STUDY analysis

Task 1

Search STUDY structure

Task 2

Load/plot/use STUDY ERSP data

Task 3

Cluster ERP analysis

Exercise...

STUDY analysis

Task 1

Search STUDY structure

Task 2

Load/plot/use STUDY ERSP data

Task 3

Cluster ERP analysis

Exercise...

STUDY structure details

Question:

How are IC and subject information stored in the STUDY structure?

Understanding STUDY structure

26 = # of clusters

```
>> STUDY.cluster
1x26 struct array with fields:
    parent
    name
    child
    comps
    sets
    algorithm
    centroid
    preclust
    dipole
    selected
    allinds
    setinds
    topo
    topox
    topoy
    topoall
    topopol
```

One cluster:

```
>> STUDY.cluster(6)
ans =
        parent: {'ParentCluster 1'}
          name: 'Cls 6'
         child: []
         comps: [35 7 12 35 10 23 7 30 4 15]
          sets: [3x10 double]
     algorithm: {'Kmeans'  [24]}
      centroid: []
      preclust: [1x1 struct]
        dipole: [1x1 struct]
      selected: 1
       allinds: []
       setinds: []
          topo: [67x67 double]
          topox: [67x1 double]
          topoy: [67x1 double]
       topoall: {1x10 cell}
       topopol: [1 1 1 -1 1 1 1 1 1 1]
```

6 = cluster number

IC indices

3 = # conditions

dataset indices

67 = # of channels

scalp map polarity

Understanding STUDY structure

```
>> STUDY.cluster(6)
ans =
       parent: {'ParentCluster 1'}
         name: 'Cls 6'
        child: []
        comps: [35 7 12 35 10 23 7 30 4 15]
         sets: [3x10 double]
    algorithm: {'Kmeans'  [24]}
     centroid: []
     preclust: [1x1 struct]
       dipole: [1x1 struct]
     selected: 1
      allinds: []
      setinds: []
         topo: [67x67 double]
        topox: [67x1 double]
        topoy: [67x1 double]
     topoall: {1x10 cell}
     topopol: [1 1 1 -1 1 1 1 1 1 1]
```

Which subject?

Which dataset(s)?

Dataset indices

```
>> STUDY.cluster(6).sets

ans =
```

Second IC = second column

2	11	14	… Condition 1
1	10	13	…
3	12	15	…

```
>> STUDY.datasetinfo(11) % access dataset 11
ans =
      filepath: [1x61 char]
      filename: 'Ignore.set'
       subject: 'S04'
       session: []
     condition: 'ignore'
         group: ''
         index: 11
         comps: [1x24 double]
```

Subject 4!

Condition 1

STUDY analysis

Task 1

Search STUDY structure

Task 2

Load/plot/use STUDY ERSP data

Task 3

Cluster ERP analysis

Exercise...

Load data from commandline

```
** Where is the raw data stored?
Data for each subject is stored in the file path
of that subject (STUDY.datasetinfo(subj).filepath)
** What is it called?
File name format:  'setname.extension'
extension = '.ica*' or '.dat*' (for channel data)
for example:
Memorize.icaerp  % ERP data
Memorize.icaersp % ERSP data
Memorize.icaitc  % ITC data
Memorize.icaspec % Power spectrum data
Memorize.icatopo % Scalp map data

% Example of channel data file name:
Memorize.daterp  % ERP data
```

Load individual ERSPs

```
% load ERSP data for all ICs in a single cluster:
clust = 5; % choose a cluster
cond = 1; % choose experimental condition
[STUDY logersp timevals logfreqs pgroup pcond pinter] = …
std_erspplot(STUDY,ALLEEG,'clusters',clust, 'plotsubjects', 'off' );
```

```
% Check imported variables in workspace:
>> whos logersp
  Name          Size                Bytes
Class    Attributes

  logersp       3x1               1983216  cell

>> logersp
logersp =
    [72x153x15 single]
    [72x153x15 single]
    [72x153x15 single]
```

frequency x times x ICs

Load individual ERSPs

```
% Check imported variables in workspace:
>> whos logersp
  Name          Size                Bytes
Class    Attributes

  logersp      3x1               1983216  cell


>> logersp
logersp =
    [72x153x15 single]
    [72x153x15 single]
    [72x153x15 single]
```

frequency x times x ICs

Plot individual ERSPs

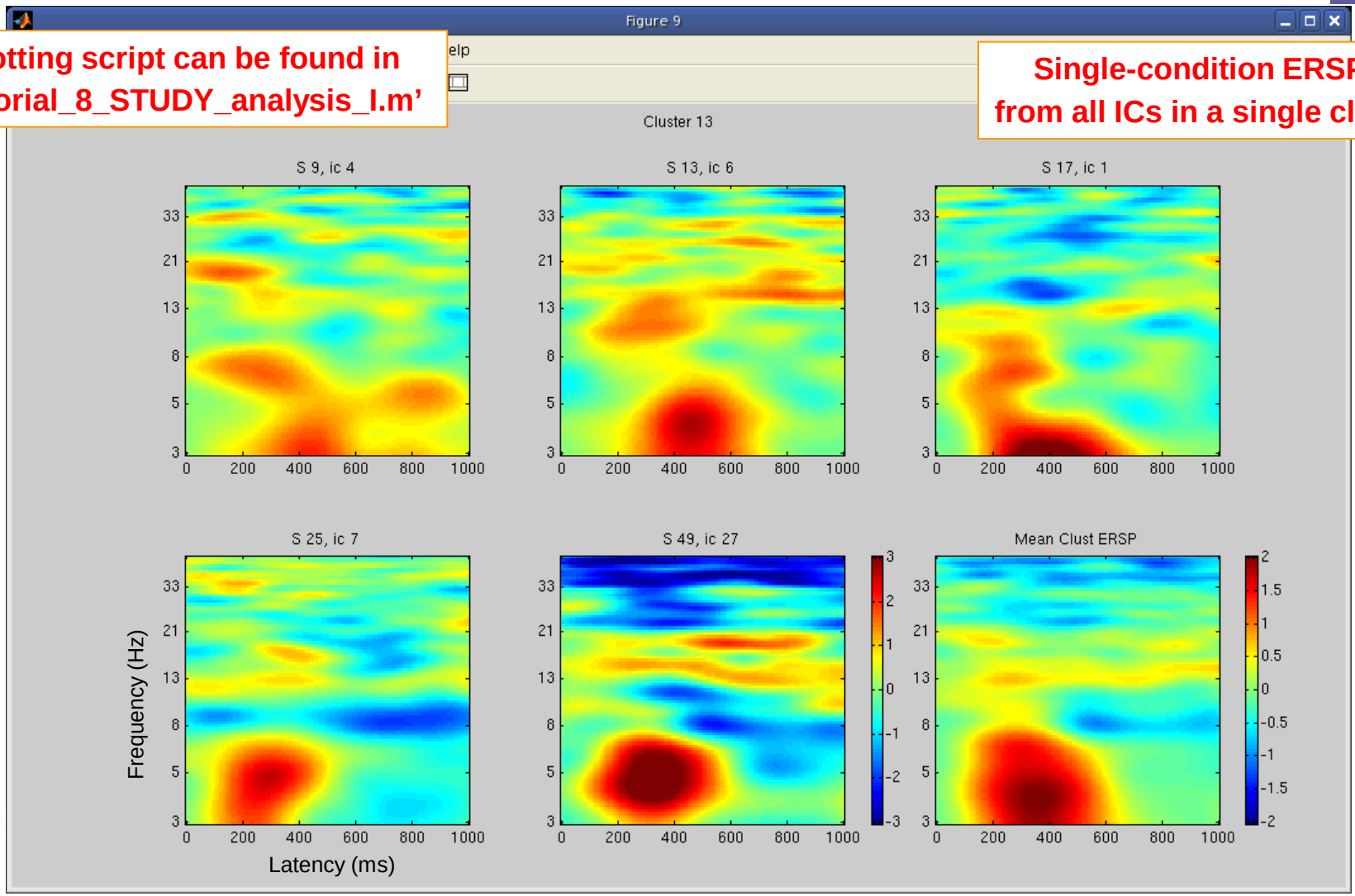
```
% load ERSP data for all ICs in a single cluster:
clust = 5; % choose a cluster
cond = 1; % choose experimental condition

[STUDY logersp timevals logfreqs pgroup pcond pinter] = …
std_erspplot(STUDY,ALLEEG,'clusters',clust, 'plotsubjects', 'on' );
% or plot them yourself from output:
figure; clim = 3; % standardize color limits
for ic = 1:size(logersp{cond},3)
    sbplot(row,col,ic);
    imagesclogy(timevals, logfreqs, logersp{cond}(:,:,ic));
    set(gca,'clim', [-clim clim]); % adjust the color limits
    set(gca,'ydir','norm'); % plot low freqs at the bottom
    title(['IC ',int2str(STUDY.cluster(clust).comps(ic))]);
end;
textsc(['Cluster ',int2str(clust)],'title');
cbar; % include a colorbar
```

