Results Supplement 2

Results 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.

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/**.

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.
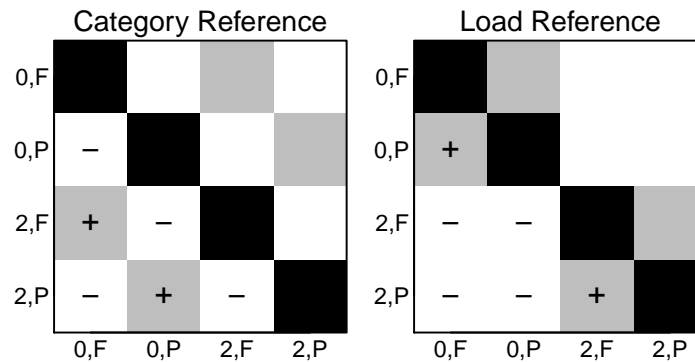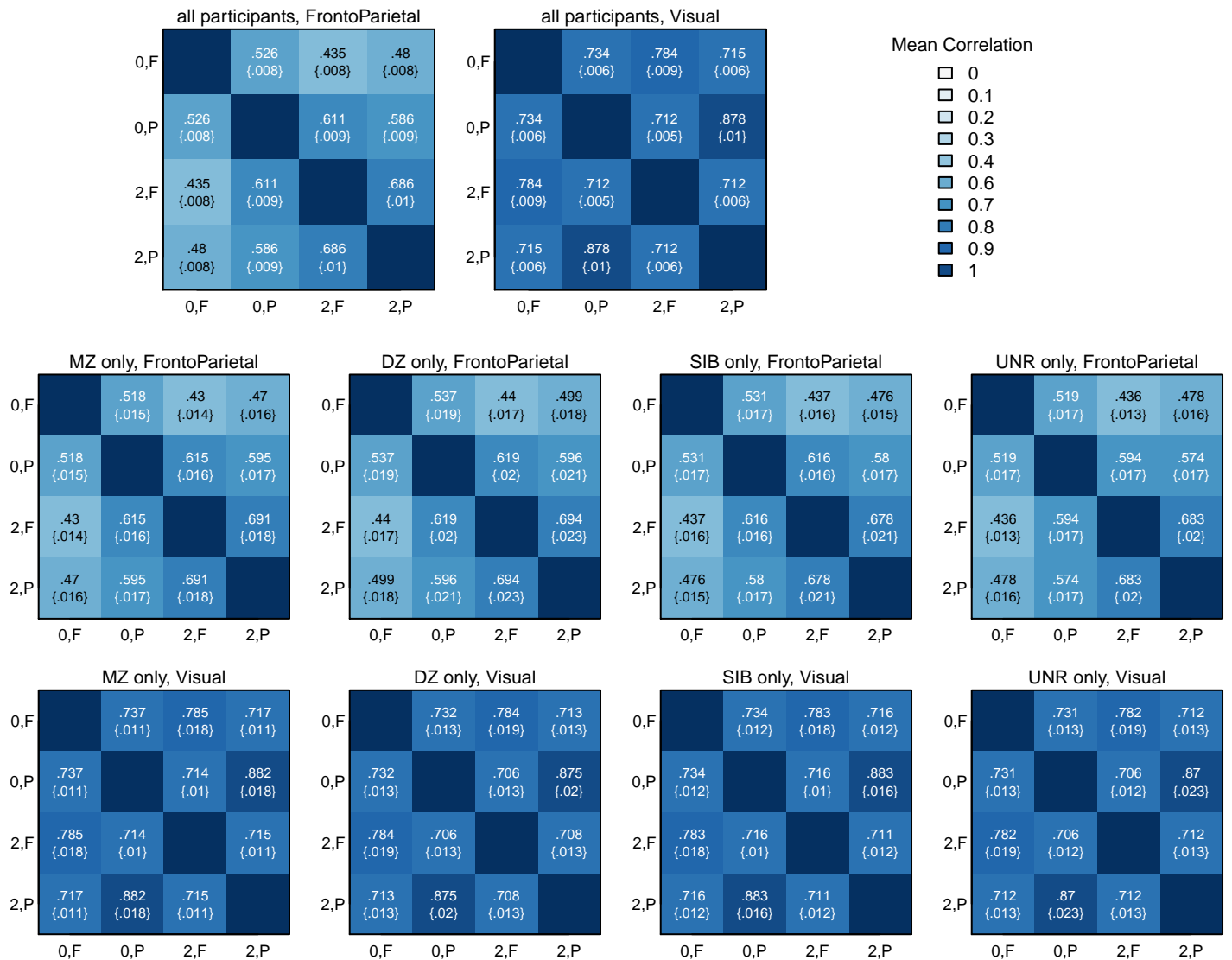

