

analyses

TODO discussion 2021-09-20

- why negative: because inverted u and a in 2 places, see chunk calc-space
- why different dfs: I wasn't doing the same analysis, now I am
- why different Fs: because the vss data was different (due to formula switch)
- explain about 2 rows that are excluded, & possible mismatch
- do we have pitch.txt & formant.txt outputted by script?
 - no, but we have output by mom! Alex to integrate
- we can also leave that be, since by now we are aligned in terms of means for point vowels?
 - no, because duration & pitch are incorrectly attributed
- not sure what to do about the fact that our vowel triangles don't look the same – how were those generated? perhaps they are not over the same tokens?
 - mystery solved! i and u based on all moms in both figures
 - what shall we do, single figure for all moms?
- “REAL” decisions:
 - removing outliers? – yes
 - removing items from f1/2 when no f0 – keeping them because they are not outliers
 - doing ANOVA first, then mixed model- agreed
 - (I don't think software matters!) - ANOVA in spss, lmer in r

interim done:

- switched input file, results are stable
- add confidence intervals to vowel space, incorporate results to paper

Replication

In this section, I'm just doing again the analyses that are already in the manuscript. Those were done with SPSS, so this is more replication than reproduction.

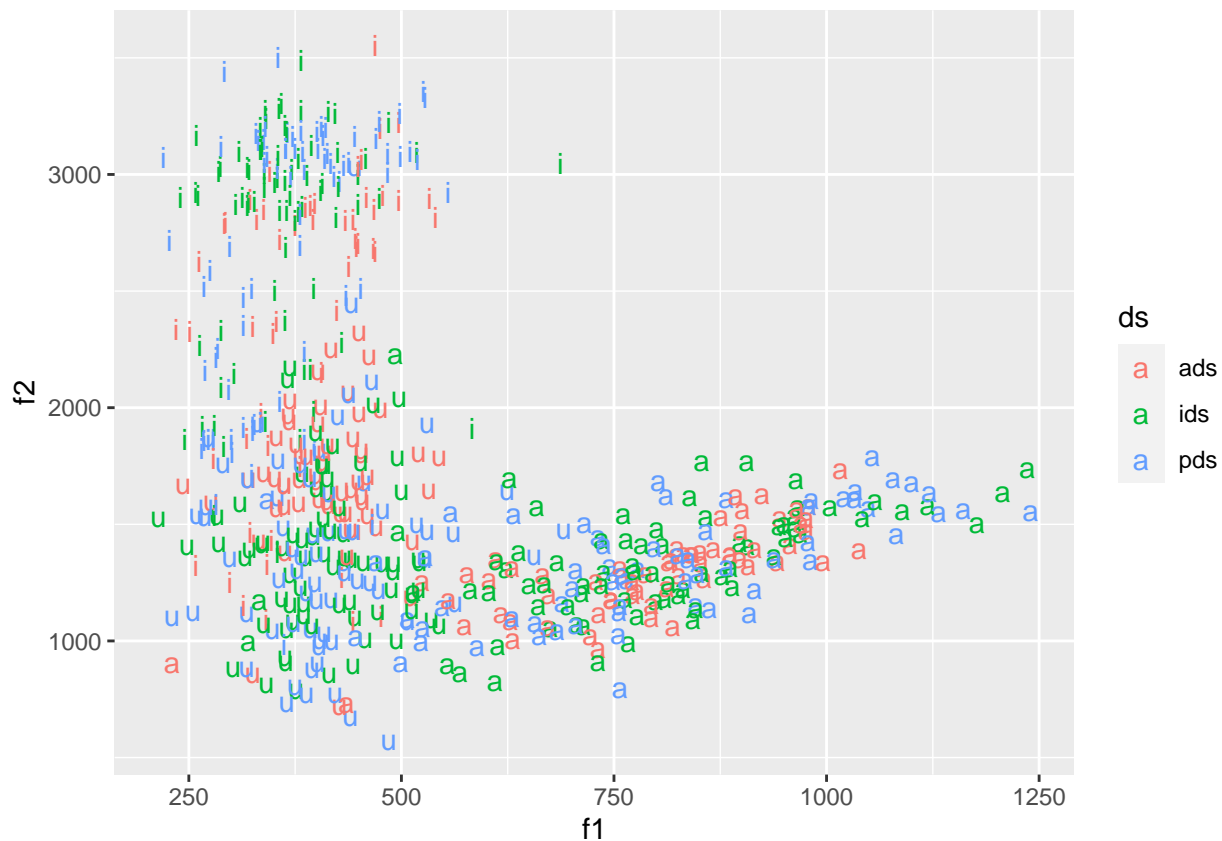
```
## [1] 614 11
```

Checking that we are getting the same means against the means in the xls file – we are.