PLOT individual ERSPs

Plotting script can be found in 'Tutorial_8_STUDY_analysis_I.m'

Single-condition ERSPs from all ICs in a single cluster



Raw data files

```
% Load *raw* ERSP data

load_string = 'C:…\workshop\STUDY\S01\Memorize.icaersp';

ERSPdata = load('-mat',load_string); % .mat format!
```

Raw data structure

```
>> ERSPdata

comp1_ersp: [100 x 200 single]
comp1_erspbase: [1 x 100 single]
comp1_erspboot: [100 x 2 single]
comp2_ersp: [100 x 200 single]
comp2_erspbase: [1 x 100 single]
comp2_erspboot: [100 x 2 single]
freqs: [1 x 100 double]
times: [1 x 200 double]
datatype: 'ERSP'
parameters: {1 x 26 cell}
datafile: [1 x 57 char]

>>
```

ERSP dB data → comp1_ersp

dB baseline → comp1_erspbase

bootstrap limits → comp1_erspboot

100 frequency bins → freqs

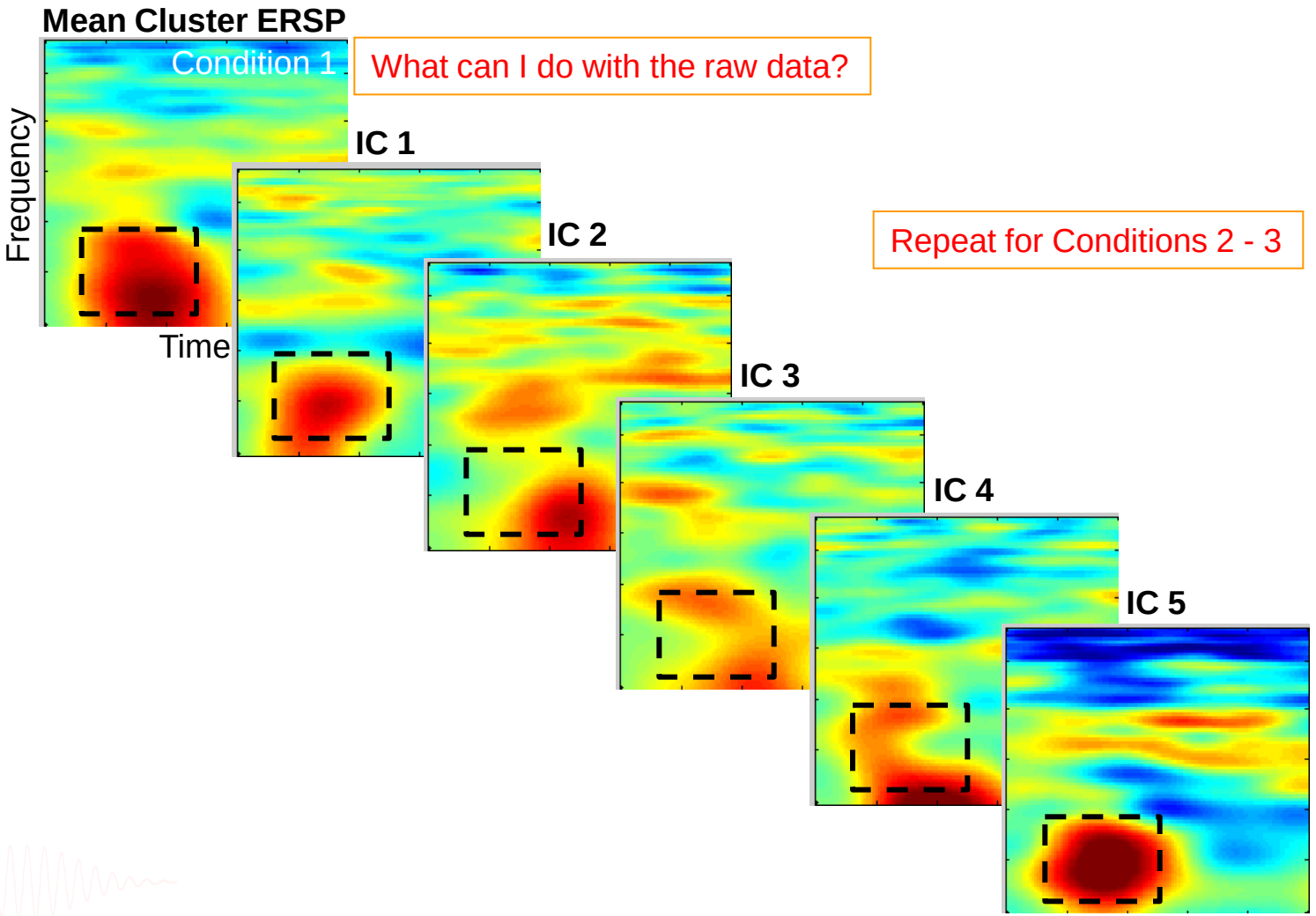
200 time points → times

200 time points

upper and lower bootstrap limits

100 frequency bins

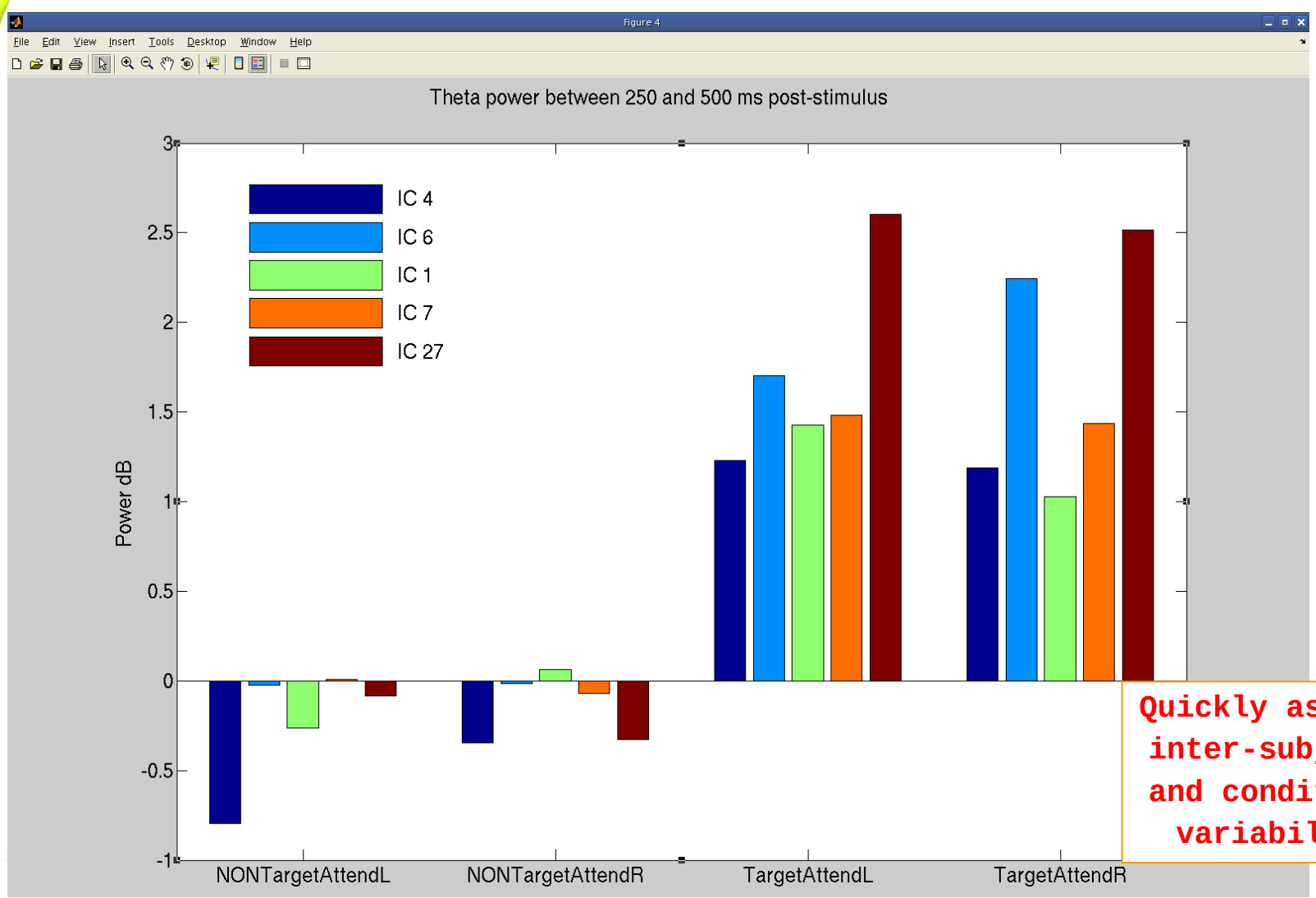
Use STUDY ERSP data for analysis



What can I do with the raw data?

