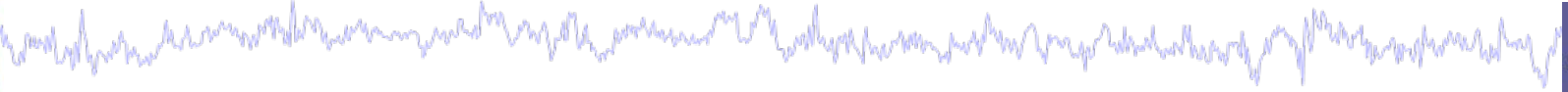


# STUDY analysis



## Task 1

Search STUDY structure

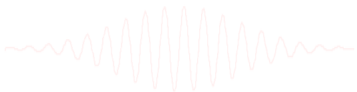
## Task 2

Load/plot/use STUDY ERSP data

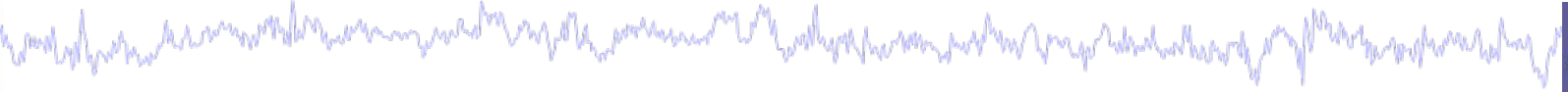
## Task 3

Cluster ERP analysis

**Exercise...**



# STUDY analysis



## Task 1

Search STUDY structure

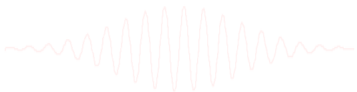
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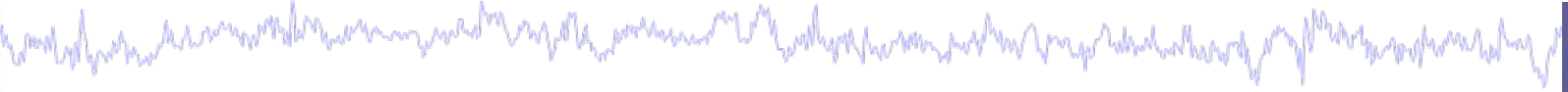
## Task 3

Cluster ERP analysis

**Exercise...**

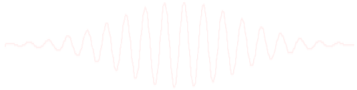


# STUDY structure details



**Question:**

**How is the IC and subject information  
stored in the STUDY structure?**



# Understanding STUDY structure



26 = # of clusters

One cluster:

```
>> STUDY.cluster
```

1x26 struct array with fields:

parent  
name  
child  
comps  
sets  
algorithm  
centroid  
preclust  
dipole  
selected  
allinds  
setinds  
topo  
topox  
topoy  
topoall  
topopol

```
>> STUDY.cluster(6)  
ans =
```

6 = cluster number

parent: {'ParentCluster 1'}

name: 'Cls 6'

child: []

3 = # conditions

IC indices

comps: [35 7 12 35 10 23 7 30 4 15]

sets: [3x10 double]

dataset indices

algorithm: {'Kmeans' [24]}

centroid: []

preclust: [1x1 struct]

dipole: [1x1 struct]

selected: 1

allinds: []

67 = # of channels

setinds: []

topo: [67x67 double]

topox: [67x1 double]

topoy: [67x1 double]

topoall: {1x10 cell}

topopol: [1 1 1 -1 1 1 1 1 1 1]

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]
```

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	...

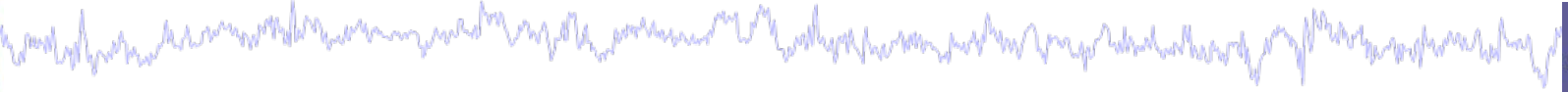
```
>> STUDY.datasetinfo(11) % access dataset 11
ans =
```

```
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

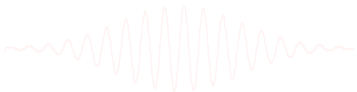
## Task 2

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 ERSF 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)
```

```
    subplot(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))]);
```

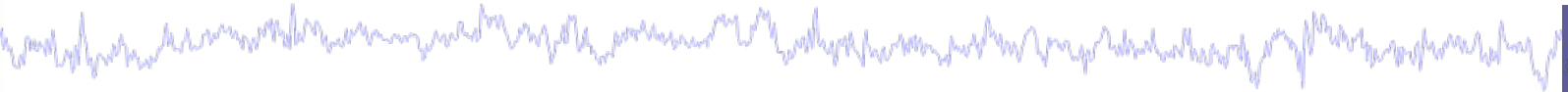
```
end;
```

```
textsc(['Cluster ',int2str(clust)], 'title');
```

```
cbar; % include a colorbar
```



# Load individual ERSPs



**% Check imported variables in workspace:**

```
>> whos logersp
```

Name	Size	Bytes
Class	Attributes	
logersp	3x1	1983216 cell

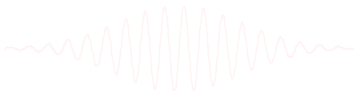
```
>> logersp
```