## S2.1 Some example individual similarity matrices.
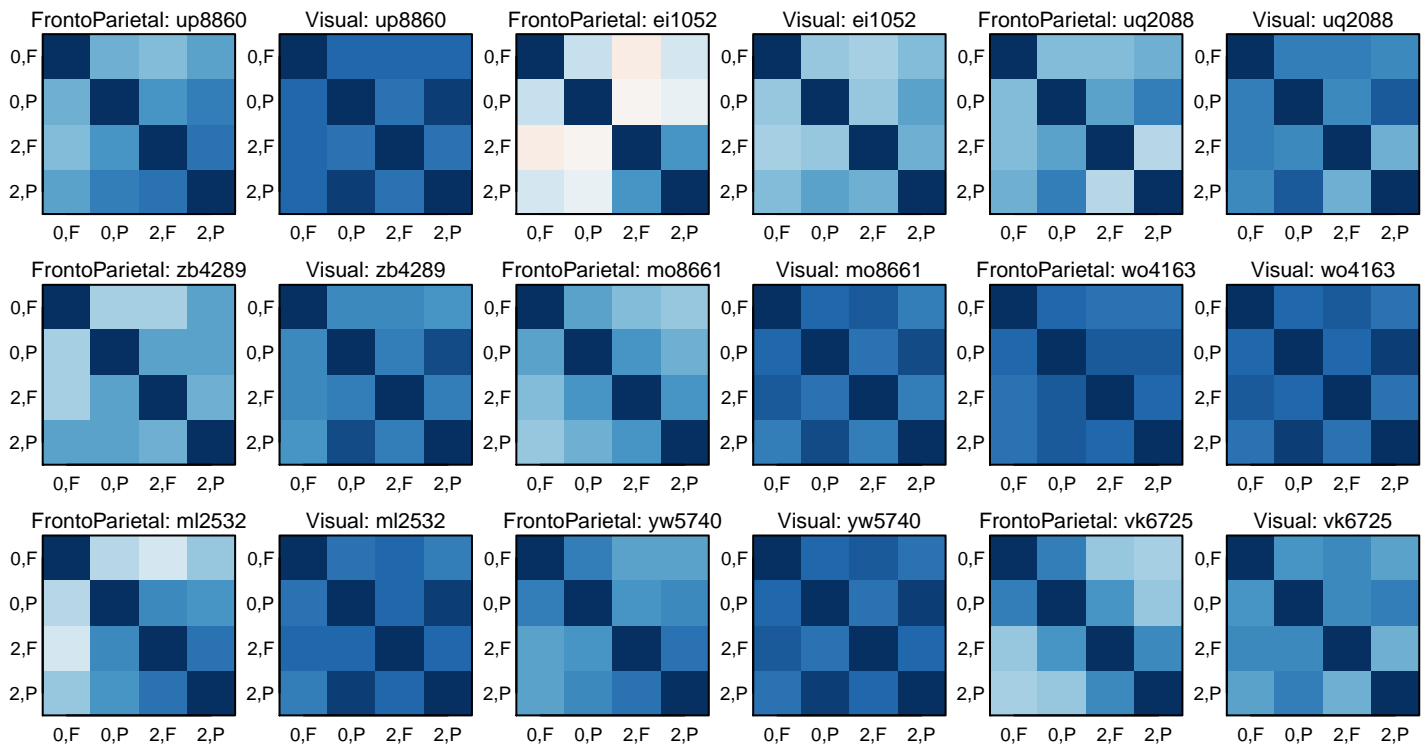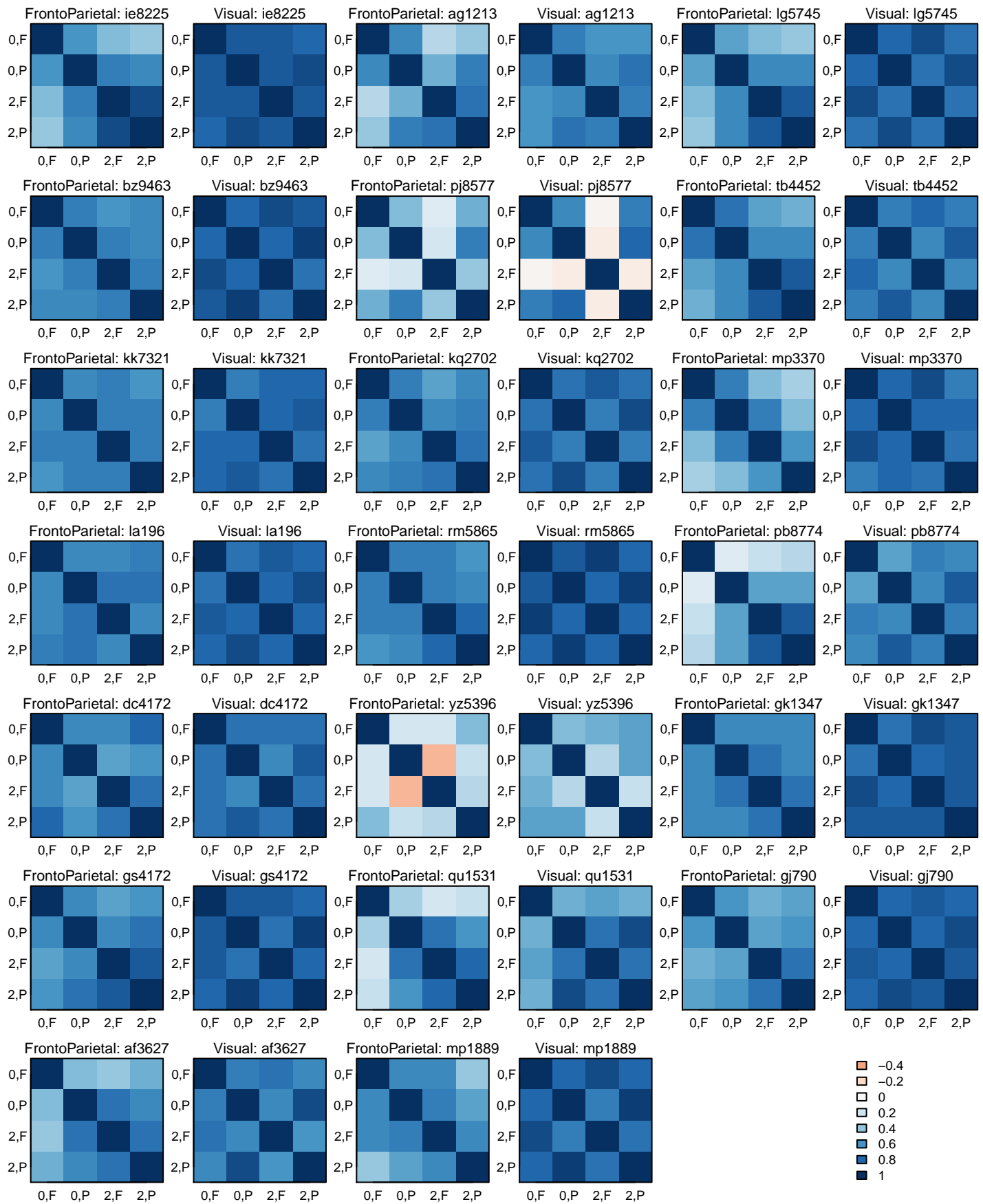
S2.2 Group-average individual similarity matrices