Repeat for Conditions 2 - 3

Mean theta power across conditions



Quickly assess inter-subject and condition variability

STUDY analysis

Task 1

Search STUDY structure

Task 2

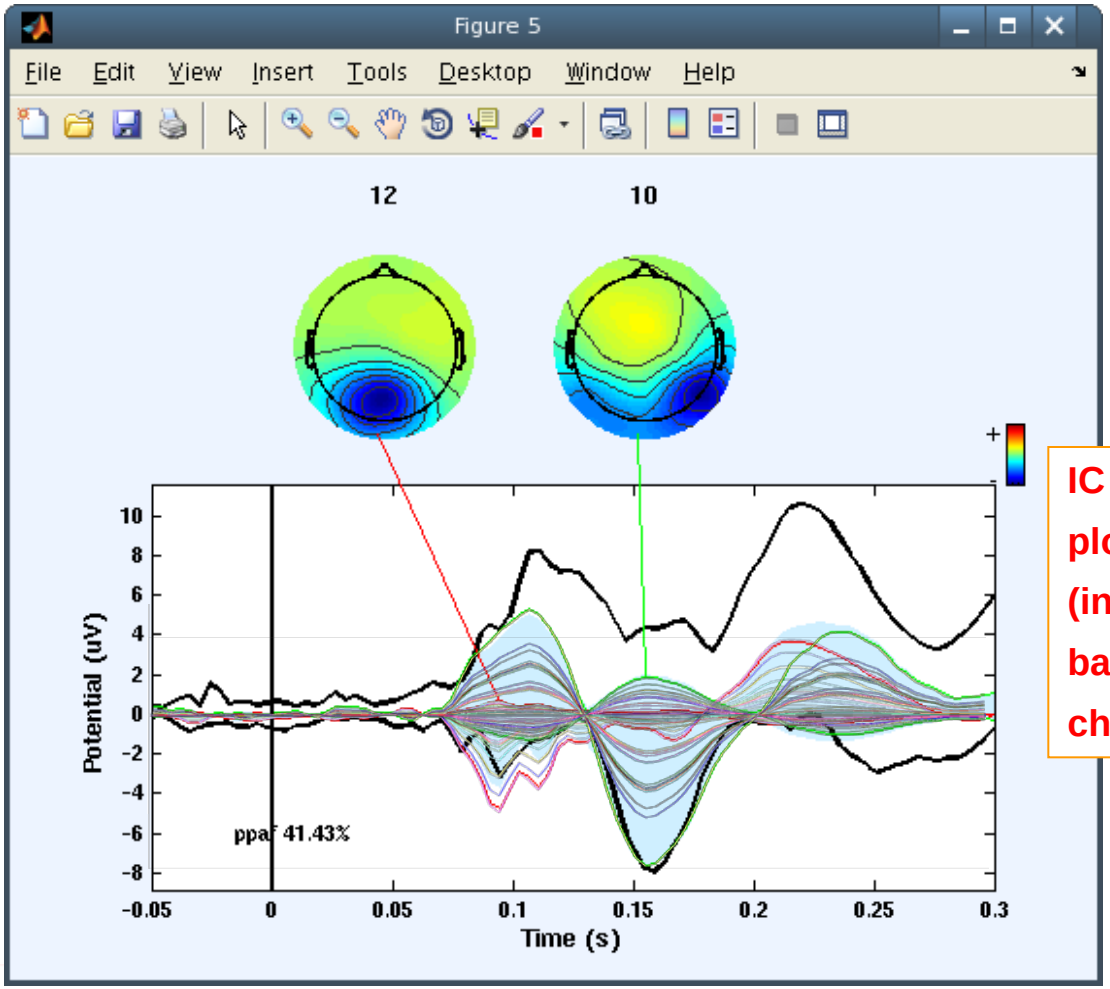
Load/plot/use STUDY ERSP data

Task 3

Cluster ERP analysis

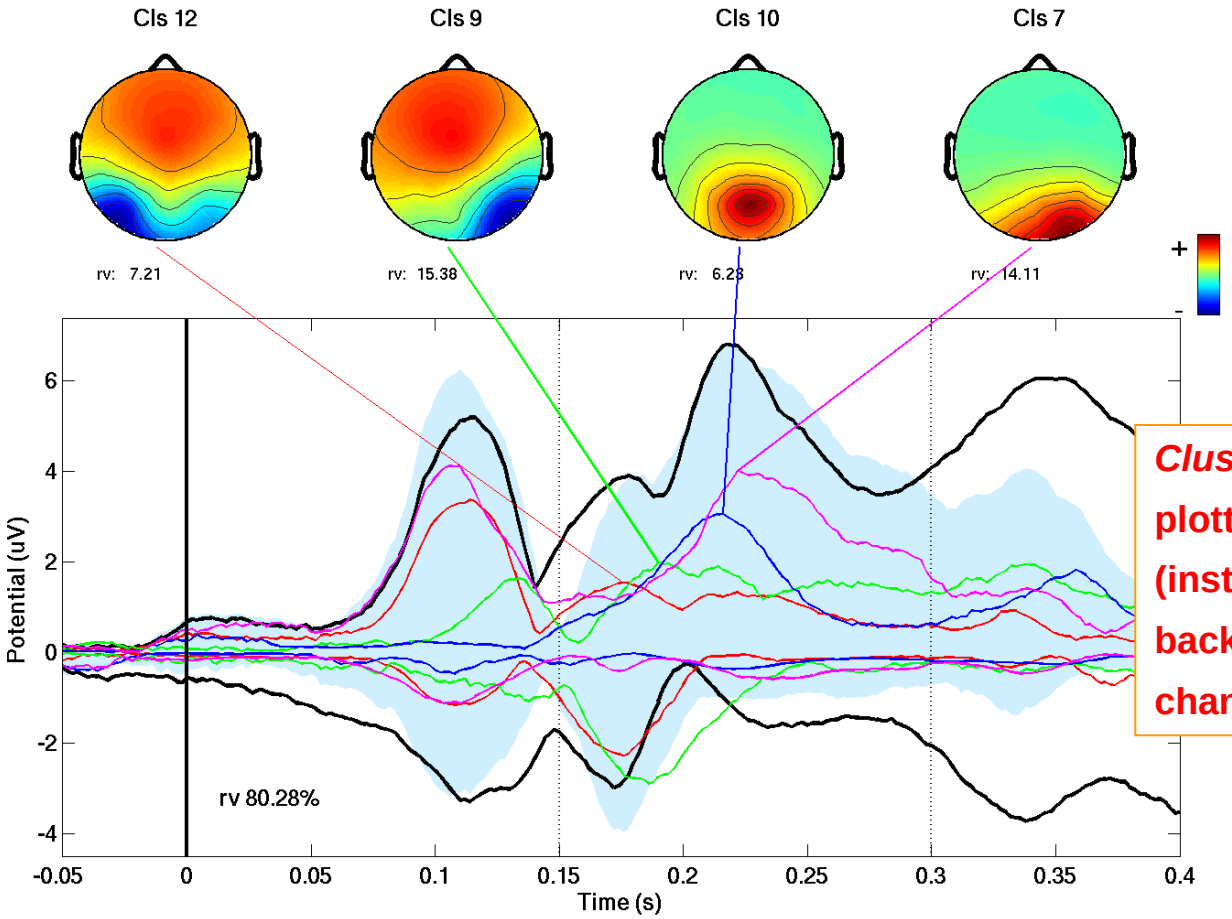
Exercise...

