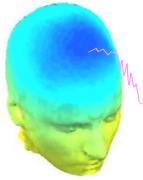
STUDY design and plotting overview



STEP 1

Build a STUDY

STEP 2

Build design(s)

STEP 3

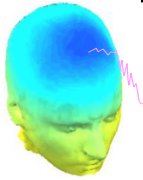
Precompute the data

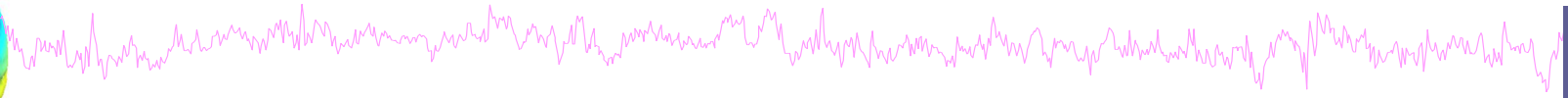
STEP 4

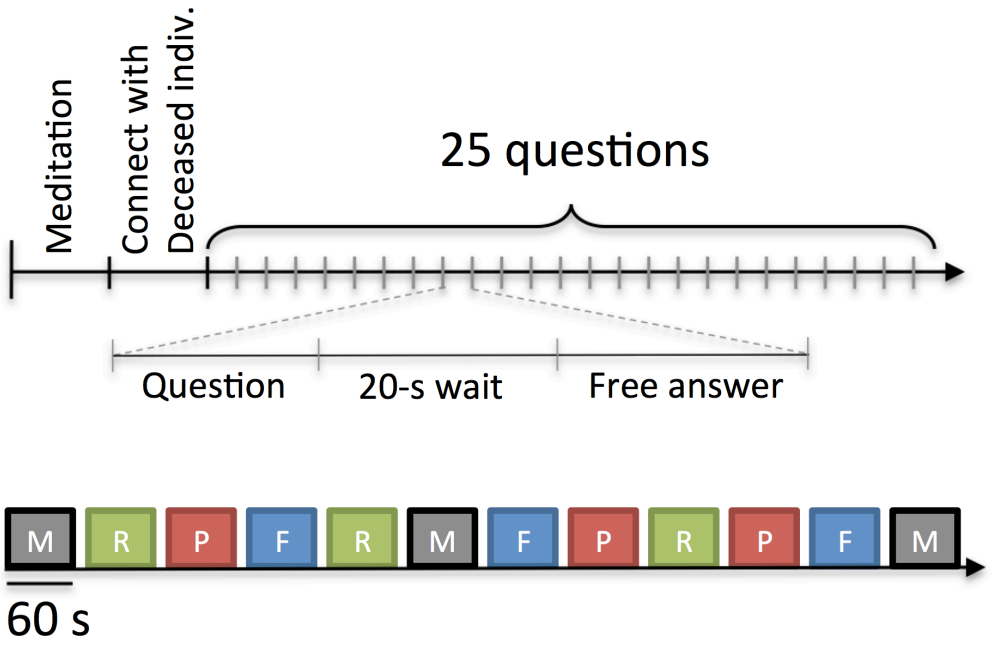
Plot the data

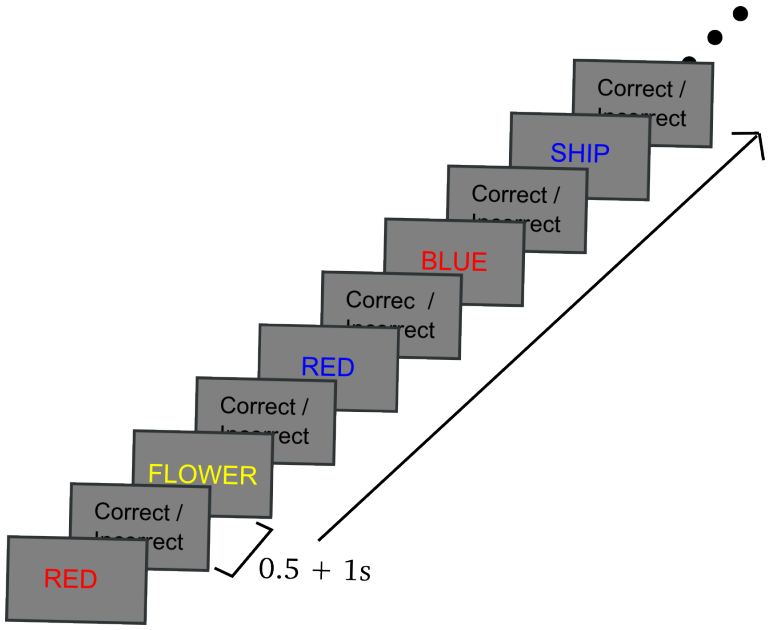
Exercise...