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.

Mean Correlation legend: 0, 0.1, 0.2, 0.3, 0.4, 0.6, 0.7, 0.8, 0.9, 1

all participants, FrontoParietal

	0,F	0,P	2,F	2,P
0,F		.526 {.008}	.435 {.008}	.48 {.008}
0,P	.526 {.008}		.611 {.009}	.586 {.009}
2,F	.435 {.008}	.611 {.009}		.686 {.01}
2,P	.48 {.008}	.586 {.009}	.686 {.01}	

all participants, Visual

	0,F	0,P	2,F	2,P
0,F		.734 {.006}	.784 {.009}	.715 {.006}
0,P	.734 {.006}		.712 {.005}	.878 {.01}
2,F	.784 {.009}	.712 {.005}		.712 {.006}
2,P	.715 {.006}	.878 {.01}	.712 {.006}	

MZ only, FrontoParietal

	0,F	0,P	2,F	2,P
0,F		.518 {.015}	.43 {.014}	.47 {.016}
0,P	.518 {.015}		.615 {.016}	.595 {.017}
2,F	.43 {.014}	.615 {.016}		.691 {.018}
2,P	.47 {.016}	.595 {.017}	.691 {.018}	

DZ only, FrontoParietal

	0,F	0,P	2,F	2,P
0,F		.537 {.019}	.44 {.017}	.499 {.018}
0,P	.537 {.019}		.619 {.02}	.596 {.021}
2,F	.44 {.017}	.619 {.02}		.694 {.023}
2,P	.499 {.018}	.596 {.021}	.694 {.023}	

