Results Supplement 5

source and input files available at `https://osf.io/p6msu/`
compiled September 6, 2019
Results Supplement 5 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.

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/**.

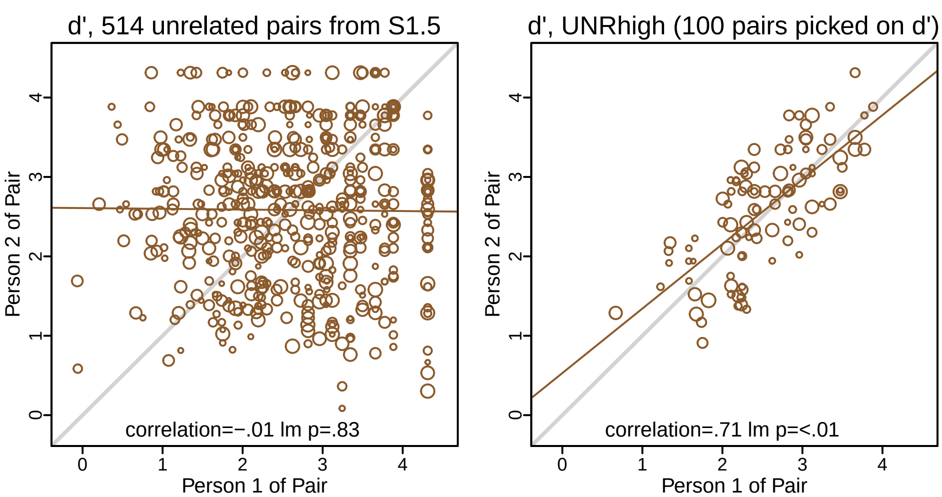
S5.1 Pairing unrelated participants by d': UNRhigh

The paired unrelated (UNR) people were not similar to each other in behavioral performance (S1.2, Table 2), and also had lower pairwise quantification scores, particularly for Load and in FrontoParietal. It might be asked whether these two things are linked: do people with greater behavioral similarity (i.e., similar d') tend to have higher pairwise quantification scores, regardless of relatedness? The lack of significant difference in d' correlation between the groups (other than UNR, S1.2) argues against d' similarity being the critical factor, but a stronger test is to create a set of unrelated people paired by d': do unrelated people with similar d' also have similar pairwise quantification scores?

To preview the analyses in sections S5.1a to S5.1c, pairing unrelated people with similar d' did not make their pairwise quantification scores appreciably more similar: UNRhigh is much more like UNR than MZ.

The UNR pairs used in the primary analyses were chosen so that each had the same gender, be within 3 years of age, not have any parents in common, and not be in any other subject groups. In S1.5 the restriction against being in another subject group was removed, allowing 514 unrelated pairs to be made. The figure showing the lack of correlation between paired unrelated people in this larger group is shown below, repeated from S1.5.

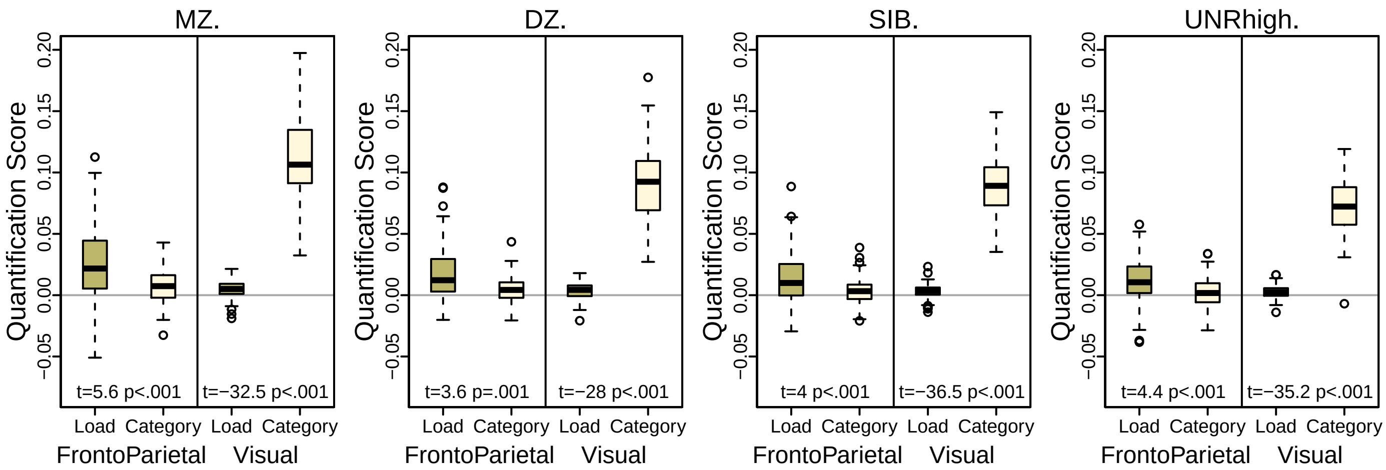
To make a group of unrelated people with similar d', 100 pairs (to match size of UNR) were chosen at random from these 514 pairs such that the paired people's d' were within 1 of each other. This new group, called **UNRhigh** (for highly similar) is shown in the right plot. As designed, these participants have a higher d' correlation than any of the actual subject groups (MZ d' correlation is 0.43; see S1.2).



S5.1a UNRhigh Pairwise quant. scores: Load and Category comparisons

The pairwise quantification scores were calculated for UNRhigh in the same manner as the subject groups (Supplemental 4), using the standard Load quantification (with both 0-back and 2-back trials). The graphs and statistics in this section are the same as those in S4.1, but with UNRhigh instead of UNR.

