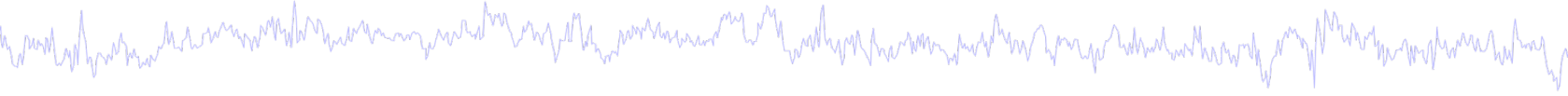
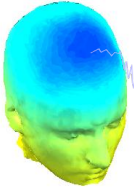


# STUDY design and plotting overview



## STEP 1

Build a STUDY

## STEP 2

Build design(s)

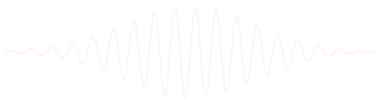
## STEP 3

Precompute the data

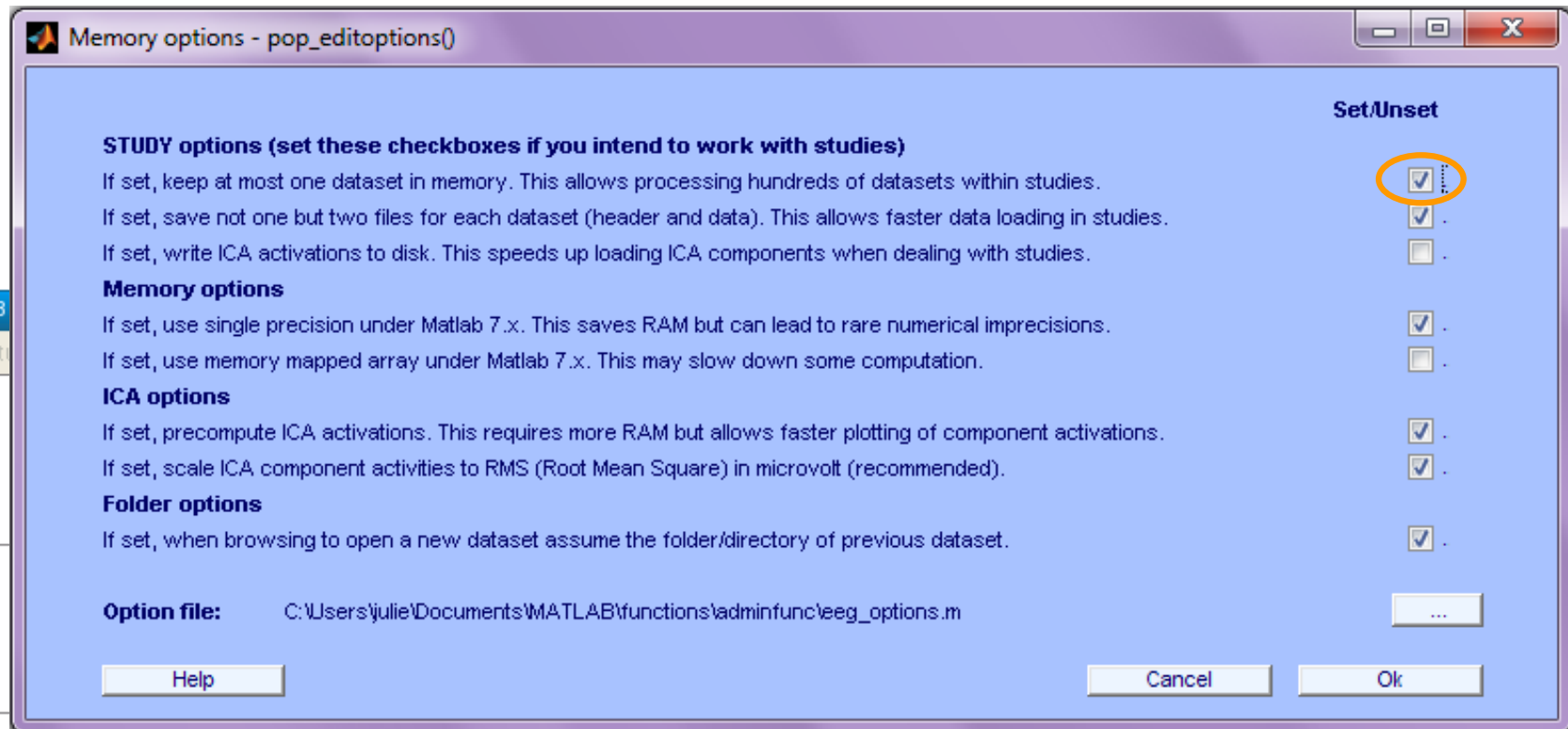
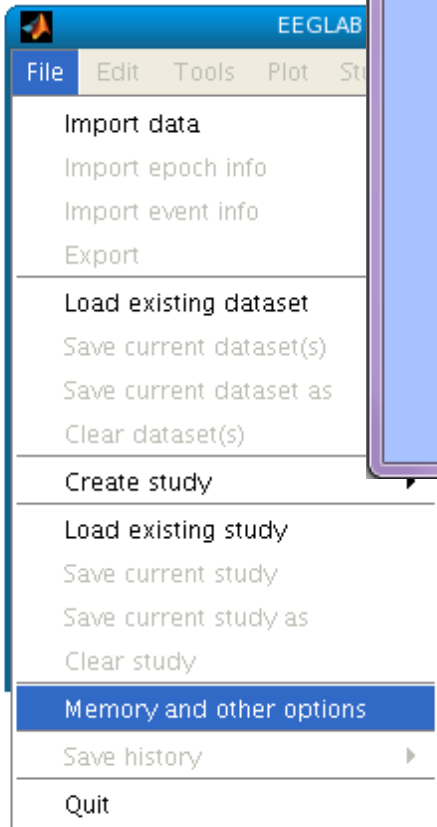
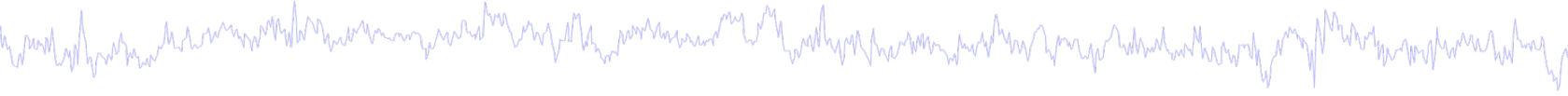
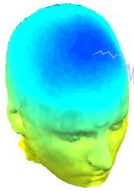
## STEP 4

Plot the data

**Exercise...**

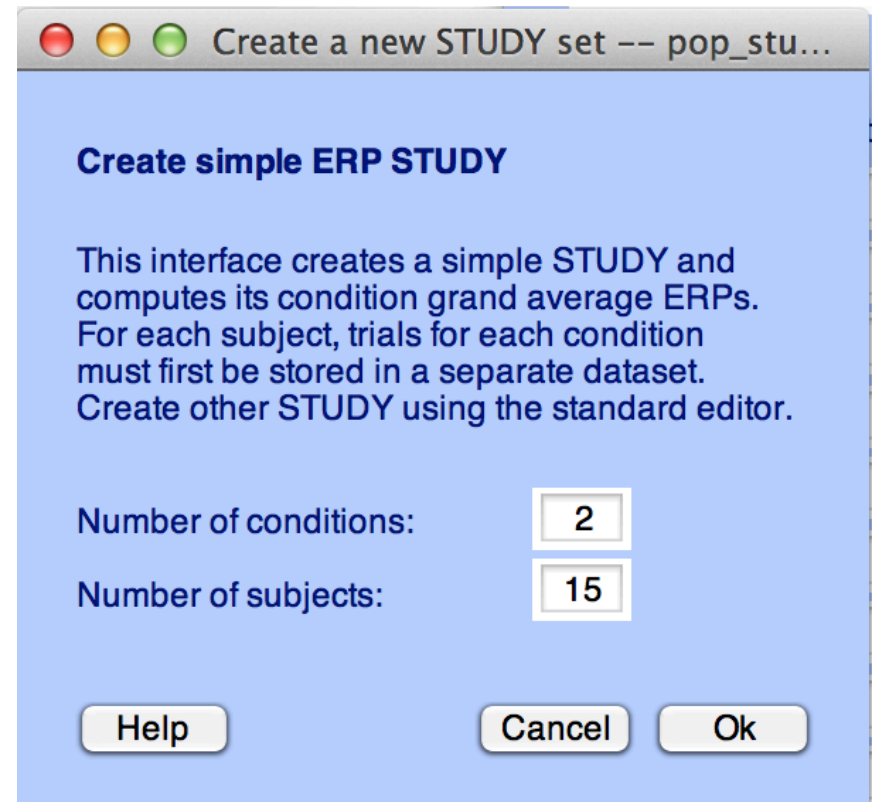
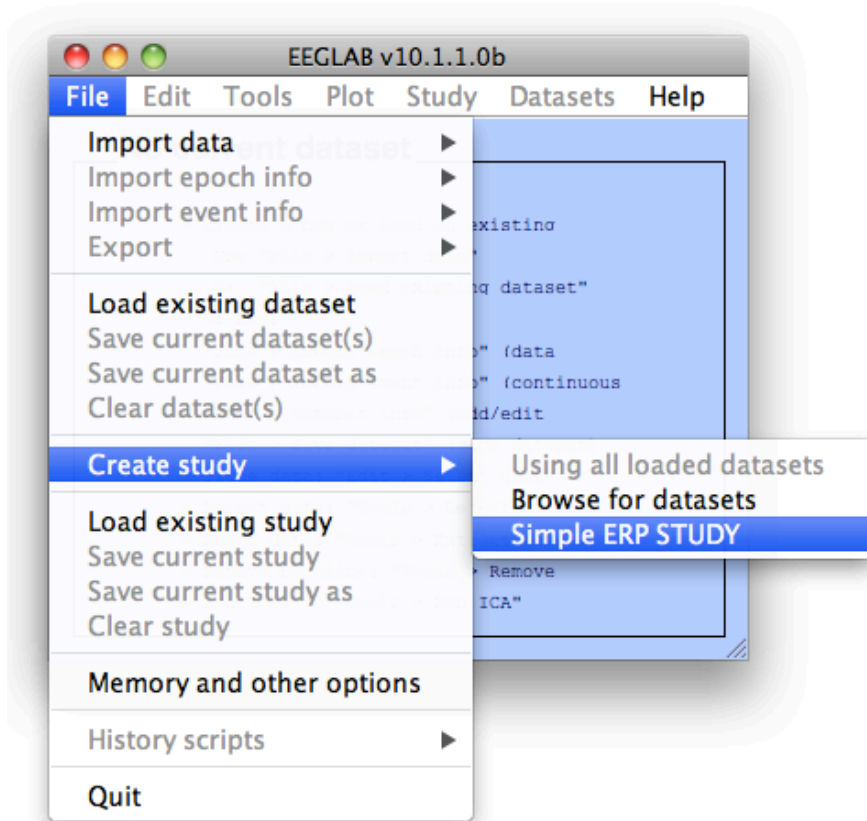
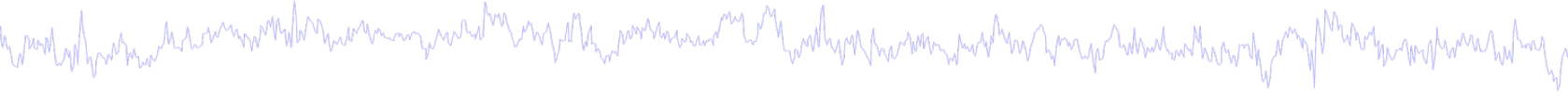
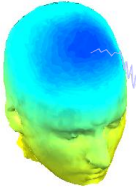


# Memory options



**Memory options should change  
when using STUDY vs single dataset**

# Create simple ERP STUDY



Create a new STUDY set -- pop\_studyerp()

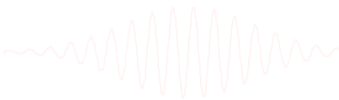
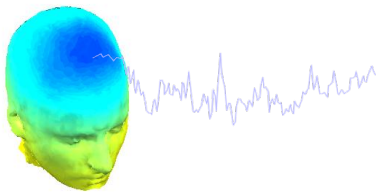
### Create simple ERP STUDY

STUDY set name:

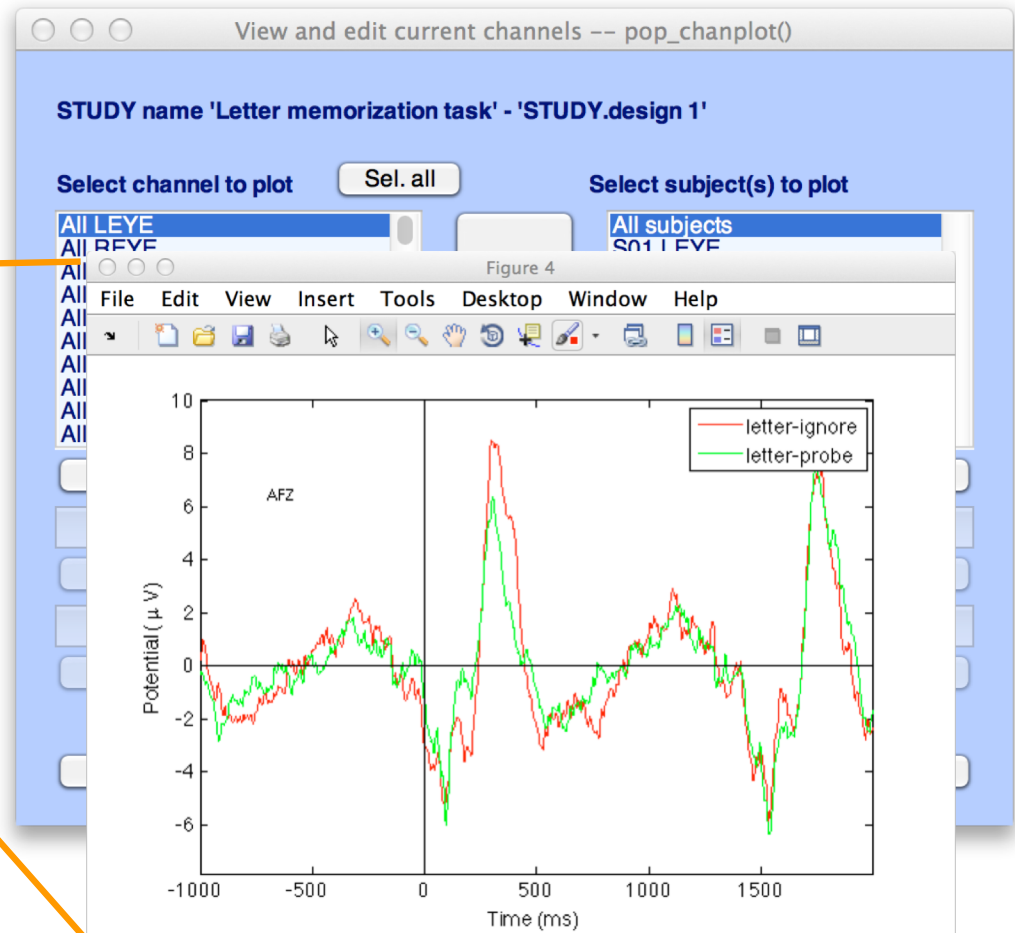
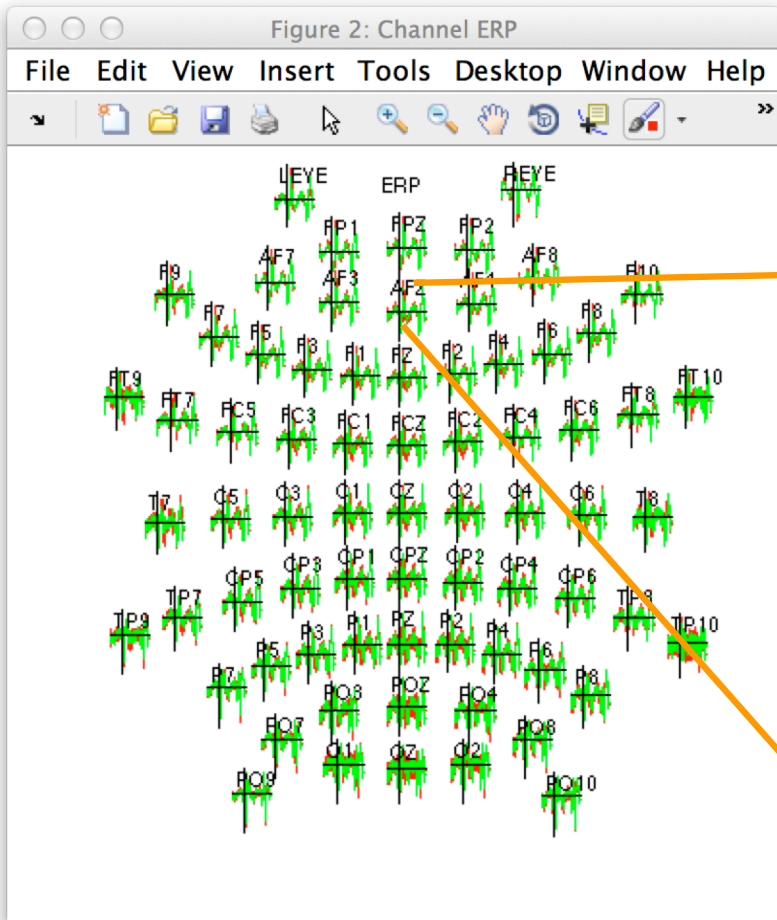
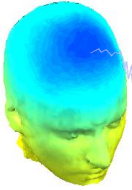
Condition 1 name:  Condition 2 name:

Condition 1 datasets		Condition 2 datasets	
<input type="text" value="/data/STUDY/S01/lgnore.set"/>	<input type="button" value="..."/>	<input type="text" value="/data/STUDY/S01/Memorize.set"/>	<input type="button" value="..."/>
<input type="text" value="/data/STUDY/S02/lgnore.set"/>	<input type="button" value="..."/>	<input type="text" value="/data/STUDY/S02/Memorize.set"/>	<input type="button" value="..."/>
<input type="text" value="/data/STUDY/S03/lgnore.set"/>	<input type="button" value="..."/>	<input type="text" value="/data/STUDY/S03/Memorize.set"/>	<input type="button" value="..."/>
<input type="text" value=""/>	<input type="button" value="..."/>	<input type="text" value=""/>	<input type="button" value="..."/>
<input type="text" value=""/>	<input type="button" value="..."/>	<input type="text" value=""/>	<input type="button" value="..."/>
<input type="text" value=""/>	<input type="button" value="..."/>	<input type="text" value=""/>	<input type="button" value="..."/>
<input type="text" value=""/>	<input type="button" value="..."/>	<input type="text" value=""/>	<input type="button" value="..."/>
<input type="text" value=""/>	<input type="button" value="..."/>	<input type="text" value=""/>	<input type="button" value="..."/>
<input type="text" value=""/>	<input type="button" value="..."/>	<input type="text" value=""/>	<input type="button" value="..."/>
<input type="text" value=""/>	<input type="button" value="..."/>	<input type="text" value=""/>	<input type="button" value="..."/>
<input type="text" value=""/>	<input type="button" value="..."/>	<input type="text" value=""/>	<input type="button" value="..."/>
<input type="text" value=""/>	<input type="button" value="..."/>	<input type="text" value=""/>	<input type="button" value="..."/>
<input type="text" value=""/>	<input type="button" value="..."/>	<input type="text" value=""/>	<input type="button" value="..."/>
<input type="text" value=""/>	<input type="button" value="..."/>	<input type="text" value=""/>	<input type="button" value="..."/>
<input type="text" value=""/>	<input type="button" value="..."/>	<input type="text" value=""/>	<input type="button" value="..."/>
<input type="text" value=""/>	<input type="button" value="..."/>	<input type="text" value=""/>	<input type="button" value="..."/>

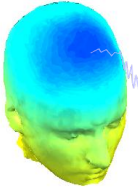
When using more than 1 condition, datasets on each line must correspond to the same subject.



# Create simple ERP STUDY

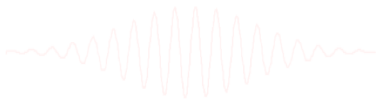


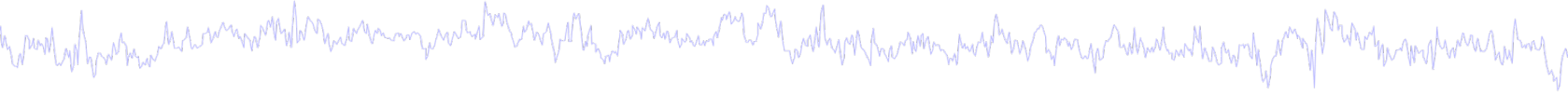
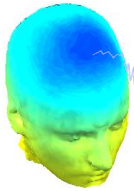
# Exercises



## Suggestion for exercise

1. From the GUI, select “File > Create STUDY > Simple ERP STUDY”
2. Enter 2 conditions “letter-ignore” and “letter-memorize”
3. In the column for “letter-ignore” select datasets “ignore.set” for 3 subjects S01, S02, S03 (in the STERN folder)
4. In the column for “letter-memorize” select datasets “memorize.set” for 3 subjects S01, S02, S03 (in the STERN folder)
5. Press OK.





EEGLAB v15.x (dev)

File Edit Tools Plot Study Datasets Help

- Import data at Sternberg
- Import epoch info
- Import event info
- Export
- Load existing dataset
- Save current dataset(s)
- Save current dataset as
- Clear dataset(s)
- Create study**
  - Using all loaded datasets
  - Browse for datasets**
  - Simple ERP STUDY
  - to precluster
- Load existing study
- Save current study
- Save current study as
- Clear study / Clear all
- Memory and other options
- History scripts
- Manage EEGLAB extensions
- Quit

Create a new STUDY set -- pop\_study()

**Edit STUDY set information - remember to save changes**

STUDY set name: Sternberg

STUDY set task name: Sternberg

STUDY set notes:

	dataset filename	browse	subject	session	condition	aroup	Select by r.v.	
1	/data/oral/EEGLAB/ASPET_2017/L	...	S01	1	memorize	1	Comp.: 3 5 ...	Clear
2	/data/oral/EEGLAB/ASPET_2017/L	...	S01	1	ignore	1	Comp.: 3 5 ...	Clear
3	/data/oral/EEGLAB/ASPET_2017/L	...	S01	1	probe	1	Comp.: 3 5 ...	Clear
4	/data/oral/EEGLAB/ASPET_2017/L	...	S02	1	memorize	1	Comp.: 5 6 ...	Clear
5	/data/oral/EEGLAB/ASPET_2017/L	...	S02	1	ignore	1	Comp.: 5 6 ...	Clear
6	/data/oral/EEGLAB/ASPET_2017/L	...	S02	1	probe	1	Comp.: 5 6 ...	Clear
7	/data/oral/EEGLAB/ASPET_2017/L	...	S03	1	memorize	1	Comp.: 6 8 ...	Clear
8	/data/oral/EEGLAB/ASPET_2017/L	...	S03	1	ignore	1	Comp.: 6 8 ...	Clear
9	/data/oral/EEGLAB/ASPET_2017/L	...	S03	1	probe	1	Comp.: 6 8 ...	Clear
10	/data/oral/EEGLAB/ASPET_2017/L	...	S04	1	memorize	1	Comp.: 1 2 ...	Clear

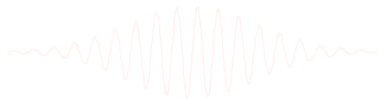
Important note: Removed datasets will not be saved before being deleted from EEGLAB memory

< Page 1 >

Dataset info (condition, aroup, ...) differs from studv info. Iset1 = Overwrite dataset info for each dataset on disk.

Delete cluster information (to allow loading new datasets, set new components for clusterina, etc.)

Help Cancel Ok



EEGLAB v9.0.0.0b

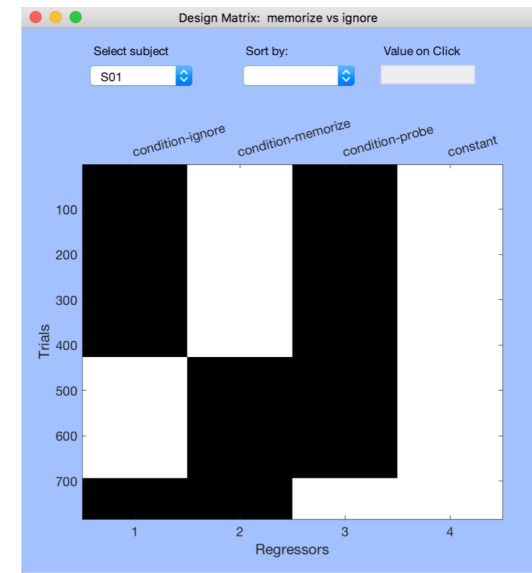
File Edit Tools Plot **Study** Datasets Help

**STUDY set:**

- Study filename: ...s/data
- Study task name
- Nb of subjects
- Nb of conditions
- Nb of sessions
- Nb of groups
- Epoch consistency
- Channels per frame: 61
- Channel locations: yes
- Clusters: 1
- Status: Pre-clustered
- Total size (Mb): 8.2

Edit study info  
**Select/Edit study design(s)**  
 Precompute channel measures  
 Plot channel measures  
 Precompute component measures  
 Measure Product clustering  
 PCA clustering (original)  
 Edit/plot clusters

# Create design



Edit STUDY design -- pop\_studydesign()

Include these subjects (default: all)  ...

