S.1 Parcels Table

FPN34 Parcel Set

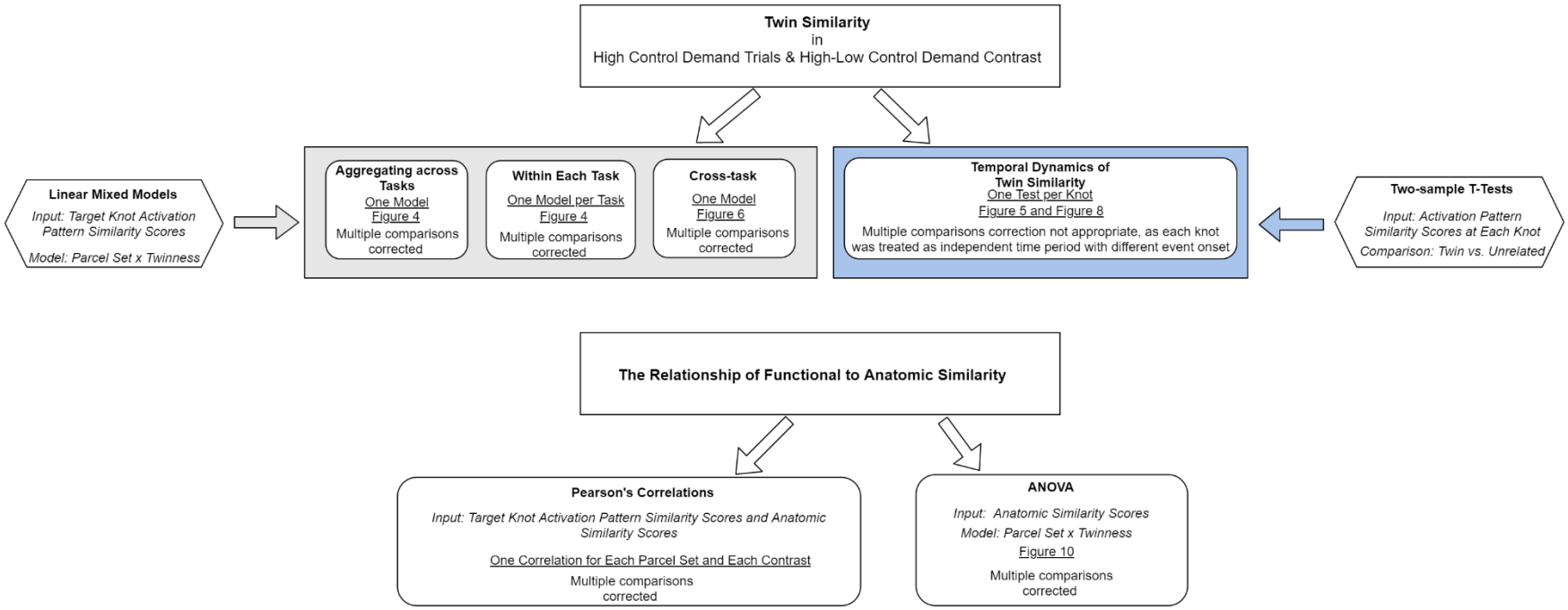
Parcel Number	Hemisphere	Network	ROI	X	Y	Z
22	Left	Visual	22	-19	-65	7
77	Left	Dorsal Attention	Post_9	-33	-46	41
78	Left	Dorsal Attention	Post_10	-29	-58	50
86	Left	Dorsal Attention	FEF_1	-40	-3	51
87	Left	Dorsal Attention	FEF_2	-25	-1	55
91	Left	Dorsal Attention	PrCv_2	-50	3	38
93	Left	Salience/Ventral Attention	ParOper_2	-58	-44	27
99	Left	Salience/Ventral Attention	FrOperIns_3	-33	25	-1
101	Left	Salience/Ventral Attention	FrOperIns_5	-33	19	8
103	Left	Salience/Ventral Attention	FrOperIns_7	-43	12	2
105	Left	Salience/Ventral Attention	FrOperIns_9	-52	9	13
107	Left	Salience/Ventral Attention	Med_1	-6	22	31
110	Left	Salience/Ventral Attention	Med_4	-5	9	48
127	Left	Control	Par_1	-29	-74	42
130	Left	Control	Par_4	-35	-62	48
139	Left	Control	PFCl_5	-42	38	22
140	Left	Control	PFCl_6	-45	20	27
144	Left	Control	pCun_1	-9	-77	45
148	Left	Control	PFCmp_1	-4	28	47
172	Left	Default	PFC_7	-48	28	0
175	Left	Default	PFC_10	-53	19	11
185	Left	Default	PFC_20	-42	7	48
189	Left	Default	PFC_24	-6	10	65
219	Right	Visual	19	9	-74	9
301	Right	Salience/Ventral Attention	PrC_1	51	3	41
303	Right	Salience/Ventral Attention	FrOperIns_2	41	8	-3
306	Right	Salience/Ventral Attention	FrOperIns_5	37	23	5
314	Right	Salience/Ventral Attention	Med_4	6	11	58
340	Right	Control	PFCv_1	34	21	-8
346	Right	Control	PFCl_6	50	30	18
347	Right	Control	PFCl_7	48	18	23
349	Right	Control	PFCl_9	47	29	28
350	Right	Control	PFCl_10	39	11	34
353	Right	Control	PFCl_13	43	7	51

NULL34 Parcel Set

Parcel Number	Hemisphere	Network	ROI	X	Y	Z
4	Left	Visual	4	-24	-55	-8
5	Left	Visual	5	-23	-73	-10
51	Left	SomatoMotor	20	-49	-17	54
72	Left	Dorsal Attention	Post_4	-48	-65	15
97	Left	Salience/Ventral Attention	FrOperIns_1	-44	5	-17
100	Left	Salience/Ventral Attention	FrOperIns_4	-40	-15	-2
121	Left	Limbic	TempPole_3	-26	-9	-33
122	Left	Limbic	TempPole_4	-54	-21	-31
123	Left	Limbic	TempPole_5	-40	-21	-27
125	Left	Limbic	TempPole_7	-32	12	-29
150	Left	Default	Temp_2	-62	-18	-21
153	Left	Default	Temp_5	-53	6	-11
174	Left	Default	PFC_9	-6	45	6
211	Right	Visual	11	9	-72	-5
221	Right	Visual	21	24	-99	7
235	Right	SomatoMotor	5	37	-8	14
244	Right	SomatoMotor	14	62	-12	15
245	Right	SomatoMotor	15	61	6	30
266	Right	SomatoMotor	36	17	-6	69
268	Right	SomatoMotor	38	5	-22	72
270	Right	SomatoMotor	40	13	-33	76
272	Right	Dorsal Attention	Post_2	59	-55	-2
279	Right	Dorsal Attention	Post_9	45	-28	42
302	Right	Salience/Ventral Attention	FrOperIns_1	40	5	-15
304	Right	Salience/Ventral Attention	FrOperIns_3	40	-10	-4
307	Right	Salience/Ventral Attention	FrOperIns_6	38	7	11
321	Right	Limbic	OFC_3	8	47	-23
323	Right	Limbic	OFC_5	5	22	-21
325	Right	Limbic	TempPole_1	28	-1	-40
326	Right	Limbic	TempPole_2	49	-7	-39
330	Right	Limbic	TempPole_6	50	-28	-26
369	Right	Default	Temp_3	47	16	-20
376	Right	Default	PFCv_2	35	38	-13
381	Right	Default	PFCdPFCm_3	7	42	4

https://github.com/ThomasYeoLab/CBIG/tree/master/stable_projects/brain_parcellation/Schaefer2018_LocalGlobal/Parcellations/

S.2 A Flowchart of Statistical Analyses for Multivariate Pattern Similarity Analyses



S.3 High Control Trials: Linear Mixed Model

LMM setup and tests of main effects and interaction.

```
## high control
head(high.tbl)# show dataframe structure

##    task control parcel.set pair.id twinness similarity
## 1 Axcpt    high      FPN34       1     twin  0.2126089
## 2 Axcpt    high      FPN34       2     twin  0.2010375
## 3 Axcpt    high      FPN34       3     twin  0.4143421
## 4 Axcpt    high      FPN34       4     twin  0.3783064
## 5 Axcpt    high      FPN34       5     twin         NA
## 6 Axcpt    high      FPN34       6     twin  0.1616736

#LMM
modelhigh<-lme(fixed=similarity~twinness*parcel.set,
                  random=list(pair.id=~1, task=~1), data=high.tbl,na.action=na.omit);
anova(modelhigh)

##                     numDF denDF  F-value p-value
## (Intercept)             1   276 736.2441  <.0001
## twinness                1    73  46.0577  <.0001
## parcel.set              1   276 471.6839  <.0001
## twinness:parcel.set     1   276  24.9393  <.0001
```

A significant interaction effect was detected, follow-up with post-hoc contrasts.

```
# post-hoc tests, correct for multiple comparisons
a<-pairs(lsmeans(modelhigh, ~ twinness | parcel.set))
b<-pairs(lsmeans(modelhigh, ~ parcel.set | twinness))
rbind(a, b, adjust="tukey")

##  parcel.set twinness  contrast         estimate      SE  df t.ratio p.value
##  NULL34     .         unrelated - twin  -0.0266 0.01055  73  -2.523 0.0463
##  FPN34      .         unrelated - twin  -0.0889 0.01055  73  -8.426 <.0001
##  .          unrelated NULL34 - FPN34    -0.1078 0.00763 276 -14.128 <.0001
##  .          twin      NULL34 - FPN34    -0.1701 0.00987 276 -17.235 <.0001
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 3.372 estimates
```

S.4 High Control Trials By Task: Linear Mixed Model

LMM setup and tests of main effects and interaction.

AX-CPT

```
## high control
head(axcpt.tbl)# show dataframe structure

##    task control parcel.set pair.id twinness similarity
## 1 Axcpt    high      FPN34       1     twin  0.2126089
## 2 Axcpt    high      FPN34       2     twin  0.2010375
## 3 Axcpt    high      FPN34       3     twin  0.4143421
## 4 Axcpt    high      FPN34       4     twin  0.3783064
## 5 Axcpt    high      FPN34       5     twin         NA
## 6 Axcpt    high      FPN34       6     twin  0.1616736

#LMM
modelax<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1), data=axcpt.tbl,na.action=na.omit);
anova(modelax)

##                     numDF denDF  F-value p-value
## (Intercept)             1    66 160.3835  <.0001
## twinness                1    66  21.9590  <.0001
## parcel.set              1    66 165.7394  <.0001
## twinness:parcel.set     1    66  17.1129   1e-04
```

A significant interaction effect was detected, follow-up with post-hoc contrasts.

```
# post-hoc tests, correct for multiple comparisons
a<-pairs(lsmeans(modelax, ~ twinness | parcel.set))
b<-pairs(lsmeans(modelax, ~ parcel.set | twinness))
rbind(a, b, adjust="tukey")

##  parcel.set twinness  contrast         estimate     SE df t.ratio p.value
##  NULL34     .         unrelated - twin  -0.0163 0.0205 66  -0.794 0.7753
##  FPN34      .         unrelated - twin  -0.1284 0.0205 66  -6.251 <.0001
##  .          unrelated NULL34 - FPN34    -0.1266 0.0168 66  -7.560 <.0001
##  .          twin      NULL34 - FPN34    -0.2387 0.0213 66 -11.212 <.0001
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 3.372 estimates
```

Cued-TS

```
## high control
head(cuedts.tbl)# show dataframe structure

##       task control parcel.set pair.id twinness similarity
## 110 Cuedts    high      FPN34       1     twin  0.3141900
## 210 Cuedts    high      FPN34       2     twin  0.2314887
## 310 Cuedts    high      FPN34       3     twin  0.2553753
## 410 Cuedts    high      FPN34       4     twin  0.2703203
## 510 Cuedts    high      FPN34       5     twin  0.3195665
## 610 Cuedts    high      FPN34       6     twin  0.1503126
```

```
#LMM
modelc<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1), data=cuedts.tbl,na.action=na.omit);
anova(modelc)

##                     numDF denDF  F-value p-value
## (Intercept)             1    73 376.8053  <.0001
## twinness                1    73  32.1907  <.0001
## parcel.set              1    73 270.3082  <.0001
## twinness:parcel.set     1    73   8.8754  0.0039
```

A significant interaction effect was detected, follow-up with post-hoc contrasts.

```
# post-hoc tests, correct for multiple comparisons
a<-pairs(lsmeans(modelc, ~ twinness | parcel.set))
b<-pairs(lsmeans(modelc, ~ parcel.set | twinness))
rbind(a, b, adjust="tukey")

##  parcel.set twinness  contrast         estimate     SE df t.ratio p.value
##  NULL34     .         unrelated - twin  -0.0524 0.0167 73  -3.145 0.0087
##  FPN34      .         unrelated - twin  -0.1063 0.0167 73  -6.382 <.0001
##  .          unrelated NULL34 - FPN34    -0.1238 0.0111 73 -11.195 <.0001
##  .          twin      NULL34 - FPN34    -0.1777 0.0143 73 -12.404 <.0001
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 3.372 estimates
```

Sternberg

```
## high control
head(stern.tbl)# show dataframe structure

##      task control parcel.set pair.id twinness  similarity
## 112 Stern    high      FPN34       1     twin  0.16884610
## 212 Stern    high      FPN34       2     twin  0.14938842
## 312 Stern    high      FPN34       3     twin  0.18802240
## 412 Stern    high      FPN34       4     twin -0.03453269
## 512 Stern    high      FPN34       5     twin  0.16604061
## 612 Stern    high      FPN34       6     twin          NA

#LMM
modelst<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1), data=stern.tbl,na.action=na.omit);
anova(modelst)

##                     numDF denDF   F-value p-value
## (Intercept)             1    64 124.61406  <.0001
## twinness                1    64   3.58063   0.063
## parcel.set              1    64  88.72655  <.0001
## twinness:parcel.set     1    64   4.58793   0.036
```

A significant interaction effect was detected, follow-up with post-hoc contrasts.

```
# post-hoc tests, correct for multiple comparisons
a<-pairs(lsmeans(modelst, ~ twinness | parcel.set))
b<-pairs(lsmeans(modelst, ~ parcel.set | twinness))
rbind(a, b, adjust="tukey")
```

```
##  parcel.set twinness  contrast         estimate     SE df t.ratio p.value
##  NULL34     .         unrelated - twin -0.00137 0.0192 64 -0.072  0.9991
##  FPN34      .         unrelated - twin -0.05428 0.0192 64 -2.827  0.0219
##  .          unrelated NULL34 - FPN34   -0.09283 0.0152 64 -6.106  <.0001
##  .          twin      NULL34 - FPN34   -0.14574 0.0195 64 -7.486  <.0001
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 3.372 estimates
```