REVIEW: Single-subject IC ERP envelope



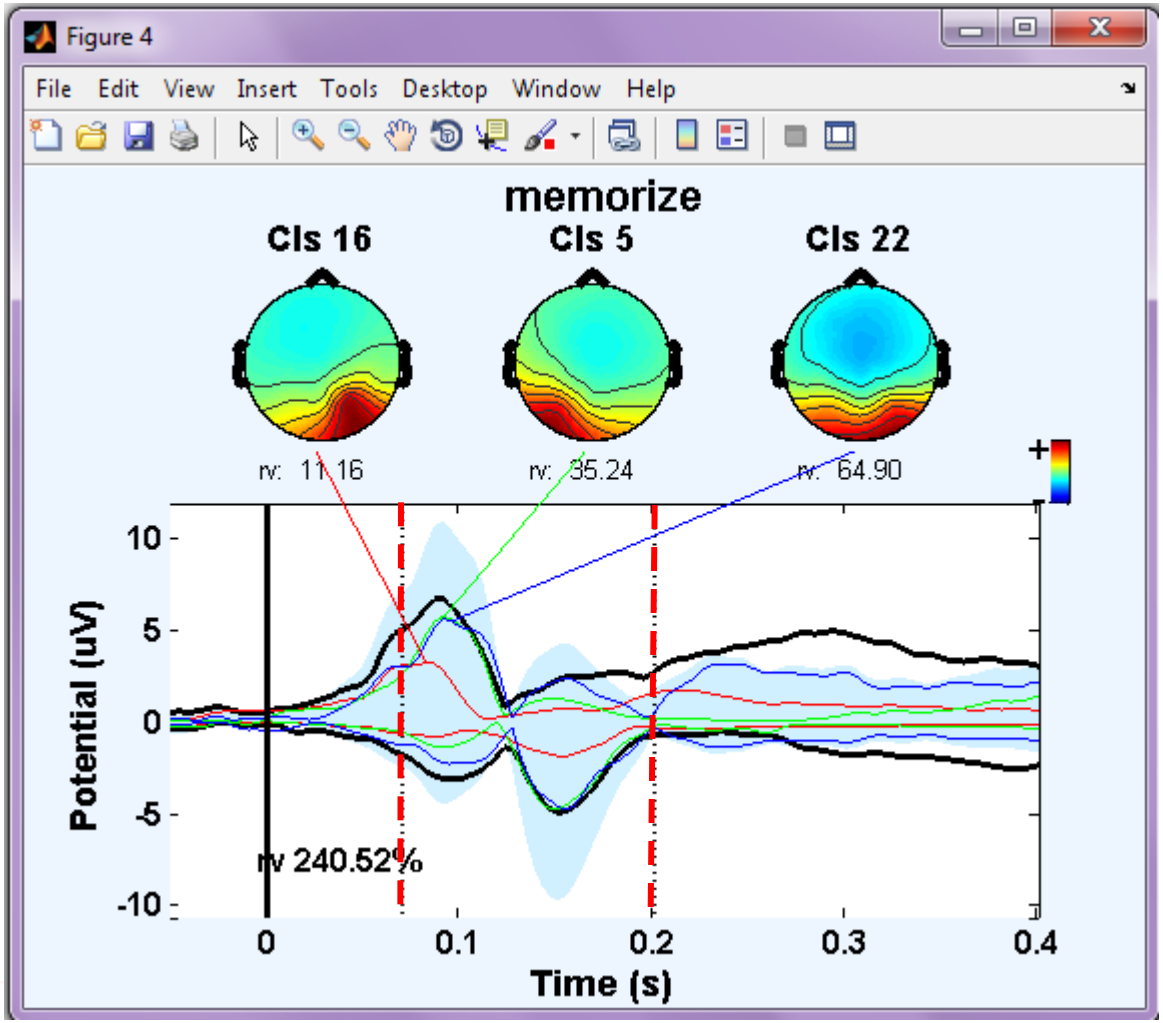
IC envelopes plotted for simplicity (instead of all back-projected channels)