Checking that we are getting the same means against the means in the sav file – we are.

Note there are no outliers:

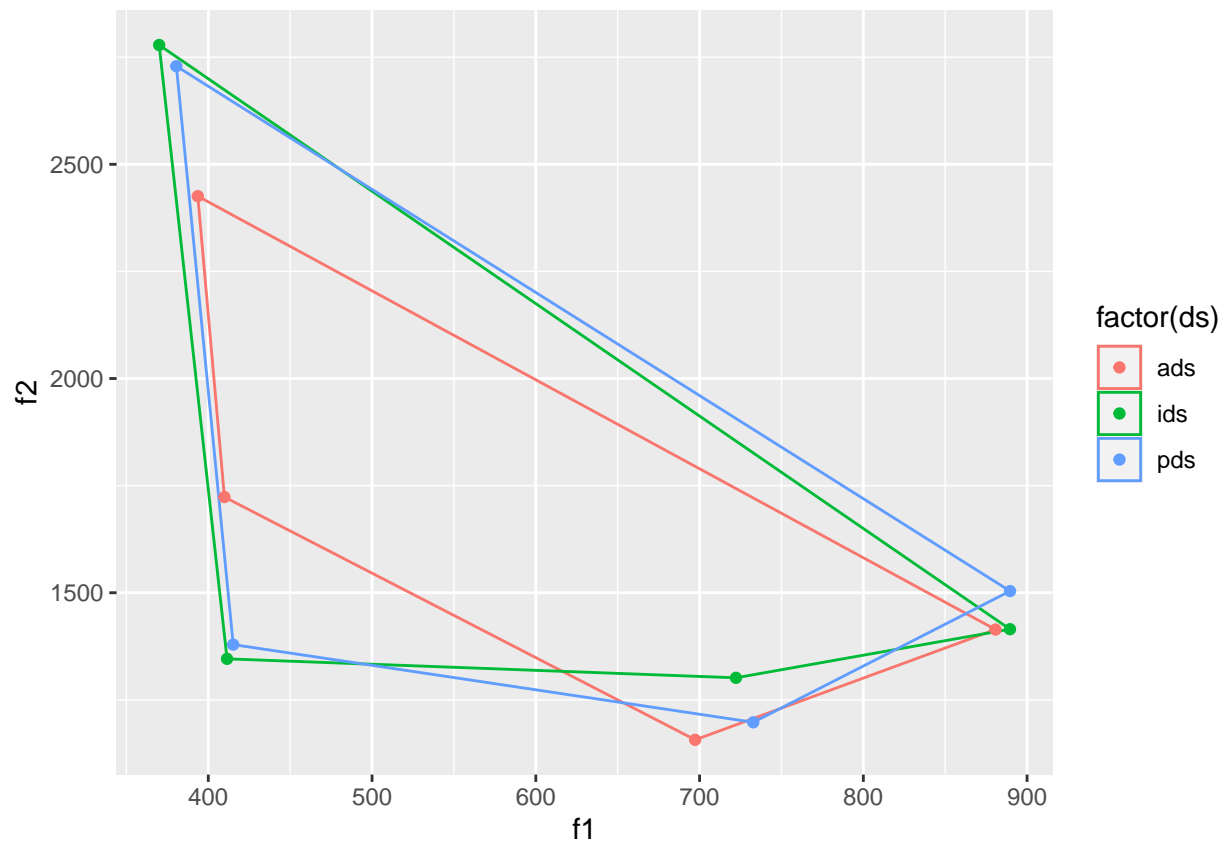
```
## Warning: Removed 3 rows containing missing values (geom_text).
```



