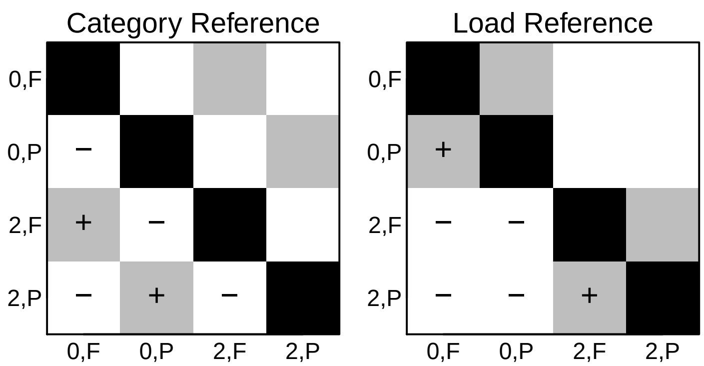
Supplement 2 with subjects omitted as suggested by the HCP

source and input files available at `https://osf.io/p6msu/`
compiled May 12, 2020
Supplement 2 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`

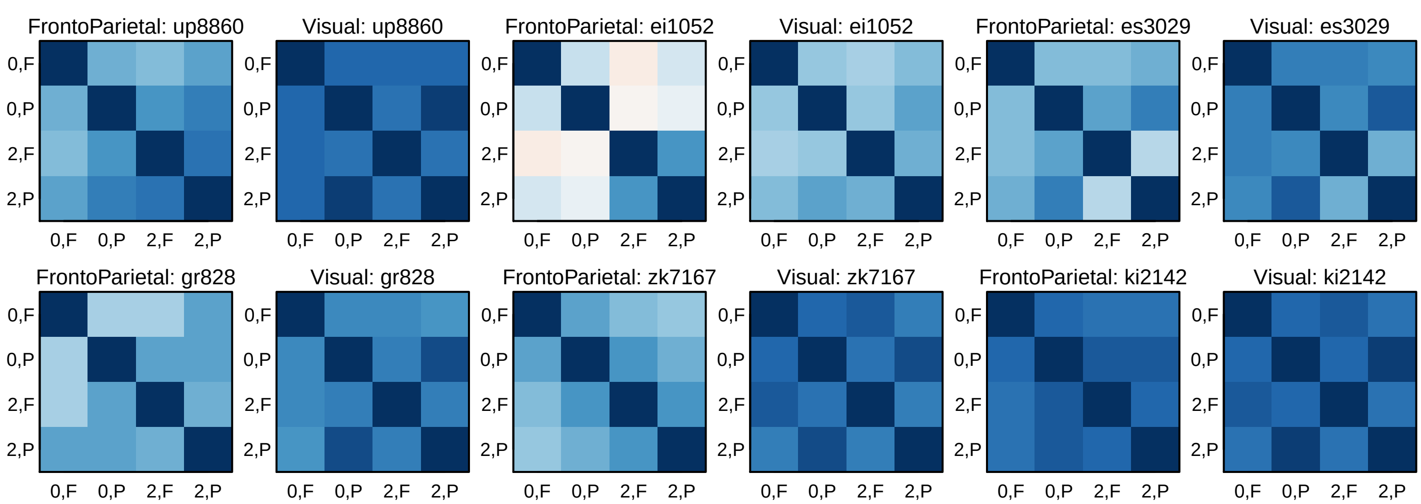
This is a `knitr` file (`https://yihui.name/knitr/`); see the `.rnw` file with the same name as this `.pdf` for the R code to generate all figures and results. To compile, change the `in.path` variable to the location of the `input` directory downloaded from **https://osf.io/p6msu/**.

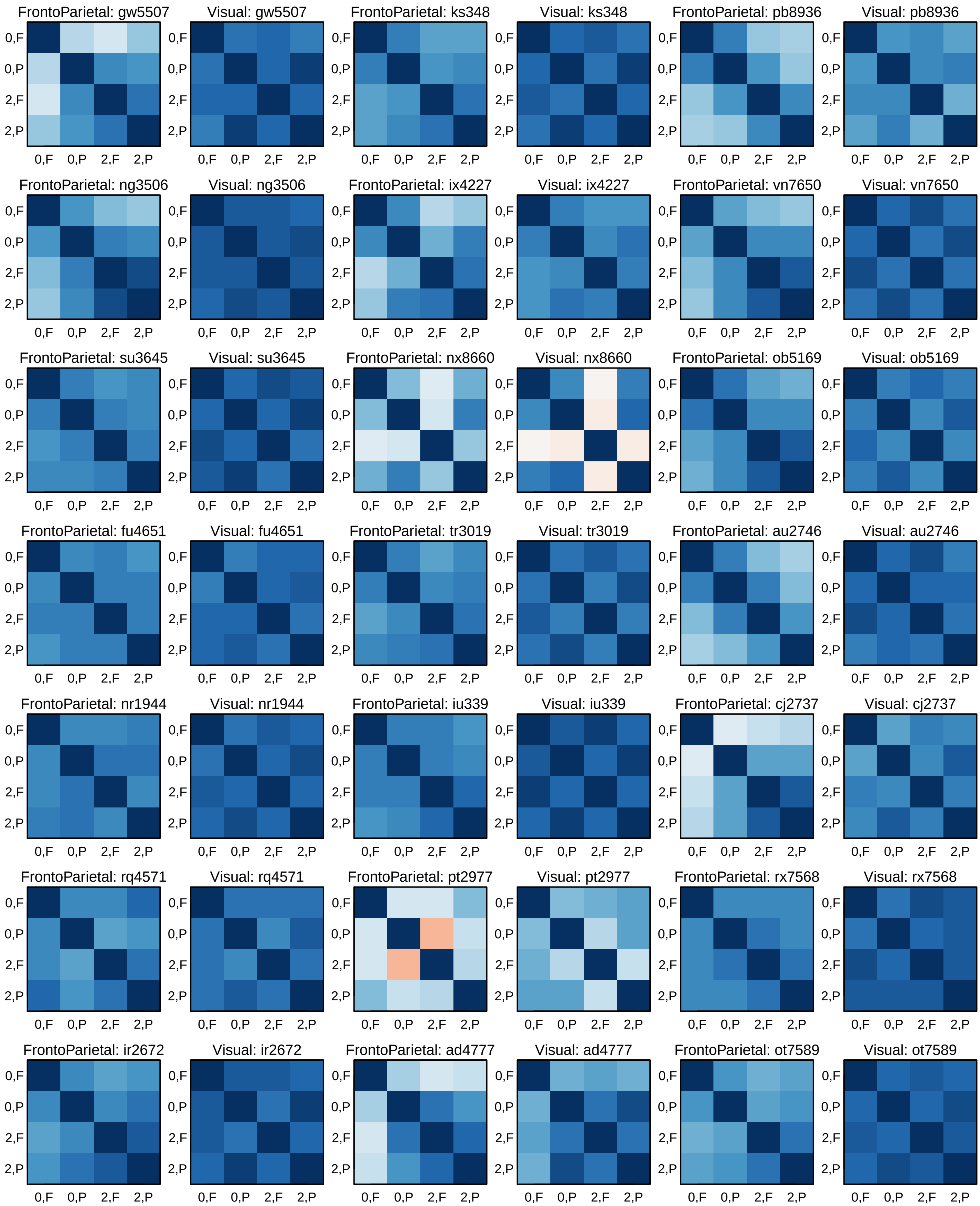
NOTE: This knitr was compiled using a subset of the participants in the published paper: 20 (as of 11 May 2020) people included in the original analysis were later flagged by the HCP as having problematic WM task fMRI data (11 MZ, 3 DZ, 2 SIB, 4 UNR). Omitting pairs in which at least one member was flagged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

