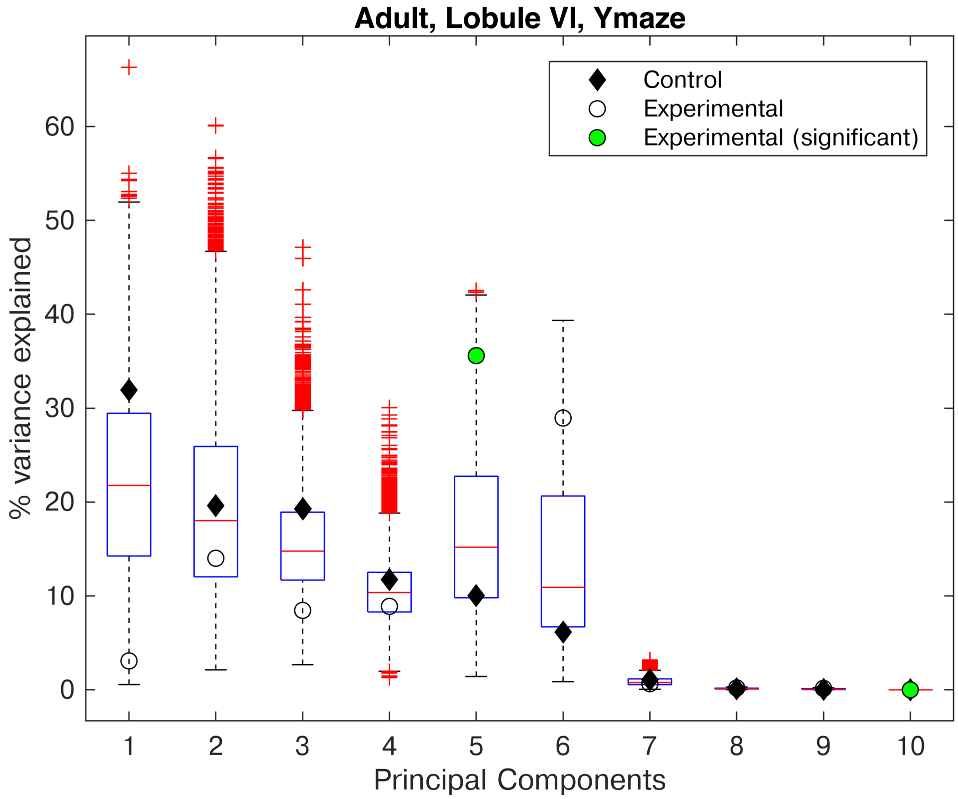
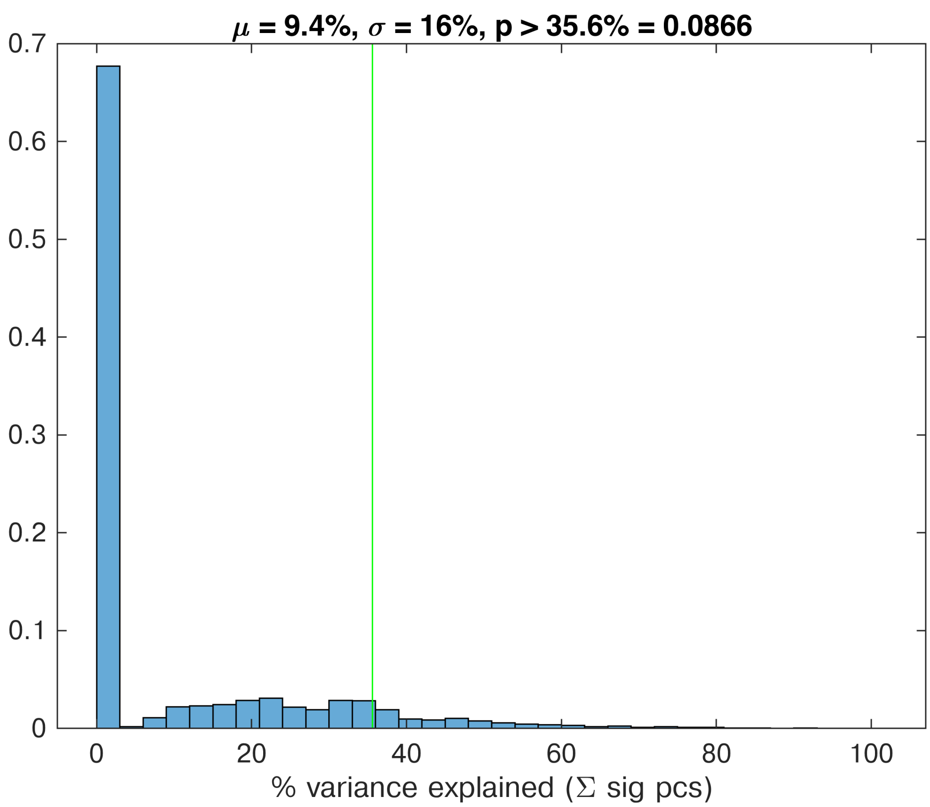
```
% For Fig 4:
% adult+juven lob 6, juven crus 1-> YM PC5, PC6
% juven crus 1, juven crus 2, adult+juven lob 7 -> SC PC3

clear all, close all, clc
```