Stroop

```
## high control
head(stroop.tbl)# show dataframe structure

##       task control parcel.set pair.id twinness  similarity
## 114 Stroop    high      FPN34       1     twin  0.26581050
## 214 Stroop    high      FPN34       2     twin  0.28225244
## 314 Stroop    high      FPN34       3     twin  0.14766637
## 414 Stroop    high      FPN34       4     twin -0.01591414
## 514 Stroop    high      FPN34       5     twin  0.31018286
## 614 Stroop    high      FPN34       6     twin  0.25863224

#LMM
modelstro<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1), data=stroop.tbl,na.action=na.omit);
anova(modelstro)

##                     numDF denDF  F-value p-value
## (Intercept)             1    67 371.6755  <.0001
## twinness                1    67  11.8195  0.0010
## parcel.set              1    67  60.1086  <.0001
## twinness:parcel.set     1    67   1.1522  0.2869
```

A significant interaction effect was not detected, suggesting the effect of twinness was similar in both parcel sets. Nevertheless, we conducted separate linear mixed models to investigate the twinness effect within each parcel set, which found twins to be greater than unrelated in pattern similarity in FPN34 but not NULL34.

```
#LMM
#FPN34
FPN34<-stroop.tbl[which(stroop.tbl$parcel.set=="FPN34"),];
modelfpn34<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=FPN34,na.action=na.omit);
summary(modelfpn34)

## Linear mixed-effects model fit by REML
##  Data: FPN34
##         AIC       BIC   logLik
##   -120.2477 -111.4289 64.12385
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
## StdDev:  0.08257397 0.03096524
##
## Fixed effects: similarity ~ twinness
##                   Value  Std.Error DF   t-value p-value
## (Intercept)  0.16293933 0.01329500 67 12.255688  0.0000
## twinnesstwin 0.06520431 0.02208731 67  2.952117  0.0043
```

```
##  Correlation:
##              (Intr)
## twinnesstwin -0.602
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -0.97171275 -0.25980282  0.00227864  0.26376166  0.72899245
##
## Number of Observations: 69
## Number of Groups: 69
```

```
#NULL34
NULL34<-stroop.tbl[which(stroop.tbl$parcel.set=="NULL34"),];
modelnull34<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=NULL34,na.action=na.omit);
summary(modelnull34)
```

```
## Linear mixed-effects model fit by REML
##  Data: NULL34
##         AIC       BIC   logLik
##   -154.2602 -145.4414 81.13009
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)  Residual
## StdDev:   0.0640632 0.0240237
##
## Fixed effects: similarity ~ twinness
##                   Value  Std.Error DF  t-value p-value
## (Intercept)  0.07635109 0.01031463 67 7.402212  0.0000
## twinnesstwin 0.03735805 0.01713595 67 2.180098  0.0328
##  Correlation:
##              (Intr)
## twinnesstwin -0.602
##
## Standardized Within-Group Residuals:
##          Min           Q1          Med           Q3          Max
## -0.930349693 -0.179647303 -0.001457457  0.251114729  0.824744220
##
## Number of Observations: 69
## Number of Groups: 69
```

S.5 Cross-task High Control Trials: Linear Mixed Model

LMM setup and tests of main effects and interaction.

```
## high control
head(high.tbl)# show dataframe structure

##   twinness parcel.set similarity pair.id
## 1     Twin      FPN34  0.1514107       1
## 2     Twin      FPN34  0.1865529       2
## 3     Twin      FPN34  0.1288416       3
## 4     Twin      FPN34  0.1480226       4
## 5     Twin      FPN34         NA       5
## 6     Twin      FPN34         NA       6

#LMM
modelhigh<-lme(fixed=similarity~twinness*parcel.set,
             random=list(pair.id=~1), data=high.tbl,na.action=na.omit);
anova(modelhigh)

##                     numDF denDF  F-value p-value
## (Intercept)             1    53 529.9198  <.0001
## twinness                1    53  31.8858  <.0001
## parcel.set              1    53 234.9413  <.0001
## twinness:parcel.set     1    53   9.3795  0.0034
```

A significant interaction effect was detected, follow-up with post-hoc contrasts.

```
# post-hoc tests, correct for multiple comparisons
a<-pairs(lsmeans(modelhigh, ~ twinness | parcel.set))
b<-pairs(lsmeans(modelhigh, ~ parcel.set | twinness))
rbind(a, b, adjust="tukey")

##  parcel.set twinness  contrast         estimate      SE df t.ratio p.value
##  FPN34      .         Unrelated - Twin  -0.0568 0.00922 53 -6.158  <.0001
##  NULL34     .         Unrelated - Twin  -0.0168 0.00922 53 -1.827  0.2085
##  .          Unrelated FPN34 - NULL34     0.0818 0.00806 53 10.159  <.0001
##  .          Twin      FPN34 - NULL34     0.1218 0.01025 53 11.879  <.0001
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 3.372 estimates
```

S.6 High-Low Control Contrast: Linear Mixed Model

LMM setup and tests of main effects and interaction.

```
## high-low control contrast
head(highlow.tbl)# show dataframe structure

##    task  control parcel.set pair.id twinness similarity
## 1 Axcpt high-low      FPN34       1     twin 0.22192699
## 2 Axcpt high-low      FPN34       2     twin 0.22422743
## 3 Axcpt high-low      FPN34       3     twin 0.27727240
## 4 Axcpt high-low      FPN34       4     twin 0.09489604
## 5 Axcpt high-low      FPN34       5     twin         NA
## 6 Axcpt high-low      FPN34       6     twin 0.19355016

#LMM
modelhighlow<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1, task=~1), data=highlow.tbl,na.action=na.omit);
anova(modelhighlow)

##                     numDF denDF   F-value p-value
## (Intercept)             1   276 160.85556  <.0001
## twinness                1    73  13.65959  0.0004
## parcel.set              1   276  95.38810  <.0001
## twinness:parcel.set     1   276   9.44518  0.0023
```

A significant interaction effect was detected, follow-up with post-hoc contrasts.

```
# post-hoc tests, correct for multiple comparisons
a<-pairs(lsmeans(modelhighlow, ~ twinness | parcel.set))
b<-pairs(lsmeans(modelhighlow, ~ parcel.set | twinness))
rbind(a, b, adjust="tukey")

##  parcel.set twinness  contrast         estimate      SE  df t.ratio p.value
##  NULL34     .         unrelated - twin -0.00425 0.00965  73 -0.440  0.9364
##  FPN34      .         unrelated - twin -0.04619 0.00965  73 -4.787  <.0001
##  .          unrelated NULL34 - FPN34   -0.04881 0.00835 276 -5.847  <.0001
##  .          twin      NULL34 - FPN34   -0.09075 0.01080 276 -8.405  <.0001
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 3.372 estimates
```

S.7 High-Low Control Contrast By Task: Linear Mixed Model

LMM setup and tests of main effects and interaction.

AX-CPT

```
## high-low control contrast
head(axcpt.tbl)# show dataframe structure

##    task  control parcel.set pair.id twinness similarity
## 1 Axcpt high-low      FPN34       1     twin 0.22192699
## 2 Axcpt high-low      FPN34       2     twin 0.22422743
## 3 Axcpt high-low      FPN34       3     twin 0.27727240
## 4 Axcpt high-low      FPN34       4     twin 0.09489604
## 5 Axcpt high-low      FPN34       5     twin         NA
## 6 Axcpt high-low      FPN34       6     twin 0.19355016

#LMM
modelax<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1), data=axcpt.tbl,na.action=na.omit);
anova(modelax)

##                     numDF denDF   F-value p-value
## (Intercept)             1    66 131.15350  <.0001
## twinness                1    66  13.98193   4e-04
## parcel.set              1    66 140.42026  <.0001
## twinness:parcel.set     1    66  17.07632   1e-04
```

A significant interaction effect was detected, follow-up with post-hoc contrasts.

```
# post-hoc tests, correct for multiple comparisons
a<-pairs(lsmeans(modelax, ~ twinness | parcel.set))
b<-pairs(lsmeans(modelax, ~ parcel.set | twinness))
rbind(a, b, adjust="tukey")

##  parcel.set twinness  contrast         estimate     SE df t.ratio p.value
##  NULL34     .         unrelated - twin -0.00139 0.0165 66  -0.084 0.9987
##  FPN34      .         unrelated - twin -0.09116 0.0165 66  -5.536 <.0001
##  .          unrelated NULL34 - FPN34   -0.09077 0.0134 66  -6.758 <.0001
##  .          twin      NULL34 - FPN34   -0.18054 0.0171 66 -10.575 <.0001
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 3.372 estimates
```

Cued-TS

```
## high-low control contrast
head(cuedts.tbl)# show dataframe structure

##       task  control parcel.set pair.id twinness  similarity
## 110 Cuedts high-low      FPN34       1     twin -0.01092737
## 210 Cuedts high-low      FPN34       2     twin -0.01508454
## 310 Cuedts high-low      FPN34       3     twin -0.01431027
## 410 Cuedts high-low      FPN34       4     twin  0.07565474
## 510 Cuedts high-low      FPN34       5     twin  0.03674998
## 610 Cuedts high-low      FPN34       6     twin  0.02490381
```

```
#LMM
modelc<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1), data=cuedts.tbl,na.action=na.omit);
anova(modelc)

##                     numDF denDF  F-value p-value
## (Intercept)             1    73 3.971081  0.0500
## twinness                1    73 3.821791  0.0544
## parcel.set              1    73 0.495905  0.4835
## twinness:parcel.set     1    73 2.394553  0.1261
```

A significant interaction effect was not detected, suggesting the effect of twinness was similar in both parcel sets. Nevertheless, we conducted separate linear mixed models to investigate the twinness effect within each parcel set, which found twins to be greater than unrelated in pattern similarity in FPN34 but not NULL34.

```
#LMM
#FPN34
FPN34<-cuedts.tbl[which(cuedts.tbl$parcel.set=="FPN34"),];
modelfpn34<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=FPN34,na.action=na.omit);
summary(modelfpn34)

## Linear mixed-effects model fit by REML
##  Data: FPN34
##       AIC       BIC logLik
##   -165.86 -156.6982  86.93
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
## StdDev:  0.06556306 0.02458615
##
## Fixed effects: similarity ~ twinness
##                    Value  Std.Error DF   t-value p-value
## (Intercept)  -0.00655381 0.01021367 73 -0.641671  0.5231
## twinnesstwin  0.03718724 0.01671604 73  2.224644  0.0292
##  Correlation:
##              (Intr)
## twinnesstwin -0.611
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -1.11796735 -0.20742430  0.03067154  0.20286372  0.90541617
##
## Number of Observations: 75
## Number of Groups: 75

#NULL34
NULL34<-cuedts.tbl[which(cuedts.tbl$parcel.set=="NULL34"),];
modelnull34<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=NULL34,na.action=na.omit);
summary(modelnull34)

## Linear mixed-effects model fit by REML
##  Data: NULL34
##         AIC      BIC   logLik
##   -203.3658 -194.204 105.6829
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
```

```
## StdDev:  0.05071001 0.01901625
##
## Fixed effects: similarity ~ twinness
##                    Value   Std.Error DF   t-value p-value
## (Intercept)  0.011762555 0.007899802 73 1.4889684  0.1408
## twinnesstwin 0.006323043 0.012929085 73 0.4890557  0.6263
##  Correlation:
##              (Intr)
## twinnesstwin -0.611
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -0.62702351 -0.25992652 -0.00663448  0.23055008  1.10516447
##
## Number of Observations: 75
## Number of Groups: 75
```

Sternberg

```
## high-low control contrast
head(stern.tbl)# show dataframe structure

##      task  control parcel.set pair.id twinness   similarity
## 112 Stern high-low      FPN34       1     twin  0.071160403
## 212 Stern high-low      FPN34       2     twin -0.002437876
## 312 Stern high-low      FPN34       3     twin -0.016845013
## 412 Stern high-low      FPN34       4     twin  0.028872827
## 512 Stern high-low      FPN34       5     twin -0.006765266
## 612 Stern high-low      FPN34       6     twin           NA

#LMM
modelst<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1), data=stern.tbl,na.action=na.omit);
anova(modelst)

##                     numDF denDF   F-value p-value
## (Intercept)             1    64 13.405395  0.0005
## twinness                1    64  0.337403  0.5634
## parcel.set              1    64  5.388711  0.0235
## twinness:parcel.set     1    64  0.186014  0.6677
```

A significant interaction effect was not detected, suggesting the effect of twinness was similar in both parcel sets. Nevertheless, we conducted separate linear mixed models to investigate the twinness effect within each parcel set, which found twins to be numerically (did not reach significance) greater than unrelated in pattern similarity in FPN34 but not NULL34.

```
#LMM
#FPN34
FPN34<-stern.tbl[which(stern.tbl$parcel.set=="FPN34"),];
modelfpn34<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=FPN34,na.action=na.omit);
summary(modelfpn34)

## Linear mixed-effects model fit by REML
##  Data: FPN34
##        AIC       BIC   logLik
##   -132.564 -123.9284 70.28199
##
```

```
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
## StdDev:  0.07157263 0.02683975
##
## Fixed effects: similarity ~ twinness
##                   Value  Std.Error DF   t-value p-value
## (Intercept)  0.02903827 0.01193786 64 2.4324513  0.0178
## twinnesstwin 0.01166911 0.01939673 64 0.6016021  0.5496
##  Correlation:
##              (Intr)
## twinnesstwin -0.615
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -0.85144692 -0.17858105 -0.02150301  0.22226323  0.82060541
##
## Number of Observations: 66
## Number of Groups: 66

#NULL34
NULL34<-stern.tbl[which(stern.tbl$parcel.set=="NULL34"),];
modelnull34<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=NULL34,na.action=na.omit);
summary(modelnull34)

## Linear mixed-effects model fit by REML
##  Data: NULL34
##         AIC       BIC   logLik
##   -189.1392 -180.5036 98.56958
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
## StdDev:  0.04600358 0.01725134
##
## Fixed effects: similarity ~ twinness
##                    Value   Std.Error DF   t-value p-value
## (Intercept)  0.006840681 0.007673105 64 0.8915141  0.3760
## twinnesstwin 0.001724395 0.012467320 64 0.1383132  0.8904
##  Correlation:
##              (Intr)
## twinnesstwin -0.615
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -0.73604293 -0.18656899 -0.01703464  0.20353289  0.94910970
##
## Number of Observations: 66
## Number of Groups: 66
```

Stroop

```
## high-low control contrast
head(stroop.tbl)# show dataframe structure

##       task  control parcel.set pair.id twinness similarity
## 114 Stroop high-low      FPN34       1     twin 0.09222377
## 214 Stroop high-low      FPN34       2     twin 0.10709531
```

```
## 314 Stroop high-low      FPN34       3     twin 0.11660831
## 414 Stroop high-low      FPN34       4     twin 0.05962269
## 514 Stroop high-low      FPN34       5     twin 0.14659129
## 614 Stroop high-low      FPN34       6     twin 0.10822541

#LMM
modelstro<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1), data=stroop.tbl,na.action=na.omit);
anova(modelstro)

##                     numDF denDF   F-value p-value
## (Intercept)             1    67 121.50445  <.0001
## twinness                1    67   4.11842  0.0464
## parcel.set              1    67  88.96339  <.0001
## twinness:parcel.set     1    67   2.12619  0.1495
```