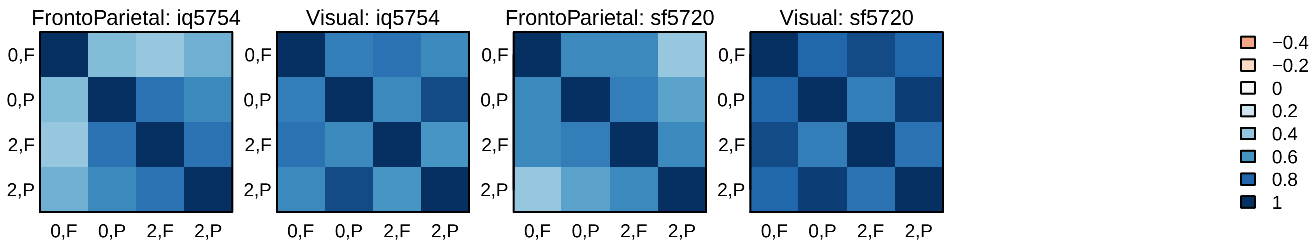
Reference matrices for the single-subject quantification (see Figure 1 of the main text). Grey cells are expected to be more correlated than white cells; black is the identity line. Symmetric matrices shown, but differences taken with the lower triangle only. Quantification is the average of the two white cells marked with - subtracted from the average of the four grey cells marked with +. "0,F" stands for 0-back Face; "2,F" for 2-back Face; "0,P" for 0-back Place; "2,P" for 2-back Place.



S2.1 Some example individual similarity matrices.