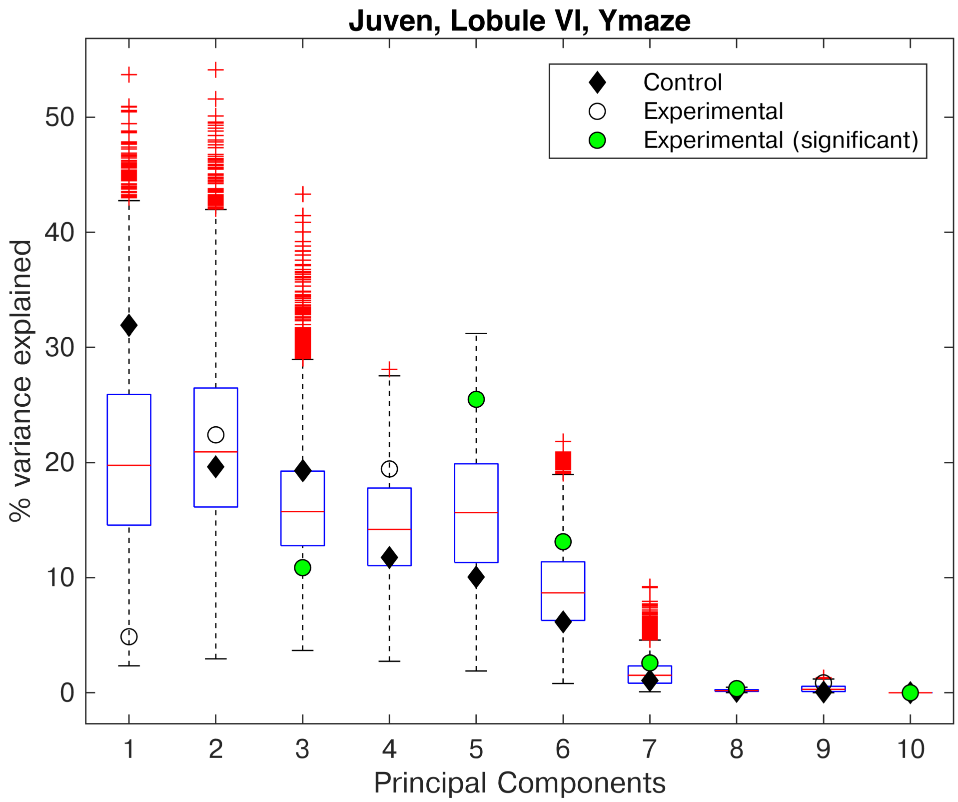
```
load('data/2017-08-31-ks_analysis.mat')
whos
```

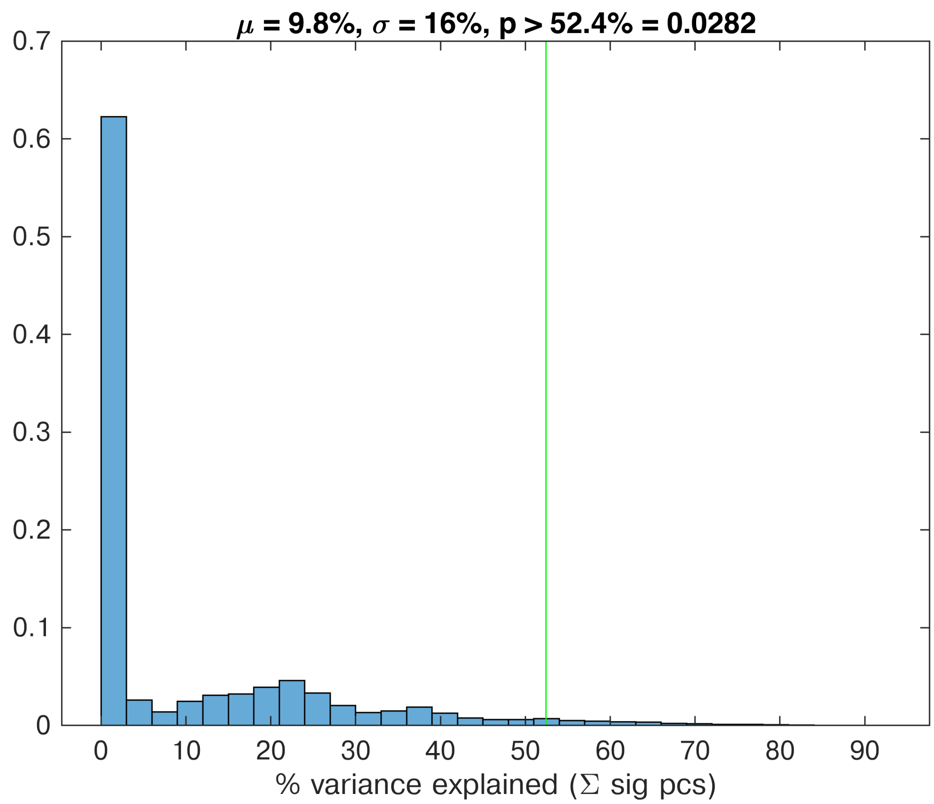
```
  Name                 Size                Bytes  Class     Attributes

  epm                  1x1                841024  struct
  exptAges             2x1                   244  cell
  exptRegions          4x1                   512  cell
  gr                   1x1                422265  struct
  kstable            336x9              53448809  table
  sc                   1x1                998745  struct
  timestamp            1x20                   40  char
  ym                   1x1               1731200  struct
```