```
logersp =
```

```
[72x153x15 single]
```

```
[72x153x15 single]
```

```
[72x153x15 single]
```

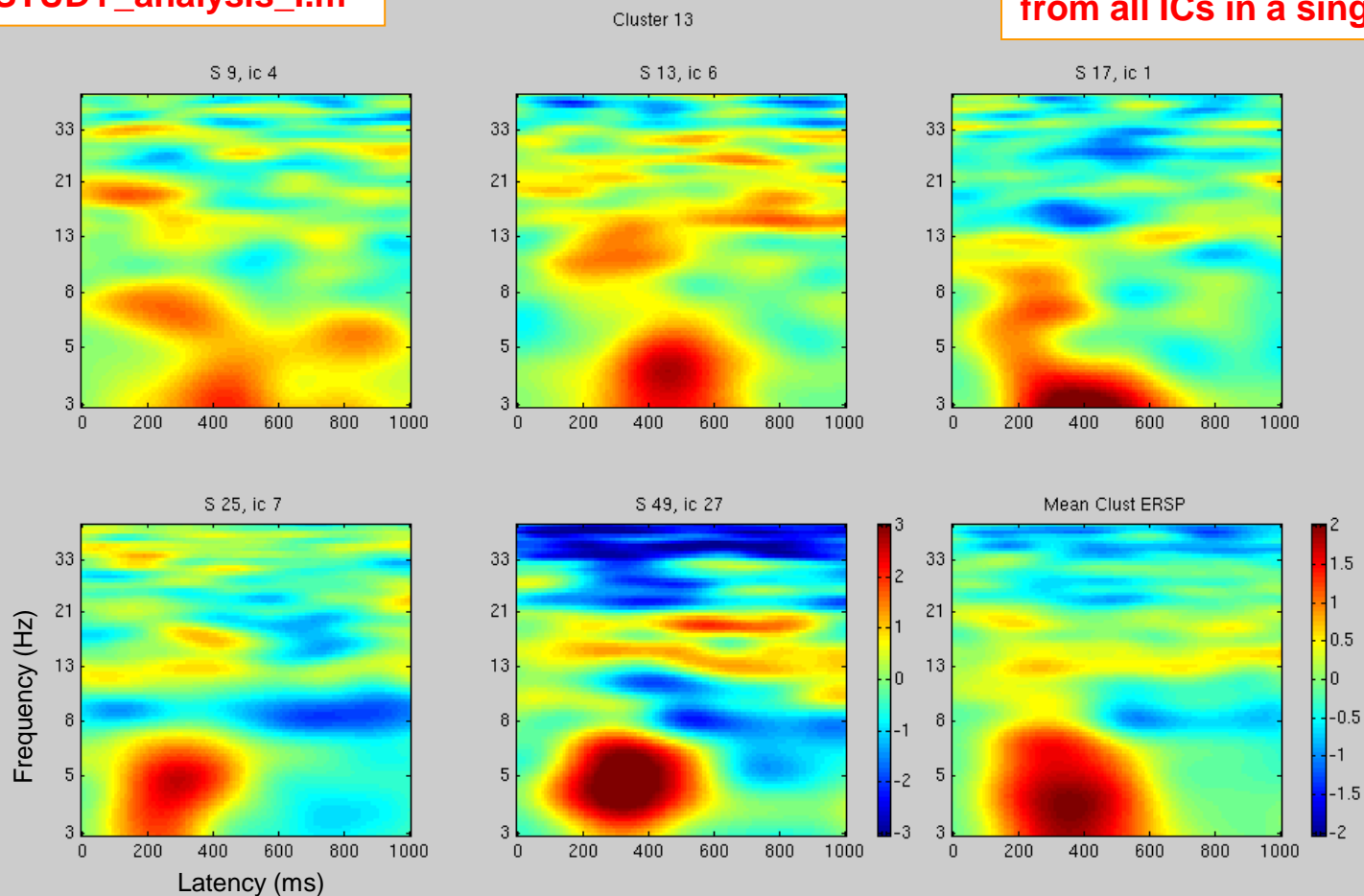


# PLOT individual ERSPs

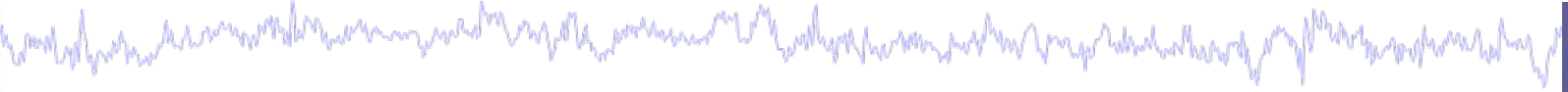


Plotting script can be found in  
'Tutorial\_8\_STUDY\_analysis\_1.m'

Single-condition ERSPs  
from all ICs in a single cluster



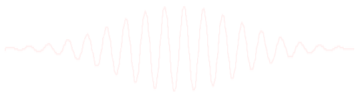
# Raw data files



```
% Load *raw* ERSP data
```

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

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



# Raw data structure

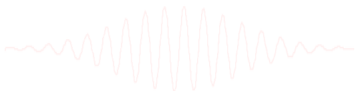