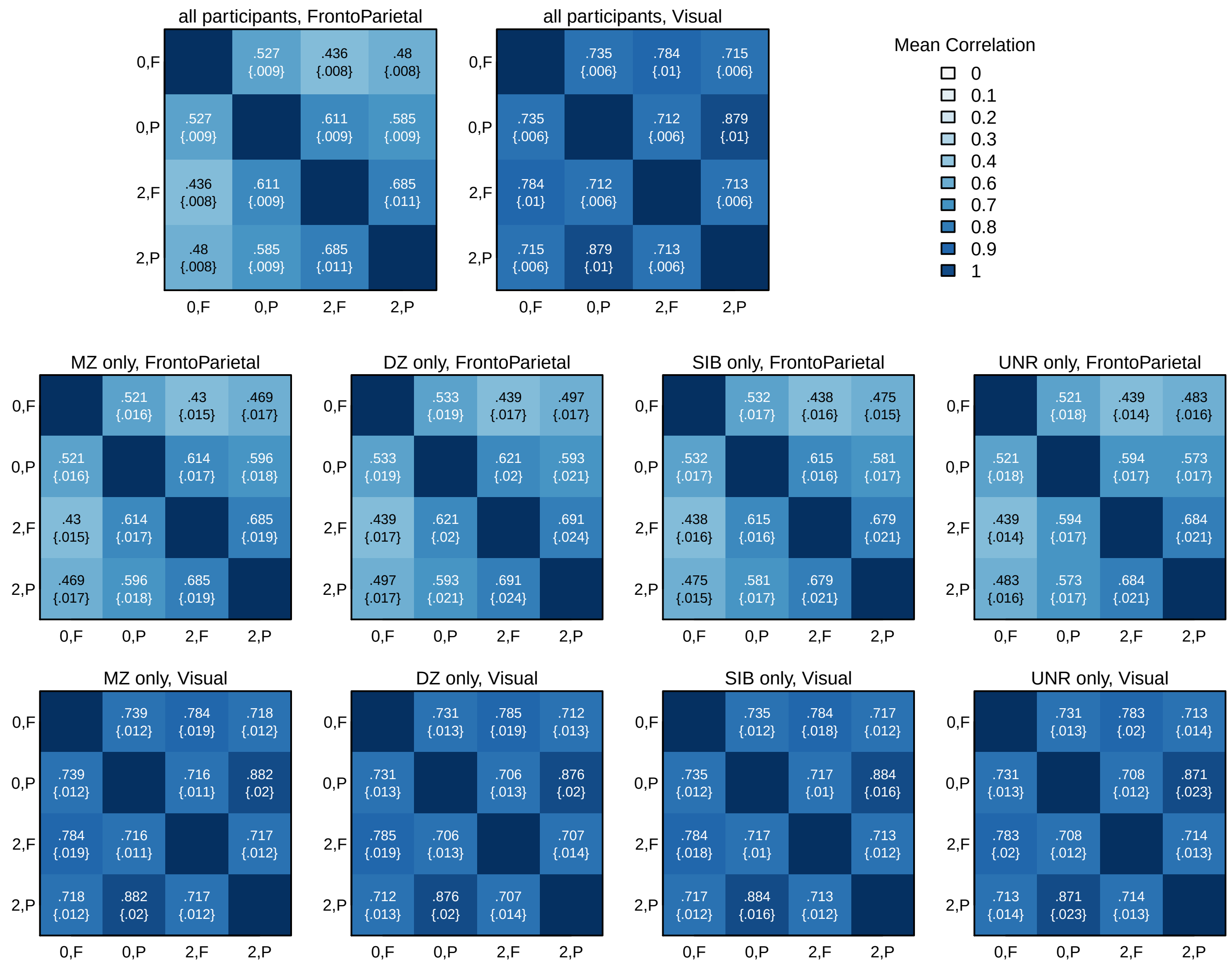



FrontoParietal: gw5507
Visual: gw5507
FrontoParietal: ks348
Visual: ks348
FrontoParietal: pb8936
Visual: pb8936
FrontoParietal: ng3506
Visual: ng3506
FrontoParietal: ix4227
Visual: ix4227
FrontoParietal: vn7650
Visual: vn7650
FrontoParietal: su3645
Visual: su3645
FrontoParietal: nx8660
Visual: nx8660
FrontoParietal: ob5169
Visual: ob5169
FrontoParietal: fu4651
Visual: fu4651
FrontoParietal: tr3019
Visual: tr3019
FrontoParietal: au2746
Visual: au2746
FrontoParietal: nr1944
Visual: nr1944
FrontoParietal: iu339
Visual: iu339
FrontoParietal: cj2737
Visual: cj2737
FrontoParietal: rq4571
Visual: rq4571
FrontoParietal: pt2977
Visual: pt2977
FrontoParietal: rx7568
Visual: rx7568
FrontoParietal: ir2672
Visual: ir2672
FrontoParietal: ad4777
Visual: ad4777
FrontoParietal: ot7589
Visual: ot7589
0,F
0,P
2,F
2,P


FrontoParietal: iq5754
Visual: iq5754
FrontoParietal: sf5720
Visual: sf5720
0,F
0,P
2,F
2,P
−0.4
−0.2
0
0.2
0.4
0.6
0.8
1

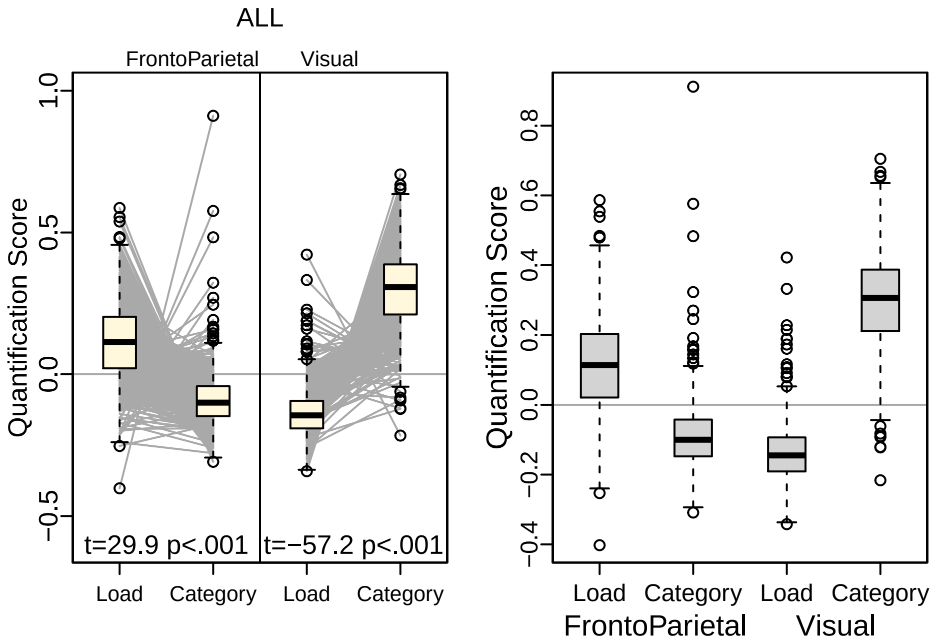
S2.2 Group-average individual similarity matrices

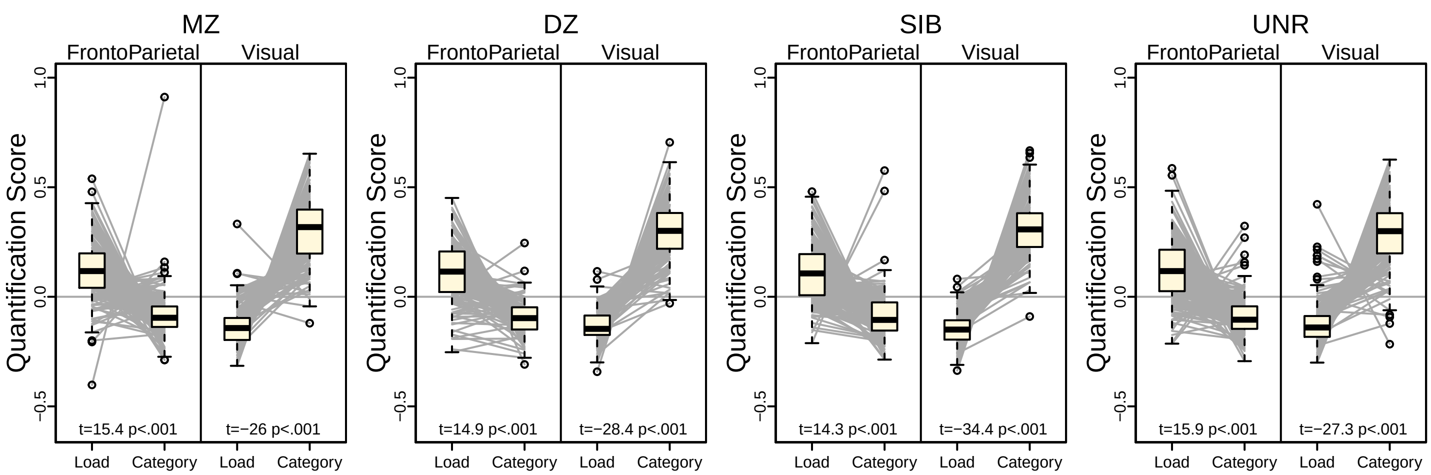
Each individual's activation similarity (e.g., similarity of a person's 2-back Face and their own 2-back Place activation pattern) matrix was calculated, then averaged across people. We do not expect differences between subject groups. Numbers in cells are robust means and standard errors of the means, both trimmed at 0.1.



S2.3 Quantification scores for the individual similarity matrices

Distribution of Load and Category quantification scores for individuals' matrices, by community. Grey lines connect points for individuals. The Load quantification scores tend to be higher than Category in FrontoParietal, but the reverse in Visual. t and p values printed on the plots are from a robust paired t-test for a difference in Load and Category quantification scores within each region. The same pattern is present in subjects from each group individually, as expected.