STUDY Cluster ERP analysis

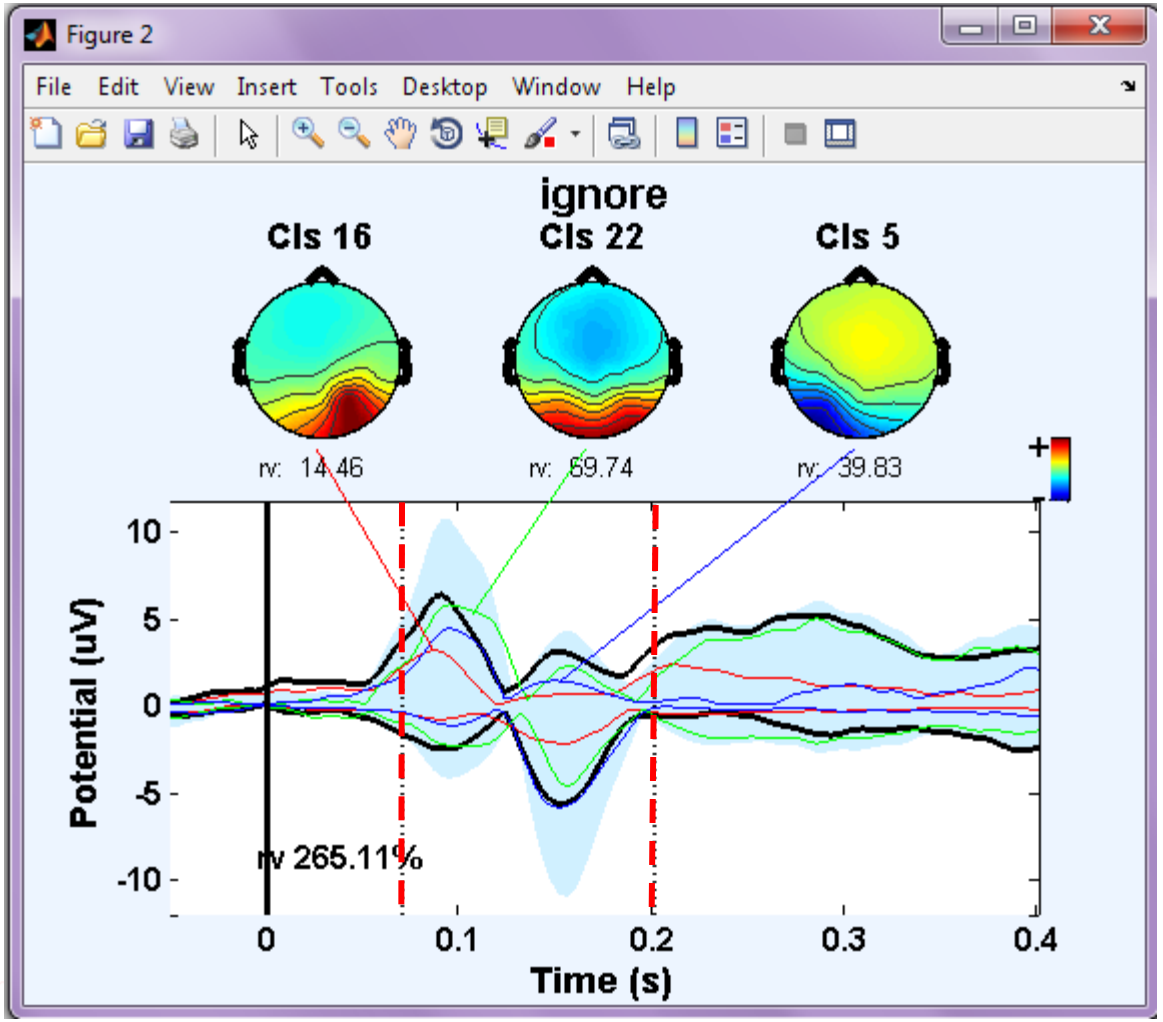


***Cluster* envelopes plotted for simplicity (instead of all back-projected channels)**

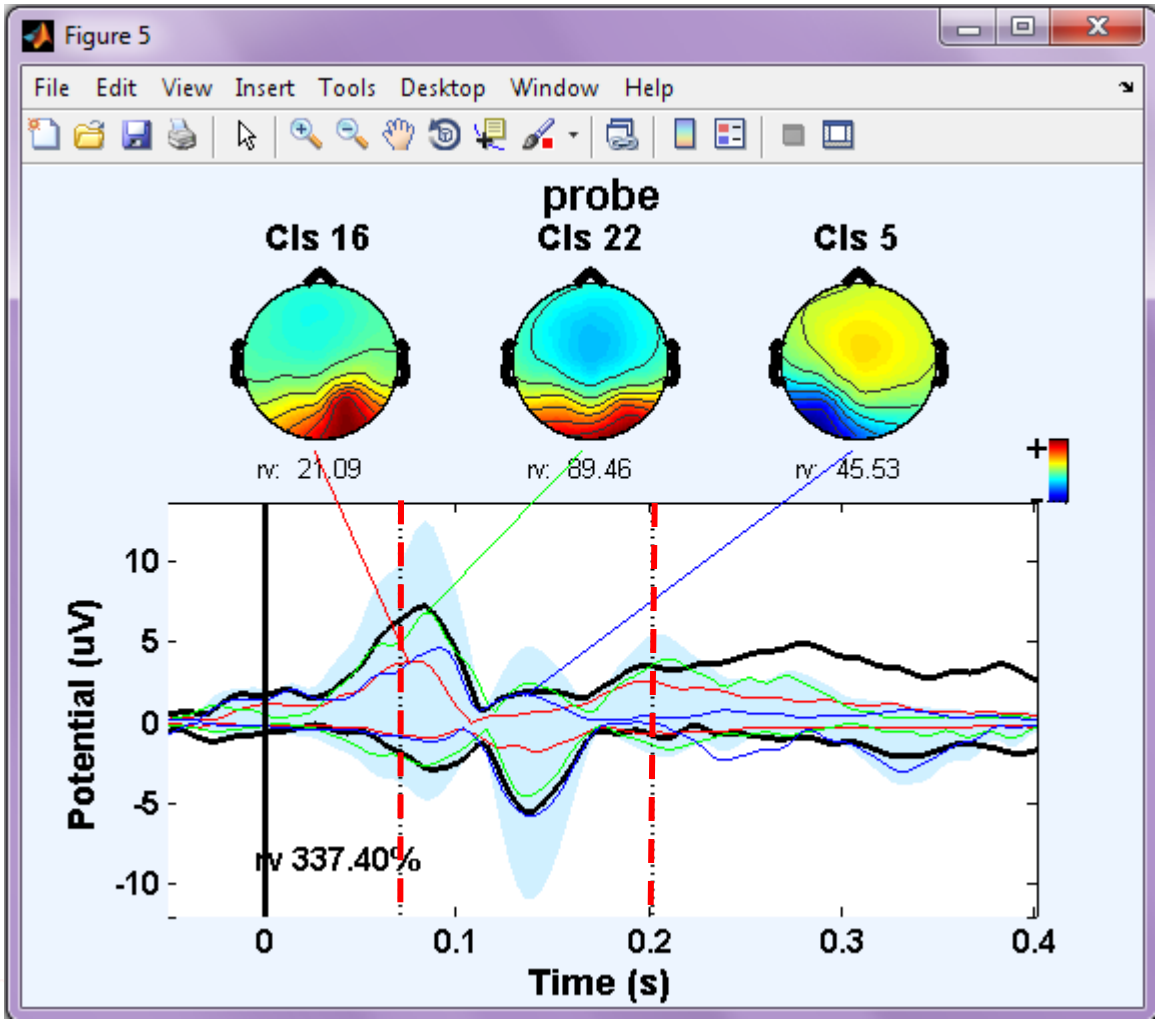
Largest early ERP contributors (Memorize)



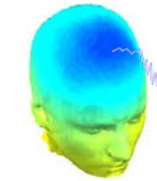
Largest early ERP contributors (Ignore)