Formalizing experimental protocols

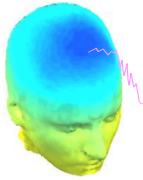


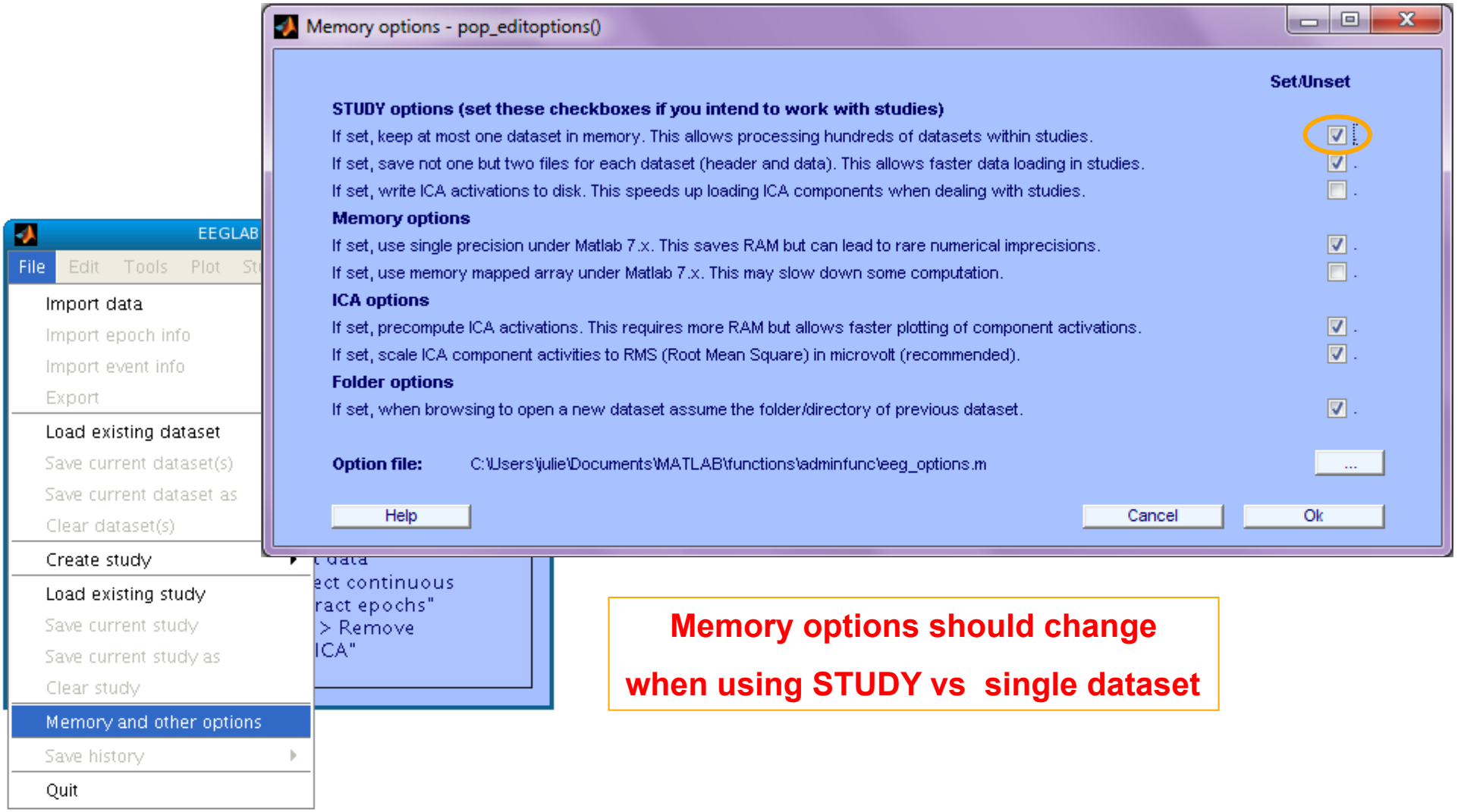






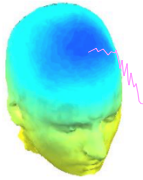
Memory options