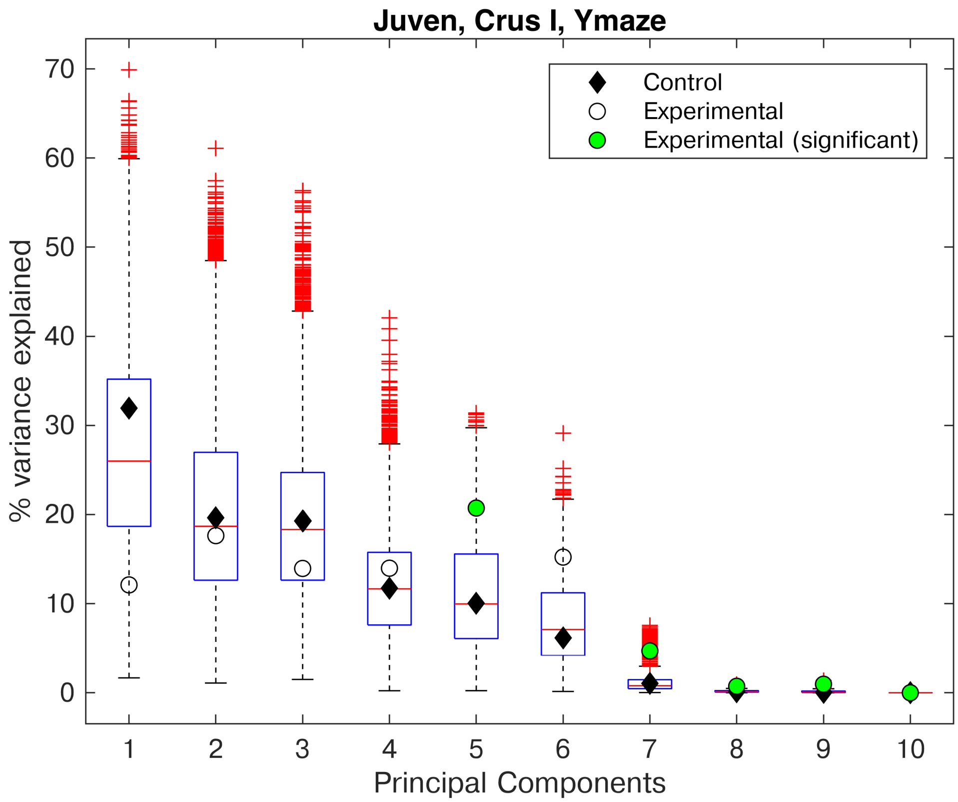
```
Bs = {
    ym.LobuleVI.Adult
    ym.LobuleVI.Juven
    ym.CrusI.Juven
    sc.CrusI.Juven
    sc.CrusII.Juven
    sc.LobuleVII.Adult
    sc.LobuleVII.Juven
};

for i = 1:numel(Bs)
    run_shuffle(Bs{i})
end
```

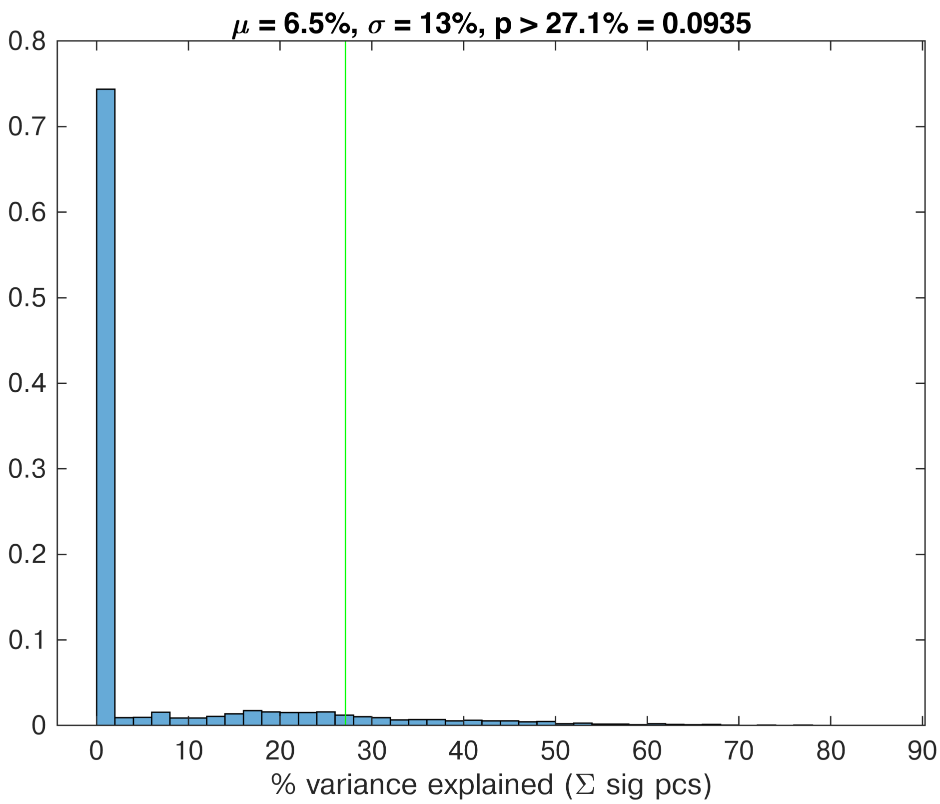

Adult, Lobule VI, Ymaze
Control
Experimental
Experimental (significant)
% variance explained
0
10
20
30
40
50
60
1
2
3
4
5
6
7
8
9
10
Principal Components