SIB only, FrontoParietal

	0,F	0,P	2,F	2,P
0,F		.531 {.017}	.437 {.016}	.476 {.015}
0,P	.531 {.017}		.616 {.016}	.58 {.017}
2,F	.437 {.016}	.616 {.016}		.678 {.021}
2,P	.476 {.015}	.58 {.017}	.678 {.021}	

UNR only, FrontoParietal

	0,F	0,P	2,F	2,P
0,F		.519 {.017}	.436 {.013}	.478 {.016}
0,P	.519 {.017}		.594 {.017}	.574 {.017}
2,F	.436 {.013}	.594 {.017}		.683 {.02}
2,P	.478 {.016}	.574 {.017}	.683 {.02}	

MZ only, Visual

	0,F	0,P	2,F	2,P
0,F		.737 {.011}	.785 {.018}	.717 {.011}
0,P	.737 {.011}		.714 {.01}	.882 {.018}
2,F	.785 {.018}	.714 {.01}		.715 {.011}
2,P	.717 {.011}	.882 {.018}	.715 {.011}	

DZ only, Visual

	0,F	0,P	2,F	2,P
0,F		.732 {.013}	.784 {.019}	.713 {.013}
0,P	.732 {.013}		.706 {.013}	.875 {.02}
2,F	.784 {.019}	.706 {.013}		.708 {.013}
2,P	.713 {.013}	.875 {.02}	.708 {.013}	

SIB only, Visual

	0,F	0,P	2,F	2,P
0,F		.734 {.012}	.783 {.018}	.716 {.012}
0,P	.734 {.012}		.716 {.01}	.883 {.016}
2,F	.783 {.018}	.716 {.01}		.711 {.012}
2,P	.716 {.012}	.883 {.016}	.711 {.012}	

UNR only, Visual

	0,F	0,P	2,F	2,P
0,F		.731 {.013}	.782 {.019}	.712 {.013}
0,P	.731 {.013}		.706 {.012}	.87 {.023}
2,F	.782 {.019}	.706 {.012}		.712 {.013}
2,P	.712 {.013}	.87 {.023}	.712 {.013}	

