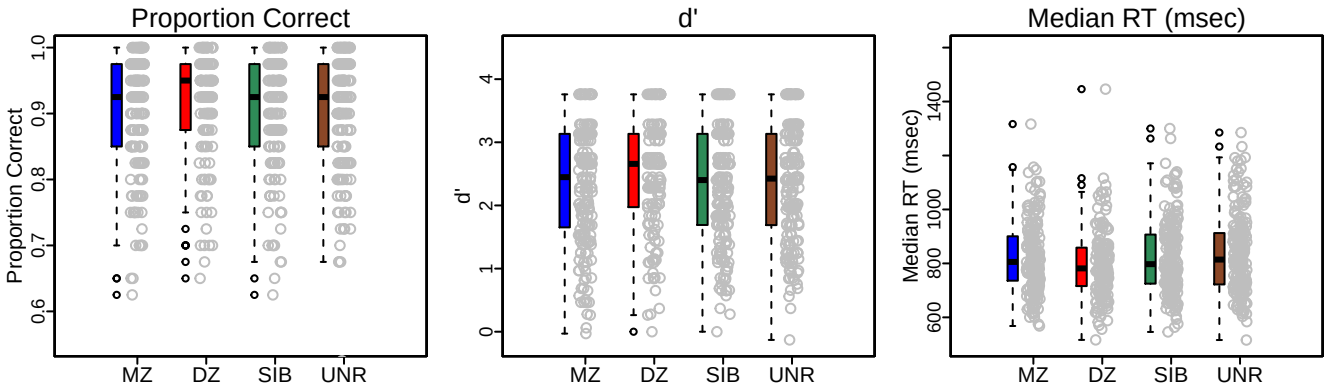
Mean and standard error of the measures plotted above. Robust statistics, trimmed at 0.1. ALL is all subjects combined.

	ALL	MZ	DZ	SIB	UNR
Proportion Correct	.925 {.003}	.926 {.006}	.94 {.006}	.917 {.006}	.921 {.006}
d prime	2.61 {.04}	2.63 {.07}	2.77 {.08}	2.52 {.08}	2.57 {.07}
Median RT	787.9 {5.1}	786.5 {9.1}	769.7 {10.6}	800.5 {11.3}	794.2 {10.3}

Below is the code testing for a group effect on each behavioral measure separately, using `t1way` (a robust anova).

```
## [1] "Proportion Correct"
## Call:
## t1way(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
## Test statistic: F = 3.4228
## Degrees of freedom 1: 3
## Degrees of freedom 2: 239.82
## p-value: 0.01794
##
## Explanatory measure of effect size: 0.14
## Call:
## lincon(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
##               psihat ci.lower ci.upper p.value
## DZ vs. MZ    0.01667 -0.00438  0.03772 0.15423
## DZ vs. SIB   0.02486  0.00178  0.04794 0.03052
## DZ vs. UNR   0.01976 -0.00124  0.04075 0.07084
## MZ vs. SIB   0.00819 -0.01569  0.03208 0.71073
## MZ vs. UNR   0.00309 -0.01879  0.02497 0.71073
## SIB vs. UNR -0.00510 -0.02895  0.01874 0.71073
## [1] ""
## [1] "d'"
## Call:
## t1way(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
## Test statistic: F = 2.7629
## Degrees of freedom 1: 3
## Degrees of freedom 2: 238.81
## p-value: 0.04272
##
## Explanatory measure of effect size: 0.13
## [1] ""
## [1] "Median RT"
## Call:
## t1way(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
## Test statistic: F = 1.6003
## Degrees of freedom 1: 3
## Degrees of freedom 2: 238.72
## p-value: 0.18998
##
## Explanatory measure of effect size: 0.1
```

S1.1e Behavioral Performance: Place, 0-back, 2-back



Mean and standard error of the measures plotted above. Robust statistics, trimmed at 0.1. ALL is all subjects combined.