The distribution of quantification scores (boxplots) is fairly similar for UNR and UNRhigh (and the other subject groups): both paired t-tests (printed on the boxplot) are highly significant, with Load quantification greater than Category in FrontoParietal, and Category much greater than Load in Visual. The t-tests for the mean of each set of quantification scores != 0 (tables) are slightly more significant for FrontoParietal Load with UNRhigh (t=6.64) than UNR (t=5.45), but still less than MZ (8.27). Given that the UNRhigh pairs are much more similar on d' than MZ, this suggests that the pairwise quantification is capturing something more than behavioral similarity.



Robust t-tests for the mean of each set of quantification scores != 0. p-values uncorrected for multiple comparisons.

Category

	FrontoParietal	Visual
MZ	5.44 (<.001)	33.33 (<.001)
DZ	4.28 (<.001)	28.16 (<.001)
SIB	3.44 (.001)	36.59 (<.001)
UNRhigh	1.9 (.062)	36.41 (<.001)

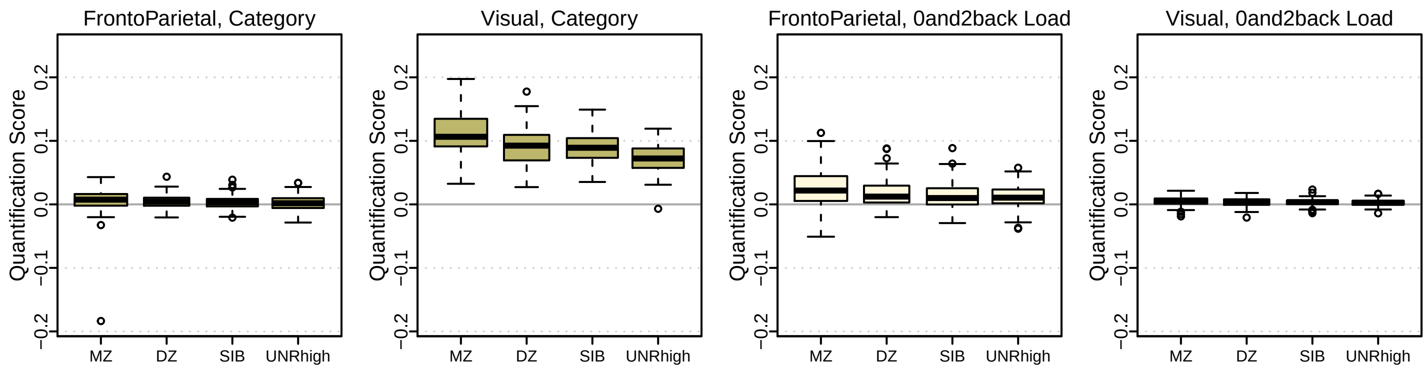
Load

	FrontoParietal	Visual
MZ	8.27 (<.001)	7.96 (<.001)
DZ	5.95 (<.001)	5.32 (<.001)
SIB	5.83 (<.001)	6.59 (<.001)
UNRhigh	6.64 (<.001)	5.09 (<.001)

S5.1b UNRhigh Pairwise quantification scores: group comparisons

This section is the same as S4.1b, but with UNRhigh instead of UNR.

The robust ANOVAs here reinforce the impression from the t-tests: MZ has a significantly higher Load quantification in FrontoParietal than UNRhigh.



Load

```
## [1] "FrontoParietal 0and2back"
## [1] "F=4.84419430435571 p=0.00294574515529067"
## [1] "Note: confidence intervals are adjusted to control FWE"
## [1] "But p-values are not adjusted to control FWE"
## [1] "Adjusted p-values can be computed with the R function p.adjusted"
##      Group Group        psihat      ci.lower    ci.upper      p.value
## [1,]     1     2  0.0094013156 -0.0006962906 0.019498922 0.0149882339
## [2,]     1     3  0.0125469449  0.0031806705 0.021913219 0.0005328541
## [3,]     1     4  0.0120590241  0.0029217950 0.021196253 0.0006399713
## [4,]     2     3  0.0031456293 -0.0052788188 0.011570077 0.3240880941
## [5,]     2     4  0.0026577086 -0.0055100133 0.010825430 0.3894456927
## [6,]     3     4 -0.0004879207 -0.0076871674 0.006711326 0.8582143687
## [1]
## [1] ################################################################################
## [1] "Visual 0and2back"
## [1] "F=3.57462002799779 p=0.0153130342694292"
## [1] "Note: confidence intervals are adjusted to control FWE"
## [1] "But p-values are not adjusted to control FWE"
## [1] "Adjusted p-values can be computed with the R function p.adjusted"
##      Group Group       psihat      ci.lower    ci.upper     p.value
## [1,]     1     2 0.0014080108 -0.0011144848 0.003930506 0.141882791
## [2,]     1     3 0.0018294730 -0.0003553603 0.004014306 0.028474702
## [3,]     1     4 0.0026595965  0.0004991049 0.004820088 0.001409223
## [4,]     2     3 0.0004214622 -0.0018720149 0.002714939 0.626504262
## [5,]     2     4 0.0012515857 -0.0010190860 0.003522257 0.145778549
## [6,]     3     4 0.0008301235 -0.0010489208 0.002709168 0.245245768
## [1]
## [1] ################################################################################
```