Group-level contrast New Rename Delete

memorize vs ignore

Edit the independent variables for this contrast New Edit Delete List conditions

Categorical variable: condition - Values (ignore - memorize - probe)

Re-save STUDY file

Cancel Ok

Add variable

Select independent variable

condition  
duration  
init\_index  
init\_time  
inset  
load  
pres\_trial

This is a categorical var.

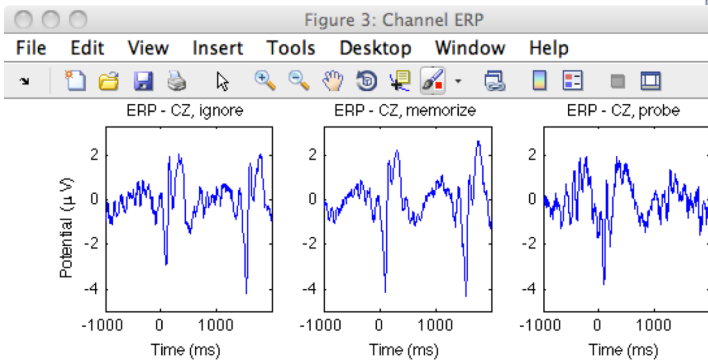
Select variable values

ignore  
memorize  
probe  
ignore & memorize

Combine selected values

Cancel Ok

1x3 design





EEGLAB v7.1.7.18b

File Edit Tools Plot Study Datasets Help

Dataset info  
Event fields  
**Event values**  
About this dataset  
Channel locations  
Select data  
Select data using events  
Select epochs or events  
Copy current dataset  
Append datasets  
Delete dataset(s)  
ICA weights  
Dataset size (Mb)

continuous -- Rere...

70  
810133  
1  
1303  
250  
0.000  
2440.528  
CZ  
Yes  
Yes  
Yes  
349

Edit event values -- pop\_editevents()

Edit event field values (currently 1303 events) Delete event

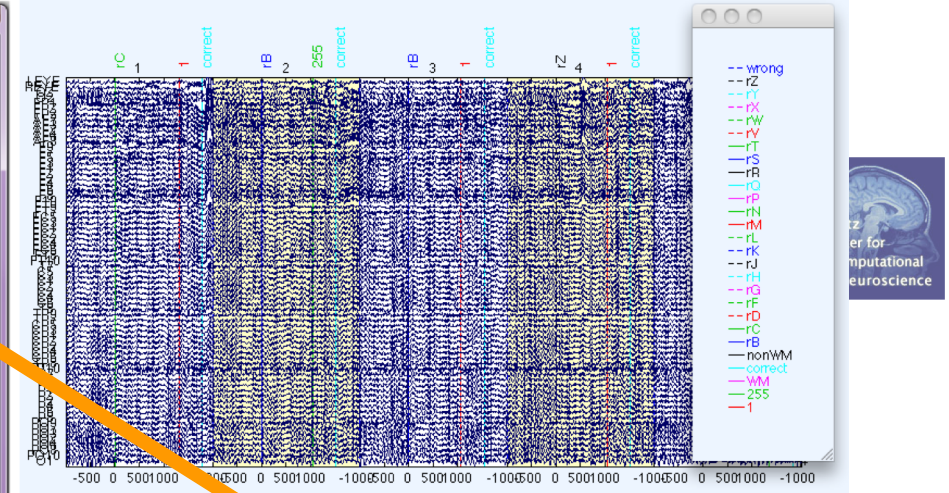
**Number of event fields is unlimited**

Trial	1
Event_Type	Picture
Type	nonWM
Latency (sec)	3.112
Time	0
Uncertainty	2
Duration	50283
Uncertainty2	3
ReqTime	0
ReqDur	50000
Init_index	1
Init_time	0.0227
Duration (sec)	0
Load	

Event Num  
Insert event << < 1 > >> Append event

Re-order events (for review only)  
Main sorting field: No field selected Click for decreasing order  
Secondary sorting field: No field selected Click for decreasing order  
Re-sort

Cancel Help Ok



Create a new STUDY set -- pop\_study()

Edit STUDY set information - remember to save changes

STUDY set name: Sternberg  
STUDY set task name: Sternberg  
STUDY set notes:

dataset filename	browse	subject	session	condition	group	Select by r.v.
1	C:\Users\julie\Documents\Wor	S01		memorize		Comp.: 3 5 ... Clear
2	C:\Users\julie\Documents\Wor	S01		ignore		Comp.: 3 5 ... Clear
3	C:\Users\julie\Documents\Wor	S01		probe		Comp.: 3 5 ... Clear
4	C:\Users\julie\Documents\Wor	S02		memorize		Comp.: 5 6 ... Clear
5	C:\Users\julie\Documents\Wor	S02		ignore		Comp.: 5 6 ... Clear
6	C:\Users\julie\Documents\Wor	S02		probe		Comp.: 5 6 ... Clear
7	C:\Users\julie\Documents\Wor	S03		memorize		Comp.: 6 7 ... Clear
8	C:\Users\julie\Documents\Wor	S03		ignore		Comp.: 6 7 ... Clear
9	C:\Users\julie\Documents\Wor	S03		probe		Comp.: 6 7 ... Clear
10	C:\Users\julie\Documents\Wor	S04		memorize		Comp.: 1 2 ... Clear

Important note: Removed datasets will not be saved before being deleted from EEGLAB memory

Dataset info (condition, group, ...) differs from study info. [set] = Overwrite dataset info.  
Delete cluster information (to allow loading new datasets, set new components for clustering, etc.)

Help Cancel Ok

Edit STUDY design -- pop\_studydesign()

Select STUDY design: Comparing conditions, Memorize-Ignore -- Load, Probe Only -- Load, Design 4, Ignore+Memorize vs Probe, My design. Resave STUDY (checked).

Select independent variable: condition, duration, init\_index, init\_time, inset, load, pres\_trial. This is a categorical var.

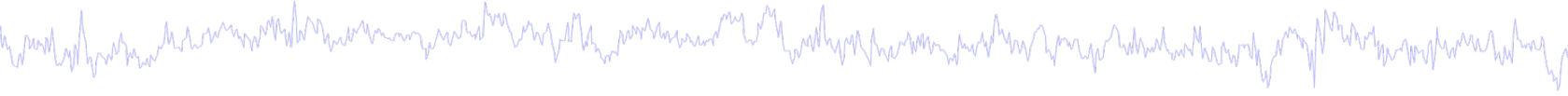
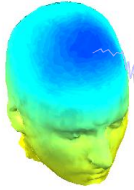
Select variable values: ignore, memorize, probe, ignore & memorize. Combine selected values.

Delete all pre-computed datafiles for this design (unchecked).

Web help Cancel Ok

Design independent of # of files per subject

# STUDY design and plotting overview



## STEP 1

Build a STUDY

## STEP 2

Build design(s)

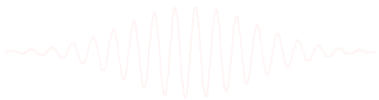
## STEP 3

Precompute the data

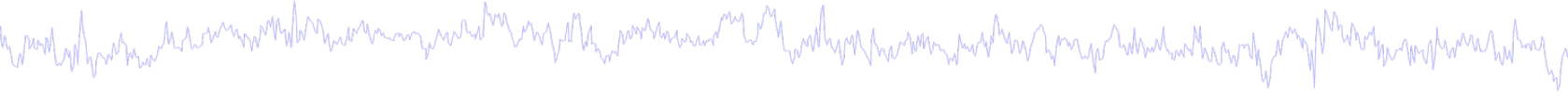
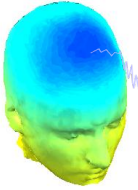
## STEP 4

Plot the data

Exercise...



# Precompute data measures



EEGLAB v13.x (dev)

File Edit Tools Plot **Study** Datasets Help

**STUDY set: Sternberg**

- Study filename: ...6/USB
- Study task name
- Nb of subjects
- Nb of conditions
- Nb of sessions
- Nb of groups
- Epoch consistency
- Channels per frame
- Channel locations: yes
- Clusters: 1
- Status: Ready to precluster
- Total size (Mb): 229.4

Study Menu:

- Edit study info
- Select/Edit study design(s)
- Precompute channel measures**
- Plot channel measures
- Precompute component measures
  - PCA clustering (original)
  - Edit/plot clusters
  - Cluster components by correlation (CORRMAP)
  - std\_ErpCalc

Select and compute component measures for later clustering -- pop\_precomp()

**Pre-compute channel measures for STUDY 'Sternberg' - 'STUDY.design 1'**

Channel list (default:all) [ ] ...

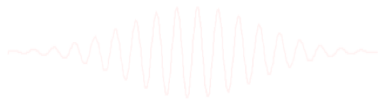
- Spherical interpolation of missing channels (performed after optional ICA removal below)
- Remove ICA artifactual components pre-tagged in each dataset
- Remove artifactual ICA cluster or clusters (hold shift key)

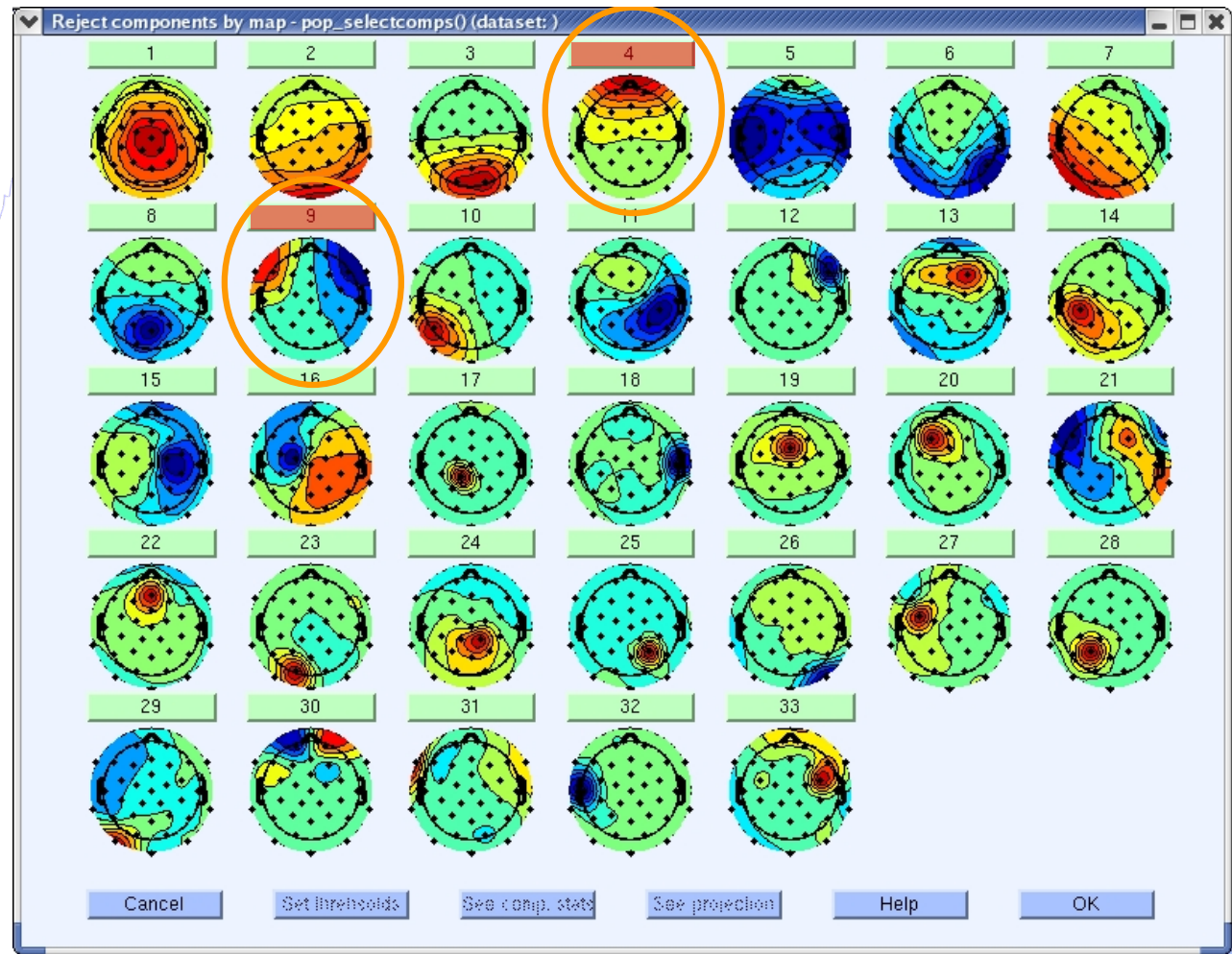
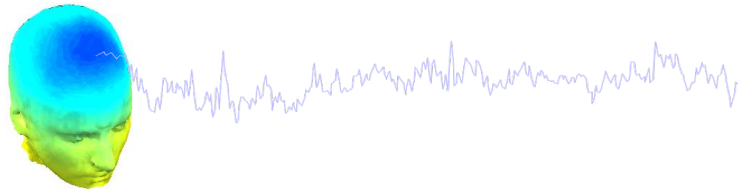
ParentCluster 1  
Cls 2  
Cls 3  
Cls 4