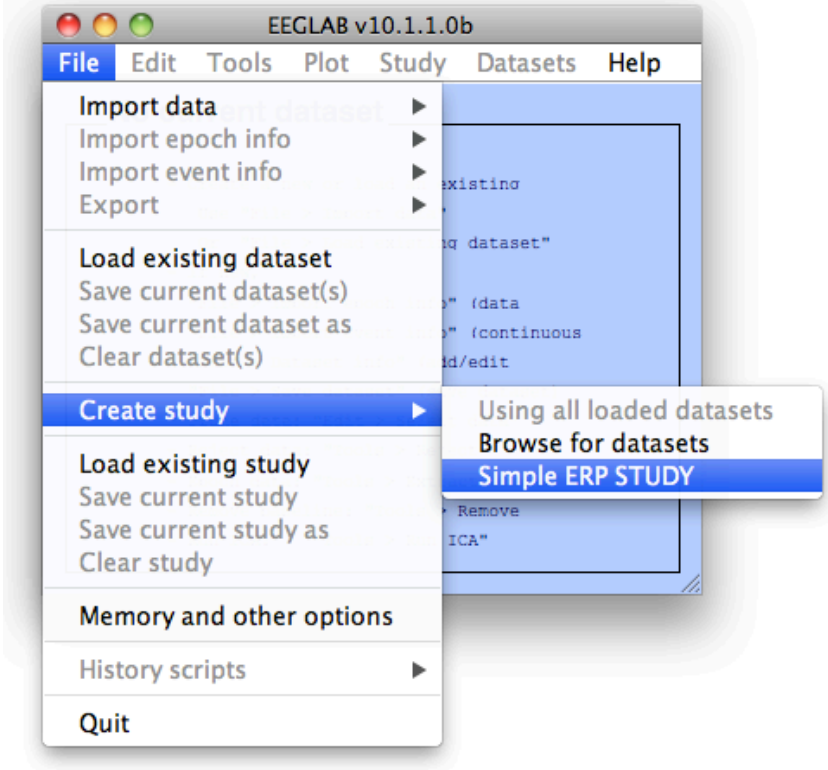


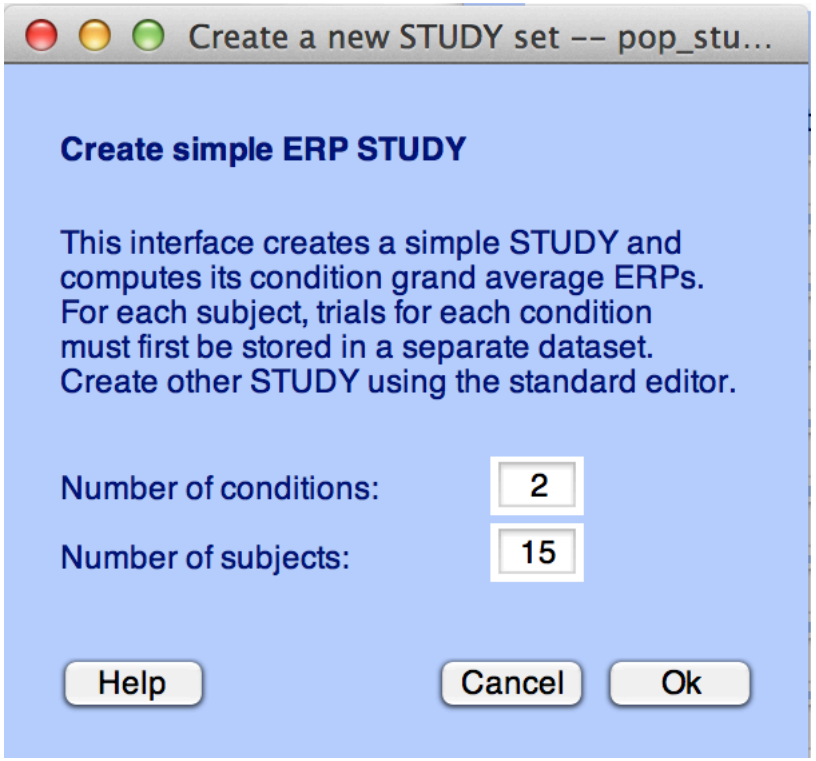


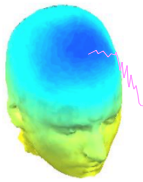
Memory options should change when using STUDY vs single dataset