```
>> ERSPdata
```

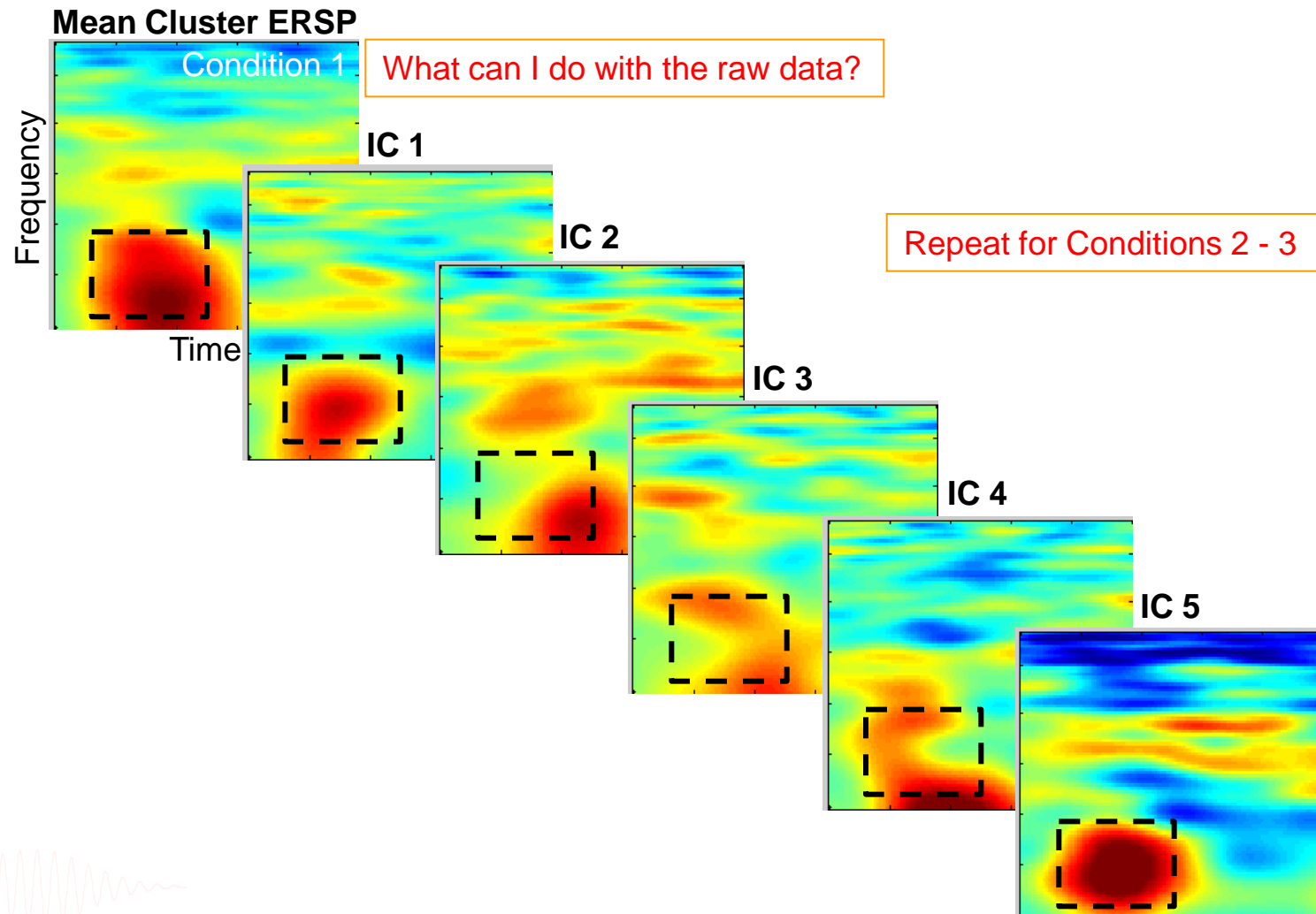
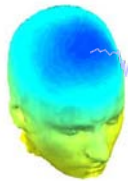
```
ERSP dB data → comp1_ersp: [100 x 200 single]
dB baseline → comp1_erspbase: [1 x 100 single] → 200 time points
bootstrap limits → comp1_erspboot: [100 x 2 single] → upper and lower bootstrap limits
                  comp2_ersp: [100 x 200 single]
                  comp2_erspbase: [1 x 100 single] → 100 frequency bins
                  comp2_erspboot: [100 x 2 single]
100 frequency bins → freqs: [1 x 100 double]
200 time points → times: [1 x 200 double]