**List of measures to precompute**

- ERPs Baseline ((min max] in ms) [ ]
- Power spectrum Spectopo parameters [ 'specmode', 'fft' ] Test
- ERSPs } Time/freq. parameters [ 'cycles', [3 0.5], 'nfreqs', 100 ] Test
- ITCs }
- Save single-trial measures for single-trial statistics - requires disk space
- Recompute even if present on disk

Help Cancel Ok





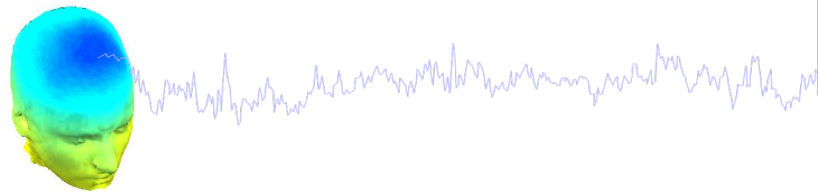
EEGLAB v9.0.3.4b

File Edit **Tools** Plot Study Datasets Help

- #3: S...
- Filename
- Channels
- Frames p...
- Epochs
- Events
- Sampling
- Epoch st...
- Epoch en...
- Referenc...
- Channel
- ICA welo...
- Dataset

- Change sampling rate
- Filter the data
- Re-reference
- Interpolate electrodes
- Reject continuous data by eye
- Extract epochs
- Remove baseline
- Run ICA
- Remove components
- Automatic channel rejection
- Automatic epoch rejection
- Reject data epochs
- Reject data using ICA
- Locate dipoles using DIPFIT 2.x
- Peak detection using EEG toolbox
- FMRIB Tools
- Locate dipoles using LORETA

- Reject components by map
- Reject data (all methods)
- Reject by inspection
- Reject extreme values
- Reject by linear trend/variance
- Reject by probability
- Reject by kurtosis
- Reject by spectra
- Export marks to data reject
- Reject marked epochs



View and edit current channels -- pop\_chanplot()

File 'Sternberg' - 'Comparing conditions'

Channel to plot: **Sel. all**

Select subject(s) to plot:

- All CZ
- All C2
- All C4
- All C6
- All T8
- All TP9
- All TP7
- All CP5
- All CP3
- All CP1

STATS

Params

Plot ERPs

Plot spectra

Plot ERPimage

Plot ERSPs

Plot ITCs

Help

Cancel

Ok

Select subject(s) to plot:

- All subjects
- S01 CZ
- S02 CZ
- S03 CZ
- S04 CZ
- S05 CZ
- S06 CZ
- S07 CZ
- S08 CZ
- S09 CZ

Plot ERP(s)

Plot spectra

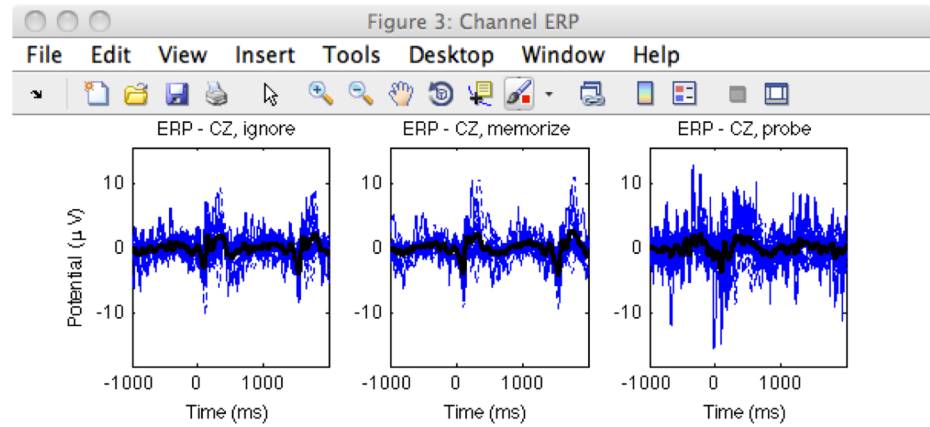
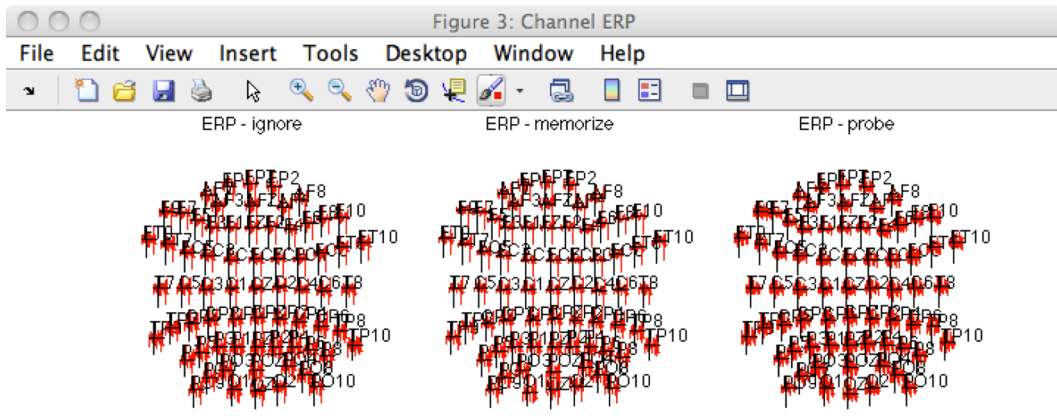
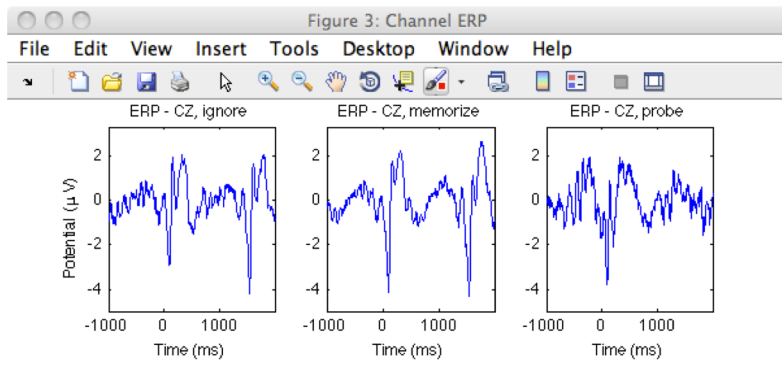
Plot ERPimage(s)

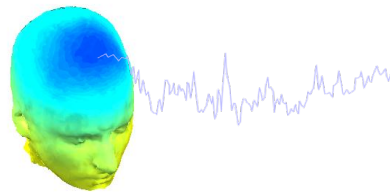
Plot ERSP(s)

Plot ITC(s)

Choose which channel

Choose which subject





View and edit current channels -- pop\_chanplot()

STUDY name 'Sternberg' - 'Comparing conditions'

Select channel to plot Sel. all

- All C1
- All C2
- All C4
- All C6
- All T8
- All TP9
- All TP7
- All CP5
- All CP3
- All CP1

STATS

Select subject(s) to plot

- All subjects
- S01 CZ
- S02 CZ
- S03 CZ
- S04 CZ
- S05 CZ
- S06 CZ
- S07 CZ
- S08 CZ
- S09 CZ

Buttons: Plot ERPs, Plot spectra, Plot ERPimage, Params, Plot ERSP(s), Plot ITC(s), Cancel, Ok

ERP plotting options -- pop\_erppar...

**ERP plotting options**

Time limits (ms) [low high]

Plot limits [low high]

Lowpass plotted data [Hz]

**ERP plotting format**

Plot first variable on the same panel

Plot second variable on the same panel

**Multiple channels selection**

Plot channels in scalp array

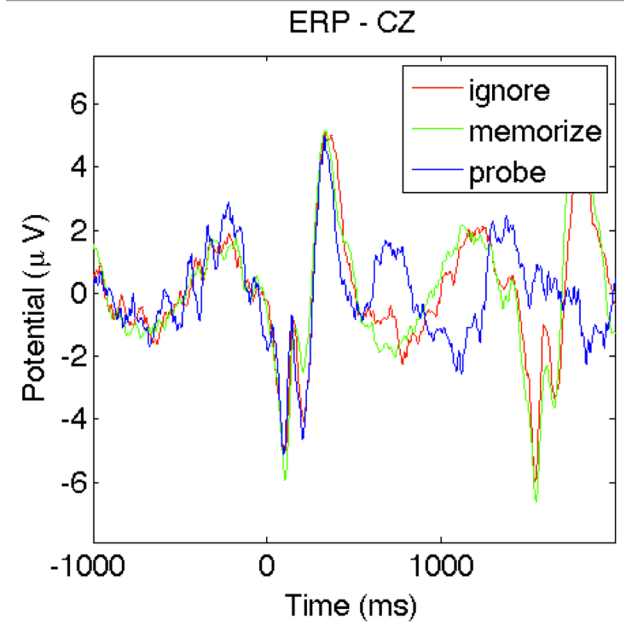
Plot topography at time (ms)

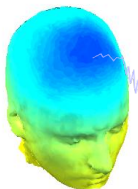
Average selected channels

Buttons: Cancel, Ok

Figure 4: Channel ERP

File Edit View Insert Tools Desktop Window Help





View and edit current channels -- pop\_chan...

**STUDY name 'Sternberg' - 'Comparing conditions'**

Select channel to plot Sel. all

- All P6
- All P8
- All PO9
- All PO7
- All PO3
- All POZ
- All PO4
- All PO8
- All PO10
- All O1

**STATS**

- All subjects
- S01 All
- S02 All
- S03 All
- S04 All
- S05 All
- S06 All
- S07 All
- S08 All
- S09 All

<span style="border: 1px solid orange; border-radius: 5px; padding: 5px;">Plot ERPs</span>	<span style="border: 1px solid orange; border-radius: 5px; padding: 5px;">Params</span>	<span style="border: 1px solid orange; border-radius: 5px; padding: 5px;">Plot ERPs(s)</span>
<span style="border: 1px solid orange; border-radius: 5px; padding: 5px;">Plot spectra</span>	<span style="border: 1px solid orange; border-radius: 5px; padding: 5px;">Params</span>	<span style="border: 1px solid orange; border-radius: 5px; padding: 5px;">Plot spectra</span>
<span style="border: 1px solid orange; border-radius: 5px; padding: 5px;">Plot ERPimage</span>	<span style="border: 1px solid orange; border-radius: 5px; padding: 5px;">Params</span>	<span style="border: 1px solid orange; border-radius: 5px; padding: 5px;">Plot ERPimage(s)</span>
<span style="border: 1px solid orange; border-radius: 5px; padding: 5px;">Plot ERSPs</span>	<span style="border: 1px solid orange; border-radius: 5px; padding: 5px;">Params</span>	<span style="border: 1px solid orange; border-radius: 5px; padding: 5px;">Plot ERSP(s)</span>
<span style="border: 1px solid orange; border-radius: 5px; padding: 5px;">Plot ITCs</span>	<span style="border: 1px solid orange; border-radius: 5px; padding: 5px;">Params</span>	<span style="border: 1px solid orange; border-radius: 5px; padding: 5px;">Plot ITC(s)</span>

Help Cancel Ok

ERP plotting options -- pop\_erppar...

**ERP plotting options**

Time limits (ms) [low high]

Plot limits [low high]

Lowpass plotted data [Hz]

**ERP plotting format**

Plot first variable on the same panel

Plot second variable on the same panel

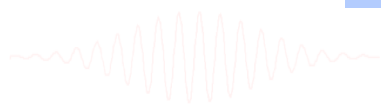
**Multiple channels selection**

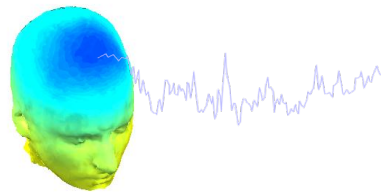
Plot channels in scalp array

Plot topography at time (ms) 200 300

Average selected channels

Cancel Ok





View and edit current channels -- pop\_chan...

**STUDY name 'Sternberg' - 'Comparing conditions'**

Select channel to plot Sel. all

- All P6
- All P8
- All PO9
- All PO7
- All PO3
- All POZ
- All PO4
- All PO8
- All PO10
- All O1

STATS

Select subject(s)

- All subjects
- S01 All
- S02 All
- S03 All
- S04 All
- S05 All
- S06 All
- S07 All
- S08 All
- S09 All

Plot ERPs Params Plot ERPs (s)

Plot spectra Params Plot spectra

Plot ERPimage Params Plot ERPimage(s)

ERP plotting options -- pop\_erppar...