A significant interaction effect was not detected, suggesting the effect of twinness was similar in both parcel sets. Nevertheless, we conducted separate linear mixed models to investigate the twinness effect within each parcel set, which found twins to be greater than unrelated in pattern similarity in FPN34 but not NULL34.

```
#LMM
#FPN34
FPN34<-stroop.tbl[which(stroop.tbl$parcel.set=="FPN34"),];
modelfpn34<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=FPN34,na.action=na.omit);
summary(modelfpn34)

## Linear mixed-effects model fit by REML
##  Data: FPN34
##         AIC       BIC   logLik
##   -134.1663 -125.3475 71.08315
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
## StdDev:  0.07442741 0.02791028
##
## Fixed effects: similarity ~ twinness
##                   Value  Std.Error DF  t-value p-value
## (Intercept)  0.11256618 0.01198334 67 9.393553  0.0000
## twinnesstwin 0.04581656 0.01990823 67 2.301388  0.0245
##  Correlation:
##              (Intr)
## twinnesstwin -0.602
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -0.86669674 -0.22155923  0.03806681  0.24063412  0.81330833
##
## Number of Observations: 69
## Number of Groups: 69

#NULL34
NULL34<-stroop.tbl[which(stroop.tbl$parcel.set=="NULL34"),];
modelnull34<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=NULL34,na.action=na.omit);
summary(modelnull34)

## Linear mixed-effects model fit by REML
##  Data: NULL34
##        AIC       BIC   logLik
```

```
##   -154.176 -145.3572 81.08799
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)  Residual
## StdDev:  0.06410346 0.0240388
##
## Fixed effects: similarity ~ twinness
##                    Value  Std.Error DF   t-value p-value
## (Intercept)  0.007326753 0.01032111 67 0.7098801  0.4802
## twinnesstwin 0.007504566 0.01714672 67 0.4376677  0.6630
##  Correlation:
##              (Intr)
## twinnesstwin -0.602
##
## Standardized Within-Group Residuals:
##          Min           Q1          Med           Q3          Max
## -1.304457487 -0.179731382 -0.000765695  0.205306758  0.757457138
##
## Number of Observations: 69
## Number of Groups: 69
```

One sample t-tests

We examined whether similarity scores in cued-ts and sternberg tasks are significantly greater than zero.

```
#cued-ts
FPN34<-cuedts.tbl[which(cuedts.tbl$parcel.set=="FPN34"),];

twin<-FPN34[which(FPN34$twinness=="twin"),];
t.test(twin$similarity, mu = 0, alternative = "greater");
```

```
##
##  One Sample t-test
##
## data:  twin$similarity
## t = 2.5077, df = 27, p-value = 0.009234
## alternative hypothesis: true mean is greater than 0
## 95 percent confidence interval:
##  0.009826314         Inf
## sample estimates:
##  mean of x
## 0.03063343
```

```
#sternberg
FPN34<-stern.tbl[which(stern.tbl$parcel.set=="FPN34"),];

twin<-FPN34[which(FPN34$twinness=="twin"),];
t.test(twin$similarity, mu = 0, alternative = "greater");
```

```
##
##  One Sample t-test
##
## data:  twin$similarity
## t = 2.5465, df = 24, p-value = 0.008858
## alternative hypothesis: true mean is greater than 0
## 95 percent confidence interval:
##  0.0133575       Inf
## sample estimates:
##  mean of x
## 0.04070738
```

S.8 High Control Trials (FPN vs. SOMA): Linear Mixed Model

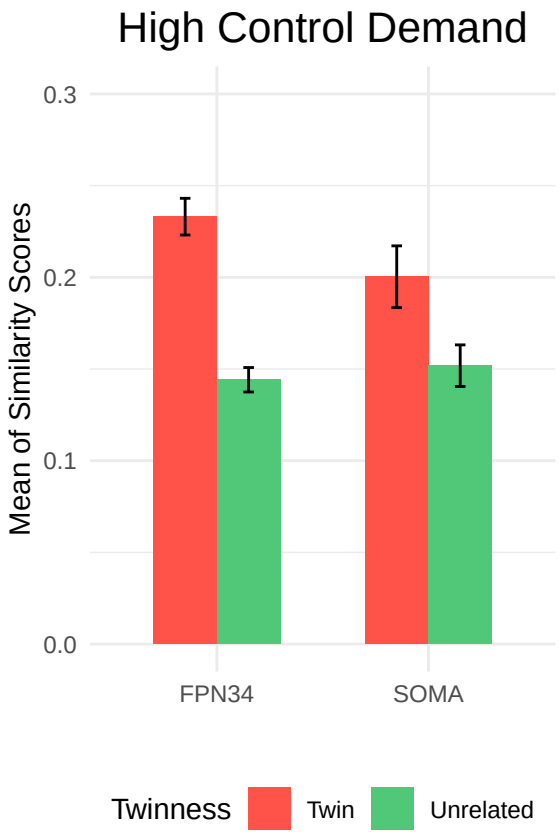
LMM setup and tests of main effects and interaction.

```
## high control
head(high.tbl)# show dataframe structure

##    task control parcel.set pair.id twinness similarity
## 1 Axcpt    high      FPN34       1     twin  0.2126089
## 2 Axcpt    high      FPN34       2     twin  0.2010375
## 3 Axcpt    high      FPN34       3     twin  0.4143421
## 4 Axcpt    high      FPN34       4     twin  0.3783064
## 5 Axcpt    high      FPN34       5     twin         NA
## 6 Axcpt    high      FPN34       6     twin  0.1616736

#LMM
modelhigh<-lme(fixed=similarity~twinness*parcel.set,
                  random=list(pair.id=~1, task=~1), data=high.tbl,na.action=na.omit);
anova(modelhigh)

##                     numDF denDF  F-value p-value
## (Intercept)             1   276 794.3845  <.0001
## twinness                1    73  29.1130  <.0001
## parcel.set              1   276   0.6109  0.4351
## twinness:parcel.set     1   276   4.2044  0.0413
```

A significant interaction effect was detected, follow-up with post-hoc contrasts.

```
# post-hoc tests, correct for multiple comparisons
a<-pairs(lsmeans(modelhigh, ~ twinness | parcel.set))
b<-pairs(lsmeans(modelhigh, ~ parcel.set | twinness))
rbind(a, b, adjust="tukey")

##  parcel.set twinness  contrast         estimate     SE  df t.ratio p.value
##  SOMA       .         unrelated - twin -0.04850 0.0161  73 -3.011  0.0128
##  FPN34      .         unrelated - twin -0.08893 0.0161  73 -5.522  <.0001
##  .          unrelated SOMA - FPN34      0.00767 0.0121 276  0.636  0.8576
##  .          twin      SOMA - FPN34     -0.03277 0.0156 276 -2.100  0.1147
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 3.372 estimates
```

Figure S1: Means of Similarity Scores of High Control Demand Trials



Linear Mixed Model by Task

AX-CPT

```
## high control
head(axcpt.tbl)# show dataframe structure

##    task control parcel.set pair.id twinness similarity
## 1 Axcpt    high      FPN34       1     twin  0.2126089
## 2 Axcpt    high      FPN34       2     twin  0.2010375
## 3 Axcpt    high      FPN34       3     twin  0.4143421
## 4 Axcpt    high      FPN34       4     twin  0.3783064
## 5 Axcpt    high      FPN34       5     twin         NA
## 6 Axcpt    high      FPN34       6     twin  0.1616736

#LMM
modelax<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1), data=axcpt.tbl,na.action=na.omit);
anova(modelax)

##                     numDF denDF   F-value p-value
## (Intercept)             1    66 124.35636  <.0001
## twinness                1    66  10.93095  0.0015
## parcel.set              1    66  98.32166  <.0001
## twinness:parcel.set     1    66  20.27971  <.0001
```

A significant interaction effect was detected, follow-up with post-hoc contrasts.

```
# post-hoc tests, correct for multiple comparisons
a<-pairs(lsmeans(modelax, ~ twinness | parcel.set))
b<-pairs(lsmeans(modelax, ~ parcel.set | twinness))
rbind(a, b, adjust="tukey")

##  parcel.set twinness  contrast         estimate     SE df t.ratio p.value
##  SOMA       .         unrelated - twin  -0.0206 0.0255 66 -0.807  0.7678
##  FPN34      .         unrelated - twin  -0.1284 0.0255 66 -5.032  <.0001
##  .          unrelated SOMA - FPN34      -0.0741 0.0148 66 -5.008  <.0001
##  .          twin      SOMA - FPN34      -0.1819 0.0188 66 -9.671  <.0001
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 3.372 estimates
```

Cued-TS

```
## high control
head(cuedts.tbl)# show dataframe structure

##       task control parcel.set pair.id twinness similarity
## 110 Cuedts    high      FPN34       1     twin  0.3141900
## 210 Cuedts    high      FPN34       2     twin  0.2314887
## 310 Cuedts    high      FPN34       3     twin  0.2553753
## 410 Cuedts    high      FPN34       4     twin  0.2703203
## 510 Cuedts    high      FPN34       5     twin  0.3195665
## 610 Cuedts    high      FPN34       6     twin  0.1503126

#LMM
modelc<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1), data=cuedts.tbl,na.action=na.omit);
anova(modelc)
```

```
##                     numDF denDF  F-value p-value
## (Intercept)             1    73 440.7674  <.0001
## twinness                1    73  30.6060  <.0001
## parcel.set              1    73  40.3760  <.0001
## twinness:parcel.set     1    73   1.6273  0.2061
```

A significant interaction effect was not detected, suggesting the effect of twinness was similar in both parcel sets. Nevertheless, we conducted separate linear mixed models to investigate the twinness effect within each parcel set, which found twins to be greater than unrelated in pattern similarity in both FPN34 and SOMA, but the twin similarity was greater in FPN34 than in SOMA.

```
#LMM
#FPN34
FPN34<-cuedts.tbl[which(cuedts.tbl$parcel.set=="FPN34"),];
modelfpn34<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=FPN34,na.action=na.omit);
summary(modelfpn34)

## Linear mixed-effects model fit by REML
##  Data: FPN34
##         AIC      BIC   logLik
##   -153.5998 -144.438 80.79992
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)  Residual
## StdDev:  0.07130641 0.0267399
##
## Fixed effects: similarity ~ twinness
##                  Value  Std.Error DF   t-value p-value
## (Intercept)  0.1635911 0.01110839 73 14.726804       0
## twinnesstwin 0.1063093 0.01818037 73  5.847478       0
##  Correlation:
##              (Intr)
## twinnesstwin -0.611
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -0.99337334 -0.24750964 -0.03277698  0.24105245  0.70983450
##
## Number of Observations: 75
## Number of Groups: 75

#SOMA
SOMA<-cuedts.tbl[which(cuedts.tbl$parcel.set=="SOMA"),];
modelSOMA<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=SOMA,na.action=na.omit);
summary(modelSOMA)

## Linear mixed-effects model fit by REML
##  Data: SOMA
##         AIC      BIC   logLik
##   -127.6628 -118.501 67.83142
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
## StdDev:  0.08516894 0.03193835
##
## Fixed effects: similarity ~ twinness
##                   Value  Std.Error DF  t-value p-value
```

```
## (Intercept)  0.10579980 0.01326795 73 7.974089   0e+00
## twinnesstwin 0.07792431 0.02171478 73 3.588538   6e-04
##  Correlation:
##              (Intr)
## twinnesstwin -0.611
##
## Standardized Within-Group Residuals:
##          Min           Q1          Med           Q3          Max
## -0.863644910 -0.189778584  0.008220879  0.234065690  0.777880061
##
## Number of Observations: 75
## Number of Groups: 75
```

Sternberg

```
## high control
head(stern.tbl)# show dataframe structure

##      task control parcel.set pair.id twinness  similarity
## 112 Stern    high      FPN34       1     twin  0.16884610
## 212 Stern    high      FPN34       2     twin  0.14938842
## 312 Stern    high      FPN34       3     twin  0.18802240
## 412 Stern    high      FPN34       4     twin -0.03453269
## 512 Stern    high      FPN34       5     twin  0.16604061
## 612 Stern    high      FPN34       6     twin          NA

#LMM
modelst<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1), data=stern.tbl,na.action=na.omit);
anova(modelst)

##                     numDF denDF   F-value p-value
## (Intercept)             1    64 167.33704  <.0001
## twinness                1    64   6.75683  0.0116
## parcel.set              1    64  13.08766  0.0006
## twinness:parcel.set     1    64   0.32751  0.5691
```

A significant interaction effect was not detected, suggesting the effect of twinness was similar in both parcel sets. Nevertheless, we conducted separate linear mixed models to investigate the twinness effect within each parcel set, which found twins to be greater than unrelated in pattern similarity in FPN34 but not SOMA.

```
#LMM
#FPN34
FPN34<-stern.tbl[which(stern.tbl$parcel.set=="FPN34"),];
modelfpn34<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=FPN34,na.action=na.omit);
summary(modelfpn34)

## Linear mixed-effects model fit by REML
##  Data: FPN34
##         AIC       BIC   logLik
##   -108.8915 -100.2559 58.44574
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
## StdDev:  0.08611247 0.03229217
##
```

```
## Fixed effects: similarity ~ twinness
##                   Value  Std.Error DF  t-value p-value
## (Intercept)  0.11551219 0.01436301 64 8.042338  0.0000
## twinnesstwin 0.05428494 0.02333713 64 2.326119  0.0232
##  Correlation:
##              (Intr)
## twinnesstwin -0.615
##
## Standardized Within-Group Residuals:
##          Min           Q1          Med           Q3          Max
## -0.840114452 -0.221813487 -0.008986425  0.219279620  0.782977214
##
## Number of Observations: 66
## Number of Groups: 66

#SOMA
SOMA<-stern.tbl[which(stern.tbl$parcel.set=="SOMA"),];
modelSOMA<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=SOMA,na.action=na.omit);
summary(modelSOMA)

## Linear mixed-effects model fit by REML
##  Data: SOMA
##         AIC       BIC   logLik
##   -119.6493 -111.0138 63.82465
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
## StdDev:  0.07917089 0.02968908
##
## Fixed effects: similarity ~ twinness
##                   Value  Std.Error DF t-value p-value
## (Intercept)  0.07407748 0.01320520 64 5.60972  0.0000
## twinnesstwin 0.03886846 0.02145591 64 1.81155  0.0747
##  Correlation:
##              (Intr)
## twinnesstwin -0.615
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -0.67433858 -0.19616805 -0.04917016  0.22740790  0.88390574
##
## Number of Observations: 66
## Number of Groups: 66
```

Stroop

```
## high control
head(stroop.tbl)# show dataframe structure

##       task control parcel.set pair.id twinness  similarity
## 114 Stroop    high      FPN34       1     twin  0.26581050
## 214 Stroop    high      FPN34       2     twin  0.28225244
## 314 Stroop    high      FPN34       3     twin  0.14766637
## 414 Stroop    high      FPN34       4     twin -0.01591414
## 514 Stroop    high      FPN34       5     twin  0.31018286
## 614 Stroop    high      FPN34       6     twin  0.25863224
```