	ALL	MZ	DZ	SIB	UNR
Proportion Correct	.917 {.003}	.912 {.007}	.928 {.007}	.914 {.006}	.915 {.007}
d prime	2.43 {.04}	2.4 {.08}	2.54 {.08}	2.36 {.08}	2.43 {.08}
Median RT	810.8 {5.1}	814.8 {9.8}	789.1 {9.6}	812.8 {9.8}	824 {11}

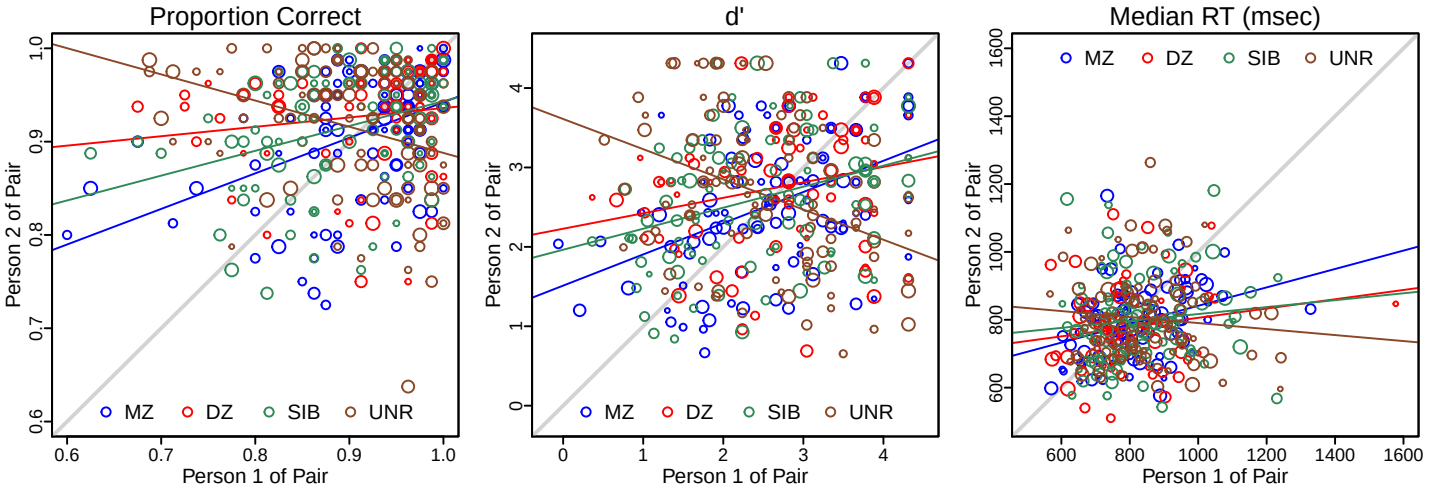
Below is the code testing for a group effect on each behavioral measure separately, using `t1way` (a robust anova).

```
## [1] "Proportion Correct"
## Call:
## t1way(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
## Test statistic: F = 2.0671
## Degrees of freedom 1: 3
## Degrees of freedom 2: 239.74
## p-value: 0.10522
##
## Explanatory measure of effect size: 0.11
## [1] ""
## [1] "d'"
## Call:
## t1way(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
## Test statistic: F = 1.0722
## Degrees of freedom 1: 3
## Degrees of freedom 2: 237.88
## p-value: 0.36157
##
## Explanatory measure of effect size: 0.08
## [1] ""
## [1] "Median RT"
## Call:
## t1way(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
## Test statistic: F = 1.9077
## Degrees of freedom 1: 3
## Degrees of freedom 2: 239.76
## p-value: 0.12894
##
## Explanatory measure of effect size: 0.11
## Call:
## lincon(formula = stats.tbl$stat ~ stats.tbl$pair.group)
##
##               psihat  ci.lower ci.upper p.value
## DZ vs. MZ   -23.63889 -59.35223 12.07445 0.41621
## DZ vs. SIB  -21.84510 -58.42416 14.73395 0.47120
## DZ vs. UNR  -31.17050 -68.46652  6.12553 0.17443
## MZ vs. SIB    1.79379 -36.07927 39.66684 0.90098
## MZ vs. UNR   -7.53161 -46.09759 31.03437 0.90098
## SIB vs. UNR  -9.32539 -48.69441 30.04362 0.90098
```

S1.2 Correlation between paired participants: behavioral performance

0-back and 2-back trials; both Face and Place.