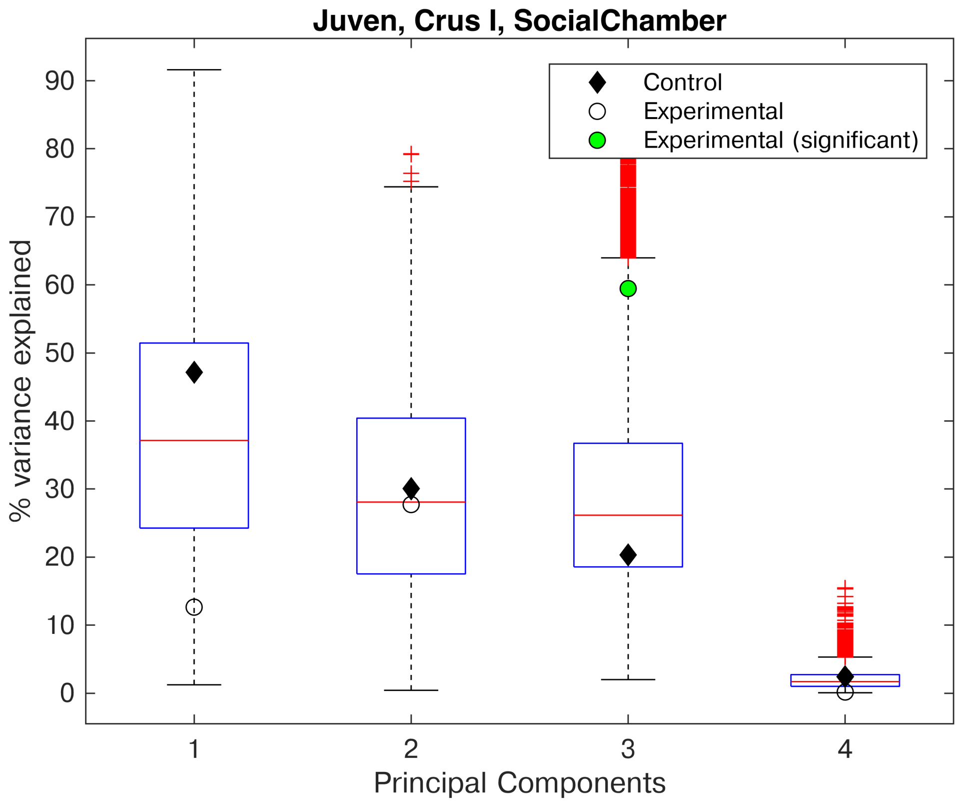

μ = 9.4%, σ = 16%, p > 35.6% = 0.0866
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
20
40
60
80
100
% variance explained (Σ sig pcs)

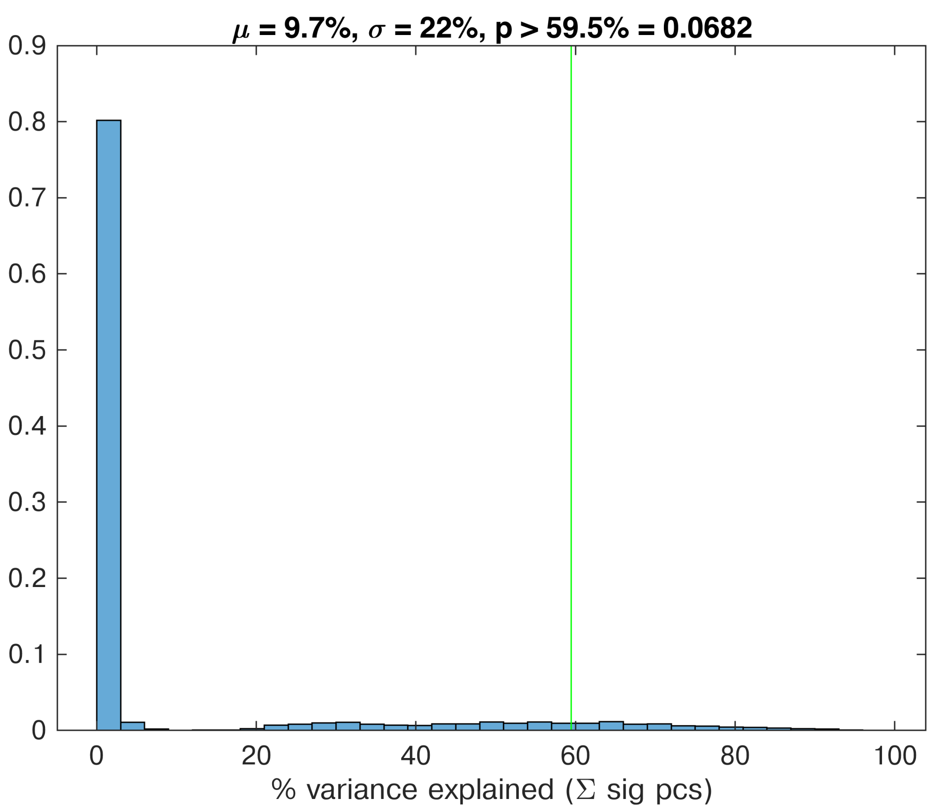

Juven, Lobule VI, Ymaze
Control
Experimental
Experimental (significant)
% variance explained
Principal Components
0
10
20
30
40
50
1
2
3
4
5
6
7
8
9
10