**ERP plotting options**

Time limits (ms) [low high]

Plot limits [low high]

Lowpass plotted data [Hz]

**ERP plotting format**

Plot first variable on the same panel

Plot second variable on the same panel

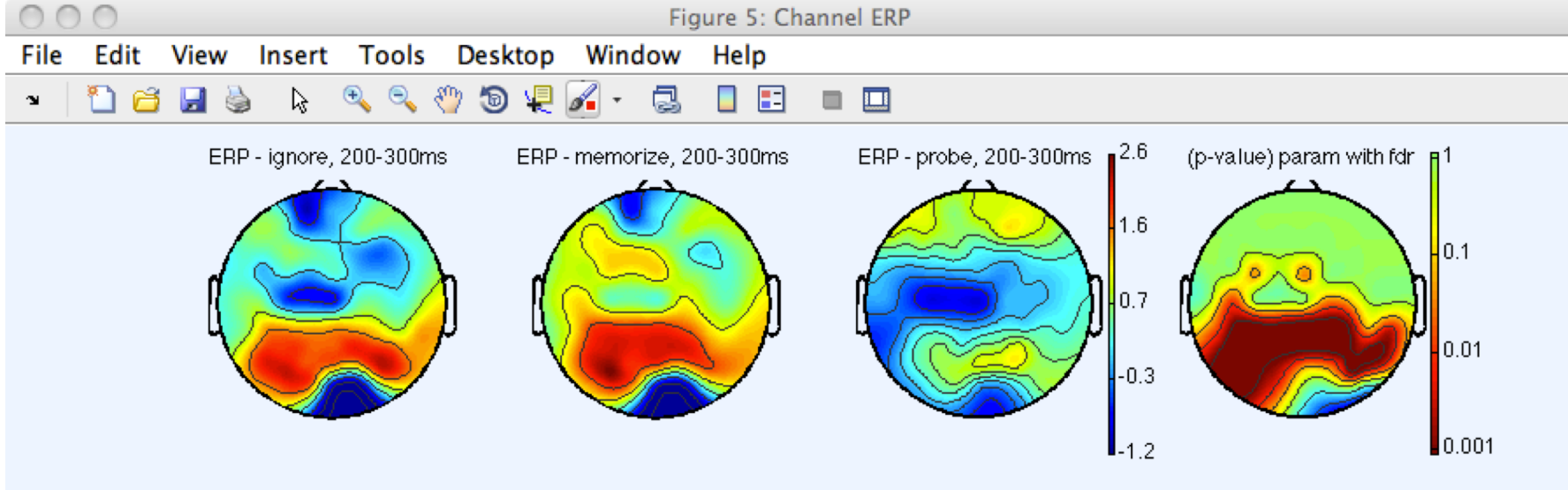
**Multiple channels selection**

Plot channels in scalp array

Plot topography at time (ms) 200 300

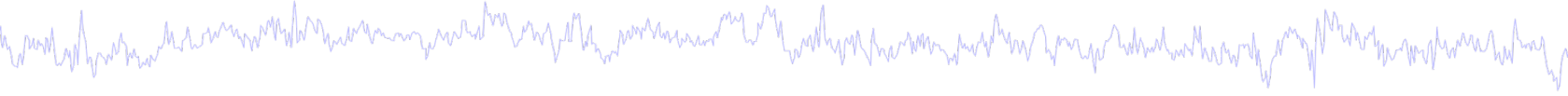
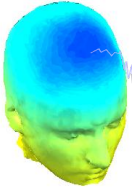
Average selected channels

Cancel Ok





# Computing Spectrum



Select and compute component measures for later clustering -- pop\_precomp()

**Pre-compute channel measures for STUDY 'Sternberg' - 'STUDY.design 1'**

Channel list (default:all)  ...

- Spherical interpolation of missing channels (performed after optional ICA removal below)
- Remove ICA artifactual components pre-tagged in each dataset
- Remove artifactual ICA cluster or clusters (hold shift key)

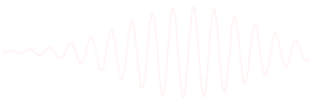
ParentCluster 1  
Cls 2  
Cls 3  
Cls 4

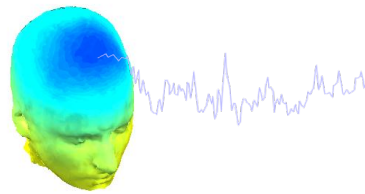
**List of measures to precompute**

- ERPs Baseline ([min max] in ms)
- Power spectrum Spectopo parameters  Test
- ERSPs } Time/freq. parameters  Test
- ITCs }

- Save single-trial measures for single-trial statistics - requires disk space
- Recompute even if present on disk

Help Cancel Ok





**Choose which channel**

**Choose which subject**

View and edit current channels -- pop\_chanplot()

STUDY name 'Sternberg' - 'STUDY.design 1'

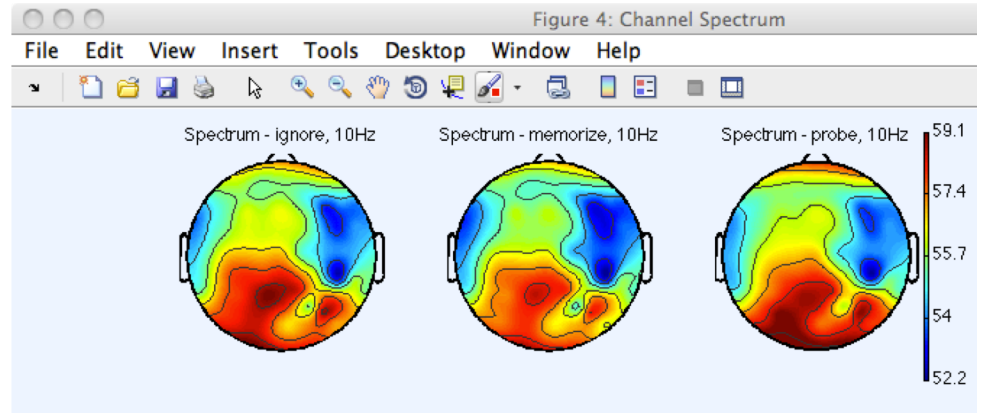
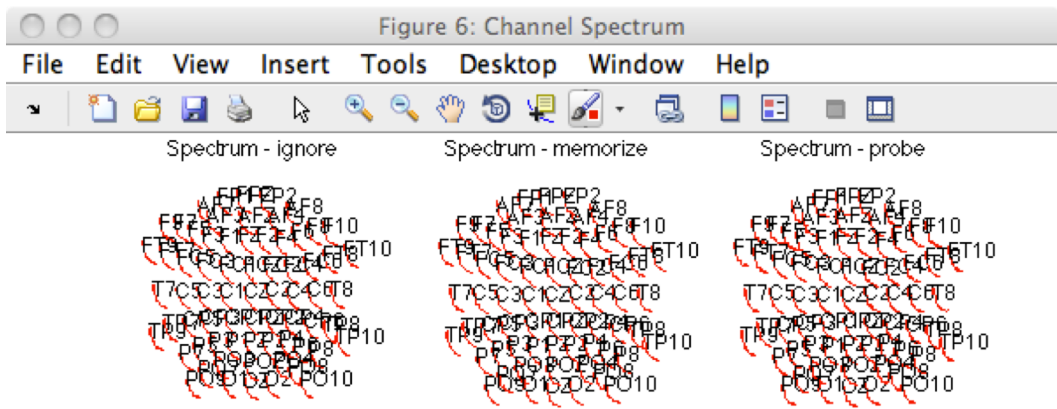
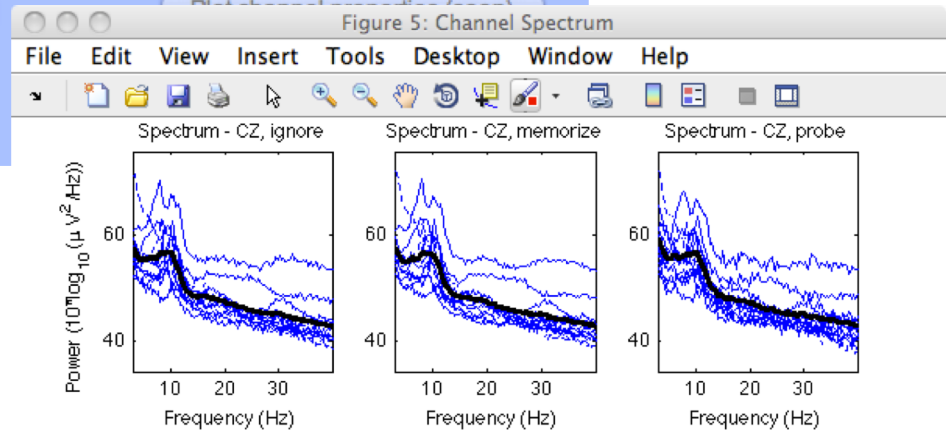
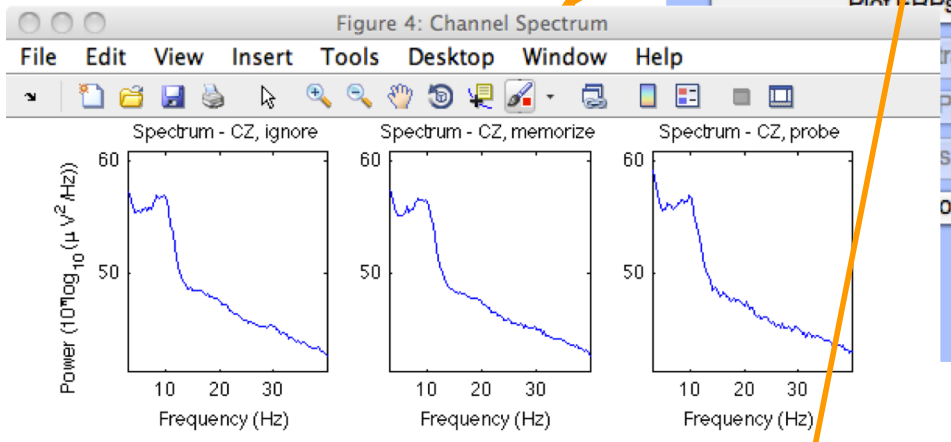
Select channel to plot Sel. all

- All F8
- All FT8
- All FT10
- All T7
- All C5
- All C3
- All C1
- All CZ
- All C2
- All C4
- All C6

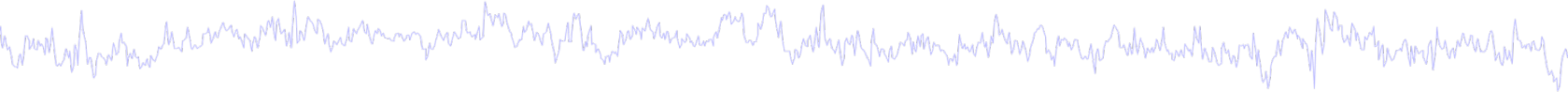
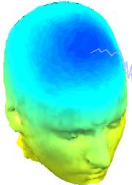
Select subject(s) to plot

- All subjects
- S01 CZ
- S02 CZ
- S03 CZ
- S04 CZ
- S05 CZ
- S06 CZ
- S07 CZ
- S08 CZ
- S09 CZ

Buttons: Plot ERP(s), Plot spectra, Plot ERSP(s), Plot ITC(s)



# Computing ERSP



Select and compute component measures for later clustering -- pop\_precomp()

**Pre-compute channel measures for STUDY 'Sternberg' - 'Design 2'**

Channel list (default:all)  ...