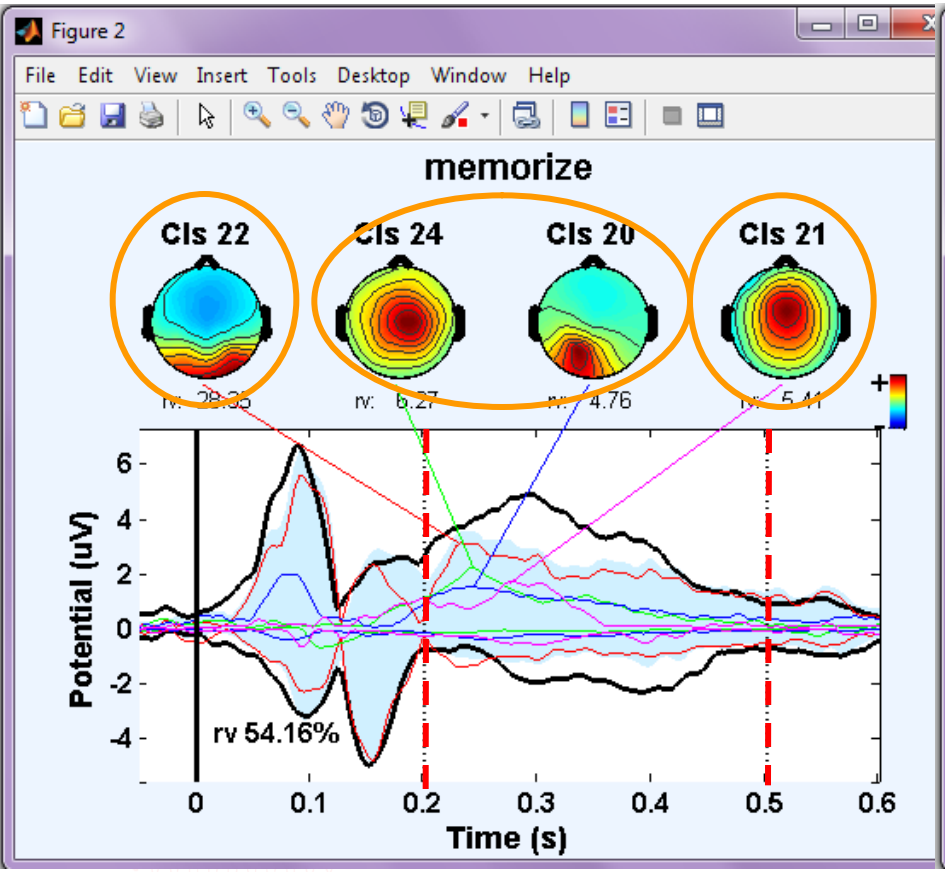


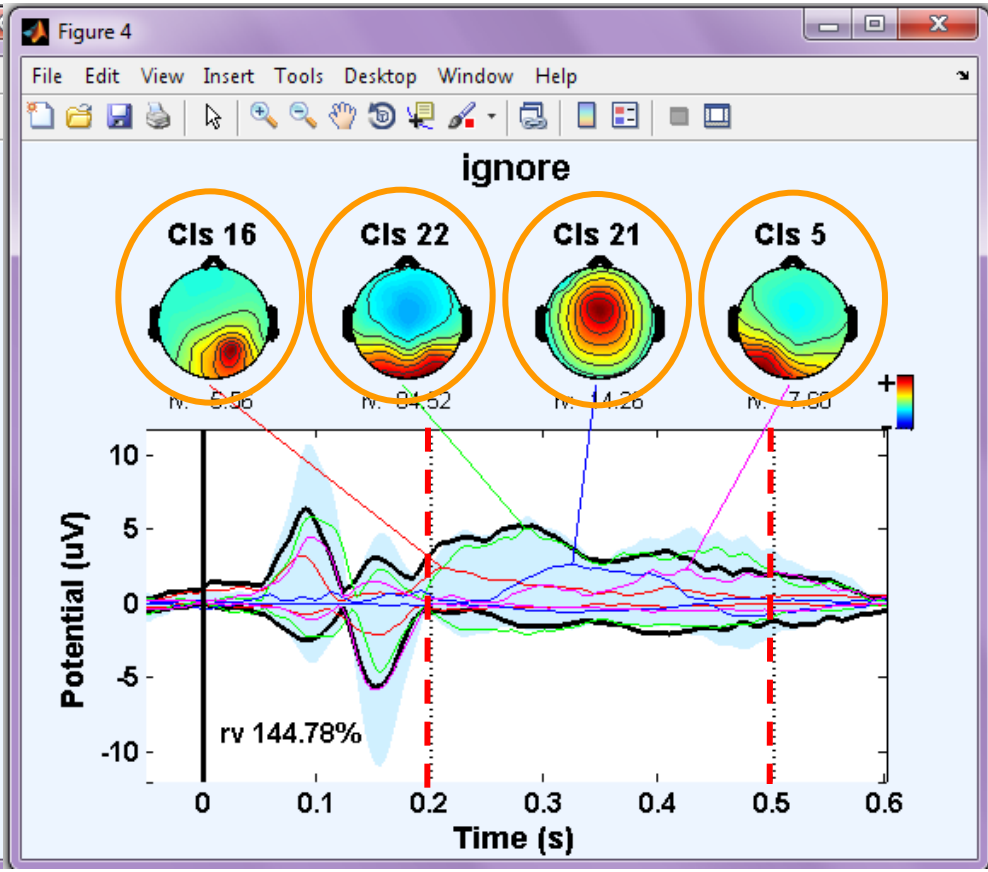
Largest early ERP contributors (Probe)



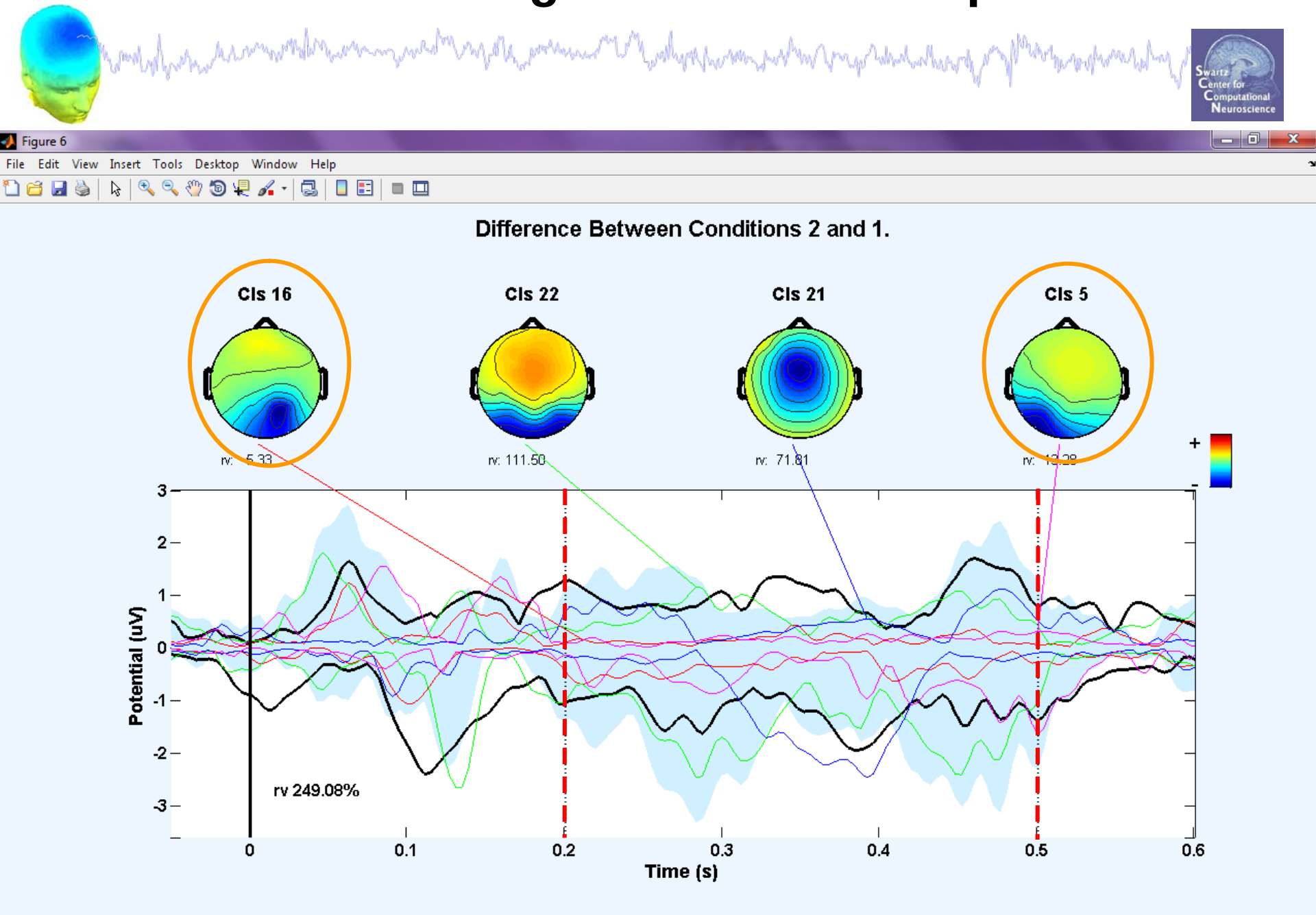
Memorize and Ignore ERP envelopes







Memorize-Ignore ERP envelopes



Exercise

- **ALL**
  - Load workshop STUDY

- **Novice**
  - Load and plot individual ERSPs for one or more clusters.
  - How consistent are the ERSPs in these clusters?