Create simple ERP STUDY









Create a new STUDY set -- pop_studyerp()

Create simple ERP STUDY

STUDY set name: Letter memorization task

Condition 1 name	Condition 2 name
letter-ignore	letter-memorize

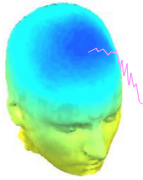
Condition 1 datasets		Condition 2 datasets	
/data/STUDY/S01/Ignore.set	...	/data/STUDY/S01/Memorize.set	...
/data/STUDY/S02/Ignore.set	...	/data/STUDY/S02/Memorize.set	...
/data/STUDY/S03/Ignore.set	...	/data/STUDY/S03/Memorize.set	...
	...		...
	...		...
	...		...
	...		...
	...		...
	...		...
	...		...
	...		...
	...		...
	...		...
	...		...
	...		...

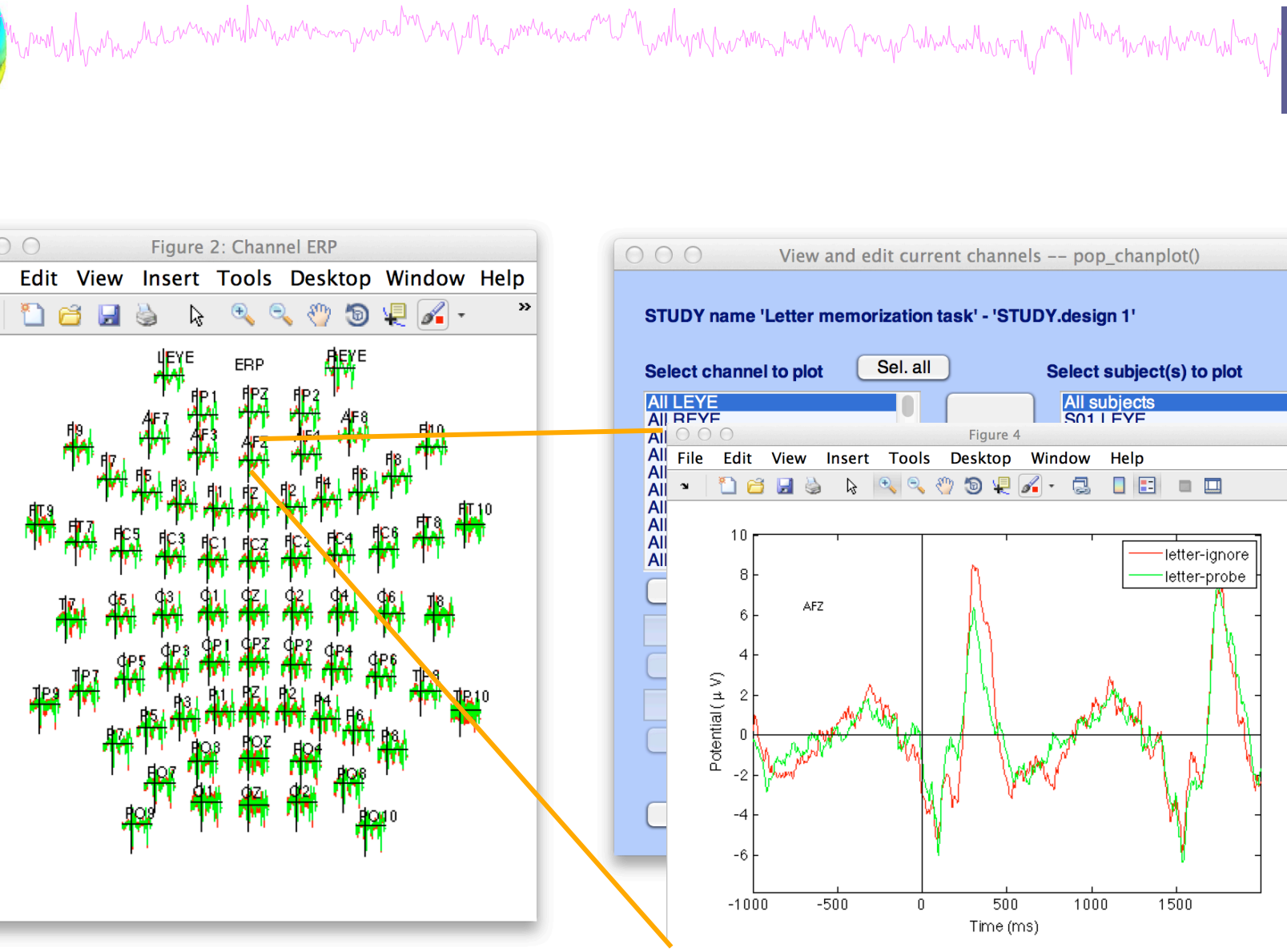
When using more than 1 condition, datasets on each line must correspond to the same subject.