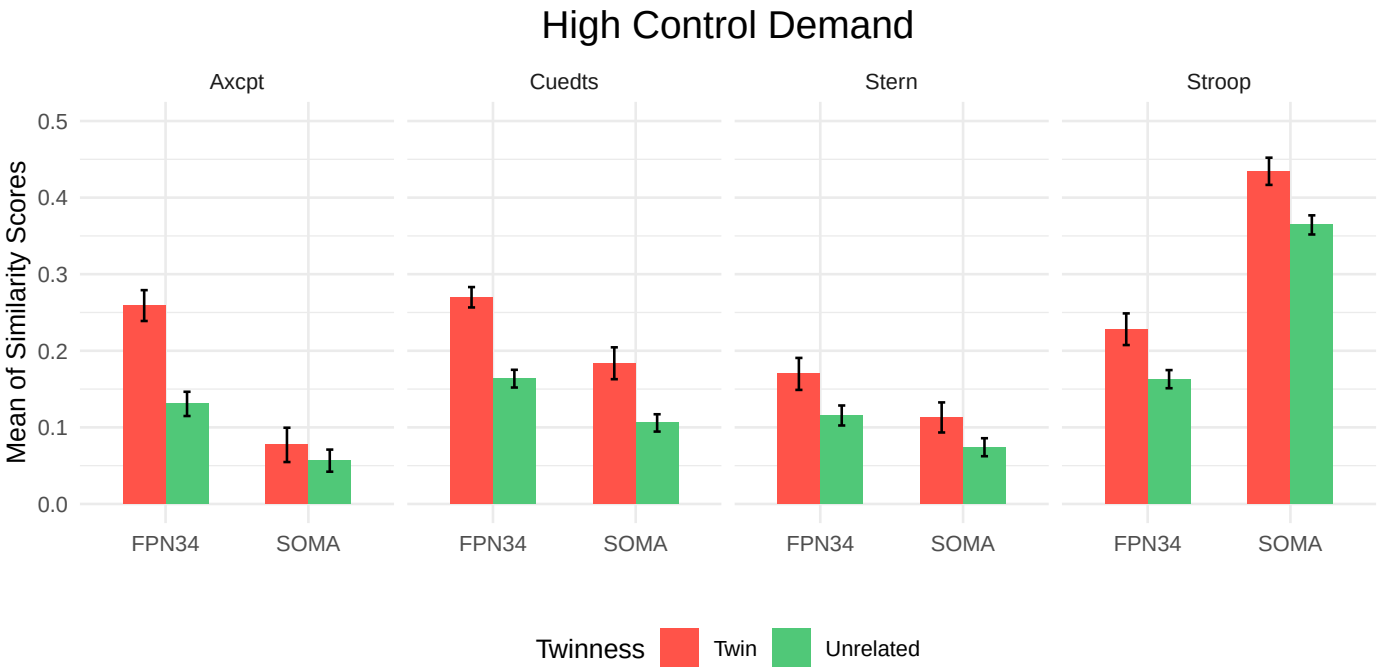
```
#LMM
modelstro<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1), data=stroop.tbl,na.action=na.omit);
anova(modelstro)

##                     numDF denDF   F-value p-value
## (Intercept)             1    67 1161.9055  <.0001
## twinness                1    67   14.7810  0.0003
## parcel.set              1    67  276.3771  <.0001
## twinness:parcel.set     1    67    0.0359  0.8503
```

A significant interaction effect was not detected, suggesting the effect of twinness was similar in both parcel sets. Nevertheless, we conducted separate linear mixed models to investigate the twinness effect within each parcel set, which found twins to be greater than unrelated in pattern similarity in both FPN34 and SOMA. The twin similarity was greather in SOMA than in FPN34, likely due to the task being vocal, which could activate the somatomotor network.

```
#LMM
#FPN34
FPN34<-stroop.tbl[which(stroop.tbl$parcel.set=="FPN34"),];
modelfpn34<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=FPN34,na.action=na.omit);
summary(modelfpn34)

## Linear mixed-effects model fit by REML
##  Data: FPN34
##         AIC       BIC   logLik
##   -120.2477 -111.4289 64.12385
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
## StdDev:  0.08257397 0.03096524
##
## Fixed effects: similarity ~ twinness
##                   Value  Std.Error DF   t-value p-value
## (Intercept)  0.16293933 0.01329500 67 12.255688  0.0000
## twinnesstwin 0.06520431 0.02208731 67  2.952117  0.0043
##  Correlation:
##              (Intr)
## twinnesstwin -0.602
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -0.97171275 -0.25980282  0.00227864  0.26376166  0.72899245
##
## Number of Observations: 69
## Number of Groups: 69

#SOMA
SOMA<-stroop.tbl[which(stroop.tbl$parcel.set=="SOMA"),];
modelSOMA<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=SOMA,na.action=na.omit);
summary(modelSOMA)

## Linear mixed-effects model fit by REML
##  Data: SOMA
##        AIC       BIC logLik
##   -125.082 -116.2632 66.541
##
## Random effects:
##  Formula: ~1 | pair.id
```

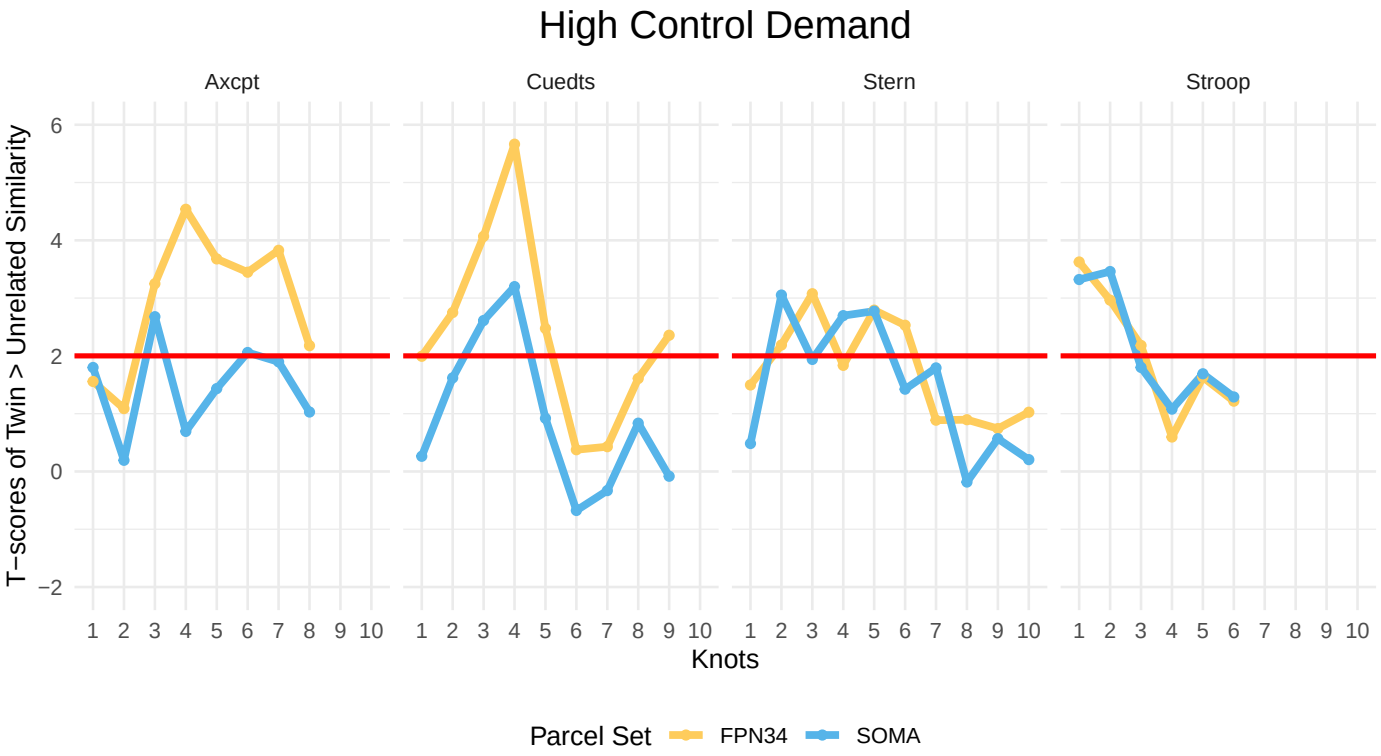
```
##         (Intercept)   Residual
## StdDev:  0.07964806 0.02986802
##
## Fixed effects: similarity ~ twinness
##                  Value  Std.Error DF   t-value p-value
## (Intercept)  0.3643525 0.01282391 67 28.411976  0.0000
## twinnesstwin 0.0700209 0.02130467 67  3.286647  0.0016
##  Correlation:
##              (Intr)
## twinnesstwin -0.602
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -0.73868409 -0.21054018 -0.01581984  0.24143702  0.98950687
##
## Number of Observations: 69
## Number of Groups: 69
```

Figure S2: Means of Similarity Scores of High Control Demand Trials by Tasks



Timecourse Analyses

Target knot: AX-CPT - 4, CuedTS - 4, Sternberg - 6, Stroop - 2.
Figure S3: Temporal Dynamics of Difference in Pattern Similarity (Twin greater than Unrelated) in High Control Demand Trials



S.8.1 Cross-task Twin Similarity Analyses (FPN vs. SOMA)

Linear Mixed Model: Cross-task Twin Similarity

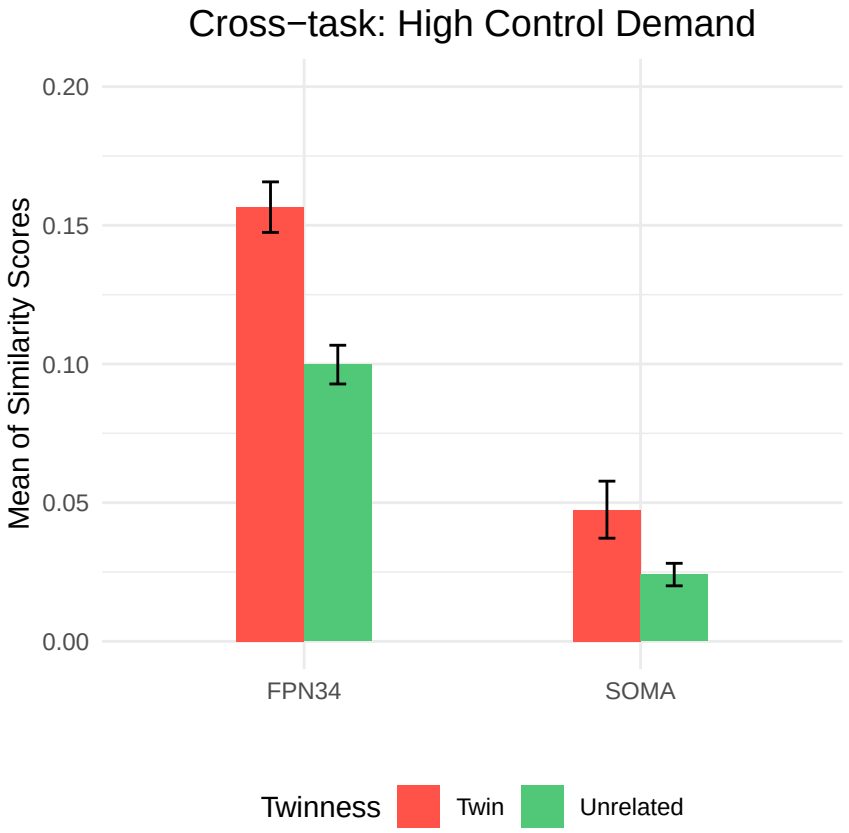
LMM setup and tests of main effects and interaction.

```
## high control
head(high.tbl)# show dataframe structure

##   twinness parcel.set similarity pair.id
## 1     Twin      FPN34  0.1514107       1
## 2     Twin      FPN34  0.1865529       2
## 3     Twin      FPN34  0.1288416       3
## 4     Twin      FPN34  0.1480226       4
## 5     Twin      FPN34         NA       5
## 6     Twin      FPN34         NA       6

#LMM
modelhigh<-lme(fixed=similarity~twinness*parcel.set,
             random=list(pair.id=~1), data=high.tbl,na.action=na.omit);
anova(modelhigh)

##                     numDF denDF  F-value p-value
## (Intercept)             1    53 377.4074  <.0001
## twinness                1    53  24.3404  <.0001
## parcel.set              1    51 196.5124  <.0001
## twinness:parcel.set     1    51   6.6820  0.0126
```

A significant interaction effect was detected, follow-up with post-hoc contrasts.

```
# post-hocb tests, correct for multiple comparisons
a<-pairs(lsmeans(modelhigh, ~ twinness | parcel.set))
b<-pairs(lsmeans(modelhigh, ~ parcel.set | twinness))
rbind(a, b, adjust="tukey")

##  parcel.set twinness  contrast         estimate      SE df t.ratio p.value
##  FPN34      .         Twin - Unrelated   0.0568 0.01043 53  5.442  <.0001
##  SOMA       .         Twin - Unrelated   0.0232 0.01064 51  2.185  0.1044
##  .          Twin      FPN34 - SOMA       0.1090 0.01022 51 10.667  <.0001
##  .          Unrelated FPN34 - SOMA       0.0755 0.00799 51  9.456  <.0001
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 3.372 estimates
```

Figure S4: Mean (and Standard Error of the Mean) of Cross-task Similarity Scores in High Control Demand Trials



S.9 High-Low Control Contrast (FPN vs. SOMA): Linear Mixed Model

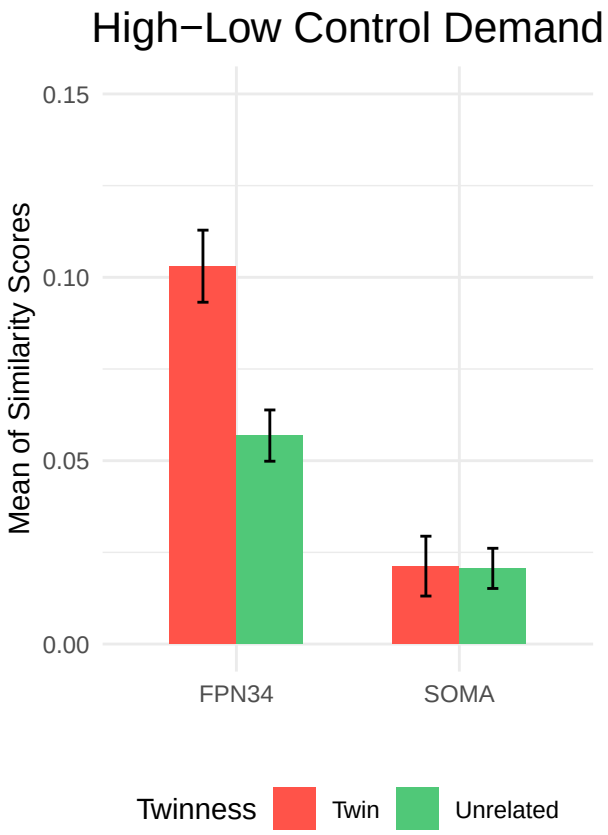
LMM setup and tests of main effects and interaction.

```
## high-low control contrast
head(highlow.tbl)# show dataframe structure

##    task  control parcel.set pair.id twinness similarity
## 1 Axcpt high-low      FPN34       1     twin 0.22192699
## 2 Axcpt high-low      FPN34       2     twin 0.22422743
## 3 Axcpt high-low      FPN34       3     twin 0.27727240
## 4 Axcpt high-low      FPN34       4     twin 0.09489604
## 5 Axcpt high-low      FPN34       5     twin         NA
## 6 Axcpt high-low      FPN34       6     twin 0.19355016

#LMM
modelhighlow<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1, task=~1), data=highlow.tbl,na.action=na.omit);
anova(modelhighlow)

##                     numDF denDF   F-value p-value
## (Intercept)             1   276 137.87737  <.0001
## twinness                1    73   7.83842  0.0065
## parcel.set              1   276  67.60575  <.0001
## twinness:parcel.set     1   276  11.59102  0.0008
```