                datatype: 'ERSP'
                parameters: {1 x 26 cell}
                datafile: [1 x 57 char]
```

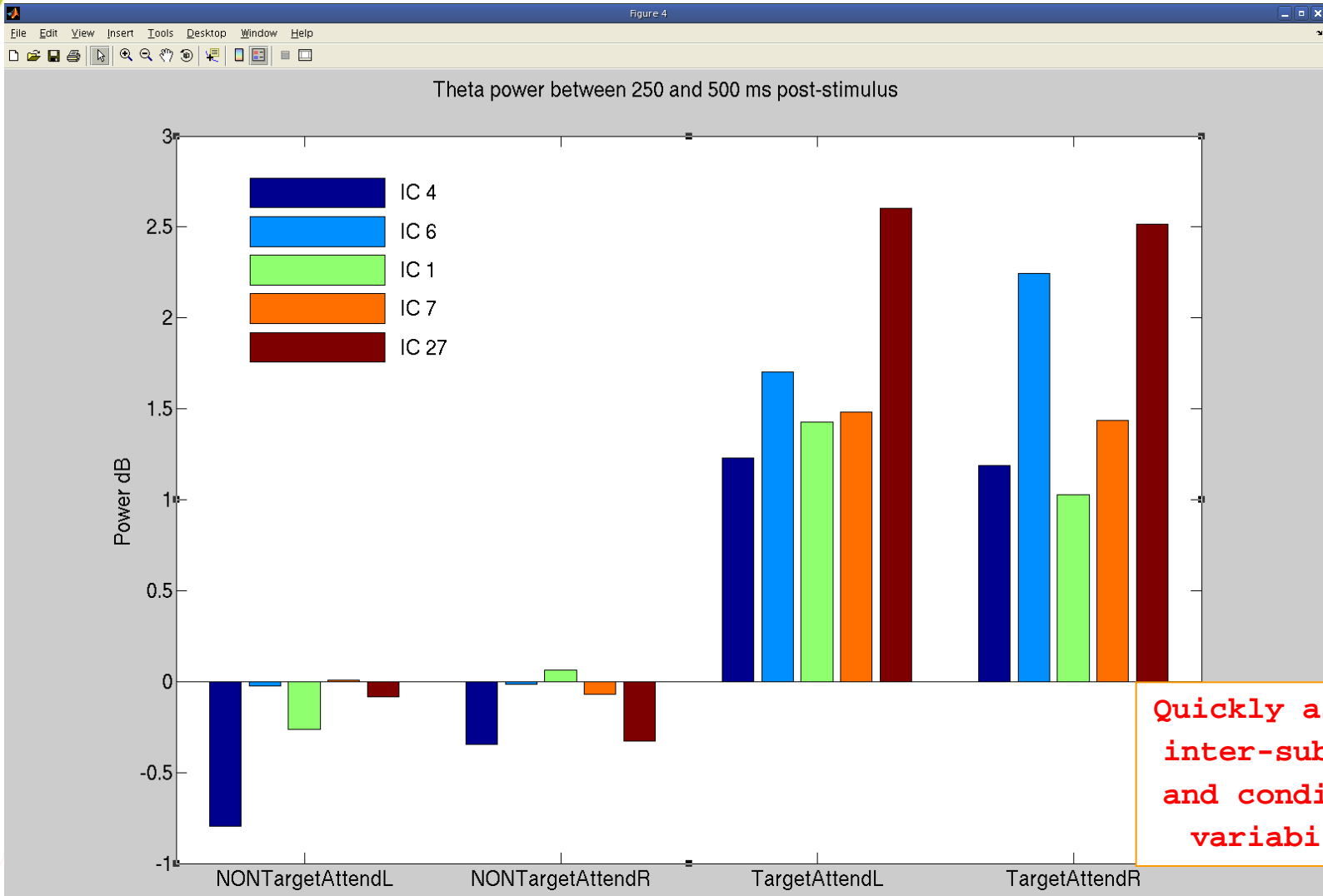
```
>>
```



# Use STUDY ERSP data for analysis

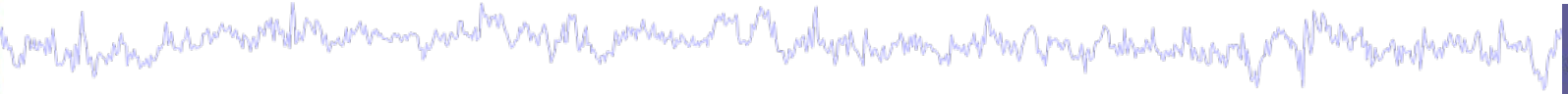


# Mean theta power across conditions



Quickly assess  
inter-subject  
and condition  
variability

# STUDY analysis



## Task 1

Search STUDY structure

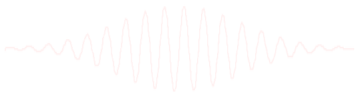