Various ANOVA and paired t-tests for the two communities and two quantification scores, both all subjects together and by subject groups.

```
# a standard anova, all subjects
quant.tbl <- read.table(paste0(in.path, "selfCorrelations/all_selfPairwiseDistanceRSAquant_z_omitSubs.txt"));
summary(aov(diff~comm.id*type.id + Error(sub.id/comm.id), data=quant.tbl));

##
## Error: sub.id
##            Df Sum Sq  Mean Sq F value Pr(>F)
## Residuals 723  6.888 0.009527
##
## Error: sub.id:comm.id
##            Df Sum Sq Mean Sq F value Pr(>F)
## comm.id     1  3.484   3.484    1086 <2e-16 ***
## Residuals 723  2.320   0.003
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Error: Within
##                   Df Sum Sq Mean Sq F value Pr(>F)
## type.id            1   9.39    9.39     435 <2e-16 ***
## comm.id:type.id    1  75.35   75.35    3492 <2e-16 ***
## Residuals       1446  31.20    0.02
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

# robust anova (I think with proper nesting)
WRS2::bwtrim(diff~comm.id*type.id, id=sub.id, tr=do.trim, data=quant.tbl)

## Call:
## WRS2::bwtrim(formula = diff ~ comm.id * type.id, id = sub.id,
##     data = quant.tbl, tr = do.trim)
##
##                     value df1      df2 p.value
## type.id          634.7990   1 1155.811       0
## comm.id          315.6261   1 1157.636       0
## type.id:comm.id 6842.7633   1 1157.636       0

####################################################################################################################
####################################################################################################################

# paired t-test, all subjects: just Load
stbl <- quant.tbl[which(quant.tbl$type.id == "load"),]
YuenTTest(diff~comm.id, data=stbl, paired=TRUE, alternative="two.sided", trim=do.trim);

##
##  Yuen Paired t-test
##
## data:  diff by comm.id
## t = 46.414, df = 579.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##  0.2460941 0.2678422
## sample estimates:
## difference of trimmed means
##                   0.2569681

# paired t-test, all subjects: just Category
stbl <- quant.tbl[which(quant.tbl$type.id == "picture"),]
YuenTTest(diff~comm.id, data=stbl, paired=TRUE, alternative="two.sided", trim=do.trim);

##
##  Yuen Paired t-test
##
## data:  diff by comm.id
## t = -70.492, df = 579.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##  -0.4086110 -0.3864586
## sample estimates:
## difference of trimmed means
##                  -0.3975348
```