A significant interaction effect was detected, follow-up with post-hoc contrasts.

```
# post-hoc tests, correct for multiple comparisons
a<-pairs(lsmeans(modelhighlow, ~ twinness | parcel.set))
b<-pairs(lsmeans(modelhighlow, ~ parcel.set | twinness))
rbind(a, b, adjust="tukey")

##  parcel.set twinness  contrast          estimate      SE  df t.ratio p.value
##  SOMA       .         unrelated - twin -0.000617 0.01071  73 -0.058  0.9995
##  FPN34      .         unrelated - twin -0.046190 0.01071  73 -4.313  0.0002
##  .          unrelated SOMA - FPN34     -0.036209 0.00819 276 -4.423  0.0001
##  .          twin      SOMA - FPN34     -0.081783 0.01059 276 -7.723  <.0001
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 3.372 estimates
```

Figure S1: Means of Similarity Scores of High-Low Control Demand Contrast



Linear Mixed Model by Task

AX-CPT

```
## high control
head(axcpt.tbl)# show dataframe structure

##    task  control parcel.set pair.id twinness similarity
## 1 Axcpt high-low      FPN34       1     twin 0.22192699
## 2 Axcpt high-low      FPN34       2     twin 0.22422743
## 3 Axcpt high-low      FPN34       3     twin 0.27727240
## 4 Axcpt high-low      FPN34       4     twin 0.09489604
## 5 Axcpt high-low      FPN34       5     twin         NA
## 6 Axcpt high-low      FPN34       6     twin 0.19355016

#LMM
modelax<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1), data=axcpt.tbl,na.action=na.omit);
anova(modelax)

##                     numDF denDF  F-value p-value
## (Intercept)             1    66 95.52929  <.0001
## twinness                1    66  5.99310  0.0170
## parcel.set              1    66 88.77291  <.0001
## twinness:parcel.set     1    66 17.44160  0.0001
```

A significant interaction effect was detected, follow-up with post-hoc contrasts.

```
# post-hoc tests, correct for multiple comparisons
a<-pairs(lsmeans(modelax, ~ twinness | parcel.set))
b<-pairs(lsmeans(modelax, ~ parcel.set | twinness))
rbind(a, b, adjust="tukey")

##  parcel.set twinness  contrast         estimate     SE df t.ratio p.value
##  SOMA       .         unrelated - twin   0.0165 0.0200 66  0.829  0.7553
##  FPN34      .         unrelated - twin  -0.0912 0.0200 66 -4.567  0.0001
##  .          unrelated SOMA - FPN34      -0.0769 0.0159 66 -4.822  <.0001
##  .          twin      SOMA - FPN34      -0.1846 0.0203 66 -9.108  <.0001
##
## Degrees-of-freedom method: containment
## P value adjustment: tukey method for comparing a family of 3.372 estimates
```

Cued-TS

```
## high control
head(cuedts.tbl)# show dataframe structure

##       task  control parcel.set pair.id twinness  similarity
## 110 Cuedts high-low      FPN34       1     twin -0.01092737
## 210 Cuedts high-low      FPN34       2     twin -0.01508454
## 310 Cuedts high-low      FPN34       3     twin -0.01431027
## 410 Cuedts high-low      FPN34       4     twin  0.07565474
## 510 Cuedts high-low      FPN34       5     twin  0.03674998
## 610 Cuedts high-low      FPN34       6     twin  0.02490381

#LMM
modelc<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1), data=cuedts.tbl,na.action=na.omit);
anova(modelc)
```

```
##                     numDF denDF   F-value p-value
## (Intercept)             1    73 0.4144325  0.5217
## twinness                1    73 2.2985697  0.1338
## parcel.set              1    73 0.2713249  0.6040
## twinness:parcel.set     1    73 1.8630504  0.1765
```

A significant interaction effect was not detected, suggesting the effect of twinness was similar in both parcel sets. Nevertheless, we conducted separate linear mixed models to investigate the twinness effect within each parcel set, which found twins to be greater than unrelated in pattern similarity in FPN34 but not SOMA.

```
#LMM
#FPN34
FPN34<-cuedts.tbl[which(cuedts.tbl$parcel.set=="FPN34"),];
modelfpn34<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=FPN34,na.action=na.omit);
summary(modelfpn34)

## Linear mixed-effects model fit by REML
##  Data: FPN34
##       AIC       BIC logLik
##   -165.86 -156.6982  86.93
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
## StdDev:  0.06556306 0.02458615
##
## Fixed effects: similarity ~ twinness
##                    Value  Std.Error DF   t-value p-value
## (Intercept)  -0.00655381 0.01021367 73 -0.641671  0.5231
## twinnesstwin  0.03718724 0.01671604 73  2.224644  0.0292
##  Correlation:
##              (Intr)
## twinnesstwin -0.611
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -1.11796735 -0.20742430  0.03067154  0.20286372  0.90541617
##
## Number of Observations: 75
## Number of Groups: 75

#SOMA
SOMA<-cuedts.tbl[which(cuedts.tbl$parcel.set=="SOMA"),];
modelSOMA<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=SOMA,na.action=na.omit);
summary(modelSOMA)

## Linear mixed-effects model fit by REML
##  Data: SOMA
##        AIC       BIC  logLik
##   -141.211 -132.0492 74.6055
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
## StdDev:  0.07762125 0.02910799
##
## Fixed effects: similarity ~ twinness
##                     Value  Std.Error DF    t-value p-value
## (Intercept)  -0.000959378 0.01209214 73 -0.0793390   0.937
```

```
## twinnesstwin  0.007547396 0.01979041 73  0.3813664   0.704
##  Correlation:
##              (Intr)
## twinnesstwin -0.611
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -1.13226203 -0.20241626  0.02582711  0.17028844  0.89314363
##
## Number of Observations: 75
## Number of Groups: 75
```

Sternberg

```
## high control
head(stern.tbl)# show dataframe structure

##      task  control parcel.set pair.id twinness   similarity
## 112 Stern high-low      FPN34       1     twin  0.071160403
## 212 Stern high-low      FPN34       2     twin -0.002437876
## 312 Stern high-low      FPN34       3     twin -0.016845013
## 412 Stern high-low      FPN34       4     twin  0.028872827
## 512 Stern high-low      FPN34       5     twin -0.006765266
## 612 Stern high-low      FPN34       6     twin           NA

#LMM
modelst<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1), data=stern.tbl,na.action=na.omit);
anova(modelst)

##                     numDF denDF   F-value p-value
## (Intercept)             1    64 18.805525  0.0001
## twinness                1    64  0.006445  0.9363
## parcel.set              1    64  1.340225  0.2513
## twinness:parcel.set     1    64  0.858732  0.3576
```

A significant interaction effect was not detected, suggesting the effect of twinness was similar in both parcel sets. Nevertheless, we conducted separate linear mixed models to investigate the twinness effect within each parcel set, which found twins to be numerically greater than unrelated in pattern similarity in FPN34 but not SOMA.

```
#LMM
#FPN34
FPN34<-stern.tbl[which(stern.tbl$parcel.set=="FPN34"),];
modelfpn34<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=FPN34,na.action=na.omit);
summary(modelfpn34)

## Linear mixed-effects model fit by REML
##  Data: FPN34
##        AIC       BIC   logLik
##   -132.564 -123.9284 70.28199
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
## StdDev:  0.07157263 0.02683975
##
## Fixed effects: similarity ~ twinness
```

```
##                   Value  Std.Error DF   t-value p-value
## (Intercept)  0.02903827 0.01193786 64 2.4324513  0.0178
## twinnesstwin 0.01166911 0.01939673 64 0.6016021  0.5496
##  Correlation:
##              (Intr)
## twinnesstwin -0.615
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -0.85144692 -0.17858105 -0.02150301  0.22226323  0.82060541
##
## Number of Observations: 66
## Number of Groups: 66

#SOMA
SOMA<-stern.tbl[which(stern.tbl$parcel.set=="SOMA"),];
modelSOMA<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=SOMA,na.action=na.omit);
summary(modelSOMA)

## Linear mixed-effects model fit by REML
##  Data: SOMA
##         AIC       BIC   logLik
##   -167.7507 -159.1152 87.87536
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
## StdDev:   0.0543702 0.02038883
##
## Fixed effects: similarity ~ twinness
##                     Value   Std.Error DF    t-value p-value
## (Intercept)   0.024203843 0.009068605 64  2.6689710  0.0096
## twinnesstwin -0.009607314 0.014734739 64 -0.6520179  0.5167
##  Correlation:
##              (Intr)
## twinnesstwin -0.615
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -0.64869038 -0.23403145 -0.02622715  0.23413728  0.98687773
##
## Number of Observations: 66
## Number of Groups: 66
```

Stroop

```
## high control
head(stroop.tbl)# show dataframe structure

##       task  control parcel.set pair.id twinness similarity
## 114 Stroop high-low      FPN34       1     twin 0.09222377
## 214 Stroop high-low      FPN34       2     twin 0.10709531
## 314 Stroop high-low      FPN34       3     twin 0.11660831
## 414 Stroop high-low      FPN34       4     twin 0.05962269
## 514 Stroop high-low      FPN34       5     twin 0.14659129
## 614 Stroop high-low      FPN34       6     twin 0.10822541

#LMM
```

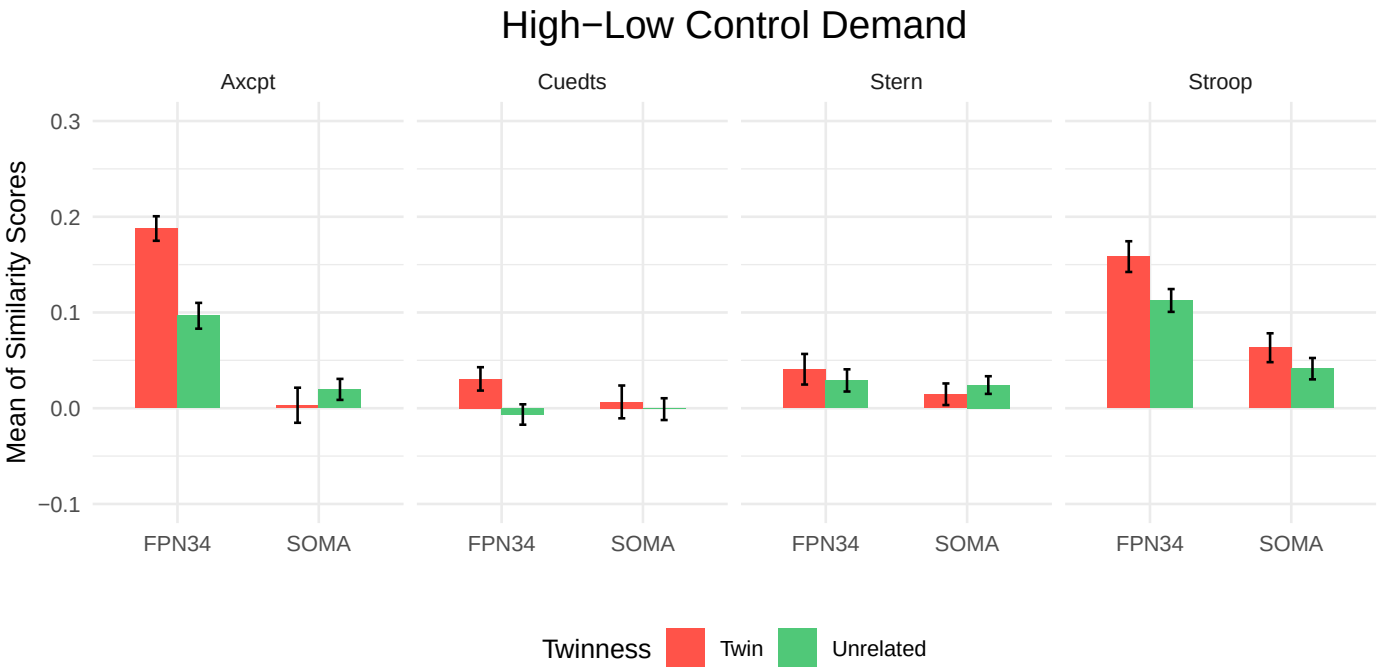
```
modelstro<-lme(fixed=similarity~twinness*parcel.set,
    random=list(pair.id=~1), data=stroop.tbl,na.action=na.omit);
anova(modelstro)

##                     numDF denDF   F-value p-value
## (Intercept)             1    67 163.50350  <.0001
## twinness                1    67   5.44075  0.0227
## parcel.set              1    67  42.80105  <.0001
## twinness:parcel.set     1    67   0.88621  0.3499
```

A significant interaction effect was not detected, suggesting the effect of twinness was similar in both parcel sets. Nevertheless, we conducted separate linear mixed models to investigate the twinness effect within each parcel set, which found twins to be greater than unrelated in pattern similarity in FPN34 but not SOMA.

```
#LMM
#FPN34
FPN34<-stroop.tbl[which(stroop.tbl$parcel.set=="FPN34"),];
modelfpn34<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=FPN34,na.action=na.omit);
summary(modelfpn34)

## Linear mixed-effects model fit by REML
##  Data: FPN34
##         AIC       BIC   logLik
##   -134.1663 -125.3475 71.08315
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
## StdDev:  0.07442741 0.02791028
##
## Fixed effects: similarity ~ twinness
##                   Value  Std.Error DF  t-value p-value
## (Intercept)  0.11256618 0.01198334 67 9.393553  0.0000
## twinnesstwin 0.04581656 0.01990823 67 2.301388  0.0245
##  Correlation:
##              (Intr)
## twinnesstwin -0.602
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -0.86669674 -0.22155923  0.03806681  0.24063412  0.81330833
##
## Number of Observations: 69
## Number of Groups: 69

#SOMA
SOMA<-stroop.tbl[which(stroop.tbl$parcel.set=="SOMA"),];
modelSOMA<-lme(fixed=similarity~twinness,
    random=list(pair.id=~1), data=SOMA,na.action=na.omit);
summary(modelSOMA)

## Linear mixed-effects model fit by REML
##  Data: SOMA
##         AIC       BIC   logLik
##   -142.8922 -134.0735 75.44612
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)  Residual
## StdDev:  0.06973521 0.0261507
```