Category

```
## [1] "FrontoParietal Category"
## [1] "F=2.69377100928983 p=0.0478095989826599"
## [1] "Note: confidence intervals are adjusted to control FWE"
## [1] "But p-values are not adjusted to control FWE"
## [1] "Adjusted p-values can be computed with the R function p.adjusted"
```

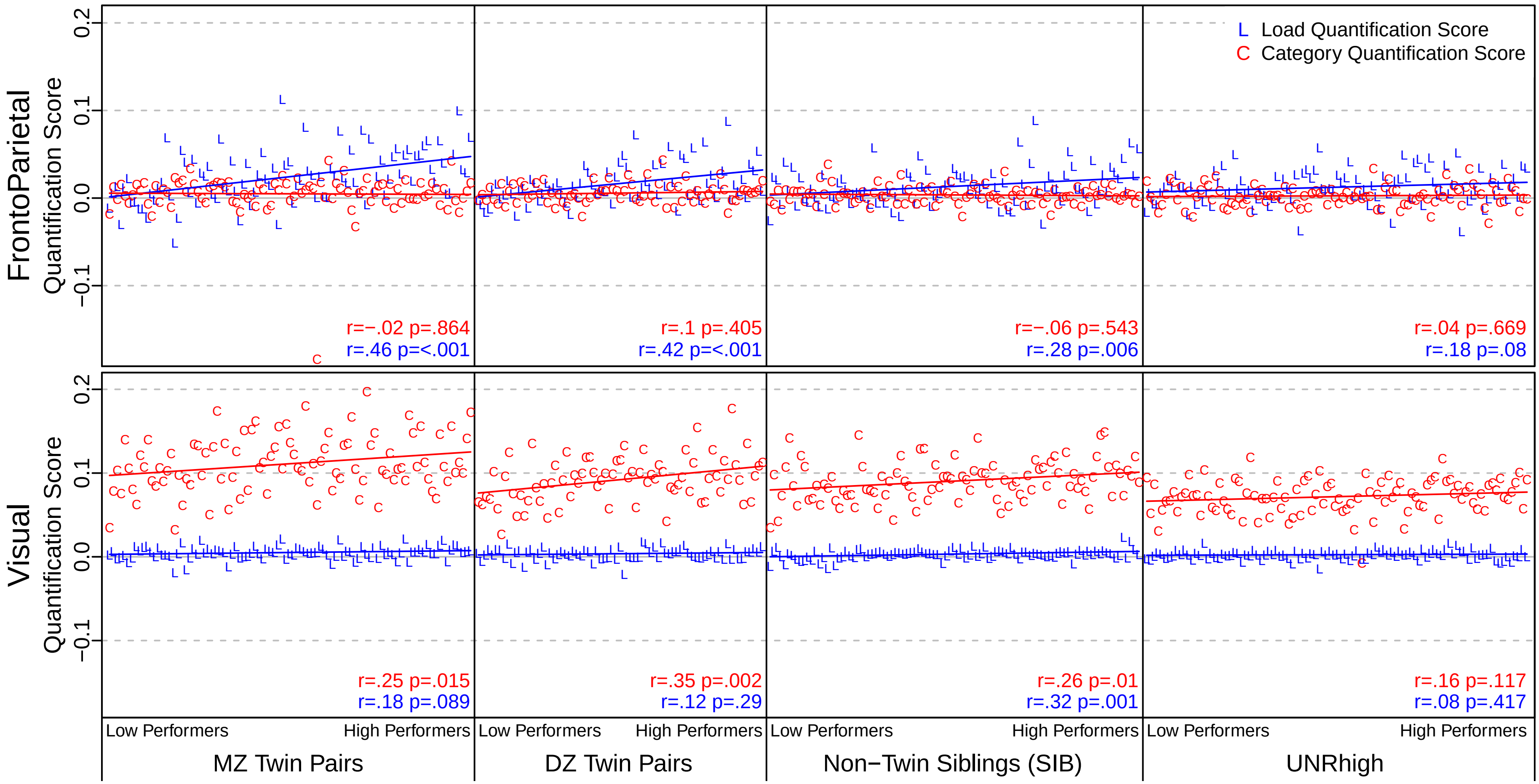
```
##      Group Group       psihat      ci.lower    ci.upper    p.value
## [1,]     1     2 0.0015326152 -0.0030331340 0.006098364 0.37612251
## [2,]     1     3 0.0034568215 -0.0006611949 0.007574838 0.02808537
## [3,]     1     4 0.0043769281 -0.0001871219 0.008940978 0.01233514
## [4,]     2     3 0.0019242063 -0.0021791325 0.006027545 0.21592408
## [5,]     2     4 0.0028443130 -0.0017038613 0.007392487 0.10016049
## [6,]     3     4 0.0009201066 -0.0031786153 0.005018829 0.55390257
## [1]
## [1] ################################################################################
## [1] "Visual Category"
## [1] "F=34.3308734968615 p=0"
## [1] "Note: confidence intervals are adjusted to control FWE"
## [1] "But p-values are not adjusted to control FWE"
## [1] "Adjusted p-values can be computed with the R function p.adjusted"
##      Group Group      psihat     ci.lower   ci.upper      p.value
## [1,]     1     2 0.020244882  0.008049413 0.03244035 2.168774e-05
## [2,]     1     3 0.021348768  0.010536977 0.03216056 5.873670e-07
## [3,]     1     4 0.037985310  0.027743979 0.04822664 0.000000e+00
## [4,]     2     3 0.001103886 -0.009523404 0.01173118 7.832438e-01
## [5,]     2     4 0.017740428  0.007688994 0.02779186 7.714334e-06
## [6,]     3     4 0.016636542  0.008399057 0.02487403 3.355300e-07
## [1]
## [1] ################################################################################
```

S5.1c UNRhigh Pairwise quantification scores: full dataset

This section is the same as S4.2 (second graph), but with UNRhigh instead of UNR.