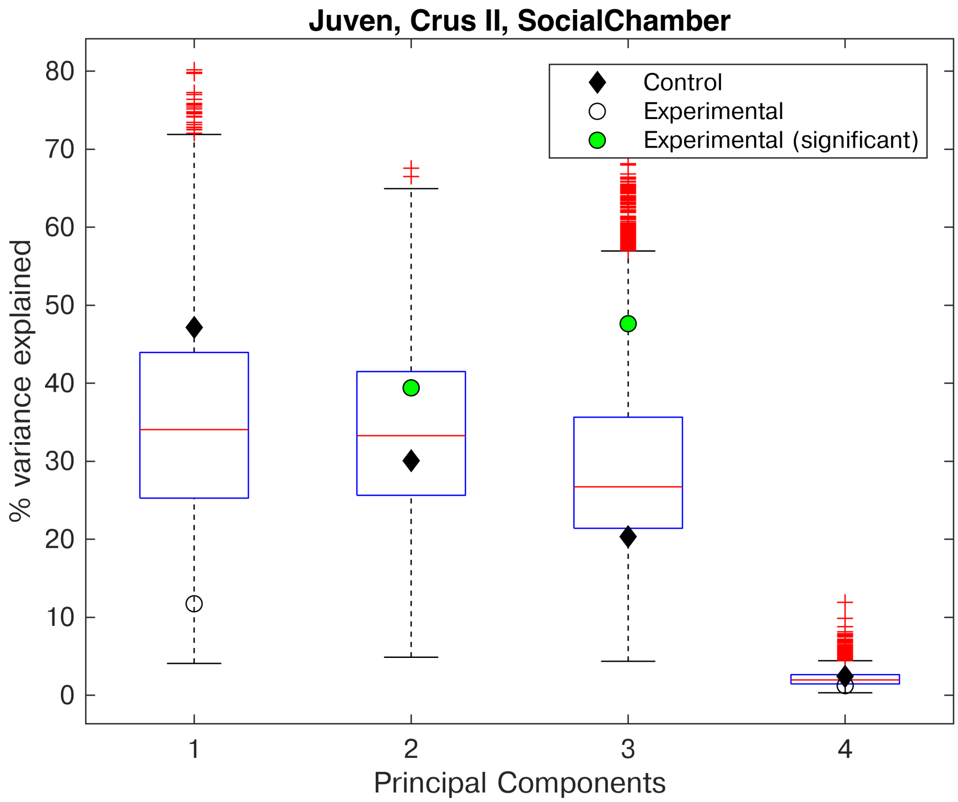

μ = 9.8%, σ = 16%, p > 52.4% = 0.0282
% variance explained (Σ sig pcs)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
10
20
30
40
50
60
70
80
90