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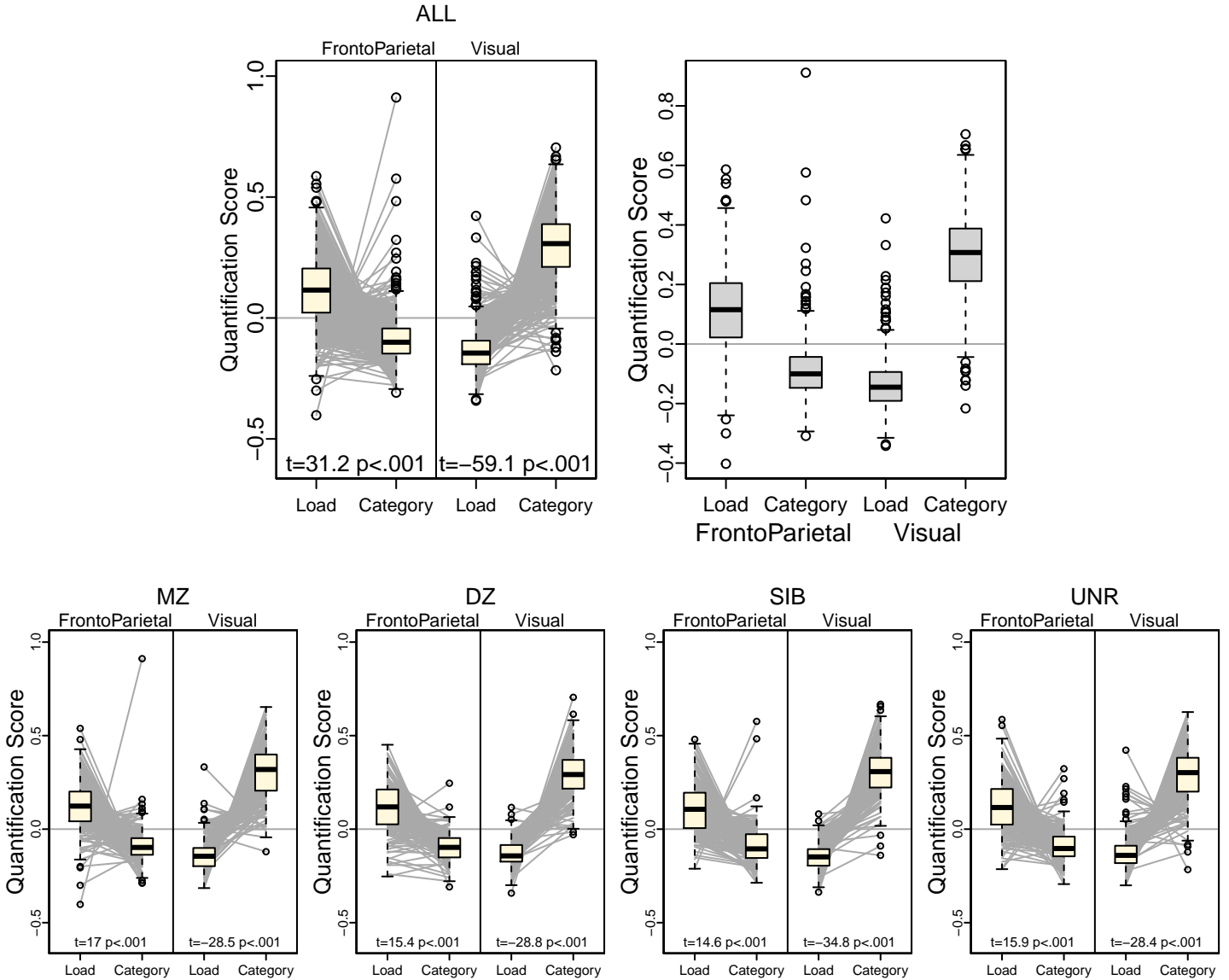
Various ANOVA and paired t-tests for the two communities and two quantification scores, both all subjects together and by subject groups.

```
# a standard anova, all subjects
quant.tbl <- read.table(paste0(in.path, "selfCorrelations/all_selfPairwiseDistanceRSAquant_z.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 763  7.373 0.009663
##
## Error: sub.id:comm.id
##            Df Sum Sq Mean Sq F value Pr(>F)
## comm.id     1  3.616   3.616    1142 <2e-16 ***
## Residuals 763  2.416   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   9.71    9.71   453.9 <2e-16 ***
## comm.id:type.id  1  79.71   79.71  3724.8 <2e-16 ***
## Residuals     1526  32.65    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         665.0871   1 1219.684       0
## comm.id         329.7285   1 1221.737       0
## type.id:comm.id 7307.9003  1 1221.737       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 = 48.036, df = 611.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##   0.2479643 0.2691036
## sample estimates:
## difference of trimmed means
##                   0.258534

# 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 = -72.906, df = 611.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##   -0.4087086 -0.3872675
## sample estimates:
## difference of trimmed means
##                  -0.397988
```

```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 = 31.203, df = 611.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##   0.1999464 0.2268052
## sample estimates:
## difference of trimmed means
##                   0.2133758

# 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 = -59.055, df = 611.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##   -0.4578830 -0.4284094
## sample estimates:
## difference of trimmed means
##                  -0.4431462


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

# paired t-test, MZ twins only: just FrontoParietal
quant.tbl <- read.table(paste0(in.path, "selfCorrelations/MZ_selfPairwiseDistanceRSAquant_z.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 = 16.995, df = 167.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##   0.1912769 0.2415590
## sample estimates:
## difference of trimmed means
##                   0.2164179

# 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 = -28.497, df = 167.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##   -0.4844111 -0.4216394
## sample estimates:
## difference of trimmed means
##                  -0.4530253

# paired t-test, DZ twins only: just FrontoParietal
quant.tbl <- read.table(paste0(in.path, "selfCorrelations/DZ_selfPairwiseDistanceRSAquant_z.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 = 15.352, df = 125.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##   0.1900363 0.2462845
## sample estimates:
## difference of trimmed means
##                  0.2181604
```

```
# 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 = -28.786, df = 125.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##   -0.4587391 -0.3997184
## sample estimates:
## difference of trimmed means
##                 -0.4292287
```

```
# paired t-test, SIB only: just FrontoParietal
quant.tbl <- read.table(paste0(in.path, "selfCorrelations/SIB_selfPairwiseDistanceRSAquant_z.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 = 14.599, df = 159.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##   0.1754683 0.2303721
## sample estimates:
## difference of trimmed means
##                  0.2029202
```

```
# 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 = -34.81, df = 159.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##   -0.4833174 -0.4314186
## sample estimates:
## difference of trimmed means
##                  -0.457368
```

```
# paired t-test, UNR only: just FrontoParietal
quant.tbl <- read.table(paste0(in.path, "selfCorrelations/UNR_selfPairwiseDistanceRSAquant_z.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 = 15.875, df = 159.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
```

```
## 95 percent confidence interval:
##   0.1896626 0.2435584
## sample estimates:
## difference of trimmed means
##                  0.2166105


# 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 = -28.355, df = 159.0, trim = 0.1, p-value < 2.2e-16
## alternative hypothesis: true difference in trimmed means is not equal to 0
## 95 percent confidence interval:
##   -0.4567782 -0.3972896
## sample estimates:
## difference of trimmed means
##                 -0.4270339
```