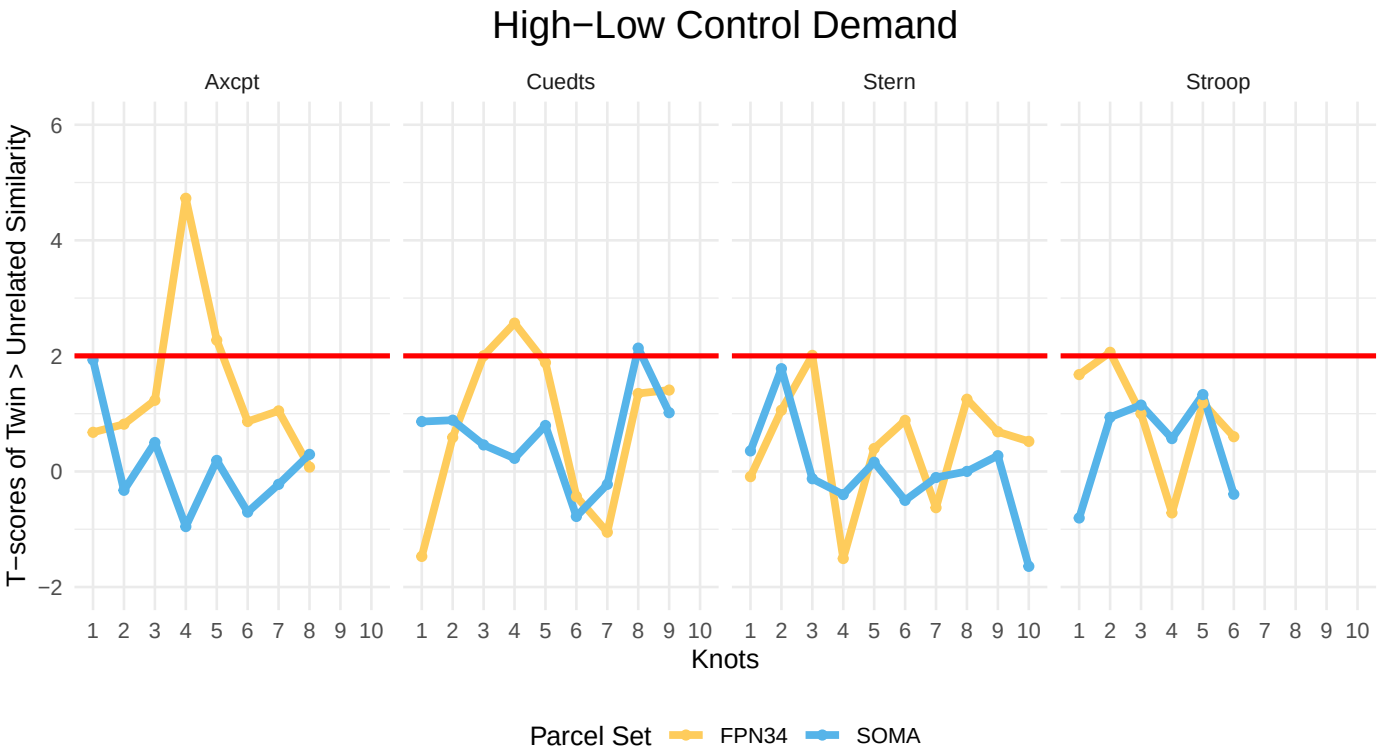
```
##
## Fixed effects: similarity ~ twinness
##                   Value  Std.Error DF  t-value p-value
## (Intercept)  0.04130912 0.01122787 67 3.679160  0.0005
## twinnesstwin 0.02188983 0.01865313 67 1.173521  0.2447
##  Correlation:
##              (Intr)
## twinnesstwin -0.602
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -0.93275835 -0.20831455 -0.02920394  0.14552634  0.88986996
##
## Number of Observations: 69
## Number of Groups: 69
```

Figure S2: Means of Similarity Scores of High-Low Control Demand Contrast by Tasks



Timecourse Analyses

Target knot: AX-CPT - 4, CuedTS - 4, Sternberg - 6, Stroop - 2.
Figure S3: Temporal Dynamics of Difference in Pattern Similarity (Twin greater than Unrelated) in High-Low Control Demand Contrast



S.9.1 Cross-task Twin Similarity Analyses (FPN vs. SOMA)

Linear Mixed Model: Cross-task Twin Similarity

LMM setup and tests of main effects and interaction.

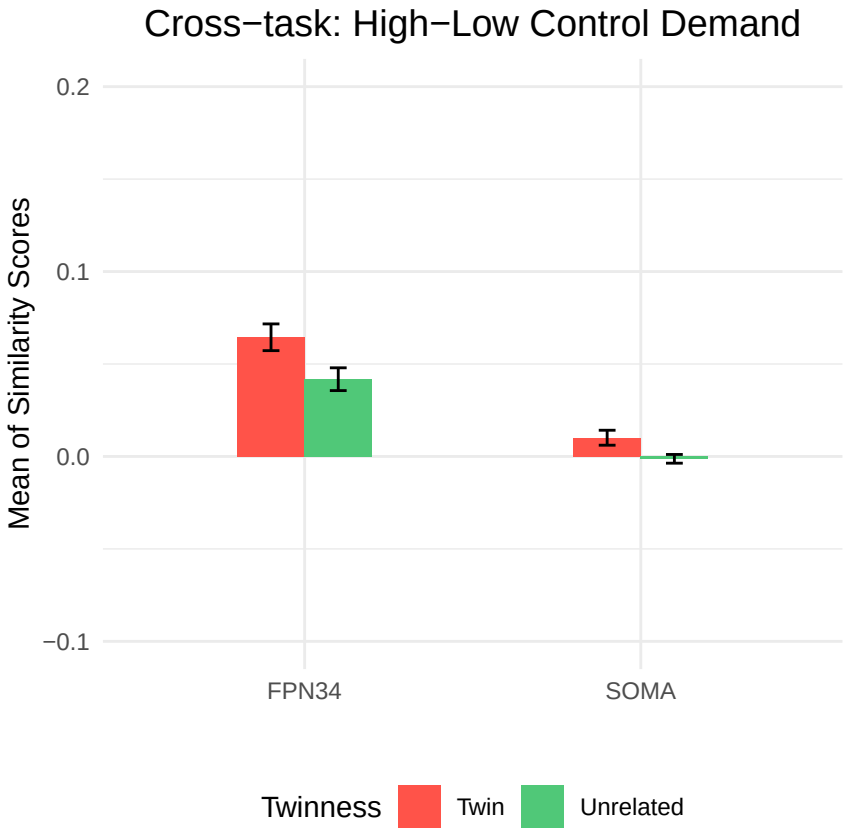
```
## high-low control
head(highlow.tbl)# show dataframe structure

##   twinness parcel.set  similarity pair.id
## 1     Twin      FPN34  0.06915955       1
## 2     Twin      FPN34  0.04661796       2
## 3     Twin      FPN34  0.06656048       3
## 4     Twin      FPN34 -0.01363391       4
## 5     Twin      FPN34          NA       5
## 6     Twin      FPN34          NA       6

modelhighlow<-lme(fixed=similarity~twinness*parcel.set,
                  random=list(pair.id=~1), data=highlow.tbl,na.action=na.omit);
anova(modelhighlow)

##                     numDF denDF   F-value p-value
## (Intercept)             1    53 100.17220  <.0001
## twinness                1    53   9.60565  0.0031
## parcel.set              1    51  89.59749  <.0001
## twinness:parcel.set     1    51   1.21043  0.2764
```

A signicant interaction effect was not detected, suggesting the effect of twinness was similar in both parcel sets. Nevertheless, we conducted separate linear mixed models to investigate the twinness effect within each parcel set, which found twins to be greater than unrelated in pattern similarity in FPN34 but also slightly in SOMA. However, we conducted a one-sample t-test to see if the simialrity scores of unrelated pairs in the SOMA parcel set was statistically significant (greater than or less than zero). Not surprisingly, we did not detect a statistical significance, suggesting that although there was a statistical significant difference between unrelated and twins similarity scores in the SOMA parcel set, the difference was not meaningful.

```
# post-hocb tests, correct for multiple comparisons

#FPN34
FPN34<-highlow.tbl[which(highlow.tbl$parcel.set=="FPN34"),];
modelfpn34<-lme(fixed=similarity~twinness,
                random=list(pair.id=~1), data=FPN34,na.action=na.omit);
summary(modelfpn34)

## Linear mixed-effects model fit by REML
##  Data: FPN34
##         AIC       BIC   logLik
##   -190.6963 -182.8151 99.34816
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
## StdDev:  0.03267289 0.01225233
##
## Fixed effects: similarity ~ twinness
##                   Value   Std.Error DF  t-value p-value
## (Intercept)  0.04178084 0.005984384 53 6.981644   0.000
## twinnessTwin 0.02267284 0.009684812 53 2.341072   0.023
##  Correlation:
##              (Intr)
## twinnessTwin -0.618
```

```
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -0.78574738 -0.26599147 -0.06519345  0.22040238  0.84434902
##
## Number of Observations: 55
## Number of Groups: 55

#SOMA
SOMA<-highlow.tbl[which(highlow.tbl$parcel.set=="SOMA"),];
modelSOMA<-lme(fixed=similarity~twinness,
                random=list(pair.id=~1), data=SOMA,na.action=na.omit);
summary(modelSOMA)

## Linear mixed-effects model fit by REML
##  Data: SOMA
##         AIC       BIC   logLik
##   -266.4745 -258.7472 137.2373
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)    Residual
## StdDev:  0.01441764 0.005406616
##
## Fixed effects: similarity ~ twinness
##                    Value   Std.Error DF    t-value p-value
## (Intercept)  -0.00128371 0.002680456 51 -0.4789149  0.6340
## twinnessTwin  0.01141506 0.004363466 51  2.6160534  0.0117
##  Correlation:
##              (Intr)
## twinnessTwin -0.614
##
## Standardized Within-Group Residuals:
##        Min         Q1        Med         Q3        Max
## -0.6581265 -0.2177218  0.0132187  0.1675449  1.2093107
##
## Number of Observations: 53
## Number of Groups: 53

# one- sample t-test
new<-SOMA[SOMA$twinness=="Unrelated",]
t.test(new$similarity, mu = 0, alternative = "two.sided")

##
##  One Sample t-test
##
## data:  new$similarity
## t = -0.54422, df = 32, p-value = 0.5901
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -0.006088477  0.003521057
## sample estimates:
##   mean of x
## -0.00128371
```

Figure S4: Mean (and Standard Error of the Mean) of Cross-task Similarity Scores in High-Low Control Demand Contrast



S.10 Cross-task High-Low Control Contrast: Linear Mixed Model

LMM setup and tests of main effects and interaction.

```
## high control
head(highlow.tbl)# show dataframe structure

##   twinness parcel.set  similarity pair.id
## 1     Twin      FPN34  0.06915955       1
## 2     Twin      FPN34  0.04661796       2
## 3     Twin      FPN34  0.06656048       3
## 4     Twin      FPN34 -0.01363391       4
## 5     Twin      FPN34          NA       5
## 6     Twin      FPN34          NA       6

#LMM
modelhighlow<-lme(fixed=similarity~twinness*parcel.set,
            random=list(pair.id=~1), data=highlow.tbl,na.action=na.omit);
anova(modelhighlow)

##                     numDF denDF   F-value p-value
## (Intercept)             1    53 102.80212  <.0001
## twinness                1    53   5.06662  0.0286
## parcel.set              1    53  80.77735  <.0001
## twinness:parcel.set     1    53   3.70074  0.0598
```

A signicant interaction effect was not detected, suggesting the effect of twinness was similar in both parcel sets. Nevertheless, we conducted separate linear mixed models to investigate the twinness effect within each parcel set, which found twins to be greater than unrelated in pattern similarity in FPN34 but not NULL34.

```
#FPN34
FPN34<-highlow.tbl[which(highlow.tbl$parcel.set=="FPN34"),];
modelfpn34<-lme(fixed=similarity~twinness,
               random=list(pair.id=~1), data=FPN34,na.action=na.omit);
summary(modelfpn34)

## Linear mixed-effects model fit by REML
##  Data: FPN34
##         AIC       BIC   logLik
##   -190.6963 -182.8151 99.34816
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)   Residual
## StdDev:  0.03267289 0.01225233
##
## Fixed effects: similarity ~ twinness
##                   Value   Std.Error DF  t-value p-value
## (Intercept)  0.04178084 0.005984384 53 6.981644   0.000
## twinnessTwin 0.02267284 0.009684812 53 2.341072   0.023
##  Correlation:
##              (Intr)
## twinnessTwin -0.618
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -0.78574738 -0.26599147 -0.06519345  0.22040238  0.84434902
##
## Number of Observations: 55
## Number of Groups: 55

#NULL34
```

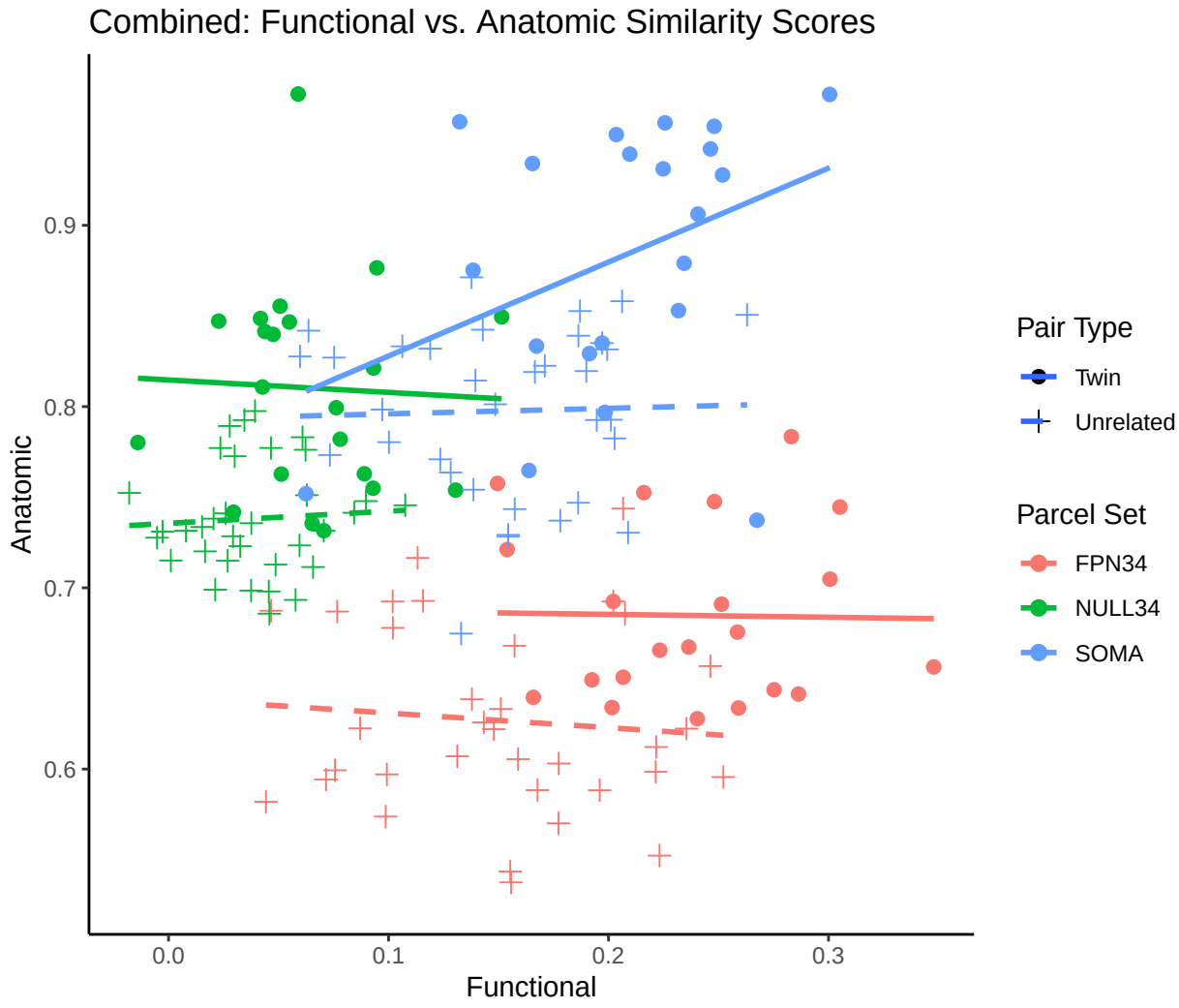
```r
NULL34<-highlow.tbl[which(highlow.tbl$parcel.set=="NULL34"),];
modelNULL34<-lme(fixed=similarity~twinness,
               random=list(pair.id=~1), data=NULL34,na.action=na.omit);
summary(modelNULL34)
```