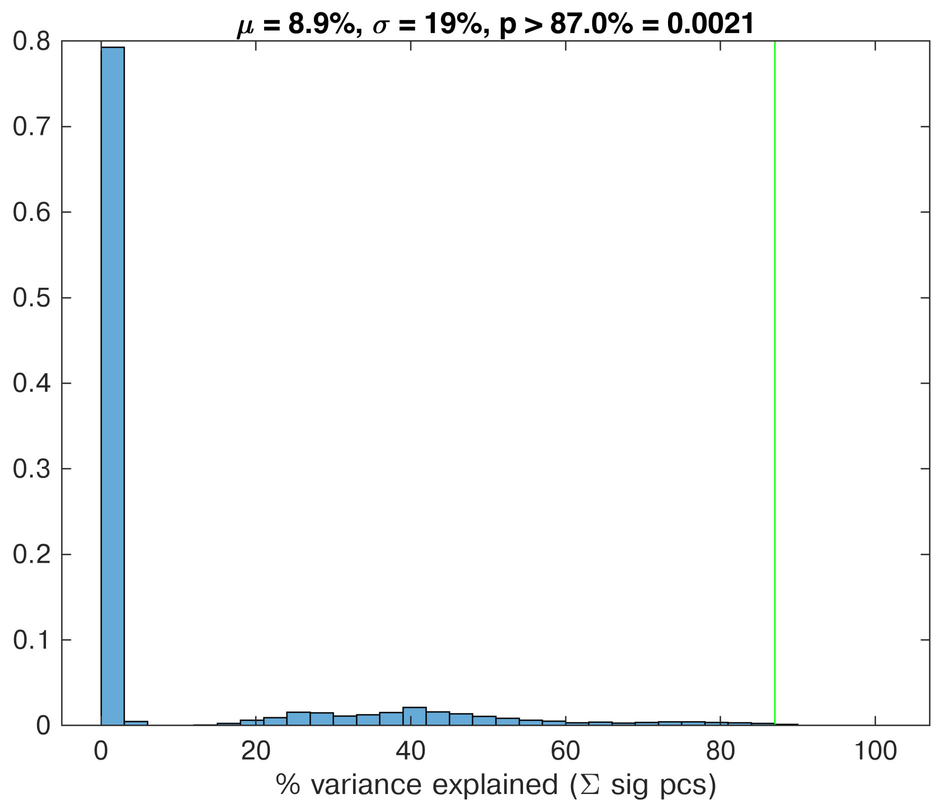

Juven, Crus I, Ymaze
% variance explained
Principal Components
Control
Experimental
Experimental (significant)
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10

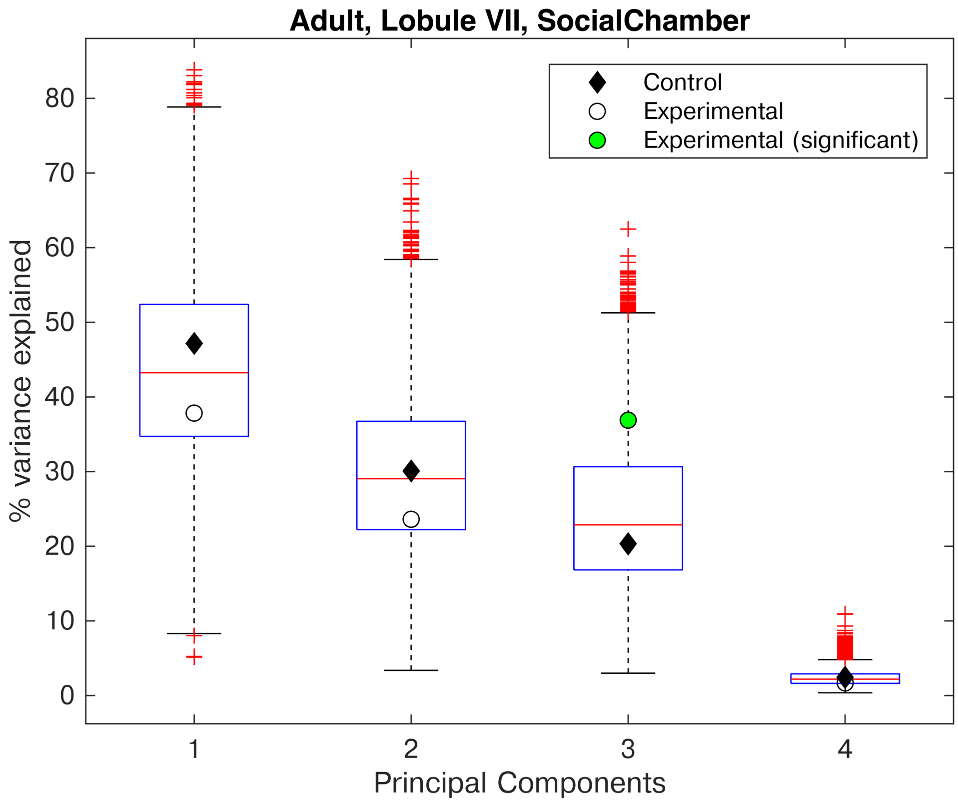

μ = 6.5%, σ = 13%, p > 27.1% = 0.0935
% variance explained (Σ sig pcs)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
10
20
30
40
50
60
70
80
90