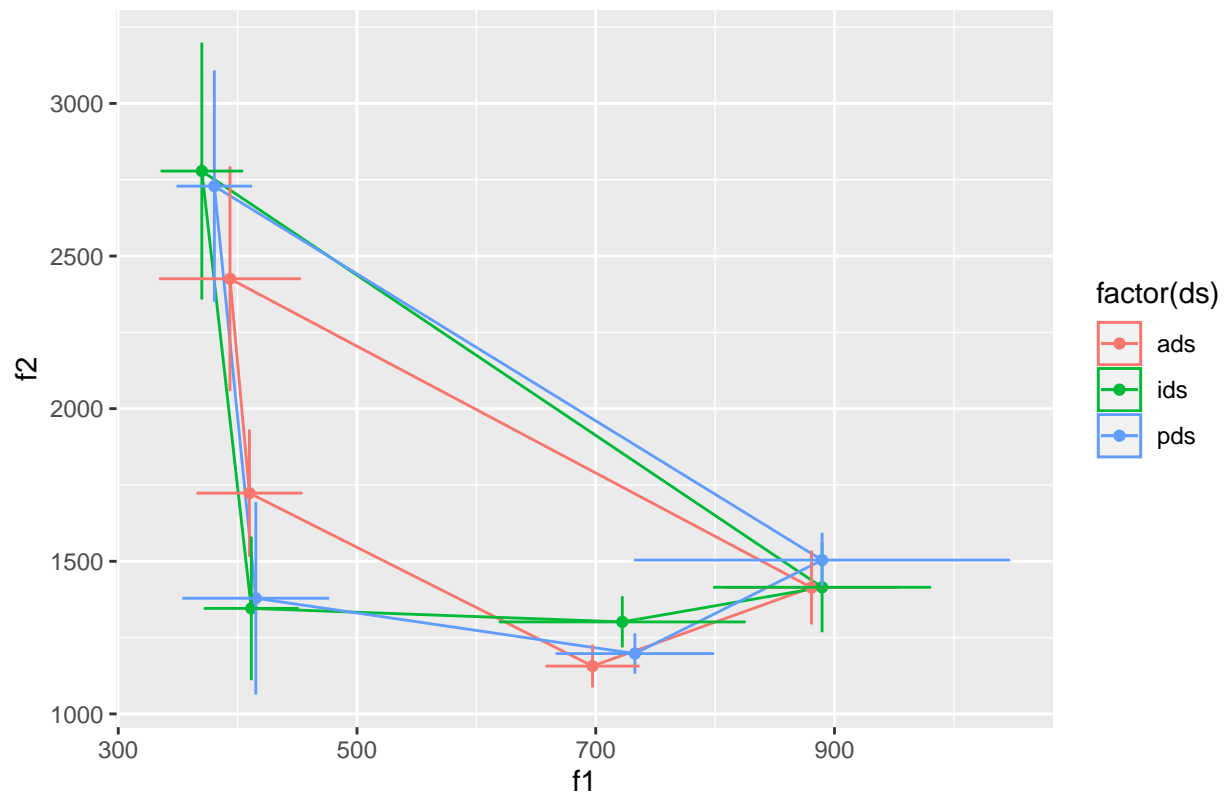
```
##
## ball bead boot  box
## 105 209 201  99
## [1] 614 16
## `summarise()` has grouped output by 'motID', 'ds', 'v', 'stim_group'. You can override using the `.groups` argument.
## `summarise()` has grouped output by 'ds', 'v'. You can override using the `.groups` argument.
## `summarise()` has grouped output by 'motID', 'ds'. You can override using the `.groups` argument.
## `summarise()` has grouped output by 'ds'. You can override using the `.groups` argument.
## `summarise()` has grouped output by 'ds'. You can override using the `.groups` argument.
## `summarise()` has grouped output by 'ds'. You can override using the `.groups` argument.
```