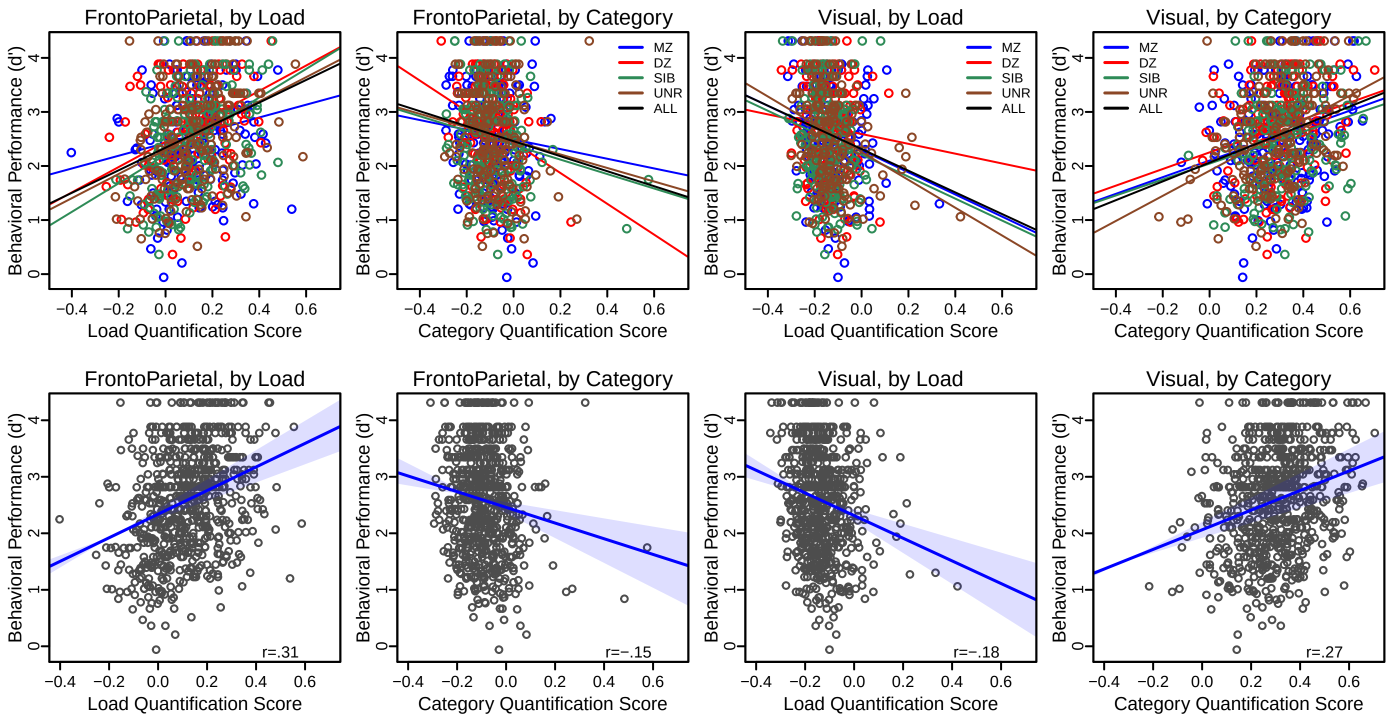
```r
# paired t-test, all subjects: just FrontoParietal (printed on boxplot)
stbl <- quant.tbl[which(quant.tbl$comm.id == "FrontoParietal"),]
YuenTTest(diff~type.id, data=stbl, paired=TRUE, alternative="two.sided", trim=do.trim);

##
##  Yuen Paired t-test
##
## data:  diff by type.id
## t = 29.948, df = 579.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##  0.1977746 0.2255363
## sample estimates:
## difference of trimmed means
##                   0.2116555

# paired t-test, all subjects: just Visual (printed on boxplot)
stbl <- quant.tbl[which(quant.tbl$comm.id == "Visual"),]
YuenTTest(diff~type.id, data=stbl, paired=TRUE, alternative="two.sided", trim=do.trim);

##
##  Yuen Paired t-test
##
## data:  diff by type.id
## t = -57.242, df = 579.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##  -0.4580422 -0.4276527
## sample estimates:
## difference of trimmed means
##                  -0.4428475

#####################################################################################################################

# paired t-test, MZ twins only: just FrontoParietal
quant.tbl <- read.table(paste0(in.path, "selfCorrelations/MZ_selfPairwiseDistanceRSAquant_z_omitSubs.txt"));
stbl <- quant.tbl[which(quant.tbl$comm.id == "FrontoParietal"),]
YuenTTest(diff~type.id, data=stbl, paired=TRUE, alternative="two.sided", trim=do.trim);

##
##  Yuen Paired t-test
##
## data:  diff by type.id
## t = 15.367, df = 151.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##  0.1837930 0.2380289
## sample estimates:
## difference of trimmed means
##                   0.2109109

# paired t-test, MZ twins only: just Visual
stbl <- quant.tbl[which(quant.tbl$comm.id == "Visual"),]
YuenTTest(diff~type.id, data=stbl, paired=TRUE, alternative="two.sided", trim=do.trim);

##
##  Yuen Paired t-test
##
## data:  diff by type.id
## t = -26.003, df = 151.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##  -0.4786848 -0.4110787
## sample estimates:
## difference of trimmed means
##                  -0.4448817

# paired t-test, DZ twins only: just FrontoParietal
quant.tbl <- read.table(paste0(in.path, "selfCorrelations/DZ_selfPairwiseDistanceRSAquant_z_omitSubs.txt"));
stbl <- quant.tbl[which(quant.tbl$comm.id == "FrontoParietal"),]
YuenTTest(diff~type.id, data=stbl, paired=TRUE, alternative="two.sided", trim=do.trim);
```

```
##
##  Yuen Paired t-test
##
## data:  diff by type.id
## t = 14.926, df = 119.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##  0.1859008 0.2427675
## sample estimates:
## difference of trimmed means
##                   0.2143341

# paired t-test, DZ twins only: just Visual
stbl <- quant.tbl[which(quant.tbl$comm.id == "Visual"),]
YuenTTest(diff~type.id, data=stbl, paired=TRUE, alternative="two.sided", trim=do.trim);

##
##  Yuen Paired t-test
##
## data:  diff by type.id
## t = -28.433, df = 119.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##  -0.4654749 -0.4048631
## sample estimates:
## difference of trimmed means
##                   -0.435169

# paired t-test, SIB only: just FrontoParietal
quant.tbl <- read.table(paste0(in.path, "selfCorrelations/SIB_selfPairwiseDistanceRSAquant_z_omitSubs.txt"));
stbl <- quant.tbl[which(quant.tbl$comm.id == "FrontoParietal"),]
YuenTTest(diff~type.id, data=stbl, paired=TRUE, alternative="two.sided", trim=do.trim);

##
##  Yuen Paired t-test
##
## data:  diff by type.id
## t = 14.332, df = 155.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##  0.1754654 0.2315679
## sample estimates:
## difference of trimmed means
##                   0.2035166

# paired t-test, SIB only: just Visual
stbl <- quant.tbl[which(quant.tbl$comm.id == "Visual"),]
YuenTTest(diff~type.id, data=stbl, paired=TRUE, alternative="two.sided", trim=do.trim);

##
##  Yuen Paired t-test
##
## data:  diff by type.id
## t = -34.415, df = 155.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##  -0.4849015 -0.4322576
## sample estimates:
## difference of trimmed means
##                  -0.4585796

# paired t-test, UNR only: just FrontoParietal
quant.tbl <- read.table(paste0(in.path, "selfCorrelations/UNR_selfPairwiseDistanceRSAquant_z_omitSubs.txt"));
stbl <- quant.tbl[which(quant.tbl$comm.id == "FrontoParietal"),]
YuenTTest(diff~type.id, data=stbl, paired=TRUE, alternative="two.sided", trim=do.trim);

##
##  Yuen Paired t-test
##
## data:  diff by type.id
## t = 15.872, df = 153.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
```

```
## 95 percent confidence interval:
##  0.1913494 0.2457568
## sample estimates:
## difference of trimmed means
##                   0.2185531

# paired t-test, UNR only: just Visual
stbl <- quant.tbl[which(quant.tbl$comm.id == "Visual"),]
YuenTTest(diff~type.id, data=stbl, paired=TRUE, alternative="two.sided", trim=do.trim);

##
##  Yuen Paired t-test
##
## data:  diff by type.id
## t = -27.33, df = 153.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##  -0.4578354 -0.3961069
## sample estimates:
## difference of trimmed means
##                  -0.4269711
```

S2.4 Quantification within individuals: correlation with behavior

This section has the correlation between each individual's behavioral performance (d') and quantification scores. If activation pattern similarity is related to individual task performance, it shouldn't matter which participant group the person is a member of (an MZ twin should have as strong a relationship as an SIB). To confirm this, the first row of plots has points and regression lines colored by subject group. The second row of plots (Figure 5) drops the group coloring but adds 0.95 confidence intervals to the ALL regression line.



Correlation between indicated quantification score 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, by Load	.31 (<.001)	.18 (.016)	.35 (<.001)	.39 (<.001)	.34 (<.001)
FrontoParietal, by Category	-.15 (.002)	-.11 (.09)	-.25 (.012)	-.15 (.032)	-.12 (.238)
Visual, by Load	-.18 (<.001)	-.2 (.016)	-.07 (.392)	-.15 (.072)	-.27 (<.001)
Visual, by Category	.27 (<.001)	.25 (.004)	.23 (.002)	.21 (.002)	.37 (<.001)