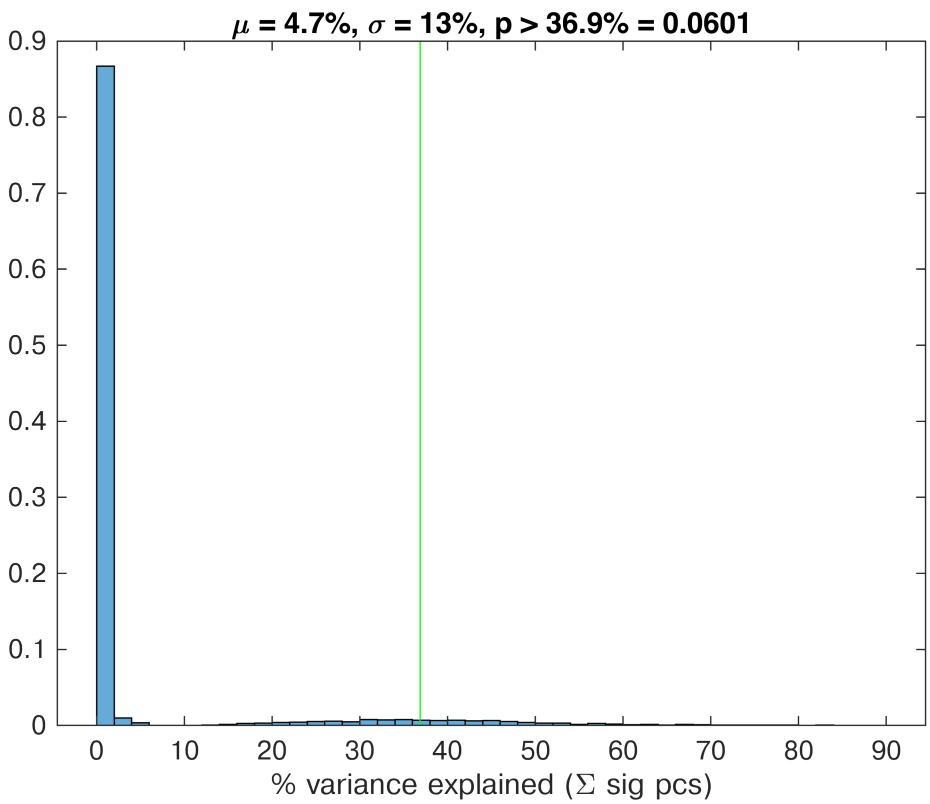

Juven, Crus I, SocialChamber
Control
Experimental
Experimental (significant)
% variance explained
Principal Components
0
10
20
30
40
50
60
70
80
90
1
2
3
4

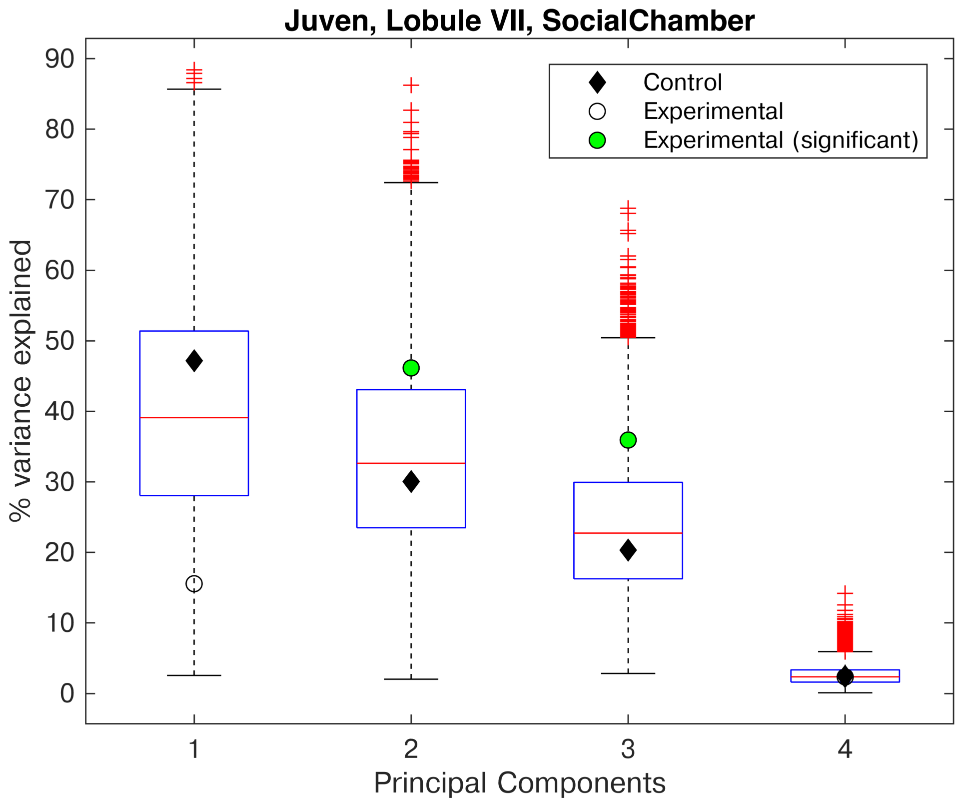

μ = 9.7%, σ = 22%, p > 59.5% = 0.0682
% variance explained (Σ sig pcs)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0
20
40
60
80
100