Quantification of each set of paired participants' similarity matrix to the Load (blue, L, with both 0 and 2-back) and Category (red, S) The paired participants are arrayed along the x-axis in **order of increasing mean behavioral performance** within each type (MZ, DZ, SIB, UNRhigh), with the two quantification scores in each column. Displayed correlation and regression lines are between the quantification score and subject order (1:n), not the actual mean pairwise behavior.

Despite chosing UNRhigh people to have similar d', the correlation in FrontoParietal Load quantification scores when participants are ordered by performance is not greater in UNRhigh than UNR (UNR numerically higher than UNRhigh). The Visual Category correlation is also a little lower, but it seems unlikely that either would be significantly different.



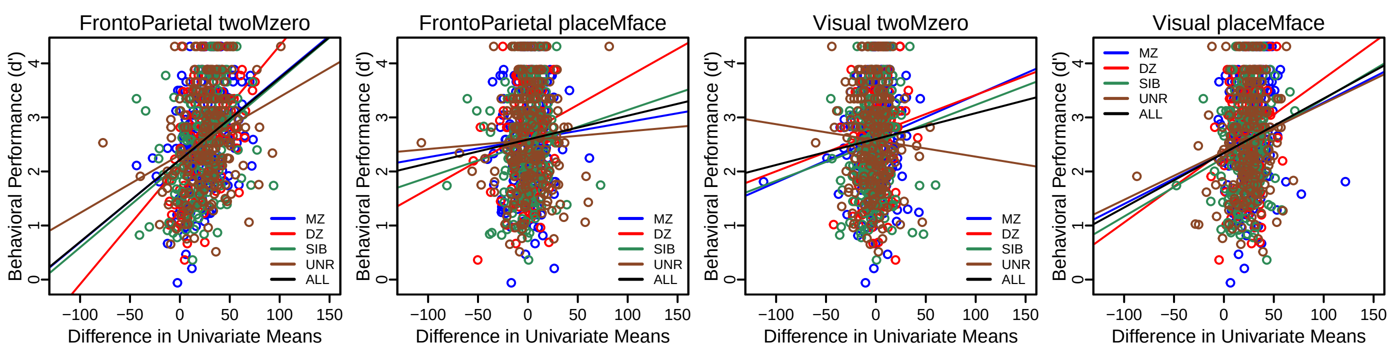
S5.2a Community-average COPEs: individual correlation with behavior

This section summarizes results from a univariate version of the analyses: instead of correlating COPEs vertex-wise across people or conditions, the average across all vertices is calculated for each person and COPE, and statistics generated from these community averages. Thus, instead of the vectors for each person shown in Figure 1 of the manuscript we have four single numbers for each person and community: the mean "activation" for each COPE.

In the main analyses we calculated Load and Category quantification scores to describe whether participants or individuals had more similar activation patterns on some conditions than others. Here, we want to look for differences in mean activations; for example, do high-performing participants tend to have greater mean FrontoParietal activation for 2-back than 0-back conditions? Specifically, we calculated two univariate difference measures: `twoMzero` (two-back MINUS zero-back) is mean(2BK_Face, 2BK_Place) - mean(0BK_Face, 0BK_Place); `placeMface` (Place MINUS Face) is mean(2BK_Face, 0BK_Face) - mean(2BK_Place, 0BK_Place).

First, these graphs show the correlation between each individual's behavioral performance (d') and difference in community-average COPEs (over FrontoParietal or Visual community vertices). Each person contributes one point to each graph. While we don't expect a difference between subject groups, the results are shown for each as well as all subjects combined ("ALL").

It can be seen that there is a positive correlation between behavioral performance (d') and the difference in univariate means: people who tended to have larger differences tended also to have higher performance, particularly for twoMzero in FrontoParietal and placeMface in Visual. While these correlations resemble those in S2.4 (Quantification within individuals: correlation with behavior), that does not establish that the two correlations are due to the same source of variance, which we explored by multiple regression in S5.2b.



Correlation between indicated difference in average COPEs and d', for all subjects combined (ALL) and each group individually, as plotted above. p-values for each in parentheses, from `hc4wtest`, uncorrected for multiple comparisons.

	ALL	MZ	DZ	SIB	UNR
FrontoParietal, twoMzero	.33 (<.001)	.32 (<.001)	.44 (<.001)	.34 (<.001)	.26 (<.001)
FrontoParietal, placeMface	.08 (.026)	.05 (.41)	.16 (.074)	.11 (.156)	.04 (.59)
Visual, twoMzero	.08 (.026)	.14 (.042)	.1 (.228)	.11 (.19)	-.05 (.452)
Visual, placeMface	.17 (<.001)	.15 (.188)	.18 (.038)	.17 (.022)	.17 (.01)

S5.2b Quant. within individuals: multiple regression with mean activation

This section extends the multiple regressions in S2.5 by adding the four predictors based on the average activation of each community described in S5.2a. These average differences were calculated for each individual and community separately, providing a univariate alternative to the main (correlation-based) multivariate analyses. Several versions of the analysis are shown below. The "full" model includes the same four quantification score predictors (FP.load, FP.category, V.load, V.category) as previously (S2.5), as well as four new predictors (FP.twoMzero, FP.placeMface, V.twoMzero, V.placeMface) generated by subtracting the community averages.