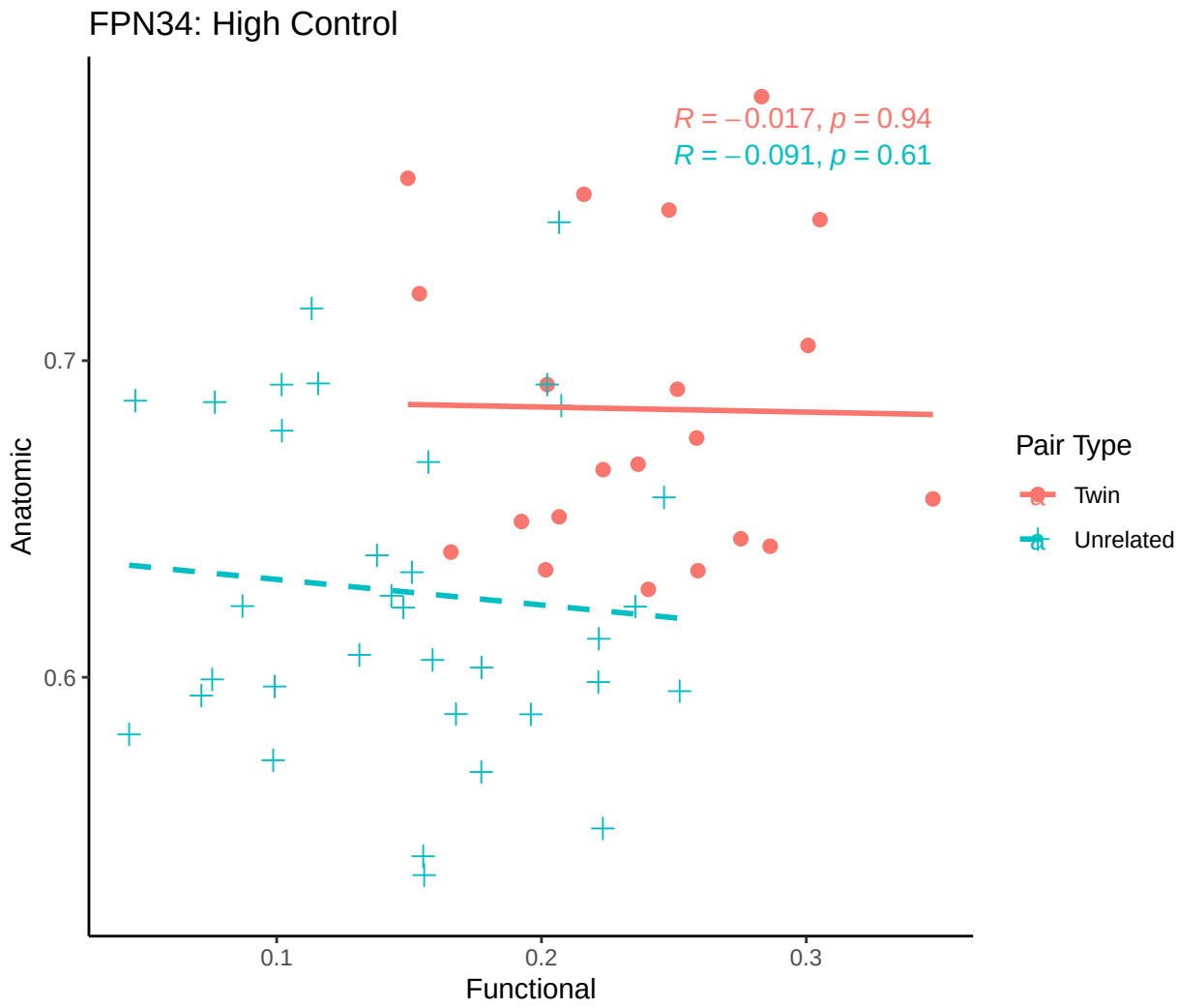
```
## Linear mixed-effects model fit by REML
##  Data: NULL34
##         AIC      BIC   logLik
##   -263.5772 -255.696 135.7886
##
## Random effects:
##  Formula: ~1 | pair.id
##         (Intercept)    Residual
## StdDev:  0.01642805 0.006160514
##
## Fixed effects: similarity ~ twinness
##                    Value   Std.Error DF   t-value p-value
## (Intercept)  0.003723423 0.003008971 53 1.2374404  0.2214
## twinnessTwin 0.002515092 0.004869560 53 0.5164926  0.6077
##  Correlation:
##              (Intr)
## twinnessTwin -0.618
##
## Standardized Within-Group Residuals:
##          Min           Q1          Med           Q3          Max
## -0.783123268 -0.241948998 -0.000522601  0.200125098  0.929234203
##
## Number of Observations: 55
## Number of Groups: 55
```

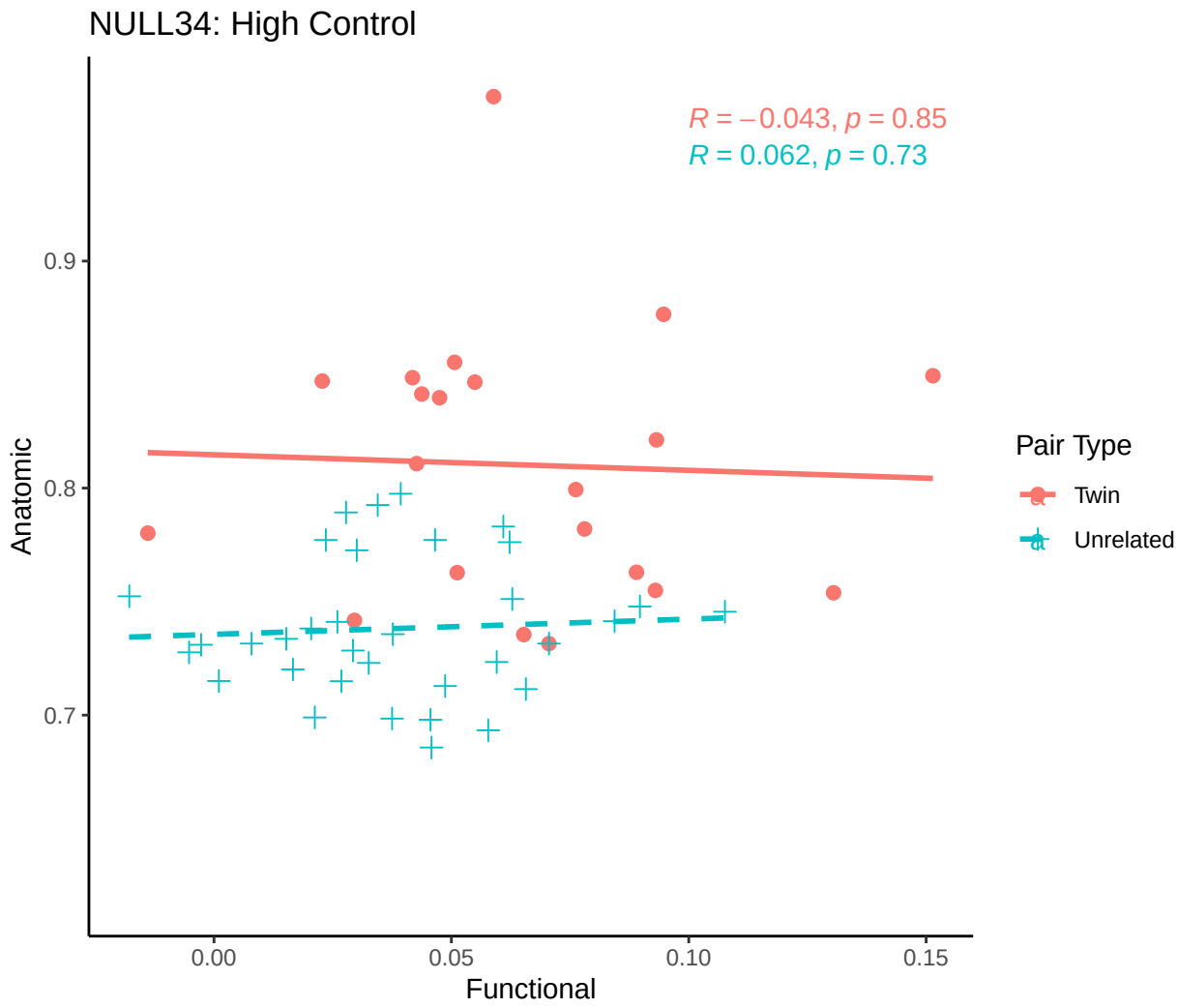
S.11 Correlation of Functional Similarity and Anatomic Similarity Scores

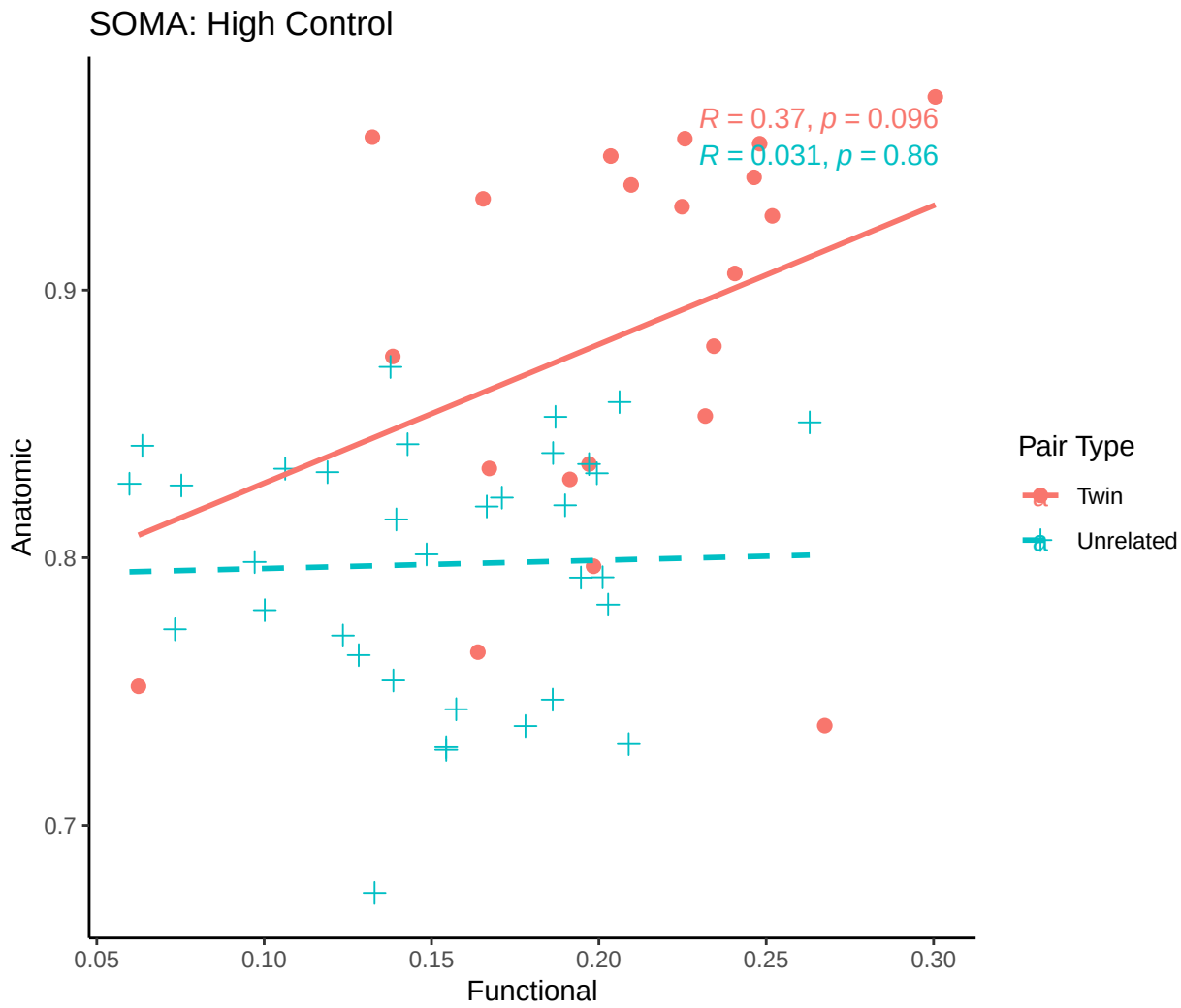
Correlating each pair's functional similarity scores with its anatomic similarity scores, expecting no meaningful correlations for twin pairs.