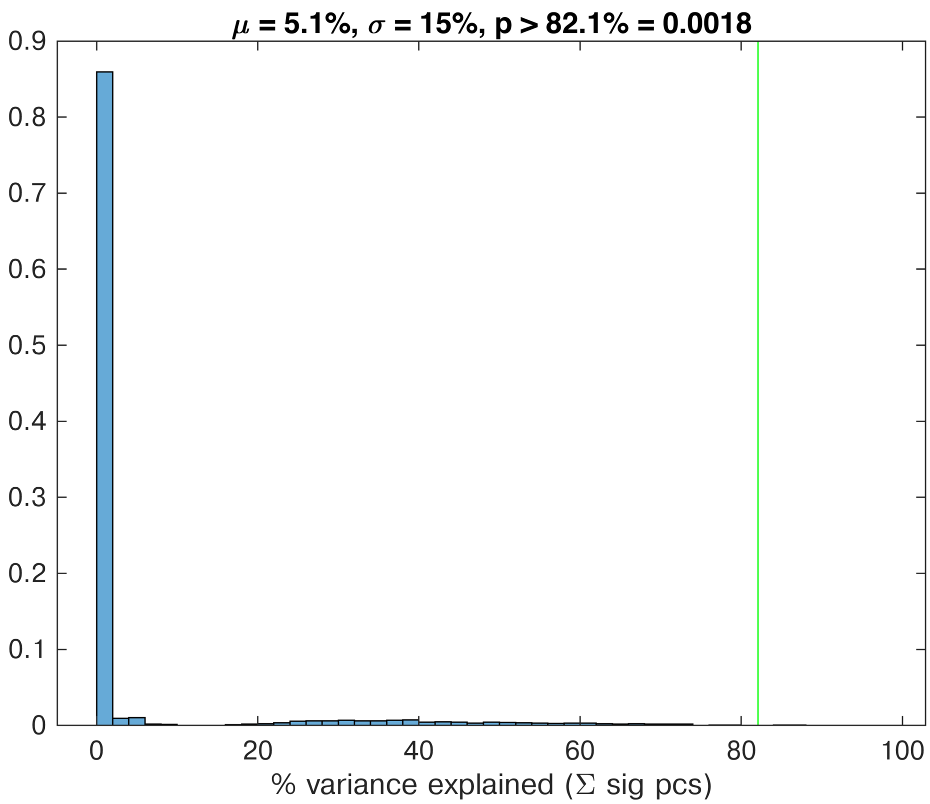

Juven, Crus II, SocialChamber
Control
Experimental
Experimental (significant)
% variance explained
Principal Components
80
70
60
50
40
30
20
10
0
1
2
3
4


μ = 8.9%, σ = 19%, p > 87.0% = 0.0021
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
20
40
60
80
100
% variance explained (Σ sig pcs)


Adult, Lobule VII, SocialChamber
Control
Experimental
Experimental (significant)
% variance explained
Principal Components
0
10
20
30
40
50
60
70
80
1
2
3
4


μ = 4.7%, σ = 13%, p > 36.9% = 0.0601
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0
10
20
30
40
50
60
70
80
90
% variance explained (Σ sig pcs)






```
function run_shuffle(B, sig_var_perc_thresh)
if nargin < 2; sig_var_perc_thresh = []; end
```

```
% already normalized/projected:
allmice_amps = B.pca{:,:};
untreat_amps = B.pca{B.isCtrl,:}; % controls
treated_amps = B.pca{~B.isCtrl,:}; % experimentals

num_untreat = size(untreat_amps,1);
num_treated = size(treated_amps,1);
d = size(allmice_amps,2); % number of pcs

% latent (eigenvalues of covariance)
untreat_latent = sum(untreat_amps .^ 2) ./ size(untreat_amps,1);
treated_latent = sum(treated_amps .^ 2) ./ size(treated_amps,1);

% percent variance explained
untreat_var_perc = untreat_latent ./ sum(untreat_latent) .* 100;
treated_var_perc = treated_latent ./ sum(treated_latent) .* 100;

N = 10000; % number of bootstrap samples
% k = size(untreat_amps,1); % number of control mice per sample
k = size(treated_amps,1); % number of experimental mice per sample
alpha = 0.05; % significance level

% repeat procedure with data for reference
[~,treated_pval] = ttest2(untreat_amps,treated_amps); % significance test
treated_is_sig = treated_pval < alpha;
treated_sig_var = sum(treated_latent(treated_is_sig));
treated_sig_var_perc = treated_sig_var / sum(treated_latent) * 100;

% bootstrap
% tic;
sample_pval = NaN(N,d);
sample_var = NaN(N,d);
sample_sig_var = NaN(N,1);
sample_num_sig = NaN(N,1);
for i = 1:N
    sample_amps = datasample(allmice_amps,k); % random subsample
    sample_latent = sum(sample_amps .^ 2) ./ size(sample_amps,1); % compute latents (eigenvalu

    [~,sample_pval(i,:)] = ttest2(untreat_amps,sample_amps); % significance test
    is_sig = sample_pval(i,:) < alpha;

    sample_var(i,:) = sample_latent; % variance per pc
    sample_sig_var(i) = sum(sample_latent(is_sig)); % sum of variance for significant pcs
    sample_num_sig(i) = sum(is_sig); % count of significant pcs
end
% toc

% compute percent variance
sample_var_perc = sample_var ./ sum(sample_var,2) * 100;
sample_sig_var_perc = sample_sig_var ./ sum(sample_var,2) * 100;

% Plot
```

```
figure,boxplot(sample_var_perc), hold on
h1 = plot(1:d, untreat_var_perc, 'dk', 'MarkerSize',6, 'MarkerFaceColor','k');
h2 = plot(1:d, treated_var_perc, 'ok', 'MarkerSize',6);
h3 = plot(find(treated_is_sig), treated_var_perc(treated_is_sig), 'ok', 'MarkerSize',6, 'Marke
xlabel('Principal Components'),ylabel('% variance explained')
legend([h1 h2 h3],{'Control', 'Experimental', 'Experimental (significant)'})
title(sprintf('%s, %s, %s', B.age_name, B.region_desc, B.assay_name))

% default to empirically computed
if isempty(sig_var_perc_thresh); sig_var_perc_thresh = treated_sig_var_perc; end

figure,histogram(sample_sig_var_perc, 'Normalization','probability'),hold on
plot([1 1] * sig_var_perc_thresh, ylim(), 'g-')
xlabel('% variance explained (\Sigma sig pcs)')
title(sprintf('\\mu = %.1f%%, \\sigma = %1.f%%, p > %.1f%% = %g', ...
    mean(sample_sig_var_perc), std(sample_sig_var_perc), ...
    sig_var_perc_thresh, mean(sample_sig_var_perc > sig_var_perc_thresh)))

end
```