S2.5 Quantification within individuals: multiple regression

All four predictors (FP.load, FP.category, V.load, V.category) on their own are significantly correlated with d'. However, when looking at the pairwise and three-way comparisons, the best model is with just the FP.load and V.load predictors, without the Category predictors. V.load has a negative correlation with d' on its own.

```
# full model (all four columns)
lm.full <- lm(mreg.tbl$dprime ~ mreg.tbl$FP.category + mreg.tbl$FP.load + mreg.tbl$V.load + mreg.tbl$V.category);
summary(lm.full);   # regressor order in model doesn't matter; FP.load & V.load significant; neither .category

##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$FP.category + mreg.tbl$FP.load +
##     mreg.tbl$V.load + mreg.tbl$V.category)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.19048 -0.63124 -0.01654  0.61438  2.39513
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)            1.8572     0.0843  22.031  < 2e-16 ***
## mreg.tbl$FP.category  -0.3169     0.3957  -0.801  0.42352
## mreg.tbl$FP.load       2.1253     0.3141   6.766 2.74e-11 ***
## mreg.tbl$V.load       -1.9150     0.6670  -2.871  0.00421 **
## mreg.tbl$V.category    0.6272     0.4094   1.532  0.12595
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8474 on 719 degrees of freedom
## Multiple R-squared:  0.162,Adjusted R-squared:  0.1573
## F-statistic: 34.74 on 4 and 719 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$V.load
## Beta.Coef          -0.03365675        0.3170366      -0.1765538
##           mreg.tbl$V.category
## Beta.Coef          0.09626678

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

lm.FPl <- lm(mreg.tbl$dprime ~ mreg.tbl$FP.load);
summary(lm.FPl);  # FP.load significant alone

##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$FP.load)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.38155 -0.66943  0.00961  0.61423  2.29517
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       2.33851    0.04297  54.425   <2e-16 ***
## mreg.tbl$FP.load  2.08721    0.23708   8.804   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8778 on 722 degrees of freedom
## Multiple R-squared:  0.09694,Adjusted R-squared:  0.09569
## F-statistic: 77.51 on 1 and 722 DF,  p-value: < 2.2e-16

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

```
##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$V.load)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.5749 -0.6827  0.0236  0.6857  2.1620
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)       2.3134     0.0634  36.491  < 2e-16 ***
## mreg.tbl$V.load  -2.0048     0.3967  -5.053 5.51e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9078 on 722 degrees of freedom
## Multiple R-squared:  0.03416,Adjusted R-squared:  0.03282
## F-statistic: 25.54 on 1 and 722 DF,  p-value: 5.507e-07
```

```r
summary(lm(mreg.tbl$dprime ~ mreg.tbl$V.category));
```

```
##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$V.category)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.36677 -0.66964  0.06198  0.66574  2.26942
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)          2.06189    0.07778  26.509  < 2e-16 ***
## mreg.tbl$V.category  1.73580    0.23372   7.427 3.14e-13 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8903 on 722 degrees of freedom
## Multiple R-squared:  0.07098,Adjusted R-squared:  0.06969
## F-statistic: 55.16 on 1 and 722 DF,  p-value: 3.142e-13
```

```r
summary(lm(mreg.tbl$dprime ~ mreg.tbl$FP.category));
```

```
##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$FP.category)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.55873 -0.69396  0.03381  0.66839  2.30231
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)            2.4587     0.0463  53.107  < 2e-16 ***
## mreg.tbl$FP.category  -1.3879     0.3466  -4.005 6.85e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9136 on 722 degrees of freedom
## Multiple R-squared:  0.02173,Adjusted R-squared:  0.02038
## F-statistic: 16.04 on 1 and 722 DF,  p-value: 6.85e-05
```

```r
##############################################################################################################
# comparing models

lm.FPlp <- lm(mreg.tbl$dprime ~ mreg.tbl$FP.load + mreg.tbl$FP.category);
summary(lm.FPlp)
```

```
##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$FP.load + mreg.tbl$FP.category)
##
## Residuals:
```

```
##      Min       1Q   Median       3Q      Max
## -2.38018 -0.66477  0.01303  0.61300  2.31668
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)            2.33503    0.04728  49.386  < 2e-16 ***
## mreg.tbl$FP.load       2.06578    0.26651   7.751  3.1e-14 ***
## mreg.tbl$FP.category -0.06605    0.37430  -0.176     0.86
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8784 on 721 degrees of freedom
## Multiple R-squared:  0.09698,Adjusted R-squared:  0.09448
## F-statistic: 38.72 on 2 and 721 DF,  p-value: < 2.2e-16
```

```
anova(lm.FPl, lm.FPlp);   # FP.category not useful added to FP.load
```

```
## Analysis of Variance Table
##
## Model 1: mreg.tbl$dprime ~ mreg.tbl$FP.load
## Model 2: mreg.tbl$dprime ~ mreg.tbl$FP.load + mreg.tbl$FP.category
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1    722 556.34
## 2    721 556.31  1  0.024029 0.0311   0.86
```

```
lm.FPl.Vp <- lm(mreg.tbl$dprime ~ mreg.tbl$FP.load + mreg.tbl$V.category);
summary(lm.FPl.Vp)
```

```
##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$FP.load + mreg.tbl$V.category)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.16940 -0.61610 -0.01559  0.63614  2.47429
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)           1.91437    0.07673  24.950  < 2e-16 ***
## mreg.tbl$FP.load      1.88048    0.23254   8.087 2.59e-15 ***
## mreg.tbl$V.category   1.48921    0.22601   6.589 8.54e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8531 on 721 degrees of freedom
## Multiple R-squared:  0.1482,Adjusted R-squared:  0.1459
## F-statistic: 62.74 on 2 and 721 DF,  p-value: < 2.2e-16
```

```
anova(lm.FPl, lm.FPl.Vp);   # V.category IS useful added to FP.load
```

```
## Analysis of Variance Table
##
## Model 1: mreg.tbl$dprime ~ mreg.tbl$FP.load
## Model 2: mreg.tbl$dprime ~ mreg.tbl$FP.load + mreg.tbl$V.category
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1    722 556.34
## 2    721 524.74  1    31.599 43.417 8.536e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
lm.FPl.Vl <- lm(mreg.tbl$dprime ~ mreg.tbl$FP.load + mreg.tbl$V.load);
summary(lm.FPl.Vl)
```

```
##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$FP.load + mreg.tbl$V.load)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.24462 -0.62029 -0.01579  0.60606  2.28942
##
## Coefficients:
```

```
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)        1.92672    0.06999  27.527  < 2e-16 ***
## mreg.tbl$FP.load  2.41542    0.23329  10.354  < 2e-16 ***
## mreg.tbl$V.load  -2.75746    0.37748  -7.305 7.37e-13 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8476 on 721 degrees of freedom
## Multiple R-squared:  0.1592,Adjusted R-squared:  0.1568
## F-statistic: 68.24 on 2 and 721 DF,  p-value: < 2.2e-16
```