- **Intermediate**
  - Choose a cluster to investigate
  - Plot mean power in a small time/frequency window across all ICs and conditions for this cluster

- **Advanced**
  - Plot cluster ERP (std_envtopo) and compare with ERP image

  (this function is still under construction and cannot be used at this time)

** All scripts for Intermediate/Advanced exercises can be found in …/Scripts/Tutorial_8_STUDY_analysis_I.m

STUDY analysis

Task 1

Search STUDY structure

Task 2

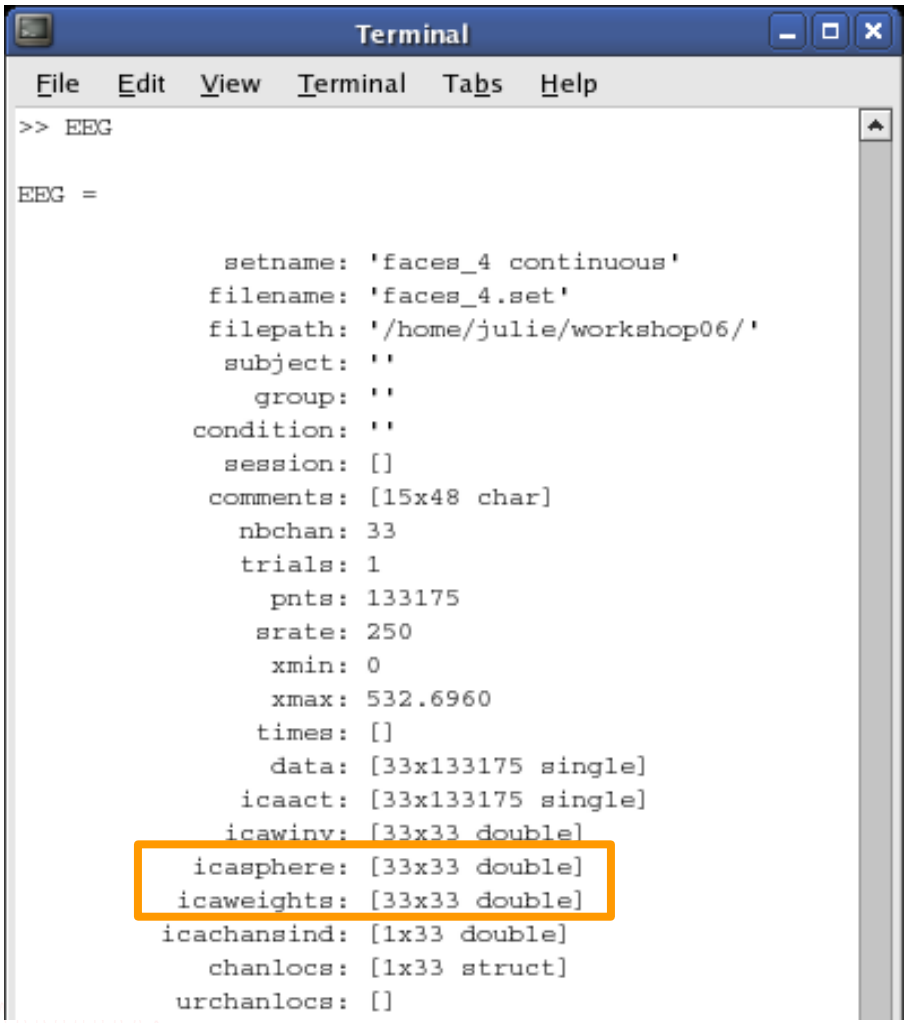
Load/plot/use STUDY ERSP data

Task 3

Alternative: saving ICA weights and applying to another .set

Exercise...

ICA weights are stored in EEG structure

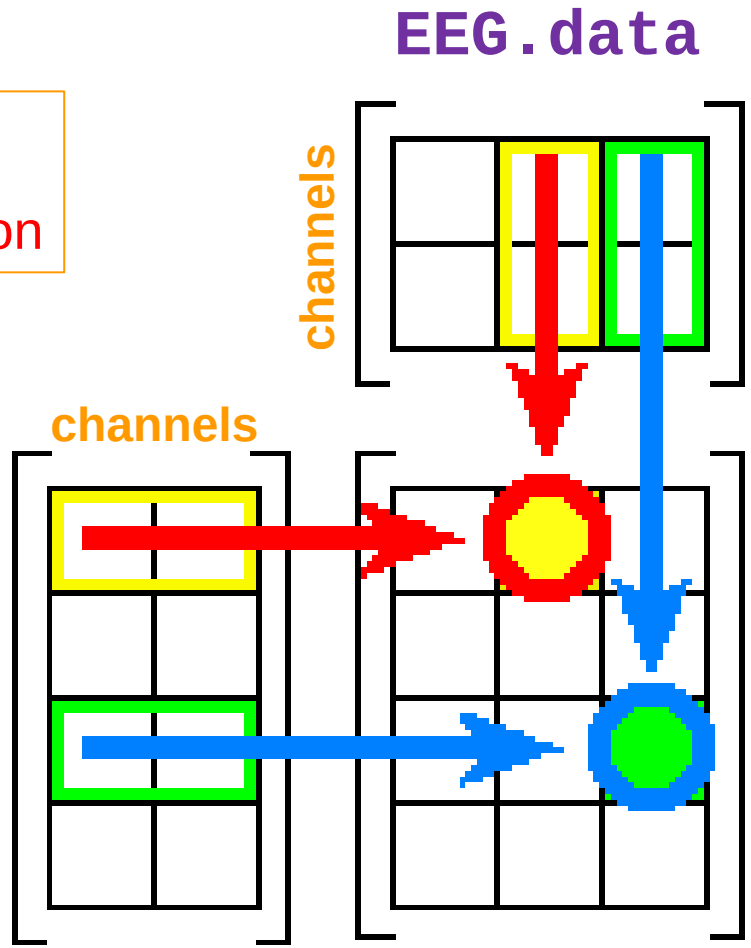


ICA weights can be applied to other datasets acquired during the same session with the ***same electrode placement***.

`EEG.icaact = (EEG.icaweights*EEG.icasphere)*EEG.data`

Applying ICA weights to EEG data

matrix multiplication



Saving/applying ICA weights

```
>> wts = EEG.icaweights;
>> sph = EEG.icasphere;
>> save subj1_ICA_Weights.mat wts sph
% close EEGLAB dataset and open another
% dataset from same subject and same day
% If you also closed matlab, load the .mat file:
>> load subj1_ICA_Weights.mat wts sph
>> EEG.icaweights = wts;
>> EEG.icasphere = sph;
>> % delete old activations and scalp maps, if present
>> EEG.icaact = []; EEG.icawinv = [];
% recalculate acts and winv
>> EEG.icaact = eeg_getdatact(EEG,…
                        'component',[1:size(EEG.data,1)]);
```