- Spherical interpolation of missing channels (performed after optional ICA removal below)
- Remove ICA artifactual components pre-tagged in each dataset
- Remove artifactual ICA cluster or clusters (hold shift key)

ParentCluster 1  
Cls 2  
Cls 3  
Cls 4

**List of measures to precompute**

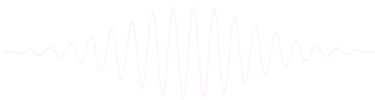
- ERPs Baseline ([min max] in ms)
- Power spectrum Spectopo parameters  Test
- ERSPs Time/freq. parameters  Test
- ITCs

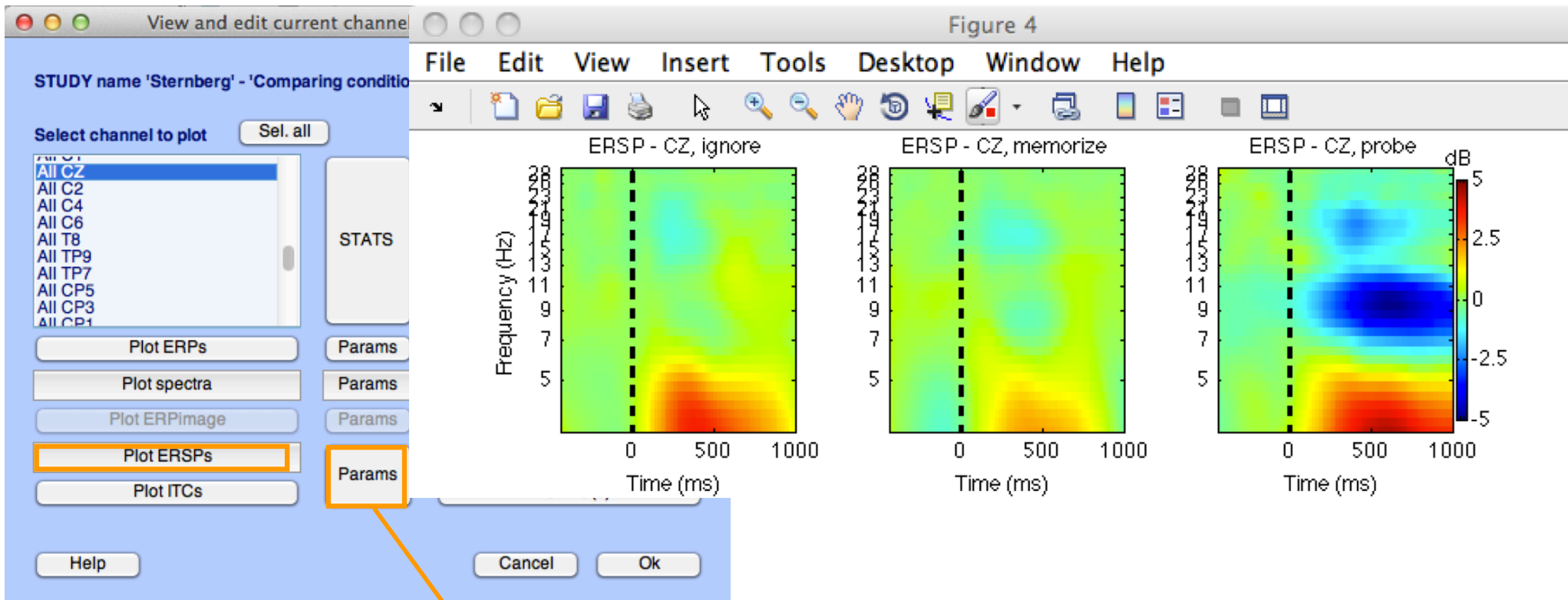
Save single-trial measures for single-trial statistics - requires disk space

Recompute even if present on disk

Help Cancel Ok

'cycles', [3 0.8], 'nfreqs', 50, 'ntimesout', 100





Set ERSP/ITC plotting parameters -- pop\_erspparams()

**ERSP/ITC plotting options**

Time range in ms [Low High]

Freq. range in Hz [Low High]

Power limits in dB [Low High]

Plot scalp map at time [ms]

Plot scalp map at freq. [Hz]

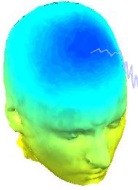
ITC limit (0-1) [High]

Compute common ERSP baseline (assumes additive baseline)

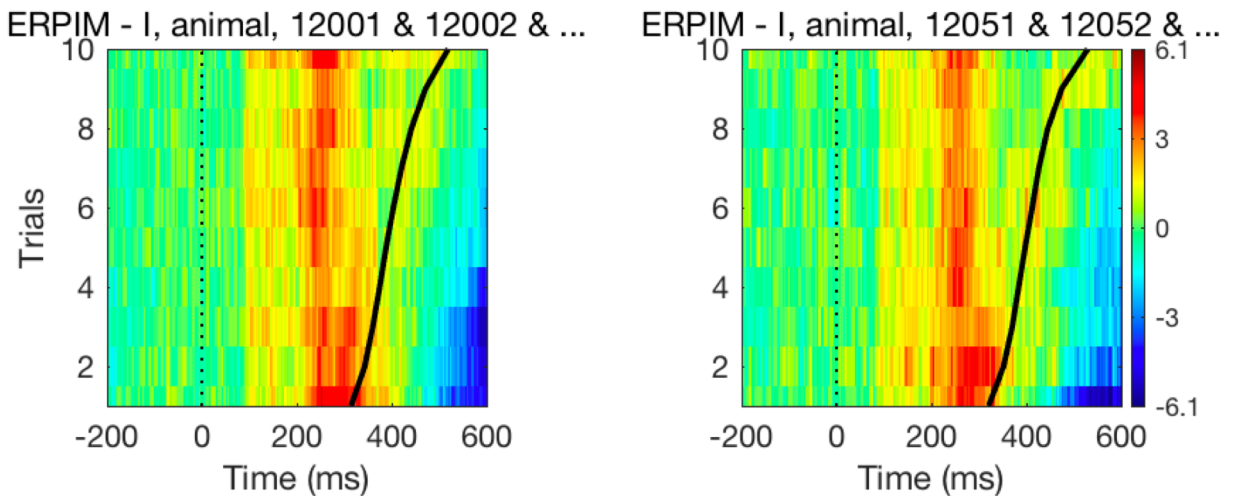
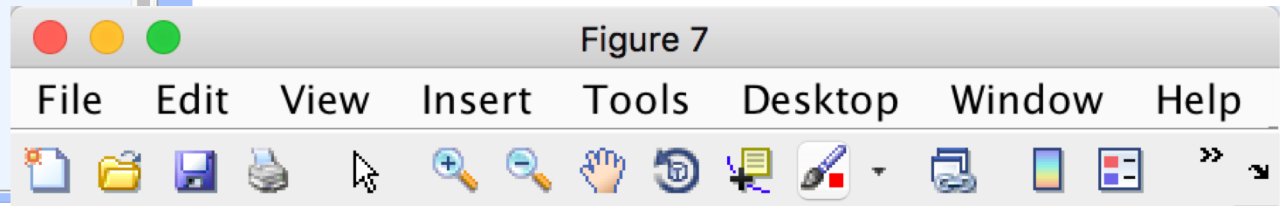
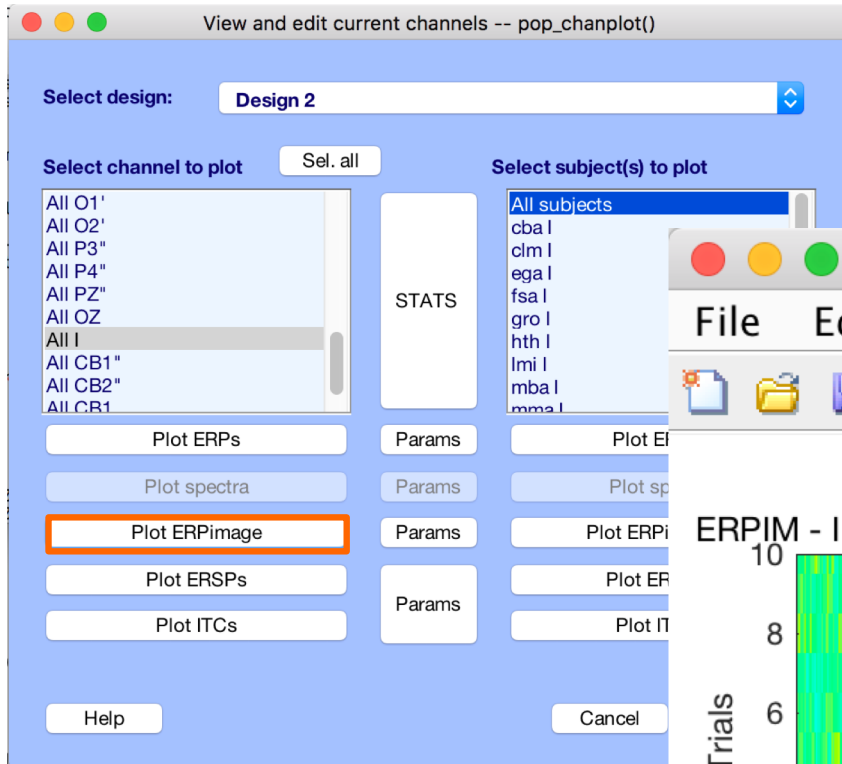
Cancel

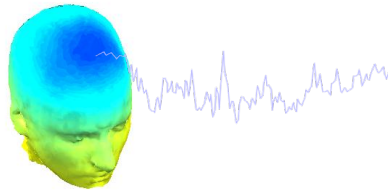
Ok

# ERP-image across subjects



Delorme, A., Miyakoshi, M., Jung, T.P., Makeig, S. (2014) **Grand average ERP-image plotting and statistics: A method for comparing variability in event-related single-trial EEG activities across subjects and conditions.** J Neurosci Methods. 2014 Oct 22. pii: S0165-0270(14)00363-X. doi: 10.1016/j.jneumeth.2014.10.003





View and edit current channels -- pop\_chanplot()

STUDY name 'Sternberg' - 'Comparing conditions'

Select channel to plot Sel. all

- All CZ
- All C2
- All C4
- All C6
- All T8
- All TP9
- All TP7
- All CP5
- All CP3
- All CP1

Plot ERPs

Plot spectra

Plot ERPImage

Select subject(s) to plot

- All subjects
- S01 CZ
- S02 CZ
- S03 CZ
- S04 CZ
- S05 CZ
- S06 CZ
- S07 CZ
- S08 CZ
- S09 CZ

STATS

Params

Plot ERP(s)

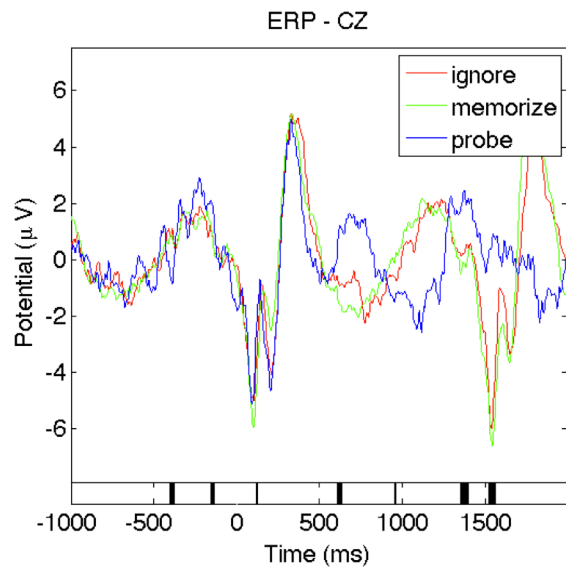
Set statistical parameters -- pop\_statparams()

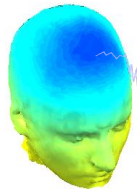
General statistical parameters

- Compute 1st independent variable statistics
- Compute 2nd independent variable statistics
- Use single trials (when available)
- Use EEGLAB statistics
  - Use parametric statistics
  - Use FDR correction
  - Statistical threshold (p-value): 0.05
  - Randomization (n): auto
- Use Fieldtrip statistics
  - Use analytic/parametric statistics
  - Do not correct for multiple comparisons
  - Statistical threshold (p-value): exact
  - Randomization (n): auto
  - CC channel neighbor parameters: 'method','triangulation' (Help)
  - CC clustering parameters: 'clusterstatistic','maxsum' (Help)

Cancel Ok

Figure 4: Channel ERP





View and edit current channels -- pop\_chanplot()

**STUDY name 'Sternberg' - 'Comparing conditions'**

Select channel to plot Sel. all

Select subject(s) to plot

All P6  
All P8  
All PO9  
All PO7  
All PO3  
All POZ  
All PO4  
All PO8  
All PO10  
All O1

STATS

All subjects  
S01 All  
S02 All  
S03 All  
S04 All  
S05 All  
S06 All  
S07 All  
S08 All  
S09 All