Correlation between paired participants on three performance-related measures. Median RT is calculated from correct trials only. Only Face and Place trials are used in these calculations (not Body or Tool), for consistency with the similarity analyses. Point size jittered to reduce overplotting.



Pearson correlation between the paired people for each behavioral measure and subject group. p-values for each in parentheses, from `hc4wtest`, uncorrected for multiple comparisons.

	MZ	DZ	SIB	UNR
Proportion Correct	.44 (<.001)	.14 (.13)	.36 (<.001)	-.32 (.004)
d prime	.43 (<.001)	.25 (.03)	.32 (<.001)	-.38 (.002)
Median RT	.33 (<.001)	.17 (.062)	.11 (.388)	-.1 (.29)

p-values for pairwise correlation differences. Asterisks mark differences with p <.0083, Bonferroni-corrected threshold for p <.05 with 6 comparisons.

Proportion Correct

	MZ	DZ	SIB	UNR
MZ				
DZ	.026			
SIB	.495	.112		
UNR	<.001 ***	.001 **	<.001 ***	

d prime

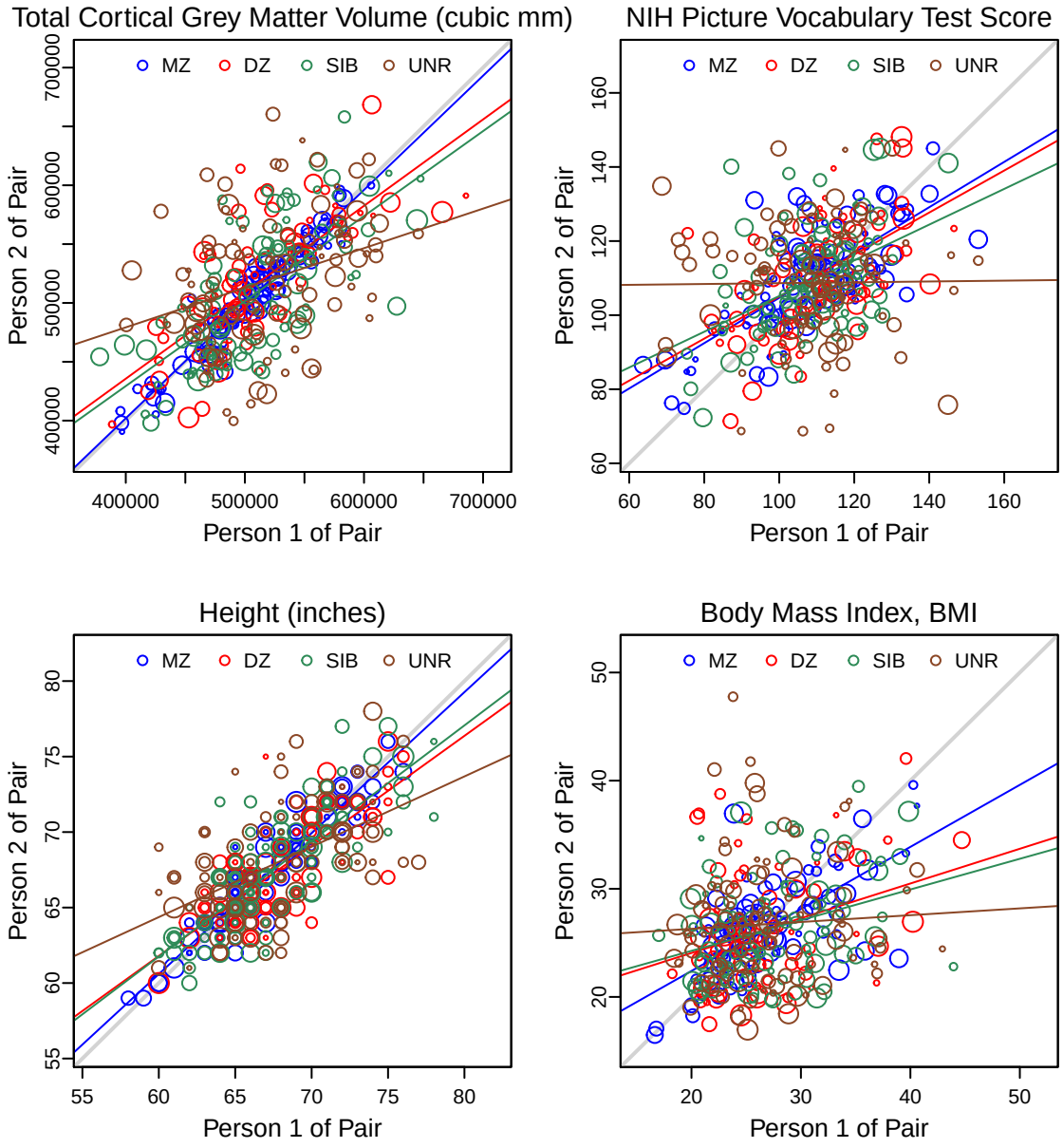
	MZ	DZ	SIB	UNR
MZ				
DZ	.181			
SIB	.388	.561		
UNR	<.001 ***	<.001 ***	<.001 ***	