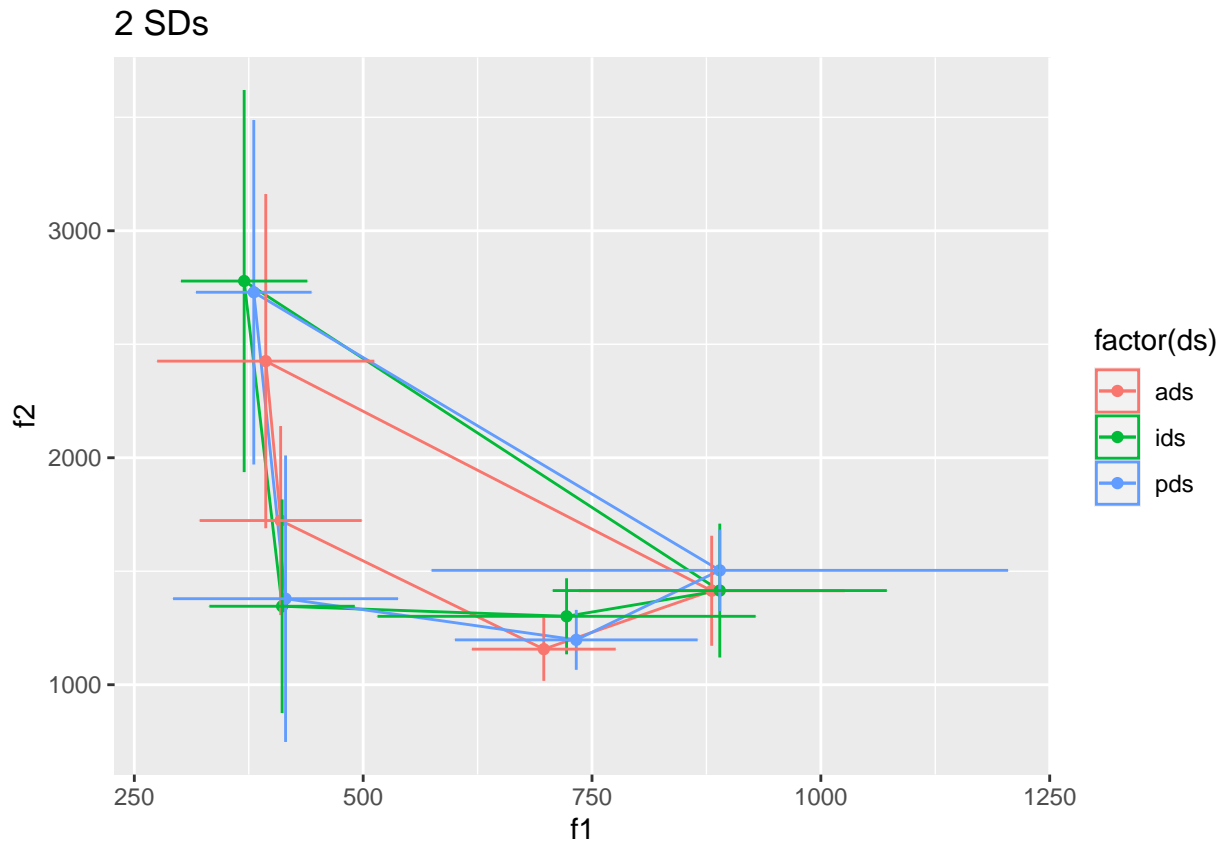
Fig vowel space

```
## pdf
## 2
```



1 SDs





Vowel space calculations

Next we calculate vowel space for each mom and register.

```
## # A tibble: 3 x 2
##   ds      vss
##   <chr>   <dbl>
## 1 ads    596848.
## 2 ids    886587.
## 3 pds    842918.
```

ANOVA

A within-subject analysis of variance (ANOVA) on average vowel space across listener conditions (3=IDS, PDS, ADS) revealed a significant main effect ($F(2,18) = 6.04$, $p < .02$), with paired contrasts indicating that the average vowel spaces for IDS and PDS were not significantly different, $t(9) = .98$, $p > .05$, but were both greater than the vowel space of ADS (IDS v. ADS, $t(9) = 3.79$, $p < .005$) and (PDS v. ADS, $t(9) = 2.24$, $p = .05$; see Figure 1a and b).

ANOVA: not the same F or dfs

explanations from Robin: “To conduct a repeated-measures ANOVA in SPSS, we do not specify the repeated-measures factor and the dependent variable in the SPSS data file. Instead, the SPSS data file contains several quantitative variables. The number of quantitative variables is equal to the number of levels of the within-subjects factor. The scores on any one of these quantitative variables are the scores on the dependent variable for a single level of the within-subjects factor. Although we do not define the within-subjects factor in

the SPSS data file, we specify it in the dialog box for the General Linear Model Repeated-Measures procedure. To define the factor, we give a name to the within-subjects factor, specify the number of levels of this factor, and indicate the quantitative variables in the data set associated with the levels of the within-subjects factor.” and “the error term in the SPSS repeated measures model is (n-1) for sample (10-1=9) x (k-1) for the number of measures per sample (3-1=2); so $9 \times 2 = 18$ (for the denominator).”

```
## Anova Table (Type III tests)
##
## Response: vss
##           Sum Sq Df F value    Pr(>F)
## (Intercept) 3.5623e+12  1 51.5874 1.005e-07 ***
## ds          4.8802e+11  2  3.5337  0.04334 *
## Residuals   1.8644e+12 27
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

## Warning: Converting "mom" to factor for ANOVA.
## Warning: Converting "ds" to factor for ANOVA.

##           Length Class      Mode
## ANOVA           9      data.frame list
## Mauchly's Test for Sphericity 4      data.frame list
## Sphericity Corrections       7      data.frame list
## aov                 3      aovlist    list

## Tables of means
## Grand mean
##
## 775451.3
##
## ds
## ds
##      ads      ids      pds
## 596848 886587 842918

Paired contrasts – same pattern of results but different t values.

##
## Paired t-test
##
## data:  vs$vss[vs$ds == "pds"] and vs$vss[vs$ds == "ids"]
## t = -0.4956, df = 9, p-value = 0.6321
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
## -242997.1 155658.9
## sample estimates:
## mean of the differences
## -43669.08

##
## Cohen's d
##
## d estimate: 0.1559337 (negligible)
## 95 percent confidence interval:
##      lower      upper
## -0.7850539  1.0969214
```

```
##
## Paired t-test
##
## data: vs$vss[vs$ds == "ids"] and vs$vss[vs$ds == "ads"]
## t = 2.4351, df = 9, p-value = 0.03767
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
## 20572.94 558905.61
## sample estimates:
## mean of the differences
## 289739.3

##
## Cohen's d
##
## d estimate: -1.121556 (large)
## 95 percent confidence interval:
## lower upper
## -2.1322879 -0.1108244

##
## Paired t-test
##
## data: vs$vss[vs$ds == "pds"] and vs$vss[vs$ds == "ads"]
## t = 1.9906, df = 9, p-value = 0.07773
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
## -33574.0 525714.4
## sample estimates:
## mean of the differences
## 246070.2

##
## Cohen's d
##
## d estimate: -0.9882865 (large)
## 95 percent confidence interval:
## lower upper
## -1.983551077 0.006978064
```