Help Cancel Ok

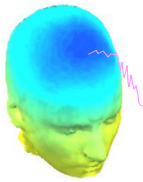
Swartz Center for Computational Neuroscience

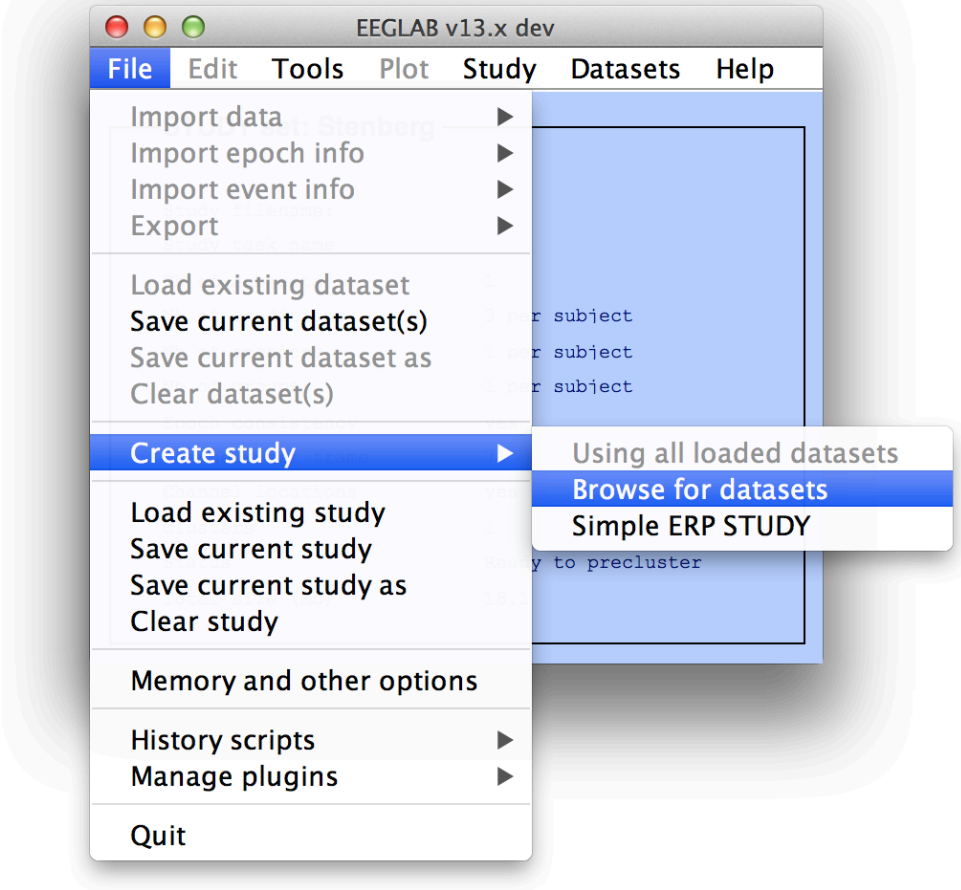
Create simple ERP STUDY



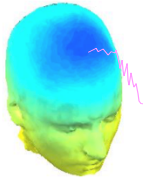


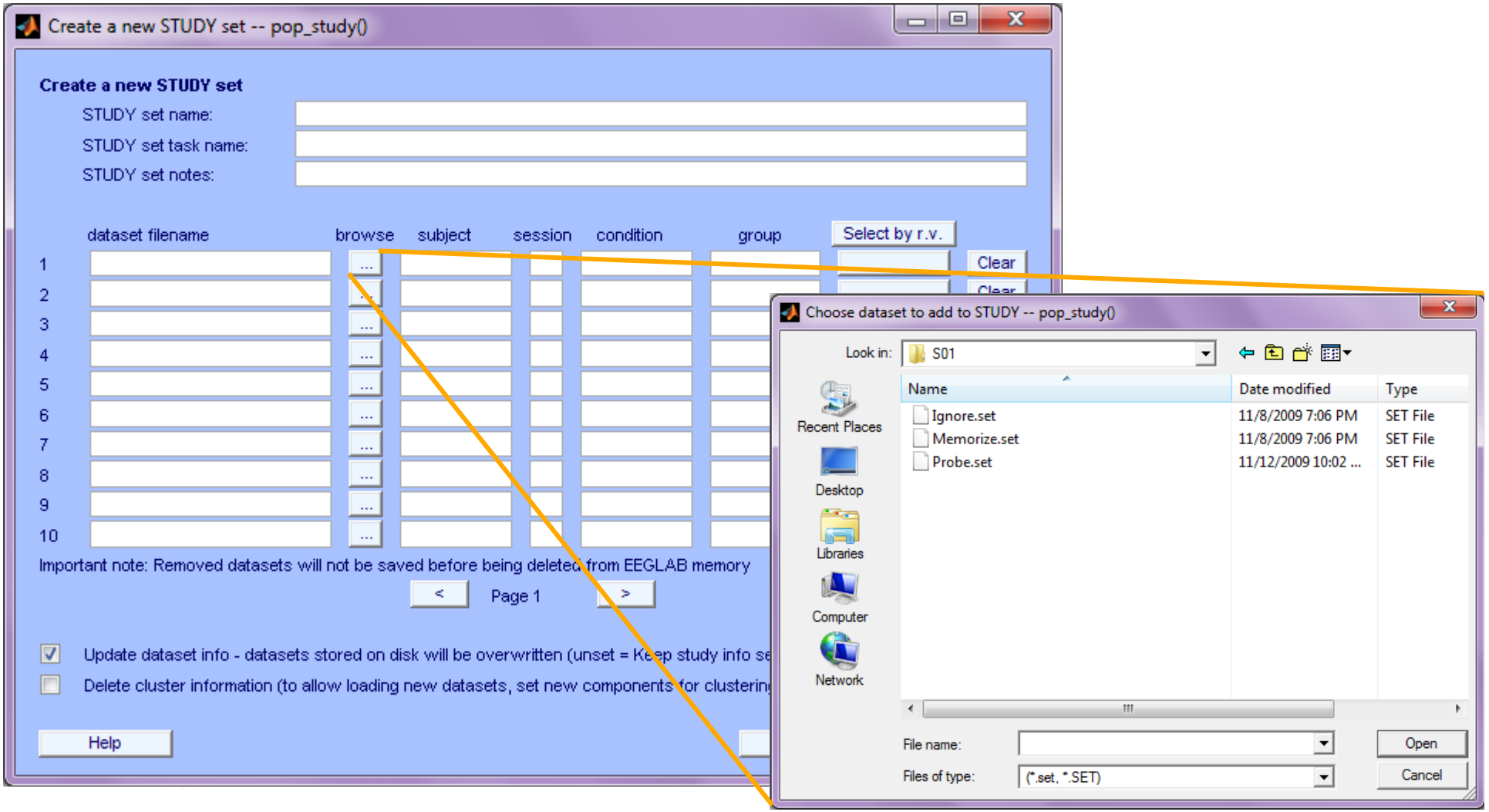
Build a STUDY



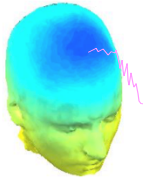


Build a STUDY, cont'd





Edit dataset info



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	/Volumes/donnees/data/STUD	...	S01		memorize		All comp.	Clear
2	/Volumes/donnees/data/STUD	...	S01		ignore		All comp.	Clear
3	/Volumes/donnees/data/STUD	...	S01		probe		All comp.	Clear
4	/Volumes/donnees/data/STUD	...	S02		memorize		All comp.	Clear
5	/Volumes/donnees/data/STUD	...	S02		ignore		All comp.	Clear
6	/Volumes/donnees/data/STUD	...	S02		probe		All comp.	Clear
7	/Volumes/donnees/data/STUD	...	S03		memorize		All comp.	Clear
8	/Volumes/donnees/data/STUD	...	S03		ignore		All comp.	Clear
9	/Volumes/donnees/data/STUD	...	S03		probe		All comp.	Clear
10	/Volumes/donnees/data/STUD	...	S04		memorize		All comp.	Clear