High Control

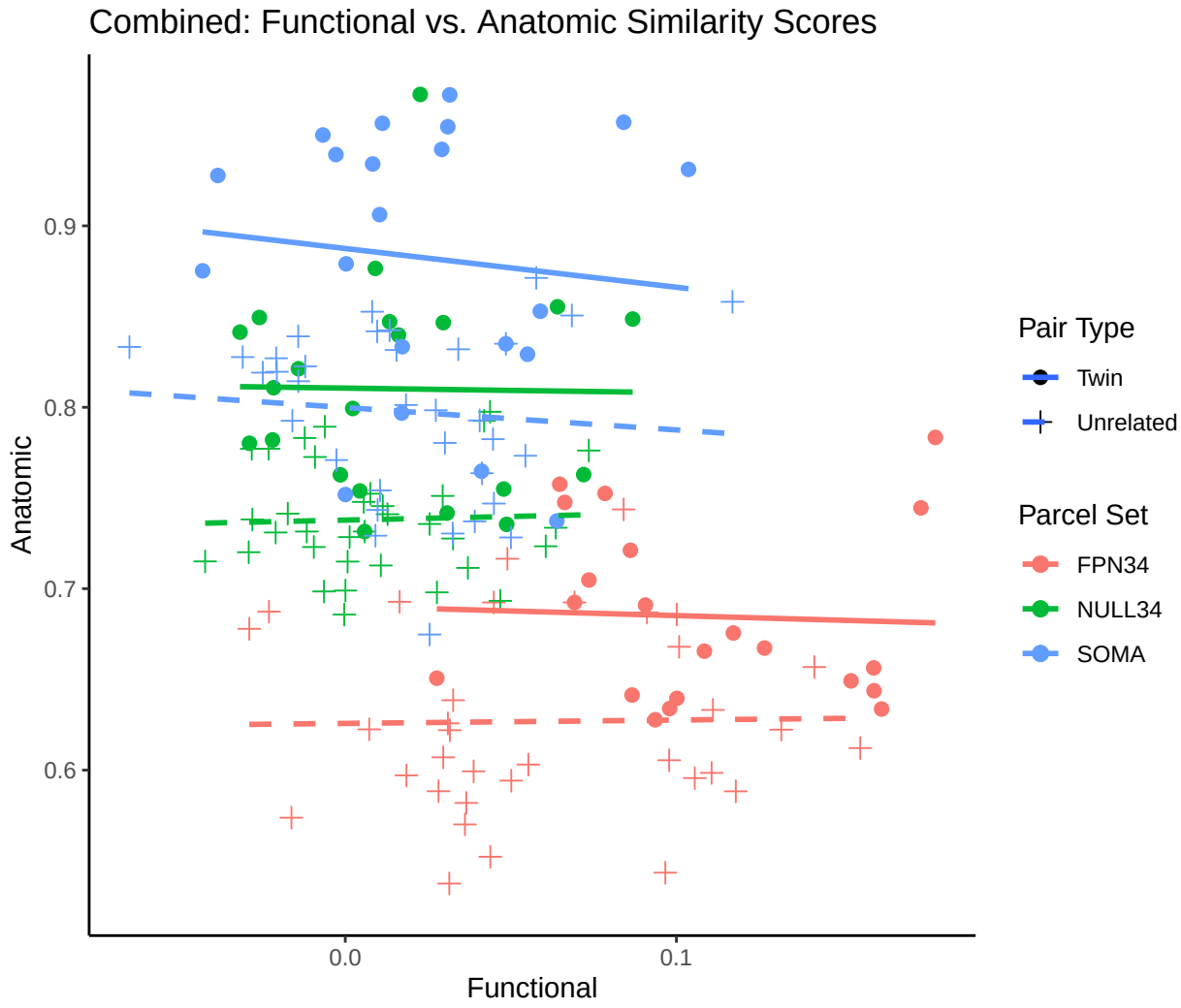


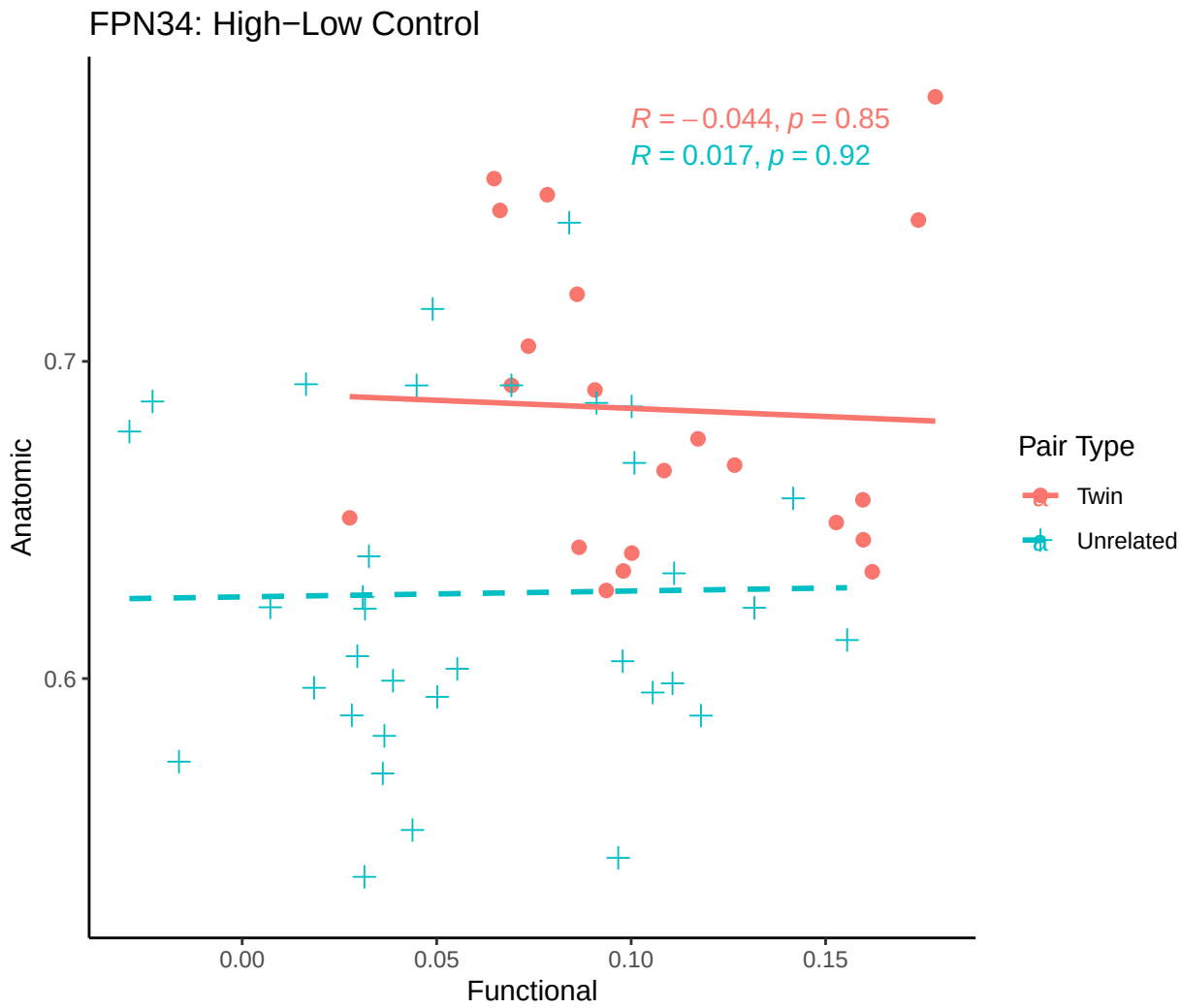

FPN34: High Control
R = −0.017, p = 0.94
R = −0.091, p = 0.61
Anatomic
0.7
0.6
0.1
0.2
0.3
Functional
Pair Type
Twin
Unrelated

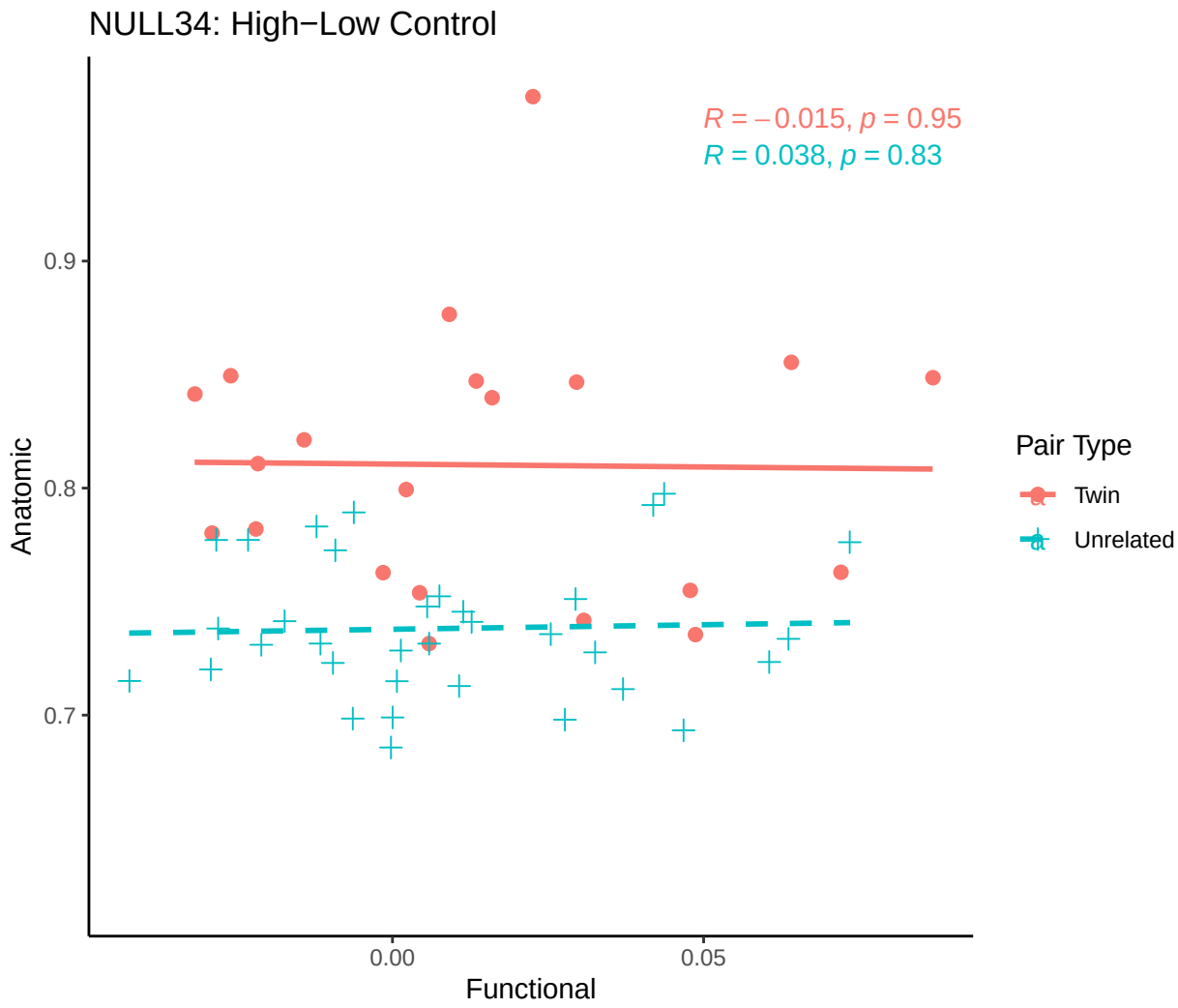

NULL34: High Control
R = −0.043, p = 0.85
R = 0.062, p = 0.73
Anatomic
0.9
0.8
0.7
0.00
0.05
0.10
0.15
Functional
Pair Type
Twin
Unrelated

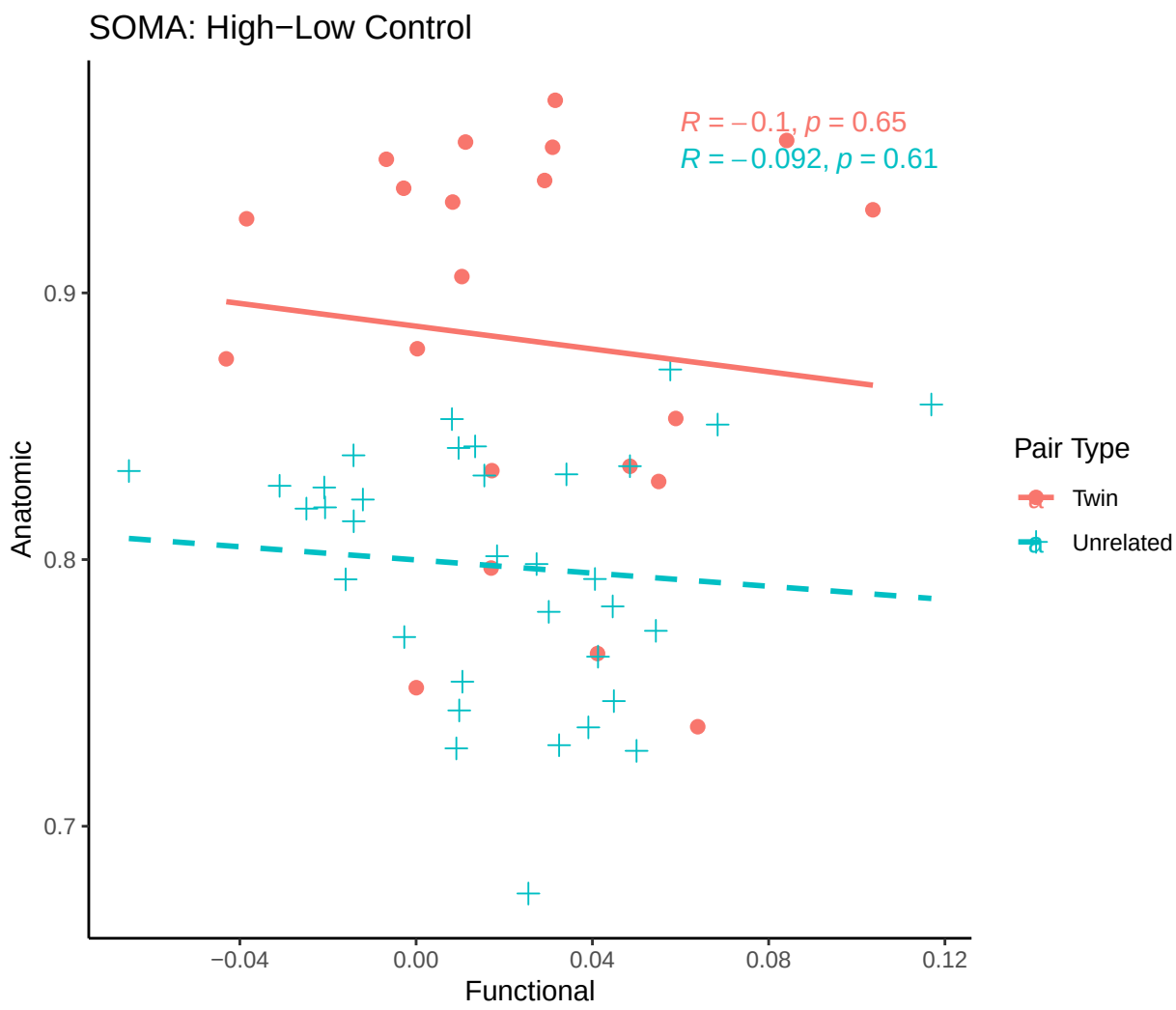

SOMA: High Control
R = 0.37, p = 0.096
R = 0.031, p = 0.86
Anatomic
0.9
0.8
0.7
0.05
0.10
0.15
0.20
0.25
0.30
Functional
Pair Type
Twin
Unrelated

High-Low Control




FPN34: High−Low Control
R = −0.044, p = 0.85
R = 0.017, p = 0.92
Anatomic
0.7
0.6
0.00
0.05
0.10
0.15
Functional
Pair Type
Twin
Unrelated


NULL34: High−Low Control
R = −0.015, p = 0.95
R = 0.038, p = 0.83
Anatomic
0.9
0.8
0.7
0.00
0.05
Functional
Pair Type
Twin
Unrelated


SOMA: High−Low Control
R = −0.1, p = 0.65
R = −0.092, p = 0.61
Anatomic
0.9
0.8
0.7
−0.04
0.00
0.04
0.08
0.12
Functional
Pair Type
Twin
Unrelated