Interestingly both FP.load (quantification score) and FP.twoMzero (subtracted community-averages) are highly significant in the new eight-predictor multiple regression, with V.load and V.placeMface less significant. Comparing subsets, the full model fits significantly better than either the quantification score or the mean activation predictors alone. Together, these results suggest that the higher mean activation in FrontoParietal 2-back does not capture all of the same variance as does Load quantification.

```
# full model (all columns)
lm.full <- lm(mreg.tbl$dprime ~ mreg.tbl$FP.category + mreg.tbl$FP.load + mreg.tbl$FP.twoMzero + mreg.tbl$FP.placeMface +
                mreg.tbl$V.load + mreg.tbl$V.category + mreg.tbl$V.twoMzero + mreg.tbl$V.placeMface);
summary(lm.full);   # regressor order in model doesn't matter; FP.load & FP.twoMzero, V.load  & V.placeMface significant

##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$FP.category + mreg.tbl$FP.load +
##     mreg.tbl$FP.twoMzero + mreg.tbl$FP.placeMface + mreg.tbl$V.load +
##     mreg.tbl$V.category + mreg.tbl$V.twoMzero + mreg.tbl$V.placeMface)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.15519 -0.61933 -0.02058  0.60008  2.43884
##
## Coefficients:
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)             1.512863   0.094007  16.093  < 2e-16 ***
## mreg.tbl$FP.category   -0.160458   0.382542  -0.419  0.67501
## mreg.tbl$FP.load        1.601483   0.306592   5.223 2.29e-07 ***
## mreg.tbl$FP.twoMzero    0.012848   0.001821   7.056 3.95e-12 ***
## mreg.tbl$FP.placeMface  0.001326   0.001997   0.664  0.50693
## mreg.tbl$V.load        -1.669649   0.636339  -2.624  0.00887 **
## mreg.tbl$V.category     0.623401   0.394384   1.581  0.11438
## mreg.tbl$V.twoMzero    -0.003677   0.002303  -1.597  0.11077
## mreg.tbl$V.placeMface   0.005382   0.002233   2.410  0.01620 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8095 on 737 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.2363,Adjusted R-squared:  0.228
## F-statistic: 28.51 on 8 and 737 DF,  p-value: < 2.2e-16

beta.coef(lm.full);  # from http://www.dataanalytics.org.uk/Data%20Analysis/R%20Monographs/BetaCoeff.htm

##
## Beta Coefficients for: lm.full
##
##           mreg.tbl$FP.category mreg.tbl$FP.load mreg.tbl$FP.twoMzero
## Beta.Coef          -0.01692063        0.2384724             0.279307
##           mreg.tbl$FP.placeMface mreg.tbl$V.load mreg.tbl$V.category
## Beta.Coef             0.02429771      -0.1547131          0.09593106
##           mreg.tbl$V.twoMzero mreg.tbl$V.placeMface
## Beta.Coef         -0.06037865            0.08947207

##################################################################################################################
# each new column individually; all four are significant if alone

lm.FPtMz <- lm(mreg.tbl$dprime ~ mreg.tbl$FP.twoMzero);
summary(lm.FPtMz);  # FP.twoMzero very significant alone

##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$FP.twoMzero)
```

```
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.24671 -0.66464 -0.00636  0.61383  2.17729
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)          2.213923   0.050955  43.448   <2e-16 ***
## mreg.tbl$FP.twoMzero 0.015156   0.001592   9.519   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8705 on 744 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.1086,Adjusted R-squared:  0.1074
## F-statistic: 90.61 on 1 and 744 DF,  p-value: < 2.2e-16
```

```
lm.FPpMf <- lm(mreg.tbl$dprime ~ mreg.tbl$FP.placeMface);
summary(lm.FPpMf);  # FP.placeMface significant alone
```

```
##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$FP.placeMface)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.57719 -0.68072  0.02389  0.71229  1.87297
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)            2.590679   0.033653  76.981   <2e-16 ***