Median RT

	MZ	DZ	SIB	UNR
MZ				
DZ	.308			
SIB	.17	.737		
UNR	.004 *	.1	.205	

S1.3 Correlation between paired participants: highly heritable measures

Correlation between paired participants on four highly heritable characteristics. Note that there is a great deal of overplotting, particularly for Height. Some correlation is present in the unrelated people, likely due to matching the pairs for age and gender. R squared and significance tests for these correlations follow.



Pearson correlation between the paired people for each highly heritable measure and subject group. p-values for each in parentheses, from `hc4wtest`, uncorrected for multiple comparisons.

	MZ	DZ	SIB	UNR
Total Grey Matter Volume	.96 (<.001)	.73 (<.001)	.69 (<.001)	.32 (<.001)
NIH Picture Vocabulary	.73 (<.001)	.56 (<.001)	.46 (.004)	.01 (.918)
Height	.94 (<.001)	.76 (<.001)	.79 (<.001)	.52 (<.001)
BMI	.67 (<.001)	.31 (.034)	.32 (.02)	.06 (.484)

p-values for pairwise correlation differences. Asterisks mark differences with p <.0083, Bonferroni-corrected threshold for p <.05 with 6 comparisons.

Total Cortical Grey Matter Volume

	MZ	DZ	SIB	UNR
MZ				
DZ	.028			
SIB	.001 **	.728		
UNR	<.001 ***	.001 **	.001 **	

NIH Picture Vocabulary Test Score

	MZ	DZ	SIB	UNR
MZ				
DZ	.234			
SIB	.051	.561		
UNR	<.001 ***	.001 **	.006 *	

Height

	MZ	DZ	SIB	UNR
MZ				
DZ	.025			
SIB	.036	.77		
UNR	<.001 ***	.037	.015	

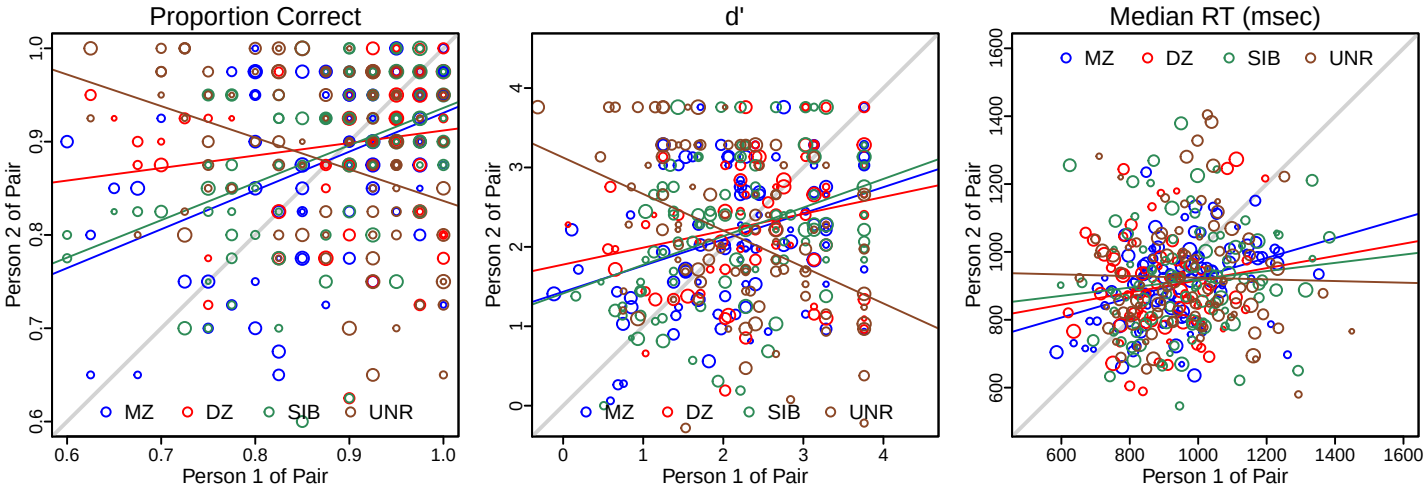
BMI

	MZ	DZ	SIB	UNR
MZ				
DZ	.053			
SIB	.04	.958		
UNR	<.001 ***	.119	.071	