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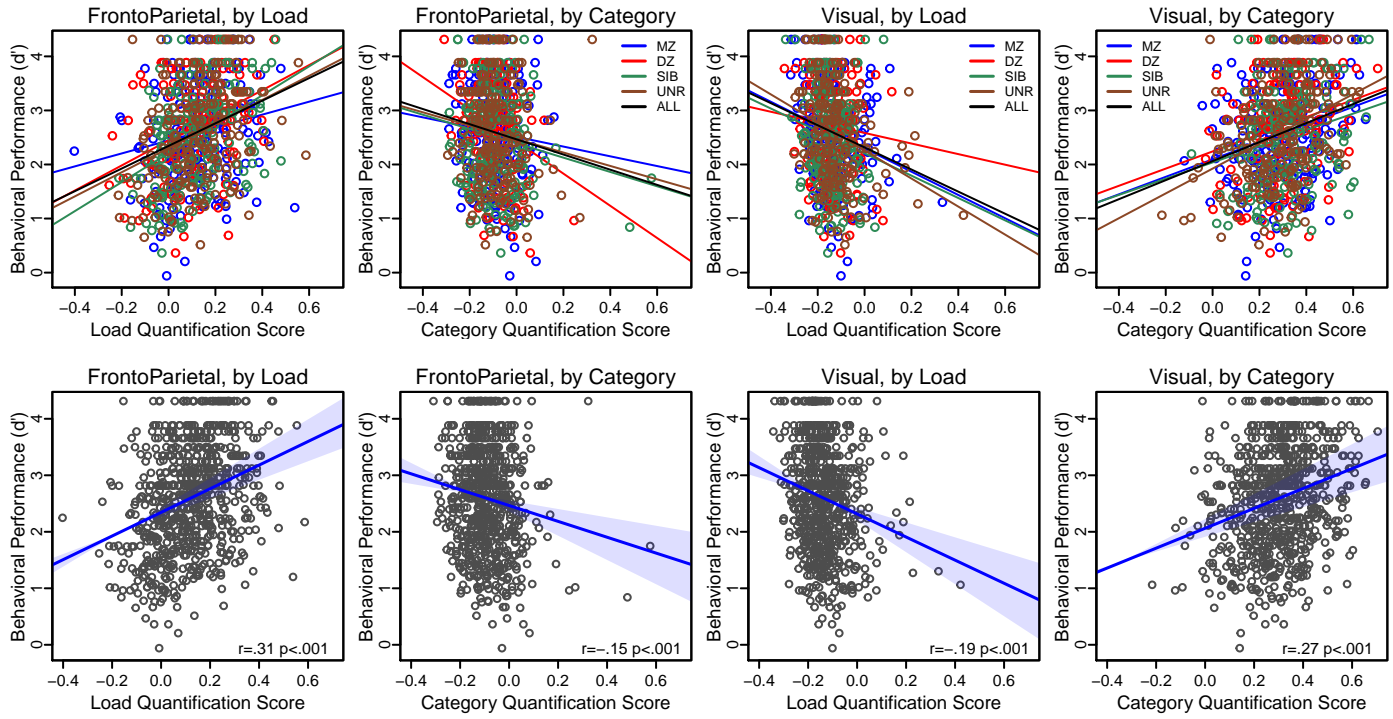
Correlation between indicated quantification score and d', for all subjects combined (ALL) and each group individually, as plotted above. p-values for each in parentheses, from `hc4wtest`, uncorrected for multiple comparisons.

	ALL	MZ	DZ	SIB	UNR
FrontoParietal, by Load	.31 (<.001)	.18 (.018)	.35 (<.001)	.39 (<.001)	.34 (<.001)
FrontoParietal, by Category	-.15 (<.001)	-.11 (.076)	-.26 (<.001)	-.15 (.038)	-.12 (.25)
Visual, by Load	-.19 (<.001)	-.22 (<.001)	-.08 (.382)	-.16 (.084)	-.28 (<.001)
Visual, by Category	.27 (<.001)	.26 (<.001)	.23 (.004)	.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$V.category)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.18890 -0.62529 -0.02288  0.61300  2.39889
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)           1.85001    0.08295  22.303  < 2e-16 ***
## mreg.tbl$FP.category -0.33283    0.39219  -0.849  0.39636
## mreg.tbl$FP.load      2.13162    0.30912   6.896 1.15e-11 ***
## mreg.tbl$V.load      -1.92187    0.65864  -2.918  0.00363 **
## mreg.tbl$V.category   0.65938    0.40439   1.631  0.10341
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.844 on 741 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.1653,Adjusted R-squared:  0.1608
## F-statistic: 36.69 on 4 and 741 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$V.load
## Beta.Coef          -0.03509711        0.3174135      -0.1780845
##          mreg.tbl$V.category
## Beta.Coef            0.101467