dur, f0, f1, f2

Duration and pitch can be done at the item level

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: Vowel.Duration ~ ds * target + (1 + ds | motID)
## Data: dat
##
## REML criterion at convergence: -1202.6
##
## Scaled residuals:
## Min 1Q Median 3Q Max
## -3.5120 -0.5243 -0.0814 0.3421 5.3534
##
```

```

## Random effects:
## Groups   Name                Variance Std.Dev. Corr
## motID    (Intercept) 0.0007915 0.02813
##          dsids      0.0049585 0.07042 0.71
##          dspds      0.0016792 0.04098 0.41 0.42
## Residual                0.0067777 0.08233
## Number of obs: 614, groups: motID, 10
##
## Fixed effects:
##              Estimate Std. Error      df t value Pr(>|t|)
## (Intercept)    0.195420   0.018230  32.341259  10.720 3.54e-12 ***
## dsids          0.071922   0.031004  23.340307   2.320  0.0294 *
## dspds          0.028832   0.025617  43.263609   1.126  0.2666
## targetbead     0.014766   0.019373 253.452590   0.762  0.4467
## targetboot    -0.025244   0.019137 254.312247  -1.319  0.1883
## targetbox     -0.007169   0.022381  84.997033  -0.320  0.7495
## dsids:targetbead 0.018547   0.025530 371.954675   0.726  0.4680
## dspds:targetbead 0.008486   0.026016 382.948878   0.326  0.7445
## dsids:targetboot -0.038286   0.025470 375.205621  -1.503  0.1336
## dspds:targetboot -0.012732   0.026305 366.612811  -0.484  0.6287
## dsids:targetbox -0.014377   0.031213 160.492273  -0.461  0.6457
## dspds:targetbox  0.008059   0.032281 166.800408   0.250  0.8032
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##              (Intr) dsids  dspds  trgtbd trgtbt trgtbx dsds:trgtbd dspds:trgtbd
## dsids          -0.183
## dspds          -0.426  0.457
## targetbead     -0.714  0.405  0.494
## targetboot     -0.723  0.410  0.500  0.677
## targetbox      -0.658  0.365  0.448  0.616  0.624
## dsds:trgtbd    0.528 -0.567 -0.370 -0.746 -0.501 -0.449
## dspds:trgtbd   0.521 -0.300 -0.711 -0.735 -0.494 -0.445  0.552
## dsds:trgtbt    0.529 -0.571 -0.371 -0.496 -0.738 -0.449  0.675  0.365
## dspds:trgtbt   0.512 -0.296 -0.717 -0.480 -0.715 -0.435  0.360  0.686
## dsds:trgtbx    0.446 -0.525 -0.312 -0.418 -0.423 -0.681  0.605  0.308
## dspds:trgtbx   0.436 -0.250 -0.640 -0.409 -0.414 -0.666  0.304  0.603
##              dsds:trgtbt dspds:trgtbt dsds:trgtbx
## dsids
## dspds
## targetbead
## targetboot
## targetbox
## dsds:trgtbd
## dspds:trgtbd
## dsds:trgtbt
## dspds:trgtbt  0.532
## dsds:trgtbx  0.609      0.303
## dspds:trgtbx  0.305      0.613      0.467