## mreg.tbl$FP.placeMface 0.004405   0.001995   2.208   0.0275 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9189 on 744 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.006513,Adjusted R-squared:  0.005177
## F-statistic: 4.877 on 1 and 744 DF,  p-value: 0.02752
```

```
lm.VtMz <- lm(mreg.tbl$dprime ~ mreg.tbl$V.twoMzero);
summary(lm.VtMz);  # V.twoMzero significant alone
```

```
##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$V.twoMzero)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.60909 -0.67972  0.03293  0.69373  1.92484
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)         2.599544   0.033813  76.880   <2e-16 ***
## mreg.tbl$V.twoMzero 0.004794   0.002226   2.154   0.0316 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9191 on 744 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.006198,Adjusted R-squared:  0.004862
## F-statistic:  4.64 on 1 and 744 DF,  p-value: 0.03156
```

```
lm.VpMf <- lm(mreg.tbl$dprime ~ mreg.tbl$V.placeMface);
summary(lm.VpMf);  # V.placeMface significant alone
```

```
##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$V.placeMface)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
```

```
## -2.46731 -0.68336  0.00538  0.67521  2.09221
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)           2.341295   0.063560  36.836  < 2e-16 ***
## mreg.tbl$V.placeMface 0.010082   0.002174   4.637 4.18e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9089 on 744 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.02809,Adjusted R-squared:  0.02678
## F-statistic:  21.5 on 1 and 744 DF,  p-value: 4.177e-06

####################################################################################################################
# comparing models

lm.FPltMz <- lm(mreg.tbl$dprime ~ mreg.tbl$FP.twoMzero + mreg.tbl$FP.load);
summary(lm.FPltMz)

##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$FP.twoMzero + mreg.tbl$FP.load)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.41104 -0.65295 -0.00527  0.59506  2.21929
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)          2.107667   0.052087  40.464  < 2e-16 ***
## mreg.tbl$FP.twoMzero 0.011929   0.001623   7.348 5.30e-13 ***
## mreg.tbl$FP.load     1.568332   0.236999   6.617 6.99e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8464 on 743 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.1582,Adjusted R-squared:  0.1559
## F-statistic: 69.81 on 2 and 743 DF,  p-value: < 2.2e-16

anova(lm.FPtMz, lm.FPltMz);

## Analysis of Variance Table
##
## Model 1: mreg.tbl$dprime ~ mreg.tbl$FP.twoMzero
## Model 2: mreg.tbl$dprime ~ mreg.tbl$FP.twoMzero + mreg.tbl$FP.load
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1    744 563.72
## 2    743 532.34  1    31.375 43.791 6.995e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

lm.FPl <- lm(mreg.tbl$dprime ~ mreg.tbl$FP.load);
anova(lm.FPl, lm.FPltMz);   # FP.load AND FP.twoMzero is better than either alone

## Analysis of Variance Table
##
## Model 1: mreg.tbl$dprime ~ mreg.tbl$FP.load
## Model 2: mreg.tbl$dprime ~ mreg.tbl$FP.twoMzero + mreg.tbl$FP.load
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1    744 571.03
## 2    743 532.34  1    38.688 53.997 5.301e-13 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

lm.VcpMf <- lm(mreg.tbl$dprime ~ mreg.tbl$V.placeMface + mreg.tbl$V.category);
summary(lm.VcpMf)

##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$V.placeMface + mreg.tbl$V.category)
```

```
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.39383 -0.66548  0.02165  0.64728  2.25476
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)          1.923084   0.086010  22.359  < 2e-16 ***