#############################################################################################################
# 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
## -2.38620 -0.66378  0.00905  0.61100  2.29116
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)        2.3432     0.0425   55.14   <2e-16 ***
## mreg.tbl$FP.load   2.0916     0.2340    8.94   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8761 on 744 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.09701,Adjusted R-squared:  0.09579
## F-statistic: 79.93 on 1 and 744 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
## -2.58182 -0.67376  0.02577  0.67851  2.16258
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       2.31624    0.06203  37.338  < 2e-16 ***
## mreg.tbl$V.load  -2.04585    0.38848  -5.266 1.82e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9052 on 744 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.03594,Adjusted R-squared:  0.03464
## F-statistic: 27.73 on 1 and 744 DF,  p-value: 1.824e-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
## -2.37027 -0.67087  0.07068  0.66275  2.26961
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)           2.06196    0.07637  26.998  < 2e-16 ***
## mreg.tbl$V.category   1.76004    0.22934   7.674 5.23e-14 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8875 on 744 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.07335,Adjusted R-squared:  0.07211
## F-statistic: 58.9 on 1 and 744 DF,  p-value: 5.225e-14
```

```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
## -2.56529 -0.69241  0.03024  0.66622  2.30124
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)            2.46476    0.04574  53.886  < 2e-16 ***
## mreg.tbl$FP.category  -1.40348    0.34383  -4.082 4.95e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9118 on 744 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.0219,Adjusted R-squared:  0.02059
## F-statistic: 16.66 on 1 and 744 DF,  p-value: 4.952e-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$FP.category)
##
## Residuals:
##      Min      1Q   Median      3Q     Max
## -2.38475 -0.66282  0.01616  0.60802  2.31401
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)           2.33951    0.04677  50.018  < 2e-16 ***
## mreg.tbl$FP.load      2.06895    0.26311   7.863 1.32e-14 ***
## mreg.tbl$FP.category -0.07016    0.37153  -0.189     0.85
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8766 on 743 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.09705,Adjusted R-squared:  0.09462
## F-statistic: 39.93 on 2 and 743 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    744 571.03
## 2    743 571.00  1  0.027405 0.0357 0.8503
```

```
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$V.category)
##
## Residuals:
##      Min      1Q   Median      3Q     Max
## -2.16698 -0.62079 -0.01551  0.63467  2.48285
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)          1.90657    0.07551  25.248  < 2e-16 ***
## mreg.tbl$FP.load     1.89137    0.22880   8.266 6.34e-16 ***
## mreg.tbl$V.category  1.52792    0.22140   6.901 1.11e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8499 on 743 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.1514,Adjusted R-squared:  0.1491
## F-statistic: 66.28 on 2 and 743 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    744 571.03
## 2    743 536.63  1    34.397 47.624 1.107e-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
## -2.24610 -0.61161 -0.01617  0.60425  2.28691
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)       1.92296    0.06877  27.963  < 2e-16 ***
## mreg.tbl$FP.load  2.43386    0.22994  10.585  < 2e-16 ***
## mreg.tbl$V.load  -2.81105    0.36952  -7.607 8.48e-14 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8444 on 743 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.1623,Adjusted R-squared:   0.16
## F-statistic: 71.95 on 2 and 743 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    744 571.03
## 2    743 529.77  1    41.264 57.872 8.477e-14 ***
## ---
## 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
## -2.20655 -0.61974 -0.02833  0.62633  2.28972
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)           1.8793     0.0754  24.923  < 2e-16 ***
## mreg.tbl$FP.load      2.2807     0.2543   8.969  < 2e-16 ***
## mreg.tbl$V.load      -2.1116     0.6194  -3.409 0.000687 ***
## mreg.tbl$V.category   0.5186     0.3688   1.406 0.160004
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8438 on 742 degrees of freedom
##   (18 observations deleted due to missingness)
## Multiple R-squared:  0.1645,Adjusted R-squared:  0.1611
## F-statistic: 48.69 on 3 and 742 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    743 529.77
## 2    742 528.36  1    1.4086 1.9782   0.16