```
anova(lm.FPl, lm.FPl.Vl);   # V.load IS VERY useful added to FP.load
```

```
## Analysis of Variance Table
##
## Model 1: mreg.tbl$dprime ~ mreg.tbl$FP.load
## Model 2: mreg.tbl$dprime ~ mreg.tbl$FP.load + mreg.tbl$V.load
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1    722 556.34
## 2    721 518.00  1    38.338 53.362 7.367e-13 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
lm.FPl.Vlp <- lm(mreg.tbl$dprime ~ mreg.tbl$FP.load + mreg.tbl$V.load + mreg.tbl$V.category);
summary(lm.FPl.Vlp)
```

```
##
## Call:
## lm(formula = mreg.tbl$dprime ~ mreg.tbl$FP.load + mreg.tbl$V.load +
##     mreg.tbl$V.category)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.20727 -0.62266 -0.02184  0.62794  2.29140
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)          1.88522    0.07669  24.581  < 2e-16 ***
## mreg.tbl$FP.load     2.26810    0.25849   8.774  < 2e-16 ***
## mreg.tbl$V.load     -2.09487    0.62785  -3.337 0.000892 ***
## mreg.tbl$V.category  0.49312    0.37349   1.320 0.187158
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8472 on 720 degrees of freedom
## Multiple R-squared:  0.1612,Adjusted R-squared:  0.1577
## F-statistic: 46.12 on 3 and 720 DF,  p-value: < 2.2e-16
```

```
anova(lm.FPl.Vl, lm.FPl.Vlp);   # V.category is NOT useful added to (V.load and FP.load)
```

```
## Analysis of Variance Table
##
## Model 1: mreg.tbl$dprime ~ mreg.tbl$FP.load + mreg.tbl$V.load
## Model 2: mreg.tbl$dprime ~ mreg.tbl$FP.load + mreg.tbl$V.load + mreg.tbl$V.category
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1    721 518.00
## 2    720 516.75  1    1.2511 1.7432 0.1872
```

```
anova(lm.FPl.Vp, lm.FPl.Vlp);   # V.load IS useful added to (V.category and FP.load)
```

```
## Analysis of Variance Table
##
## Model 1: mreg.tbl$dprime ~ mreg.tbl$FP.load + mreg.tbl$V.category
## Model 2: mreg.tbl$dprime ~ mreg.tbl$FP.load + mreg.tbl$V.load + mreg.tbl$V.category
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1    721 524.74
## 2    720 516.75  1      7.99 11.133 0.0008917 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova(lm.full, lm.FPl.Vlp);   # full model not better than V.load + FP.load + V.category
```

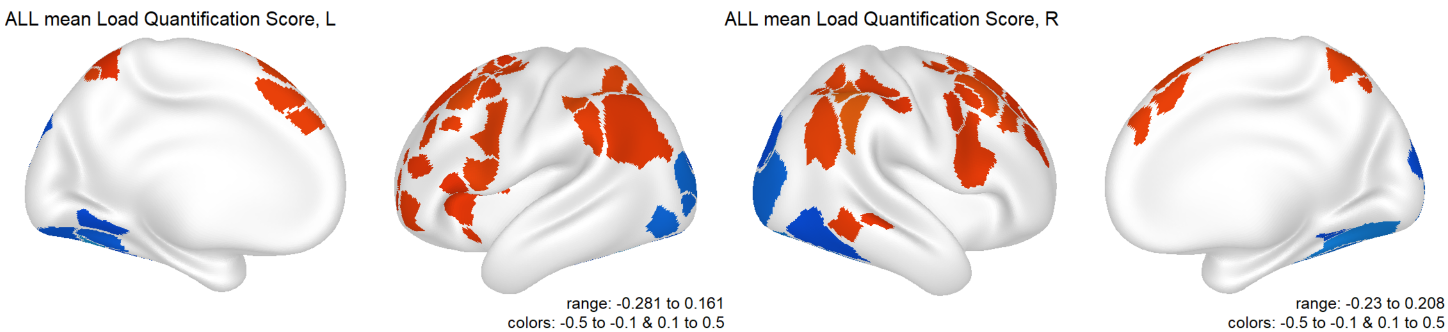
```
## Analysis of Variance Table
##
## Model 1: mreg.tbl$dprime ~ mreg.tbl$FP.category + mreg.tbl$FP.load + mreg.tbl$V.load +
##     mreg.tbl$V.category
## Model 2: mreg.tbl$dprime ~ mreg.tbl$FP.load + mreg.tbl$V.load + mreg.tbl$V.category
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1    719 516.29
## 2    720 516.75 -1  -0.46047 0.6413 0.4235