## Task 2

Load/plot/use STUDY ERSP data

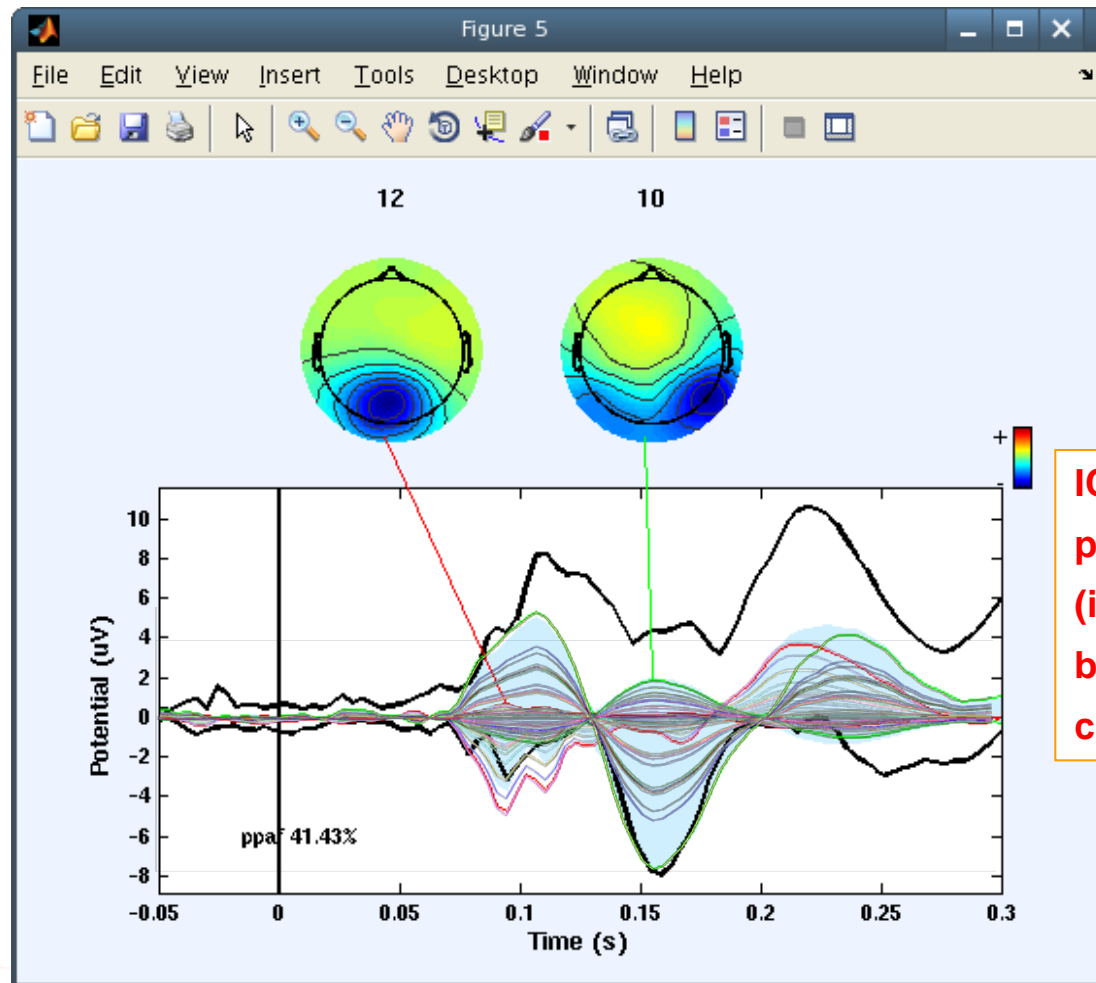
## Task 3

Cluster ERP analysis

**Exercise...**



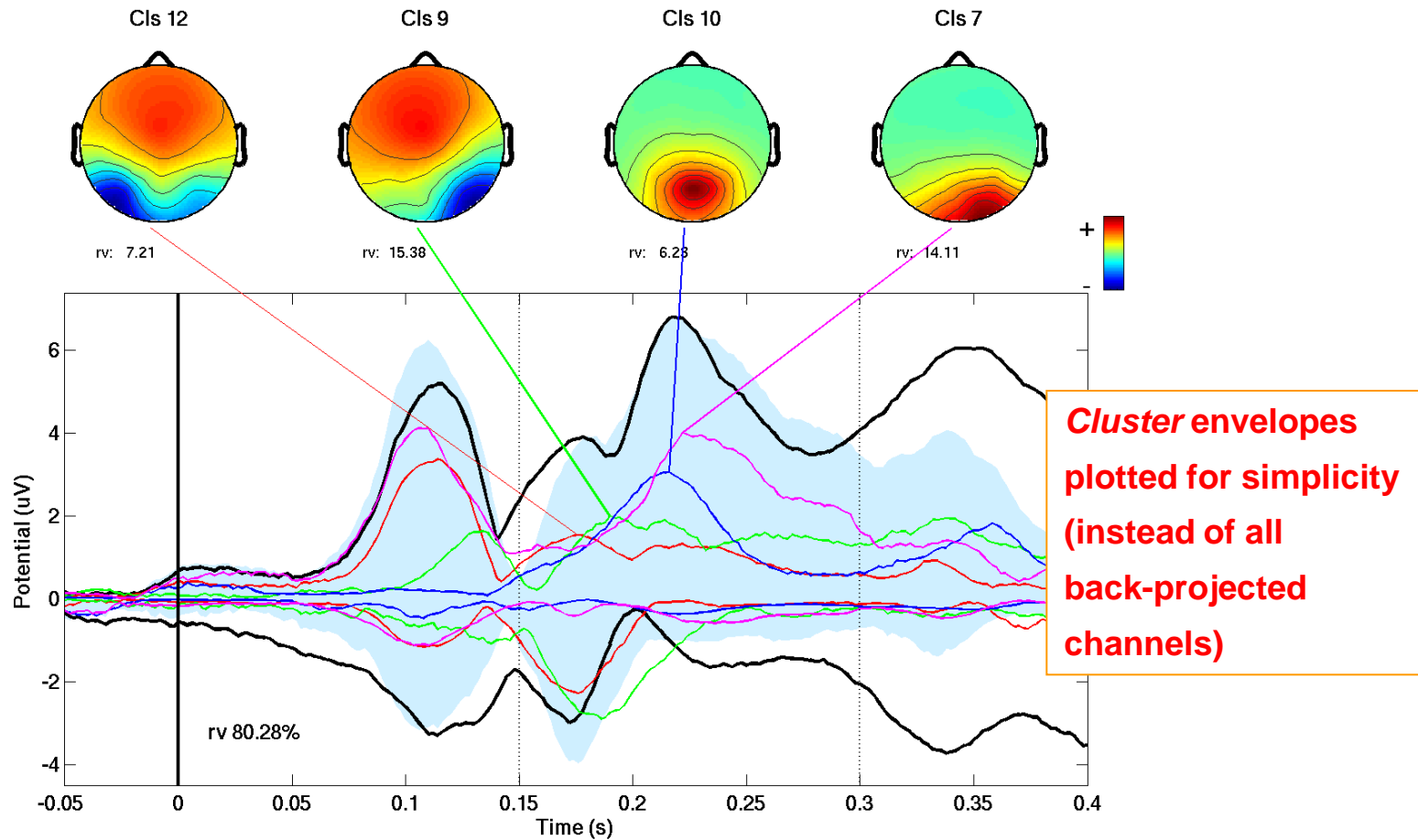
# REVIEW: Single-subject IC ERP envelope



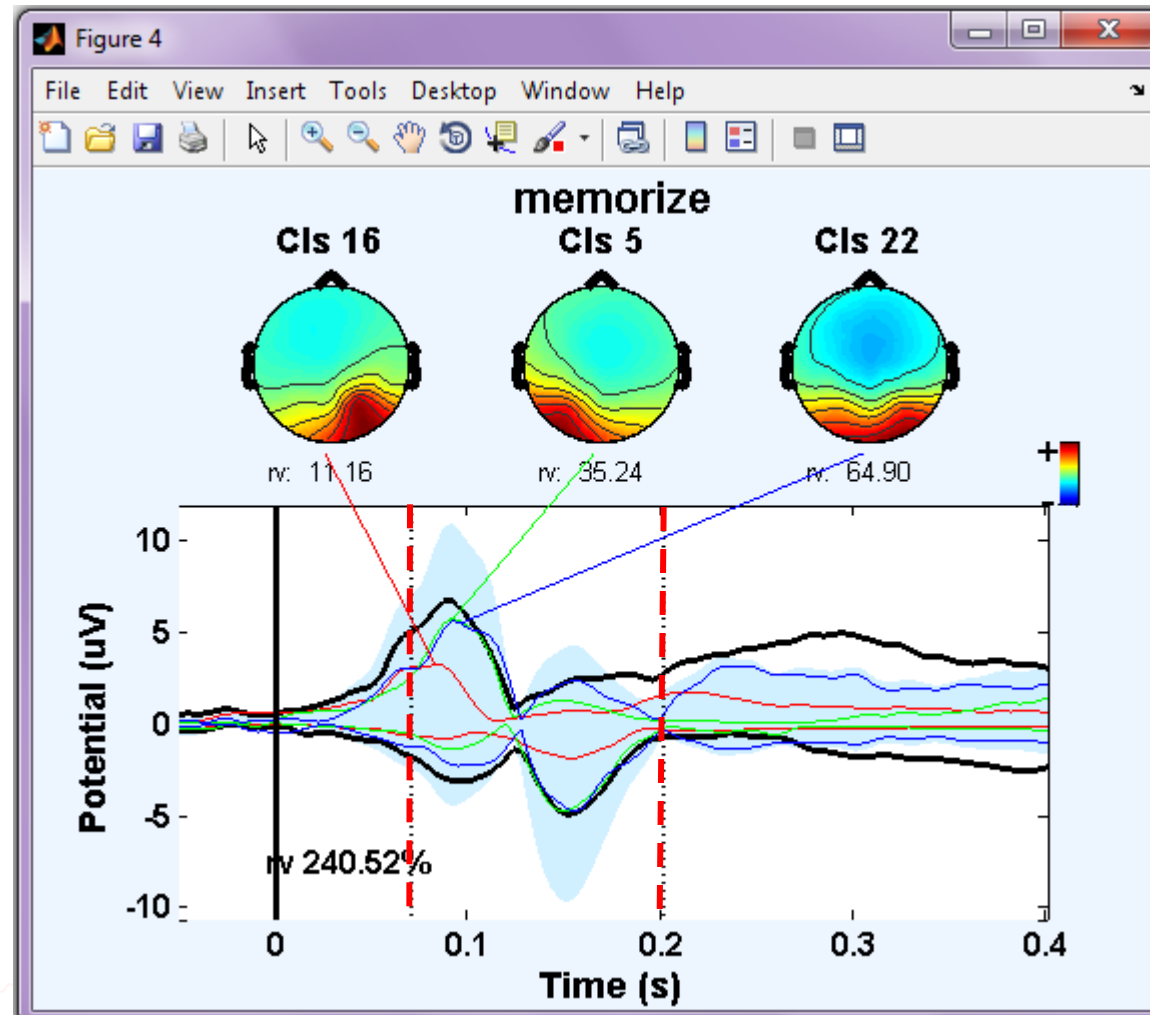
**IC envelopes  
plotted for simplicity  
(instead of all  
back-projected  
channels)**



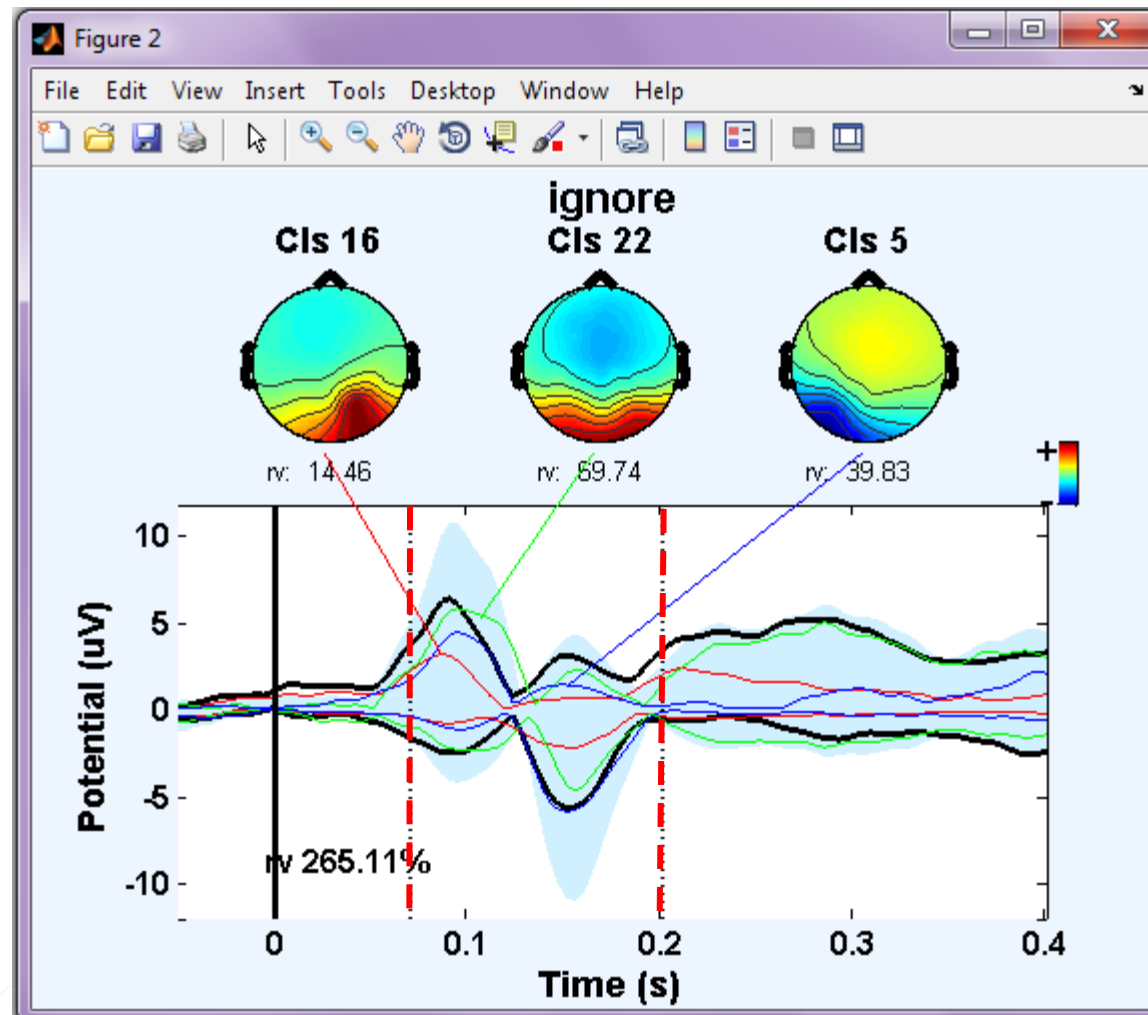
# STUDY Cluster ERP analysis



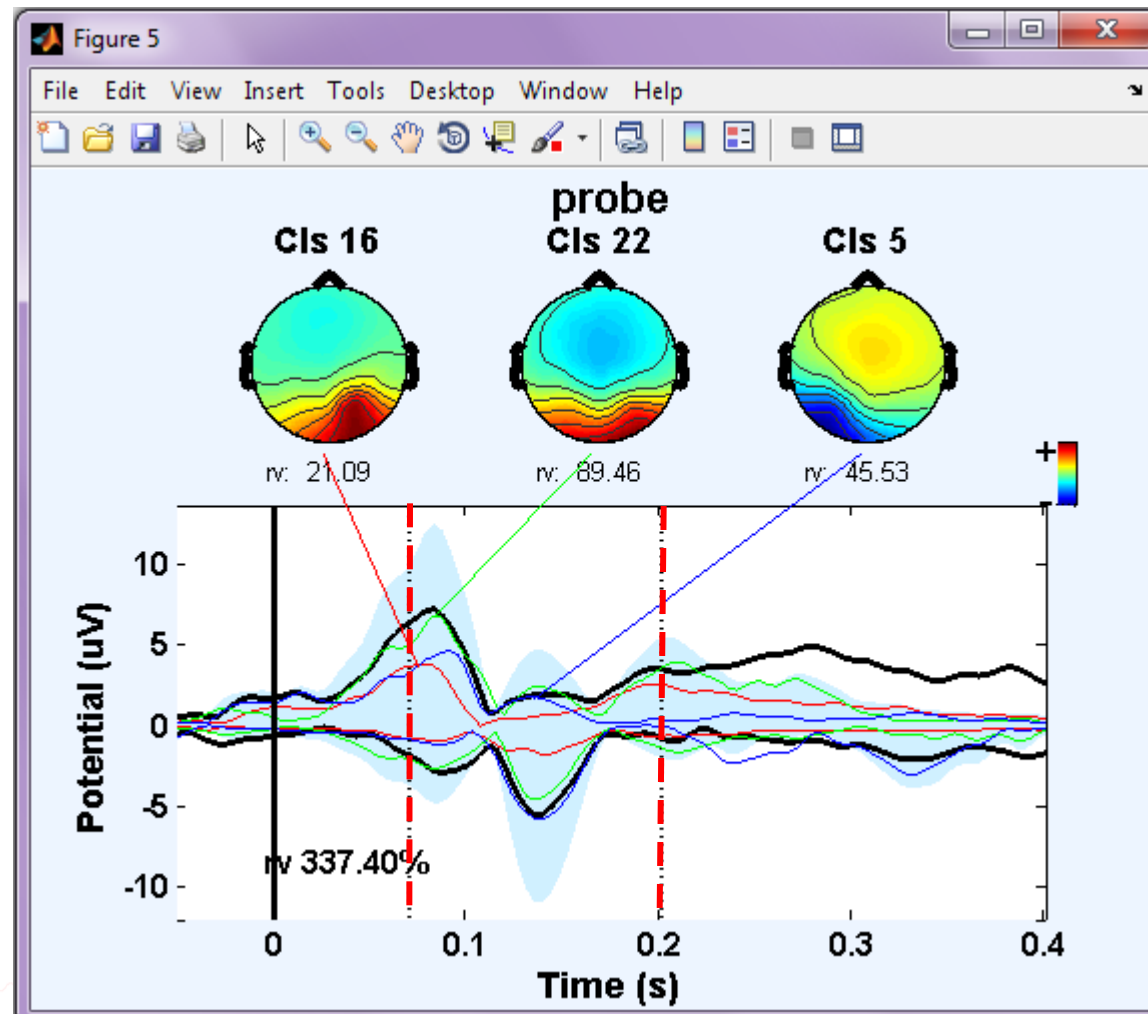