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     743 536.63
## 2     742 528.36  1     8.2754 11.622 0.0006871 ***
## ---
## 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     741 527.85
## 2     742 528.36 -1    -0.513 0.7202 0.3964

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     741 527.85
## 2     743 529.77 -2   -1.9216 1.3488 0.2602
```

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.

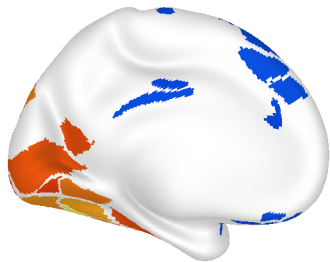ALL mean Load Quantification Score, L
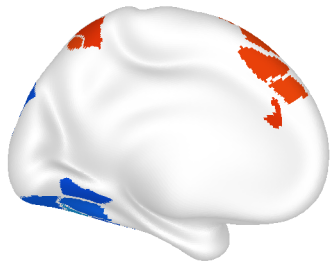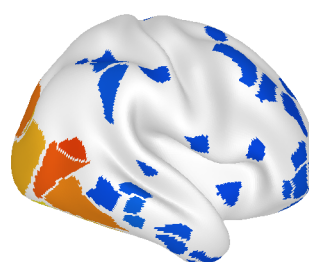
ALL mean Load Quantification Score, R
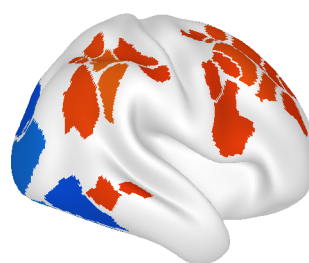
range: -0.28 to 0.163
colors: -0.5 to -0.1 & 0.1 to 0.5

range: -0.23 to 0.208
colors: -0.5 to -0.1 & 0.1 to 0.5

ALL mean Category Quantification Score, L

ALL mean Category Quantification Score, R

range: -0.143 to 0.544
colors: -0.5 to -0.1 & 0.1 to 0.5

range: -0.165 to 0.474
colors: -0.5 to -0.1 & 0.1 to 0.5

```
## [1] Number of parcels with Load > 0.1 in each Community:
## [1] CinguloOperc: 9 of 40 total.
## [1] Default: 18 of 41 total.
## [1] DorsalAttn: 20 of 32 total.
## [1] FrontoParietal: 14 of 24 total.
## [1] Salience: 2 of 4 total.
## [1] SMhand: 3 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: 10 of 41 total.
## [1] DorsalAttn: 15 of 32 total.
## [1] FrontoParietal: 12 of 24 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.
```
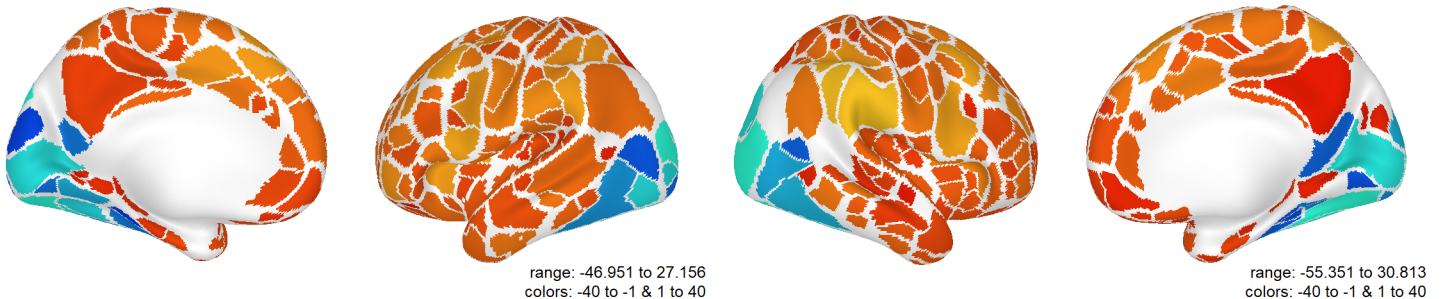
Next, we carried out the paired t-tests (for a difference between Load and Category quantification scores), as in S2.3, but on each parcel separately. The next set of images show the resulting t values of parcels with p<0.00015 (Bonferroni correction of 0.05 for 333 parcels). Following the convention 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>31.2 for Load and t<-59.1 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.

ALL t-test ts, L

ALL t-test ts, R

range: -46.951 to 27.156
colors: -40 to -1 & 1 to 40

range: -55.351 to 30.813
colors: -40 to -1 & 1 to 40

```
## [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: 40 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: 19 of 23 total.
## [1] Visual: 35 of 39 total.
```