Plot ERPs

Plot spectra

Plot ERPimage

Params

Params

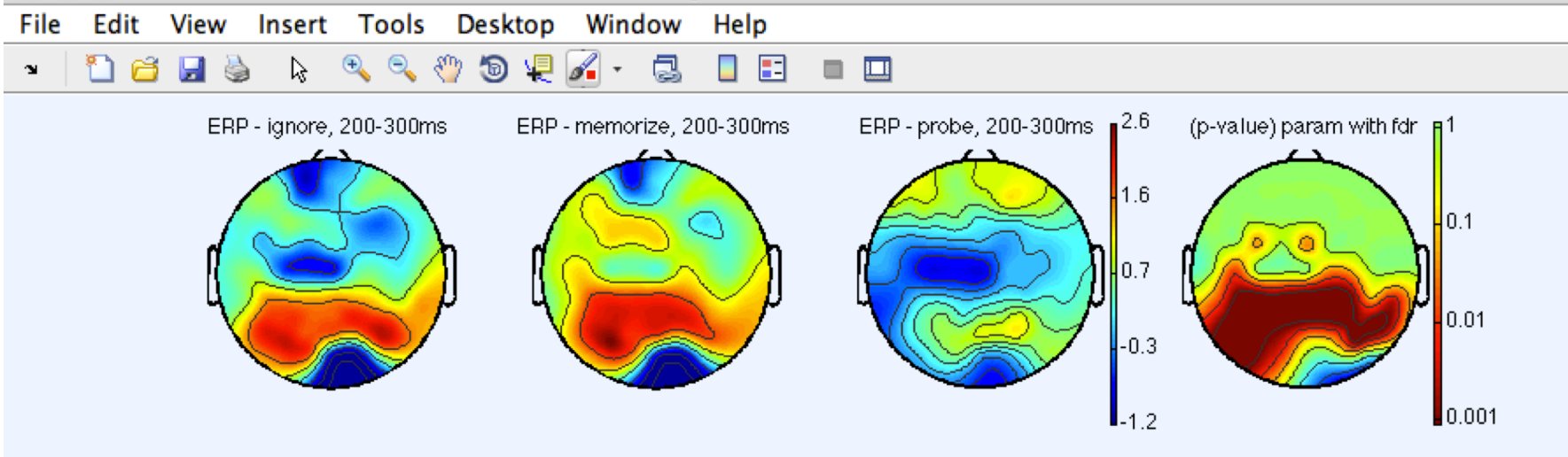
Params

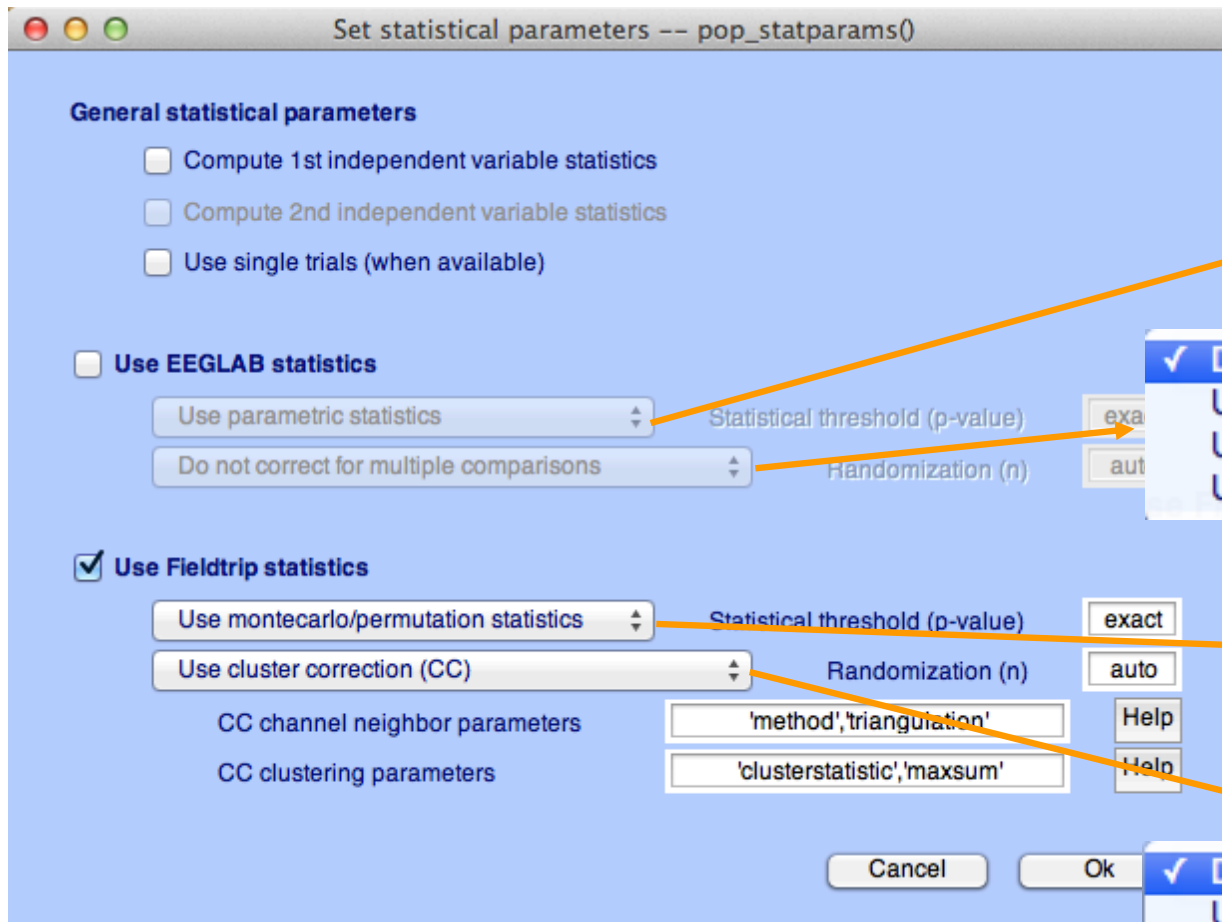
Plot ERP(s)

Plot spectra

Plot ERPimage(s)

Figure 5: Channel ERP



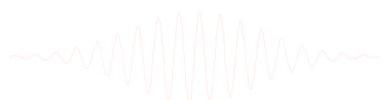


- ✓ Use parametric statistics
- Use permutation statistics
- Use bootstrap statistics

- ✓ Do not correct for multiple comparisons
- Use Bonferoni correction
- Use Holms correction
- Use FDR correction

- ✓ Use analytic/parametric statistics
- Use montecarlo/permutation statistics

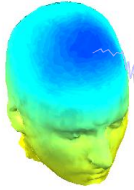
- ✓ Do not correct for multiple comparisons
- Use Bonferoni correction
- Use Holms correction
- Use FDR correction
- Use max correction
- Use cluster correction (CC)



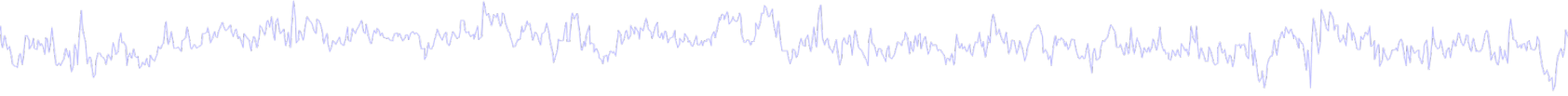
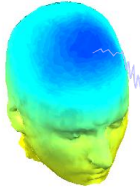
**std\_stat() function in EEGLAB**



# Exercises



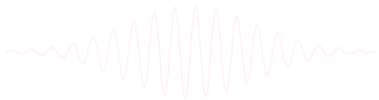
1. Load “stern.study” file in STUDY folder
2. Edit STUDY design and delete current variable(s)
3. Create a new indep. Variable design to compare Ignore vs. Memorize letter
4. Recompute spectrum and ERP.
5. Plot spectrum and ERP for electrode Cpz
6. Plot scalp topography at 10 Hz (spectrum) and 200-300 ms (ERP) for both conditions
7. Plot spectrum for electrode CPz within 1 to 50 Hz and compute parametric statistics (with and without FDR correction)
8. Plot scalp topography at 10Hz for both conditions using permutation statistics cluster correction (Fieldtrip – statistics)

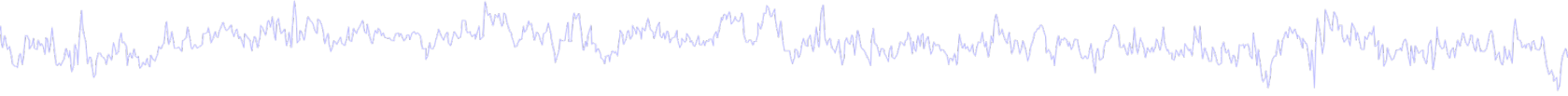
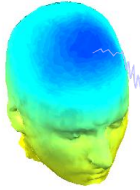


# EEGLAB and BIDS

- Export EEGLAB STUDY to BIDS
- Import BIDS to EEGLAB STUDY
- HED support (meta-tags)
- Mapping the BIDS architecture

<https://github.com/sccn/bids-matlab-tools>



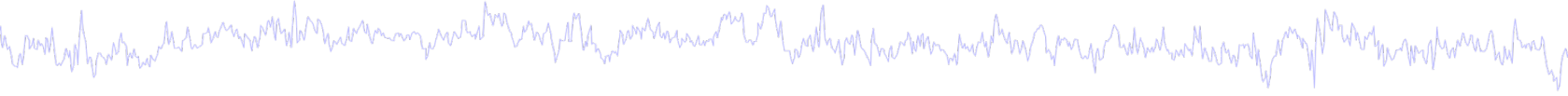
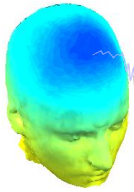


# BIDS data structure...

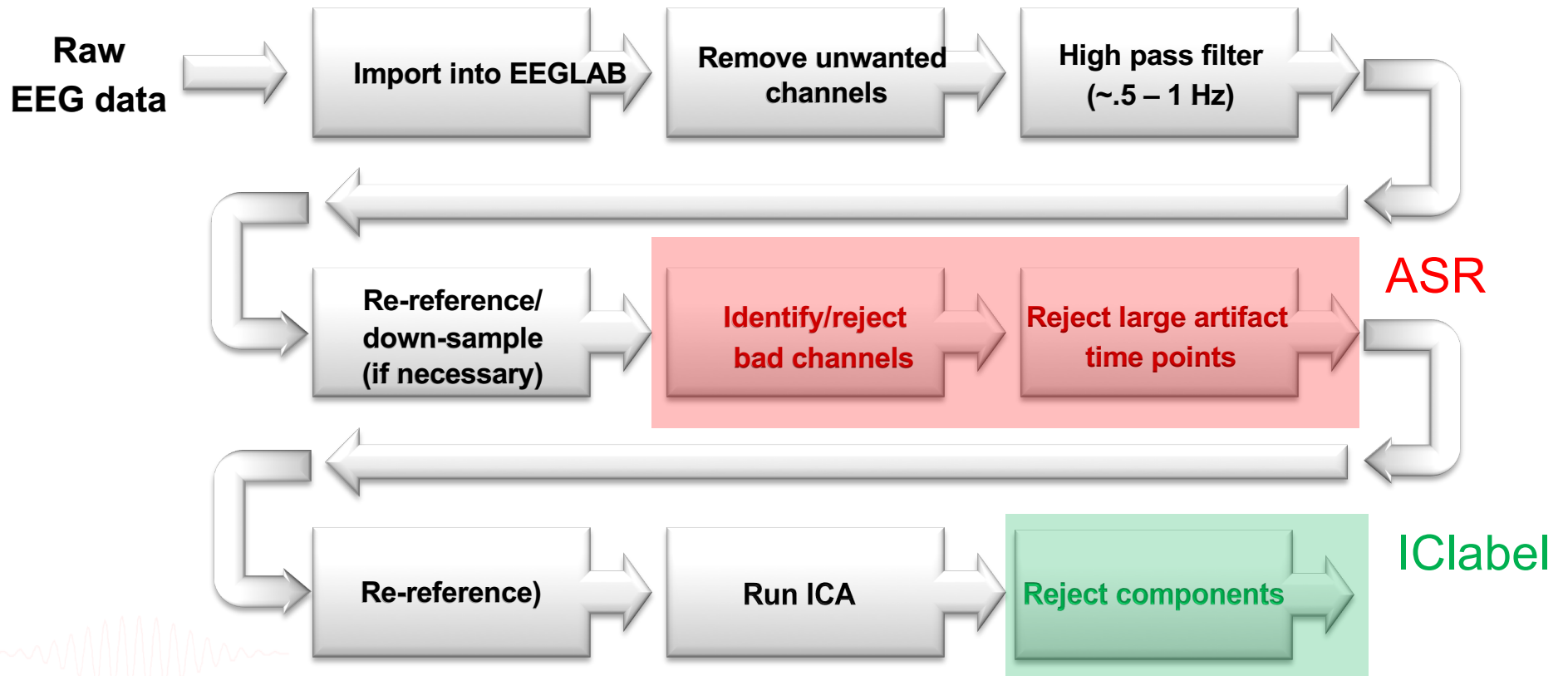
■ CHANGES	▶ changes compared to previous release of data
▶ code	▶ scripts and program to process/convert the data
✕ dataset_description.json	▶ description of dataset in JSON format
✕ participants.json	▶ description of participants table file columns (below)
participants.tsv	▶ participants table files in tab delimited format
■ README	▶ readme file for users
▶ sourcedata	▶ original raw data if converted to a supported format
▶ stimuli	▶ original stimuli (sound files and images)
▼ sub-001	▶ anonymized subject 1 folder
▼ eeg	
sub-001_ses-01_task-meditation_channels.tsv	▶ file describing channels
sub-001_ses-01_task-meditation_eeg.bdf	▶ raw EEG data file (not all raw formats are possible)
✕ sub-001_ses-01_task-meditation_eeg.json	▶ amplifier and recording information
sub-001_ses-01_task-meditation_events.tsv	▶ events in tabular format

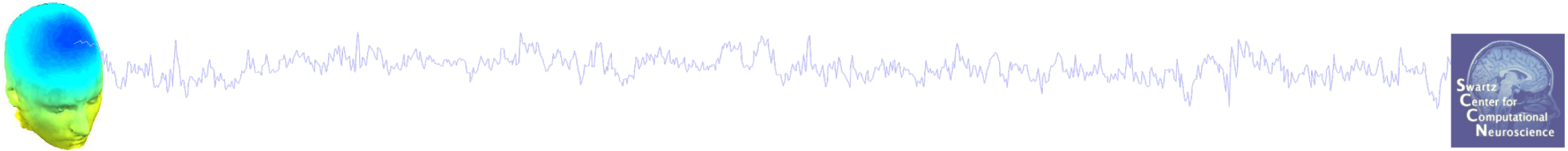
**BIDS-EEG: an Addition to the Brain Imaging Data Structure (BIDS) Specification for Electroencephalography**  
(2019) Cyril R Pernet, Stefan Appelhoff, Guillaume Flandin, Christophe Phillips, Arnaud Delorme, Robert Oostenveld.  
Scientific data, in press.