# Largest early ERP contributors (Memorize)



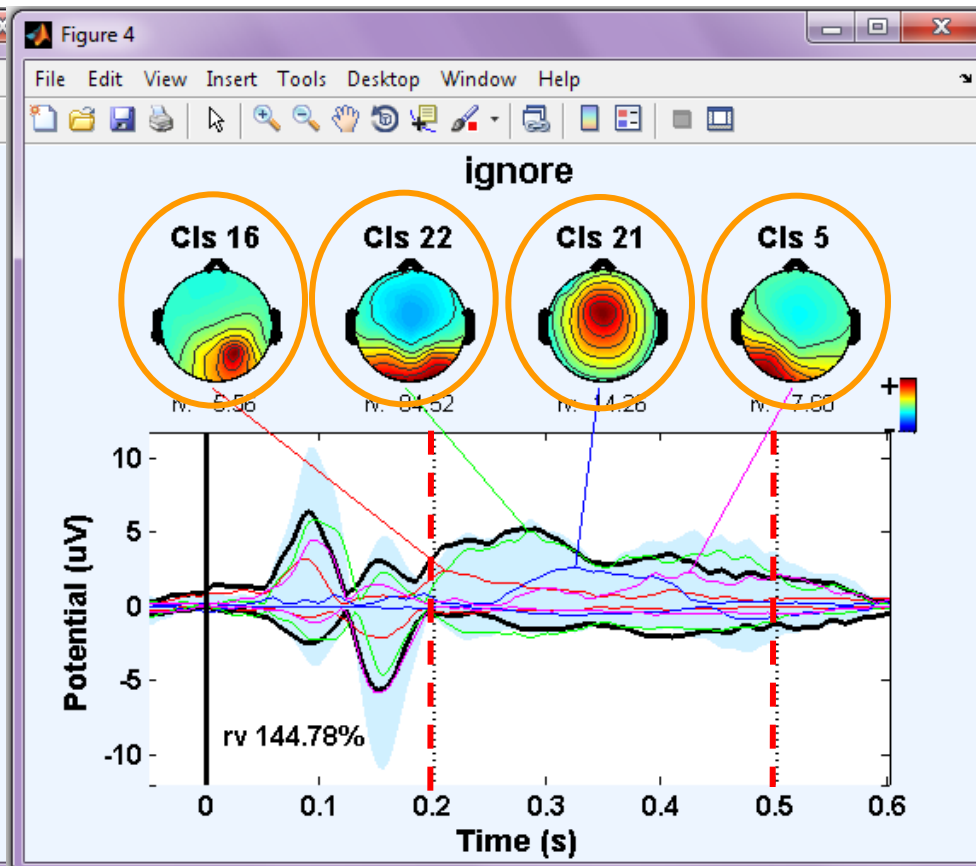
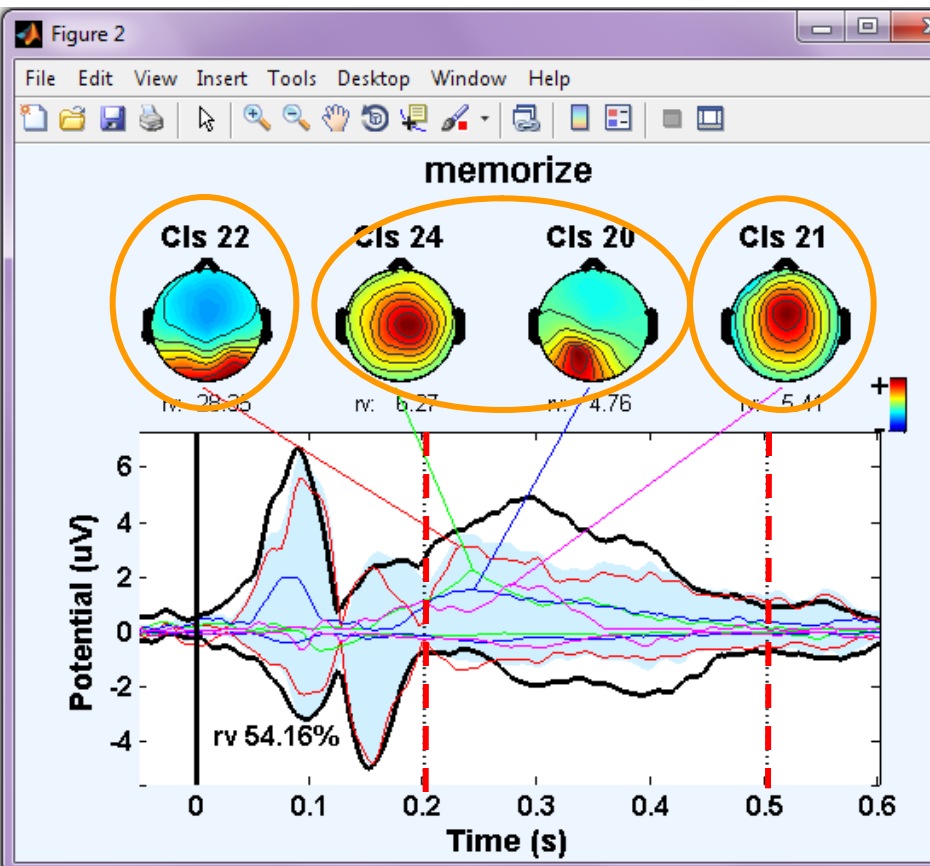
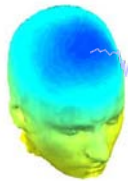
# Largest early ERP contributors (Ignore)



# Largest early ERP contributors (Probe)



# Memorize and Ignore ERP envelopes



# Memorize-Ignore ERP envelopes

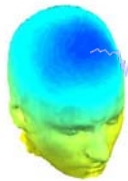
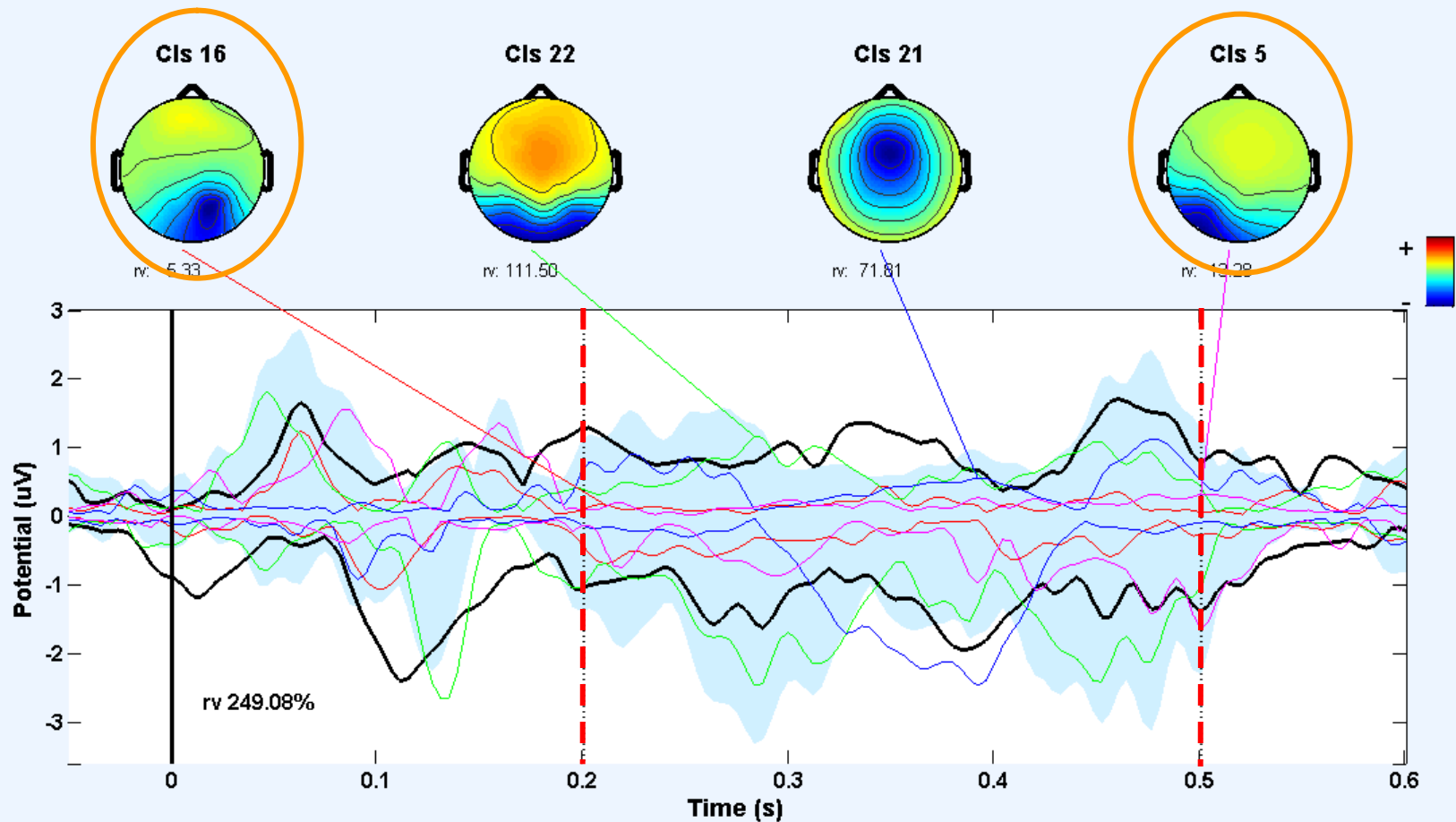


Figure 6

File Edit View Insert Tools Desktop Window Help



Difference Between Conditions 2 and 1.



# Script to run std\_envtopo()



% std\_envtopo variables:

plotlims = [-50 600]; % x-axis limits

tmlims = [200 500]; % selection window

bsln = [-100 0]; % subtract uV baseline

conddiffs = [2 1]; % 2 minus 1

artifact\_cls = [13];

plot\_clusters = -4; % 4 largest

% std\_envtopo function call:

std\_envtopo(STUDY,ALLEEG,...

'clustnums', plot\_clusters, 'env\_erp', 'contrib',...

'only\_clust', 'on', 'timerange', plotlims, ...

'subclus', artifact\_cls, 'limcontrib', tmlims,...

'baseline', bsln, 'diff', conddiffs);

std\_envtopo() script can  
be found in Tutorial\_8\_STUDY\_analysis\_1.m  
(std\_envtopo is currently under construction  
but check back soon...)

# 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**
  - Pick 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

\*\* All scripts for Intermediate/Advanced exercises can be found in  
.../workshop/Scripts/Tutorial\_8\_STUDY\_analysis\_1.m