anova(lm.full, lm.FPl.Vl);  # full model not better than just V.load + FP.load

## 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$FP.load + mreg.tbl$V.load
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1    719 516.29
## 2    721 518.00 -2   -1.7115 1.1918 0.3043
```

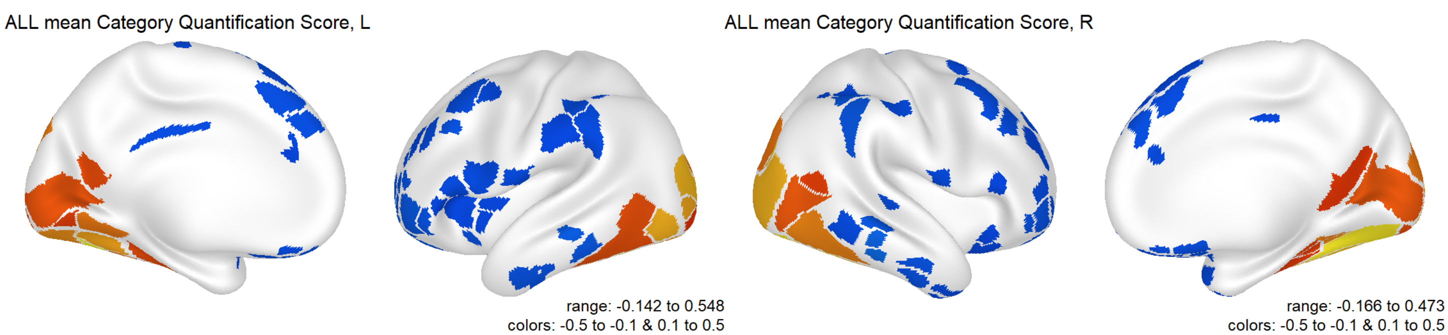
S2.6 Quantification within individuals: by parcel

This section has the results of the same type of analysis as in S2.3, but calculated within each parcel separately. Since these quantification scores are calculated within each participant individually the subject grouping should not have an influence (and it did not in the previous analyses in this supplemental). The results here are thus for ALL (all subjects together) for brevity, not including the subject groups individually. The results for each subject group were checked to confirm that they resembled ALL, however, and the code to do so is in this section.

Here are the across-subjects (robust) mean quantification score for each parcel, first with Load and then with Category. Community membership of these parcels is listed below the plots. Parcels with mean quantification scores above 0.1 are shown in warm colors, and below -0.1 in cool colors. This threshold was chosen somewhat arbitrarily, but aiming to be lenient enough to show many parcels to give a sense of their distribution.

There is a clear difference in the brain areas in which the parcels with the highest Load and Category quantification scores fall: the highest Load parcels are in an array of frontal and parietal areas (hot colors in top row), while the highest Category parcels are nearly all in occipital visual areas (hot colors in second row). Counting the displayed parcels (listed below the plots), slightly more than half of the FrontoParietal parcels (14 of 24) had Load quantification above 0.1; most (25 of 39) of the Visual parcels had Category quantification above 0.1. We can also compare these means to those from the entire Visual and FrontoParietal communities (S2.3): 0.117 for Load in FrontoParietal and 0.3 for Category in Visual. As listed below the plots, 12 of the 24 FrontoParietal parcels have a Load mean greater than 0.117, and 9 of the 39 Visual parcels have a Category mean greater than 0.3.





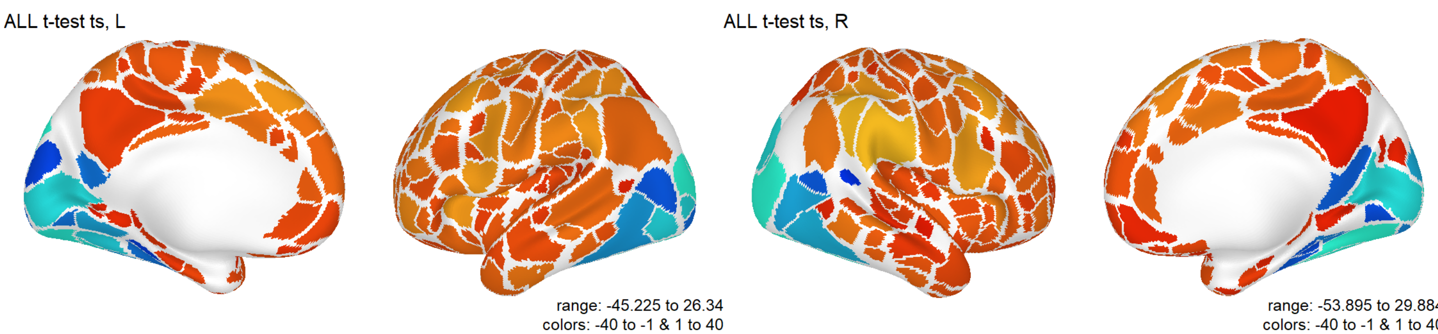

```
## [1] Number of parcels with Load > 0.1 in each Community:
## [1] CinguloOperc: 8 of 40 total.
## [1] Default: 16 of 41 total.
## [1] DorsalAttn: 20 of 32 total.
## [1] FrontoParietal: 13 of 24 total.
## [1] Salience: 1 of 4 total.
## [1] SMhand: 2 of 38 total.
## [1] VentralAttn: 2 of 23 total.
## [1]
## [1] Number of parcels with Category > 0.1 in each Community:
## [1] DorsalAttn: 1 of 32 total.
## [1] RetrosplenialTemporal: 6 of 8 total.
## [1] Visual: 25 of 39 total.
## [1]
```

```
## [1] Number of parcels with Load > 0.117 in each Community:
## [1] CinguloOperc: 3 of 40 total.
## [1] Default: 9 of 41 total.
## [1] DorsalAttn: 15 of 32 total.
## [1] FrontoParietal: 10 of 24 total.
## [1] SMhand: 1 of 38 total.
## [1] VentralAttn: 1 of 23 total.
## [1]
## [1] Number of parcels with Category > 0.3 in each Community:
## [1] Visual: 9 of 39 total.
```

Next, we carried out the paired t-tests (for a difference between Load and Category quantification scores), as in S2.3, but on each parcel separately. The next set of images show the resulting t values of parcels with p<0.00015 (Bonferroni correction of 0.05 for 333 parcels). Following the convention in earlier sections, positive t values and warm colors are used for Load>Category, while negative t values and cool colors are used for Category>Load. As noted above, the largest parcel-average Load and Category quantification scores tend to be in different brain areas, a split reflected in the results of paired t-tests for a difference between Load and Category quantification scores: posterior occipital areas in cool colors (Category>Load) and the warmest (Load>Category, yellows) frontal and parietal.

While nearly all parcels have a significant difference between Load and Category quantification (consistent with the double dissociation seen in the FrontoParietal and Visual communities), no individual parcel had as large a t-value as those two communities (S2.3; t>29.9 for Load and t<-57.2 for Category), suggesting that the community-level effects were not due to a small number of parcels (or are stronger in the community as a whole). If the statistics are run on each subject group individually (the results shown here are for all subjects together), there are still no parcels in any subject group with t values larger than Visual for Category, and only a few (none for MZ twins) with t values larger than FrontoParietal for Load. The parcels that do pass the Load threshold in DZ, SIB, and/or UNR are nearly all in the DorsalAttn or CinguloOperc communities (one FrontoParietal and one Default), which are not surprising regions for Load.

Overall, these parcelwise t-tests underscore a dissociation between Load and Category coding, and suggest that we did not miss highly informative parcels (or those with very unexpected properties) by our *a priori* choice to focus on the Visual and FrontoParietal communities.




```
## [1] Number of parcels in each Community with t-test p < 0.00015:
## [1] Auditory: 23 of 24 total.
## [1] CinguloOperc: 40 of 40 total.
## [1] CinguloParietal: 2 of 5 total.
## [1] Default: 38 of 41 total.
## [1] DorsalAttn: 30 of 32 total.
## [1] FrontoParietal: 24 of 24 total.
## [1] None: 39 of 47 total.
## [1] RetrosplenialTemporal: 7 of 8 total.
## [1] Salience: 4 of 4 total.
## [1] SMhand: 38 of 38 total.
## [1] SMmouth: 8 of 8 total.
## [1] VentralAttn: 20 of 23 total.
## [1] Visual: 35 of 39 total.
```