## Warning: NAs introduced by coercion

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]

```

```

## Formula: Pitch ~ ds * target + (1 + ds | motID)
## Data: dat
##
## REML criterion at convergence: 6746.6
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.3545 -0.5564 -0.1364  0.4836  8.8010
##
## Random effects:
## Groups Name Variance Std.Dev. Corr
## motID (Intercept) 348.8 18.68
## dsids 3636.3 60.30 -0.59
## dspds 1946.0 44.11 -0.44 0.98
## Residual 4369.5 66.10
## Number of obs: 606, groups: motID, 10
##
## Fixed effects:
## Estimate Std. Error df t value Pr(>|t|)
## (Intercept) 200.1587 14.7500 42.3778 13.570 <2e-16 ***
## dsids 27.1051 26.6546 24.2858 1.017 0.3192
## dspds 46.6849 22.5136 31.7025 2.074 0.0463 *
## targetbead -2.0223 16.1501 298.5380 -0.125 0.9004
## targetboot 11.7437 15.9741 294.1606 0.735 0.4628
## targetbox -3.3188 18.8580 117.0155 -0.176 0.8606
## dsids:targetbead 16.4764 21.4548 503.9741 0.768 0.4429
## dspds:targetbead 0.1623 21.0737 336.0349 0.008 0.9939
## dsids:targetboot 25.0384 21.4710 504.4648 1.166 0.2441
## dspds:targetboot 11.1454 21.1429 288.3700 0.527 0.5985
## dsids:targetbox 10.9551 26.8979 343.5838 0.407 0.6841
## dspds:targetbox -13.5956 25.4359 111.5193 -0.535 0.5941
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
## (Intr) dsids dspds trgtbd trgtbt trgtbx dsds:trgtbd dspds:trgtbd
## dsids -0.660
## dspds -0.630 0.768
## targetbead -0.762 0.443 0.474
## targetboot -0.772 0.449 0.479 0.701
## targetbox -0.710 0.423 0.428 0.644 0.651
## dsds:trgtbd 0.595 -0.582 -0.395 -0.772 -0.546 -0.511
## dspds:trgtbd 0.562 -0.349 -0.651 -0.748 -0.517 -0.466 0.596
## dsds:trgtbt 0.597 -0.586 -0.397 -0.541 -0.765 -0.512 0.704 0.419
## dspds:trgtbt 0.554 -0.351 -0.653 -0.505 -0.730 -0.456 0.418 0.690
## dsds:trgtbx 0.536 -0.544 -0.371 -0.485 -0.491 -0.750 0.641 0.387
## dspds:trgtbx 0.485 -0.331 -0.573 -0.441 -0.445 -0.689 0.387 0.602
## dsds:trgtbt dspds:trgtbt dsds:trgtbx
## dsids
## dspds
## targetbead
## targetboot
## targetbox
## dsds:trgtbd

```



```

## dspds:trgtbd
## dsds:trgtbt
## dspds:trgtbt 0.583
## dsds:trgtbx 0.645 0.390
## dspds:trgtbx 0.389 0.605 0.586

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: f1 ~ ds * target + (1 + ds | motID)
## Data: dat
##
## REML criterion at convergence: 7352.5
##
## Scaled residuals:
## Min 1Q Median 3Q Max
## -4.9580 -0.5054 -0.0140 0.5005 3.6533
##
## Random effects:
## Groups Name Variance Std.Dev. Corr
## motID (Intercept) 1802 42.46
## dsids 1336 36.55 -0.69
## dspds 2056 45.35 -0.75 0.75
## Residual 11086 105.29
## Number of obs: 611, groups: motID, 10
##
## Fixed effects:
## Estimate Std. Error df t value Pr(>|t|)
## (Intercept) 716.49 25.49 40.48 28.106 < 2e-16 ***
## dsids 16.74 30.00 45.67 0.558 0.580
## dspds 38.90 32.50 49.79 1.197 0.237
## targetbead -322.74 25.82 458.13 -12.498 < 2e-16 ***
## targetboot -306.20 25.51 458.03 -12.005 < 2e-16 ***
## targetbox 146.59 31.04 264.54 4.723 3.78e-06 ***
## dsids:targetbead -38.79 33.04 424.12 -1.174 0.241
## dspds:targetbead -55.05 34.15 492.90 -1.612 0.108
## dsids:targetboot -12.69 32.94 417.43 -0.385 0.700
## dspds:targetboot -35.35 34.39 447.67 -1.028 0.305
## dsids:targetbox -12.15 40.21 148.61 -0.302 0.763
## dspds:targetbox -37.64 42.66 239.88 -0.882 0.378
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
## (Intr) dsids dspds trgtbd trgtbt trgtbx dsds:trgtbd dspds:trgtbd
## dsids -0.731
## dspds -0.736 0.602
## targetbead -0.707 0.579 0.550
## targetboot -0.716 0.586 0.557 0.701
## targetbox -0.666 0.535 0.516 0.652 0.659
## dsds:trgtbd 0.538 -0.758 -0.428 -0.767 -0.534 -0.489
## dspds:trgtbd 0.532 -0.446 -0.749 -0.753 -0.528 -0.489 0.584
## dsds:trgtbt 0.539 -0.762 -0.429 -0.528 -0.759 -0.489 0.683 0.404
## dspds:trgtbt 0.527 -0.445 -0.753 -0.516 -0.738 -0.483 0.402 0.701
## dsds:trgtbx 0.486 -0.694 -0.395 -0.476 -0.482 -0.734 0.613 0.369

```