## mreg.tbl$V.placeMface 0.007337   0.002144   3.422 0.000657 ***
## mreg.tbl$V.category   1.614486   0.231646   6.970 7.02e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8812 on 743 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.08773,Adjusted R-squared:  0.08527
## F-statistic: 35.73 on 2 and 743 DF,  p-value: 1.534e-15

anova(lm.VpMf, lm.VcpMf);   # V.category AND V.placeMface is better than either alone

## Analysis of Variance Table
##
## Model 1: mreg.tbl$dprime ~ mreg.tbl$V.placeMface
## Model 2: mreg.tbl$dprime ~ mreg.tbl$V.placeMface + mreg.tbl$V.category
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1    744 614.61
## 2    743 576.90  1    37.716 48.576 7.019e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

# the four subtraction-based columns only
lm.sub <- lm(mreg.tbl$dprime ~ mreg.tbl$FP.twoMzero + mreg.tbl$FP.placeMface + mreg.tbl$V.twoMzero + mreg.tbl$V.placeMface);
summary(lm.sub);   # FP.twoMzero, V.placeMface, and V.twoMzero significant

##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$FP.twoMzero + mreg.tbl$FP.placeMface +
##     mreg.tbl$V.twoMzero + mreg.tbl$V.placeMface)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.3920 -0.6787 -0.0090  0.6308  2.1574
##
## Coefficients:
##                        Estimate Std. Error t value Pr(>|t|)
## (Intercept)            1.915166   0.078535  24.386  < 2e-16 ***
## mreg.tbl$FP.twoMzero    0.017307   0.001821   9.505  < 2e-16 ***
## mreg.tbl$FP.placeMface -0.001241   0.002073  -0.598   0.5497
## mreg.tbl$V.twoMzero    -0.006063   0.002410  -2.516   0.0121 *
## mreg.tbl$V.placeMface   0.009495   0.002282   4.161 3.54e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8563 on 741 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.1408,Adjusted R-squared:  0.1361
## F-statistic: 30.35 on 4 and 741 DF,  p-value: < 2.2e-16

anova(lm.sub, lm.full);   # significantly different; full model better

## Analysis of Variance Table
##
## Model 1: mreg.tbl$dprime ~ mreg.tbl$FP.twoMzero + mreg.tbl$FP.placeMface +
##     mreg.tbl$V.twoMzero + mreg.tbl$V.placeMface
## Model 2: mreg.tbl$dprime ~ mreg.tbl$FP.category + mreg.tbl$FP.load + mreg.tbl$FP.twoMzero +
##     mreg.tbl$FP.placeMface + mreg.tbl$V.load + mreg.tbl$V.category +
##     mreg.tbl$V.twoMzero + mreg.tbl$V.placeMface
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1    741 543.36
## 2    737 482.93  4    60.434 23.057 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
# the four quantification-based columns only (same as in S2.5)
lm.quant <- lm(mreg.tbl$dprime ~ mreg.tbl$FP.category + mreg.tbl$FP.load + mreg.tbl$V.load + mreg.tbl$V.category);
# summary(lm.quant);   # FP.load & V.load significant
anova(lm.quant, lm.full);   # significantly different; full model better

## Analysis of Variance Table
##
## Model 1: mreg.tbl$dprime ~ mreg.tbl$FP.category + mreg.tbl$FP.load + mreg.tbl$V.load +
##     mreg.tbl$V.category
## Model 2: mreg.tbl$dprime ~ mreg.tbl$FP.category + mreg.tbl$FP.load + mreg.tbl$FP.twoMzero +
##     mreg.tbl$FP.placeMface + mreg.tbl$V.load + mreg.tbl$V.category +
##     mreg.tbl$V.twoMzero + mreg.tbl$V.placeMface
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1    741 527.85
## 2    737 482.93  4    44.916 17.137 1.894e-13 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

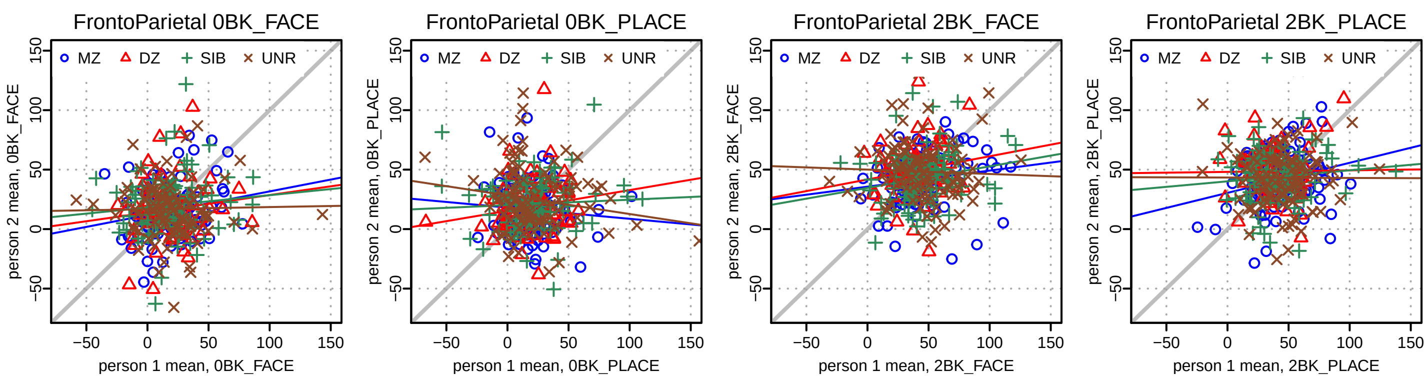
S5.2c Community-average COPEs: similarity of paired participants

The previous sections show that the difference in community-averaged COPE is related to behavioral performance in individuals, though not in exactly the same way as for Load and Category. Taking this univariate analysis to the paired subjects, do twins have similar mean activation? Rephrased, if a person has a high mean COPE in Visual to 2BK_FACE, does their twin as well?