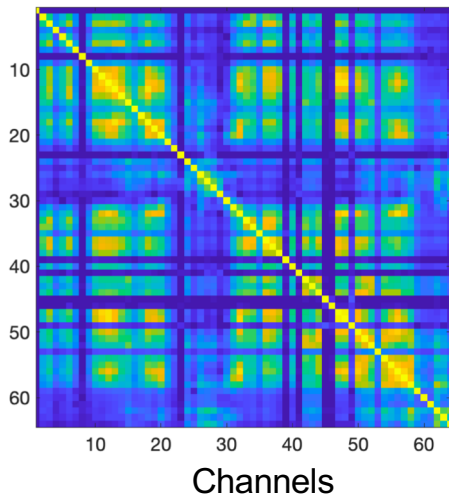
# Preprocessing pipeline



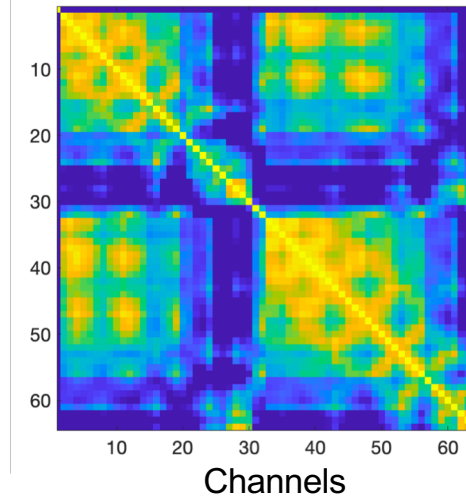


## Pairwise correlation to find bad channels

Bad data



Good data



## ASR finds and reconstructs bad portions of data

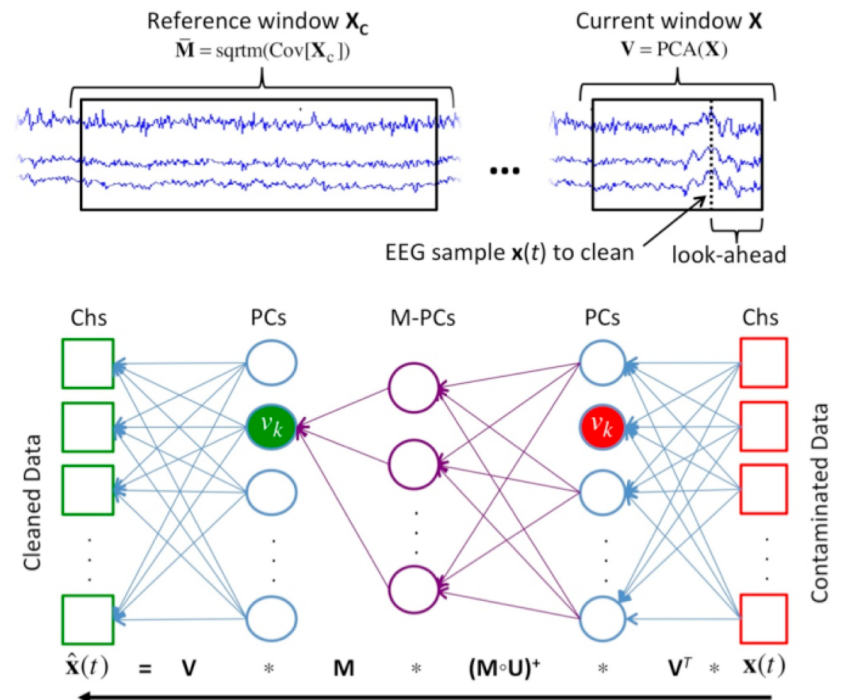
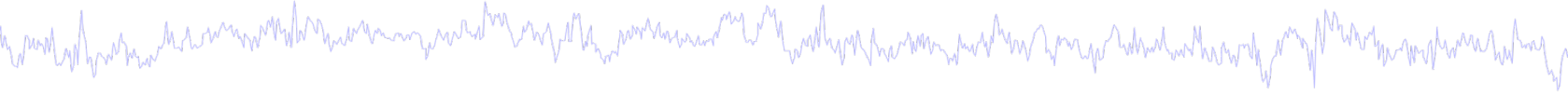
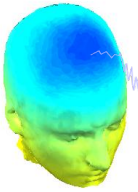
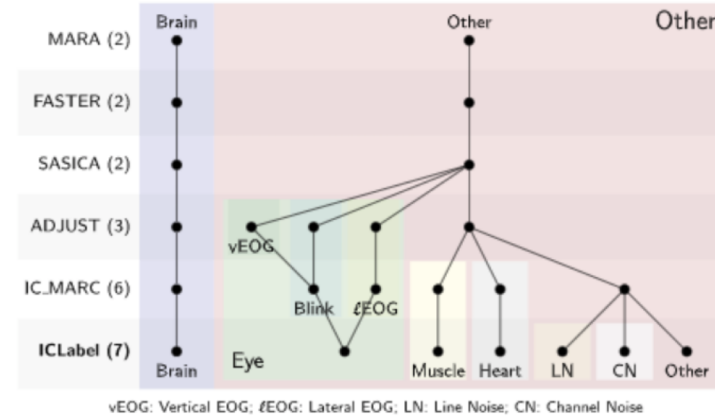
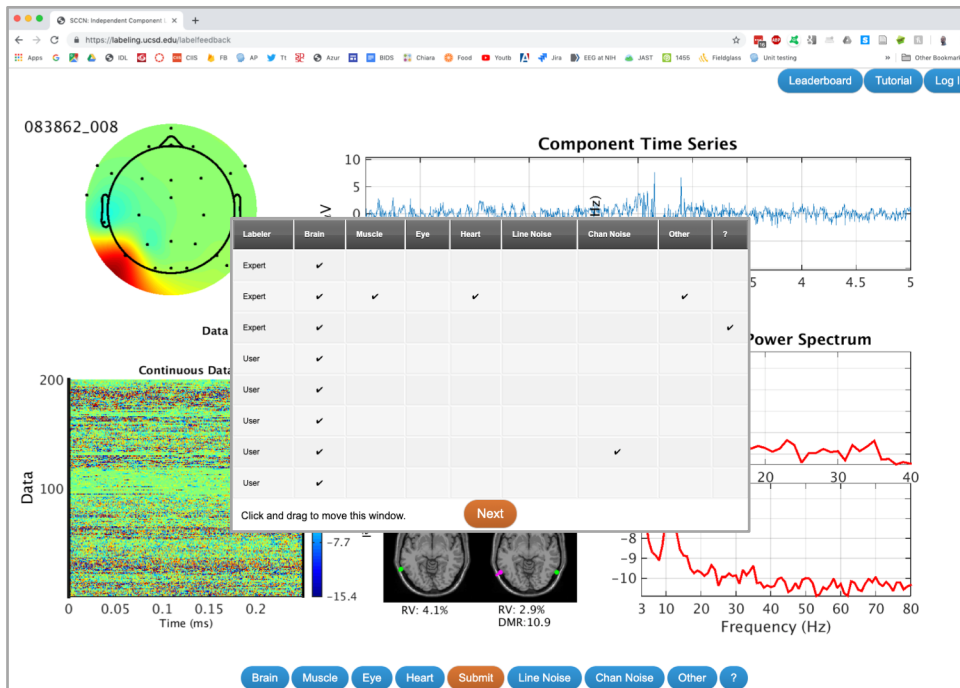


Fig. 3. The Artifact Subspace Reconstruction method. High-variance

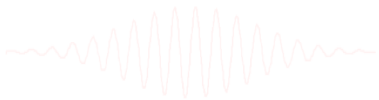
Tim R. Mullen, Christian Kothe, et al.(2015) Real-time neuroimaging and cognitive monitoring using wearable dry EEG. Published in IEEE Transactions on Biomedical Engineering. DOI:10.1109/TBME.2015.2481482



# IC label



**Pion-Tonachini L et al. (2019) ICLabel: An automated electroencephalographic independent component classifier, dataset, and website. Neuroimage, 98:181-197. doi: 10.1016/j.neuroimage.2019.05.026.**



# STUDY Script

```
% Create Stern STUDY
[ALLEEG EEG CURRENTSET ALLCOM] = eeglab;
pop_editoptions( 'option_storedisk', 1);
subjects = {'S01' 'S02' 'S03' 'S04' 'S05' 'S06' 'S07' 'S08' 'S09' 'S10' 'S11' 'S12'};
filepath = '/Users/arno/temp/STUDY'; % XXXXX Change path here XXXXX
if ~exist(filepath), error('You need to change the path to the STUDY'); end;
commands = {}; % initialize STUDY dataset list

% Loop through all of the subjects in the study to create the dataset
for loopnum = 1:length(subjects) %for each subject
    IgnoreFile = fullfile(filepath, subjects{loopnum}, 'Ignore.set');
    MemorizeFile = fullfile(filepath, subjects{loopnum}, 'Memorize.set');
    ProbeFile = fullfile(filepath, subjects{loopnum}, 'Probe.set');
    commands = {commands{:} ...
        {'index' 3*loopnum-2 'load' IgnoreFile 'subject' subjects{loopnum} 'condition' 'Ignore'} ...
        {'index' 3*loopnum-1 'load' MemorizeFile 'subject' subjects{loopnum} 'condition' 'Memorize'} ...
        {'index' 3*loopnum 'load' ProbeFile 'subject' subjects{loopnum} 'condition' 'Probe'}};
end;
% Uncomment the line below to select ICA components with less than 15% residual variance
% commands = {commands{:} {'dipselect', 0.15}};
[STUDY, ALLEEG] = std_editset(STUDY, ALLEEG, 'name', 'Sternberg', 'commands', commands, 'updatedat', 'on');

% Update workspace variables and redraw EEGLAB
CURRENTSTUDY = 1; EEG = ALLEEG; CURRENTSET = [1:length(EEG)];
[STUDY, ALLEEG] = std_checkset(STUDY, ALLEEG);
eeglab redraw

[STUDY ALLEEG] = std_precomp(STUDY, ALLEEG, {}, 'rmicacoms', 'on', 'interp', 'on', 'recompute', 'on', 'erp', 'on');
STUDY = pop_erpparams(STUDY, 'topotime', [200 300] );
[STUDY erpdata] = std_erpplot(STUDY, ALLEEG, 'channels', {'LEYE' 'REYE' 'OZ' 'O2' 'FP1' 'FPZ' 'FP2' 'AF7' ...
    'AF3' 'AFZ' 'AF4' 'AF8' 'F9' 'F7' 'F5' 'F3' 'F1' 'FZ' 'F2' 'F4' 'F6' 'F8' 'F10' 'FT9' ...
    'FT7' 'FC5' 'FC3' 'FC1' 'FCZ' 'FC2' 'FC4' 'FC6' 'FT8' 'FT10' 'T7' 'C5' 'C3' 'C1' 'CZ' ...
    'C2' 'C4' 'C6' 'T8' 'TP9' 'TP7' 'CP5' 'CP3' 'CP1' 'CPZ' 'CP2' 'CP4' 'CP6' 'TP8' 'TP10' ...
    'P7' 'P5' 'P3' 'P1' 'PZ' 'P2' 'P4' 'P6' 'P8' 'PO9' 'PO7' 'PO3' 'POZ' 'PO4' 'PO8' 'PO10' 'O1'});

dlmwrite('erpfile.txt', squeeze(erpdata{1}), 'delimiter', '\t', 'precision', 2);
dlmwrite('erpfile.txt', squeeze(erpdata{2}), '-append', 'roffset', 1, 'delimiter', '\t', 'precision', 2);
dlmwrite('erpfile.txt', squeeze(erpdata{2}), '-append', 'roffset', 1, 'delimiter', '\t', 'precision', 2);
```