```

## dspds:trgtbx  0.479 -0.404 -0.679 -0.469 -0.474 -0.720  0.364      0.625
##              dsds:trgtbt dspds:trgtbt dsds:trgtbx
## dsids
## dspds
## targetbead
## targetboot
## targetbox
## dsds:trgtbd
## dspds:trgtbd
## dsds:trgtbt
## dspds:trgtbt  0.569
## dsds:trgtbx  0.616      0.369
## dspds:trgtbx  0.364      0.632      0.552

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: f2 ~ ds * target + (1 | motID)
## Data: dat
##
## REML criterion at convergence: 8892.5
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -4.3784 -0.4657  0.0809  0.6162  3.5867
##
## Random effects:
## Groups Name Variance Std.Dev.
## motID (Intercept) 20970 144.8
## Residual 146885 383.3
## Number of obs: 611, groups: motID, 10
##
## Fixed effects:
##              Estimate Std. Error      df t value Pr(>|t|)
## (Intercept) 1215.902      86.546    77.610  14.049 < 2e-16 ***
## dsids       121.682      92.610   589.882   1.314  0.18938
## dspds        5.147      96.225   590.271   0.053  0.95736
## targetbead 1166.371      89.679   597.501  13.006 < 2e-16 ***
## targetboot  500.447      88.580   597.450   5.650 2.49e-08 ***
## targetbox   189.969     103.213   598.231   1.841  0.06618 .
## dsids:targetbead 277.876    114.914   590.458   2.418  0.01590 *
## dspds:targetbead 327.536    117.963   590.915   2.777  0.00567 **
## dsids:targetboot -454.262    114.473   590.218  -3.968 8.13e-05 ***
## dspds:targetboot -330.646    117.766   590.092  -2.808  0.00516 **
## dsids:targetbox -139.676    131.426   590.281  -1.063  0.28832
## dspds:targetbox  65.126     137.244   590.525   0.475  0.63530
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##              (Intr) dsids  dspds  trgtbd trgtbt trgtbx dsds:trgtbd dspds:trgtbd
## dsids          -0.613
## dspds          -0.592  0.551
## targetbead     -0.692  0.592  0.572
## targetboot     -0.701  0.599  0.578  0.674

```

```
## targetbox      -0.637  0.514  0.496  0.612  0.619
## dsds:trgtbd    0.507 -0.806 -0.445 -0.749 -0.495 -0.431
## dspds:trgtbd   0.495 -0.450 -0.817 -0.731 -0.483 -0.422  0.563
## dsds:trgtbt    0.507 -0.809 -0.446 -0.488 -0.740 -0.430  0.654      0.365
## dspds:trgtbt   0.485 -0.450 -0.816 -0.469 -0.713 -0.408  0.364      0.667
## dsds:trgtbx    0.432 -0.705 -0.389 -0.416 -0.422 -0.691  0.567      0.317
## dspds:trgtbx   0.415 -0.387 -0.701 -0.401 -0.405 -0.664  0.312      0.573
##               dsds:trgtbt dspds:trgtbt dsds:trgtbx
## dsids
## dspds
## targetbead
## targetboot
## targetbox
## dsds:trgtbd
## dspds:trgtbd
## dsds:trgtbt
## dspds:trgtbt  0.549
## dsds:trgtbx   0.570      0.317
## dspds:trgtbx  0.312      0.572      0.522
```

Variability analyses

Get standard deviation of f1 and f2, separating by mom and register.

```
## `summarise()` has grouped output by 'motID', 'ds'. You can override using the `.groups` argument.
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: f1.sd ~ ds * target + (1 | motID)
## Data: sds
##
## REML criterion at convergence: 803.1
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.5964 -0.5157  0.0173  0.4615  3.2291
##
## Random effects:
## Groups Name Variance Std.Dev.
## motID (Intercept) 95.23 9.758
## Residual 1211.56 34.807
## Number of obs: 90, groups: motID, 10
##
## Fixed effects:
##              Estimate Std. Error    df t value Pr(>|t|)
## (Intercept)    112.08     17.95  77.95   6.245 2.07e-08 ***
## dsids          -10.49     24.61  69.22  -0.426 0.671215
## dspds           37.71     24.61  69.22   1.532 0.130086
## targetbead     -62.41     20.83  73.75  -2.997 0.003716 **
## targetboot     -69.92     20.83  73.75  -3.357 0.001247 **
## targetbox      -50.30     23.06  77.33  -2.181 0.032210 *
## dsids:targetbead  21.06     29.12  69.22   0.723 0.472112
## dspds:targetbead -15.93     29.12  69.22  -0.547 0.586190
## dsids:targetboot  19.44     29.12  69.22   0.667 0.506734
```