Results are first shown for each condition individually, then for the differences (twoMzero and placeMface, as above). On each page the correlations are listed below the graphs (p-values for each in parentheses, from `hc4wtest`, uncorrected for multiple comparisons), then tests for pairwise correlation differences between the subject groups.

each mean COPE, FrontoParietal

Only a significant difference between DZ and UNR on 0BK_PLACE (and is likely due to the negative correlation in UNR); no correlations significant. This suggests that there is not a relationship between the twins (or other paired subjects) on mean activation difference in FrontoParietal.



	MZ	DZ	SIB	UNR
FrontoParietal, 0BK_FACE	.18 (.126)	.12 (.24)	.1 (.208)	.02 (.846)
FrontoParietal, 0BK_PLACE	-.09 (.37)	.16 (.06)	.06 (.652)	-.17 (.086)
FrontoParietal, 2BK_FACE	.16 (.204)	.17 (.208)	.2 (.078)	-.04 (.65)
FrontoParietal, 2BK_PLACE	.24 (.064)	.01 (.952)	.09 (.234)	0 (.966)

FrontoParietal, 0BK_FACE

	MZ	DZ	SIB	UNR
MZ				
DZ	.727			
SIB	.59	.877		
UNR	.294	.48	.52	

FrontoParietal, 0BK_PLACE

	MZ	DZ	SIB	UNR
MZ				
DZ	.072			
SIB	.429	.529		
UNR	.549	.006 *	.18	

FrontoParietal, 2BK_FACE

	MZ	DZ	SIB	UNR
MZ				
DZ	.952			
SIB	.788	.842		
UNR	.207	.193	.093	

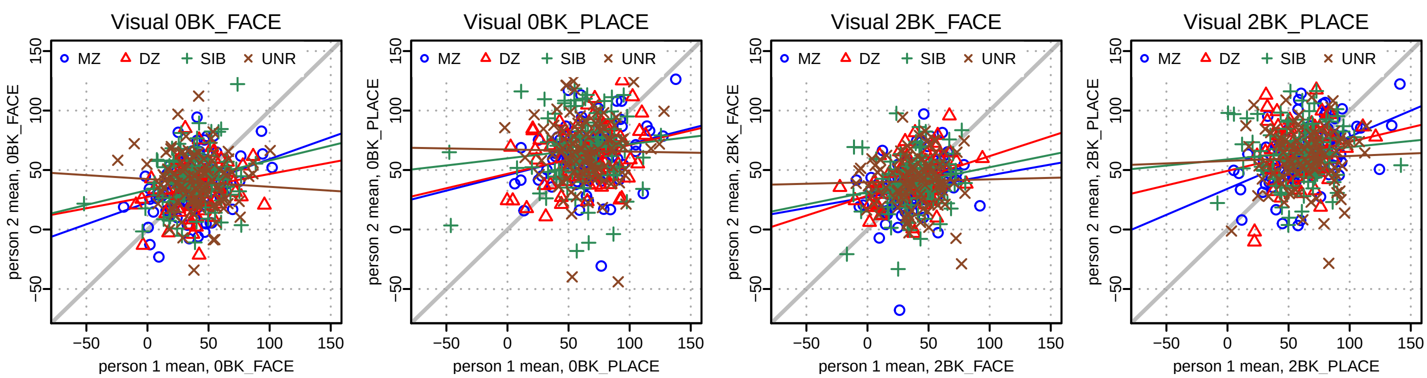
FrontoParietal, 2BK_PLACE

	MZ	DZ	SIB	UNR
MZ				
DZ	.332			
SIB	.276	.736		
UNR	.093	.937	.433	

each mean COPE, Visual

Unlike in FrontoParietal, in Visual there are some significant positive correlations in mean activation between the paired participants: 0BK_FACE, 0BK_PLACE, and 2BK_PLACE for MZ; 0BK_PLACE and 2BK_FACE for DZ; 0BK_FACE for SIB; and none for UNR. Additionally, MZ was significantly different than UNR on 0BK_FACE and 2BK_PLACE.

This suggests that we can weakly detect some heritability effects with the community-average activation in Visual.



	MZ	DZ	SIB	UNR
Visual, 0BK_FACE	.34 (<.001)	.19 (.094)	.23 (.032)	-.06 (.516)
Visual, 0BK_PLACE	.27 (.016)	.27 (.034)	.11 (.432)	-.01 (.904)
Visual, 2BK_FACE	.12 (.52)	.38 (<.001)	.19 (.132)	.02 (.856)
Visual, 2BK_PLACE	.47 (<.001)	.21 (.132)	.09 (.36)	.04 (.754)

Visual, 0BK_FACE

	MZ	DZ	SIB	UNR
MZ				
DZ	.3			
SIB	.42	.79		
UNR	.003 *	.104	.043	

Visual, 0BK_PLACE

	MZ	DZ	SIB	UNR
MZ				
DZ	.988			
SIB	.393	.406		
UNR	.069	.084	.483	

Visual, 2BK_FACE

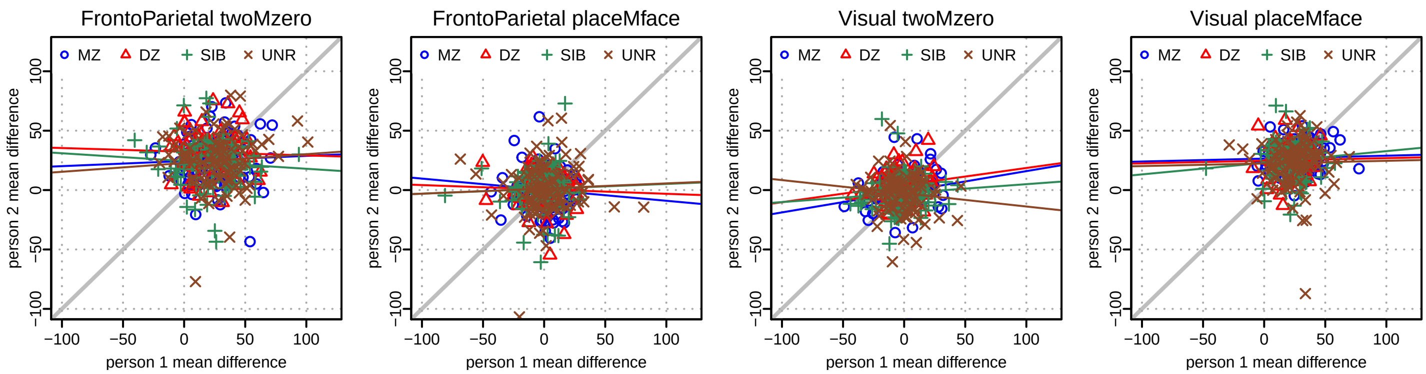
	MZ	DZ	SIB	UNR
MZ				
DZ	.143			
SIB	.724	.238		
UNR	.579	.019	.319	

Visual, 2BK_PLACE

	MZ	DZ	SIB	UNR
MZ				
DZ	.129			
SIB	.011	.529		
UNR	.006 *	.362	.725	

mean COPE differences

Finally, these plot the difference in community-averaged activation across the paired participants (twoMzero and placeMFace as in S5.2a, rather than the four COPEs individually). It is clear from the plots that there is no relationship between the participants' mean activation difference, as confirmed by the listed correlations. There are also no significant differences in correlation between the subject groups (p-values from `twohc4cor`, a robust test if two Pearson correlations are equal) for any combination of community and difference, as listed in the four tables. So, while some twin similarity in mean activation could be seen in Visual on the individual conditions (previous page), it did not lead to similarity in the placeMface difference.



	MZ	DZ	SIB	UNR
FrontoParietal, twoMzero	.04 (.664)	-.03 (.776)	-.07 (.326)	.07 (.412)
FrontoParietal, placeMface	-.08 (.366)	-.04 (.772)	.04 (.654)	.04 (.692)
Visual, twoMzero	.15 (.054)	.16 (.12)	.09 (.236)	-.1 (.27)
Visual, placeMface	.02 (.942)	.02 (.852)	.09 (.228)	.02 (.832)

FrontoParietal, twoMzero

	MZ	DZ	SIB	UNR
MZ				
DZ	.653			
SIB	.403	.774		
UNR	.836	.494	.239	

FrontoParietal, placeMface

	MZ	DZ	SIB	UNR
MZ				
DZ	.794			
SIB	.368	.648		
UNR	.425	.67	.99	

Visual, twoMzero

	MZ	DZ	SIB	UNR
MZ				
DZ	.935			
SIB	.559	.575		
UNR	.038	.07	.133	

Visual, placeMface

	MZ	DZ	SIB	UNR
MZ				
DZ	.984			
SIB	.715	.651		
UNR	.968	.985	.541	