S1.4 Correlation between paired participants: behavioral performance

2-back trials only; both Face and Place.

Correlation between paired participants on three performance-related measures. Significance tests follow. Median RT is calculated from correct trials only. Only Face and Place trials are used in these calculations (not Body or Tool), for consistency with the similarity analyses. Point size jittered to reduce overplotting.



Pearson correlation between the paired people for each behavioral measure and subject group. p-values for each in parentheses, from `hc4wtest`, uncorrected for multiple comparisons.

	MZ	DZ	SIB	UNR
Proportion Correct	.44 (.002)	.16 (.16)	.44 (<.001)	-.31 (.004)
d prime	.35 (.002)	.25 (.038)	.38 (<.001)	-.39 (.002)
Median RT	.37 (<.001)	.18 (.194)	.12 (.26)	-.02 (.798)

p-values for pairwise correlation differences. Asterisks mark differences with p <.0083, Bonferroni-corrected threshold for p <.05 with 6 comparisons.

Proportion Correct

	MZ	DZ	SIB	UNR
MZ				
DZ	.106			
SIB	.963	.044		
UNR	<.001 ***	.001 **	<.001 ***	

d prime

	MZ	DZ	SIB	UNR
MZ				
DZ	.515			
SIB	.776	.33		
UNR	<.001 ***	<.001 ***	<.001 ***	

Median RT

	MZ	DZ	SIB	UNR
MZ				
DZ	.279			
SIB	.102	.719		
UNR	.009	.223	.331	

S1.5 Correlation of behavioral performance in unrelated paired participants

NOTE: This section was not rerun with HCP-flagged participants omitted.

S1.6 Correlation between paired participants: heritability estimates

NOTE: This section was not rerun with HCP-flagged participants omitted.