```

## dspds:targetboot   -11.49      29.12  69.22  -0.394 0.694478
## dsids:targetbox    111.52      31.77  69.22   3.510 0.000794 ***
## dspds:targetbox     70.58      31.77  69.22   2.221 0.029616 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##          (Intr) dsids  dspds  trgtbd trgtbt trgtbx dsds:trgtbd dspds:trgtbd
## dsids          -0.686
## dspds          -0.686  0.500
## targetbead     -0.836  0.591  0.591
## targetboot     -0.836  0.591  0.591  0.721
## targetbox      -0.771  0.534  0.534  0.664  0.664
## dsds:trgtbd    0.580 -0.845 -0.423 -0.699 -0.499 -0.451
## dspds:trgtbd  0.580 -0.423 -0.845 -0.699 -0.499 -0.451  0.500
## dsds:trgtbt    0.580 -0.845 -0.423 -0.499 -0.699 -0.451  0.714      0.357
## dspds:trgtbt  0.580 -0.423 -0.845 -0.499 -0.699 -0.451  0.357      0.714
## dsds:trgtbx    0.531 -0.775 -0.387 -0.458 -0.458 -0.689  0.655      0.327
## dspds:trgtbx  0.531 -0.387 -0.775 -0.458 -0.458 -0.689  0.327      0.655
##          dsds:trgtbt dspds:trgtbt dsds:trgtbx
## dsids
## dspds
## targetbead
## targetboot
## targetbox
## dsds:trgtbd
## dspds:trgtbd
## dsds:trgtbt
## dspds:trgtbt  0.500
## dsds:trgtbx  0.655      0.327
## dspds:trgtbx  0.327      0.655      0.500
##
## boundary (singular) fit: see ?isSingular
##
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: f2.sd ~ ds * target + (1 | motID)
## Data: sds
##
## REML criterion at convergence: 1019.6
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.7122 -0.5822 -0.0900  0.4701  3.3161
##
## Random effects:
## Groups   Name            Variance Std.Dev.
## motID    (Intercept)      0         0.0
## Residual                20638    143.7
## Number of obs: 90, groups: motID, 10
##
## Fixed effects:
##              Estimate Std. Error    df t value Pr(>|t|)
## (Intercept)    121.25     71.83   78.00  1.688  0.09541 .
## dsids           80.26    101.58   78.00  0.790  0.43189

```

```

## dspds          42.89      101.58    78.00    0.422  0.67400
## targetbead     488.77      84.99    78.00    5.751 1.65e-07 ***
## targetboot     65.34      84.99    78.00    0.769  0.44435
## targetbox     -45.07      92.73    78.00   -0.486  0.62831
## dsids:targetbead -396.78    120.20    78.00   -3.301  0.00145 **
## dspds:targetbead -212.95    120.20    78.00   -1.772  0.08035 .
## dsids:targetboot -29.54    120.20    78.00   -0.246  0.80654
## dspds:targetboot  50.50    120.20    78.00    0.420  0.67553
## dsids:targetbox  31.85    131.14    78.00    0.243  0.80876
## dspds:targetbox  21.80    131.14    78.00    0.166  0.86843
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##          (Intr) dsids  dspds  trgtbd trgtbt trgtbx dsds:trgtbd dspds:trgtbd
## dsids          -0.707
## dspds          -0.707  0.500
## targetbead     -0.845  0.598  0.598
## targetboot     -0.845  0.598  0.598  0.714
## targetbox      -0.775  0.548  0.548  0.655  0.655
## dsds:trgtbd     0.598 -0.845 -0.423 -0.707 -0.505 -0.463
## dspds:trgtbd     0.598 -0.423 -0.845 -0.707 -0.505 -0.463  0.500
## dsds:trgtbt     0.598 -0.845 -0.423 -0.505 -0.707 -0.463  0.714      0.357
## dspds:trgtbt     0.598 -0.423 -0.845 -0.505 -0.707 -0.463  0.357      0.714
## dsds:trgtbx     0.548 -0.775 -0.387 -0.463 -0.463 -0.707  0.655      0.327
## dspds:trgtbx     0.548 -0.387 -0.775 -0.463 -0.463 -0.707  0.327      0.655
##          dsds:trgtbt dspds:trgtbt dsds:trgtbx
## dsids
## dspds
## targetbead
## targetboot
## targetbox
## dsds:trgtbd
## dspds:trgtbd
## dsds:trgtbt
## dspds:trgtbt  0.500
## dsds:trgtbx  0.655      0.327
## dspds:trgtbx  0.327      0.655      0.500
## optimizer (nloptwrap) convergence code: 0 (OK)
## boundary (singular) fit: see ?isSingular

```