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

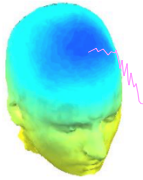
< Page 1 >

☐ 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

Experimental design



1x2 unpaired

Patients	Controls
Group A	Group B

2x2 unpaired

	Patients	Controls
Old	Group A	Group B
Young	Group C	Group D

1x2 paired

Stim A	Stim B

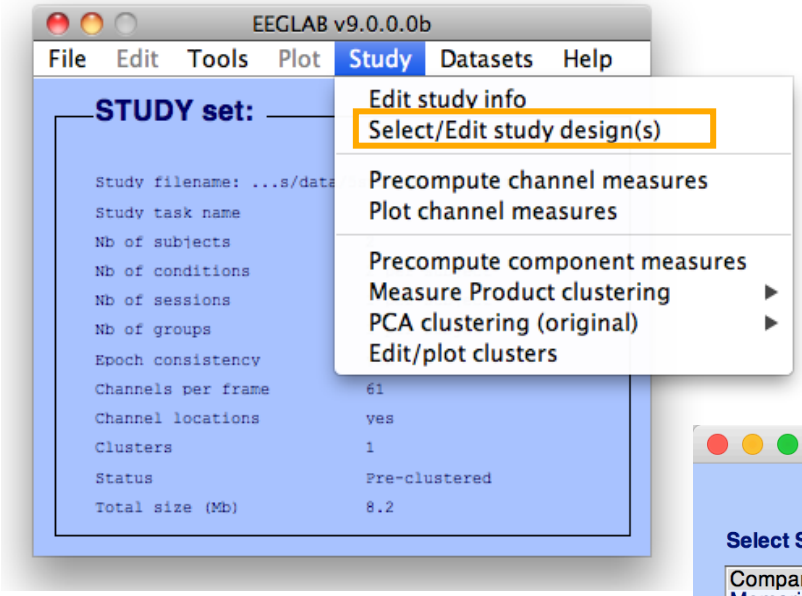
2x2 paired

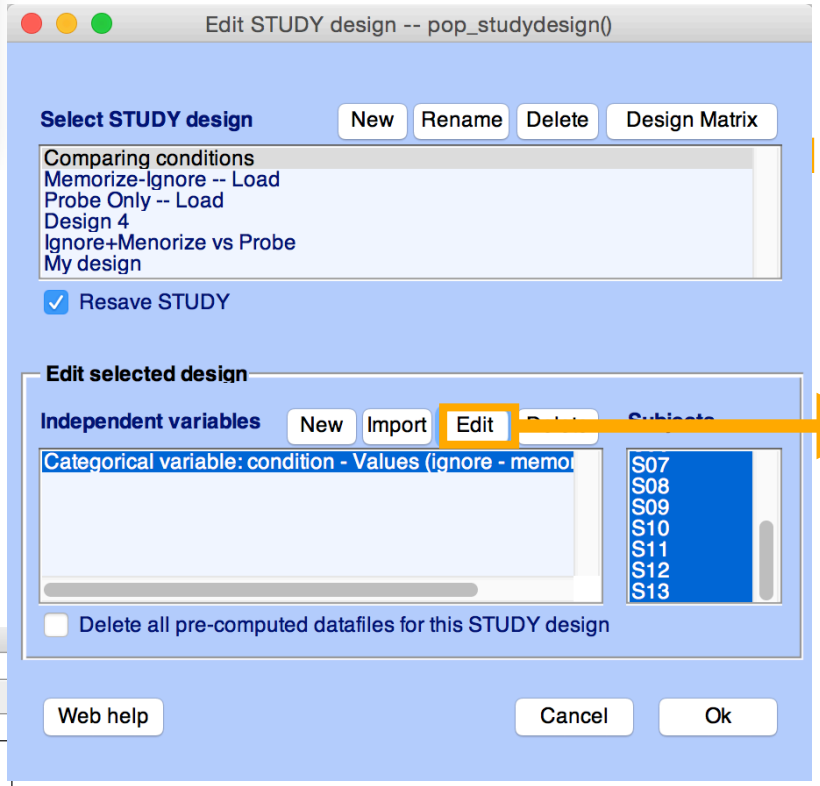
	Stim A	Stim B
Drug A		
Drug B		

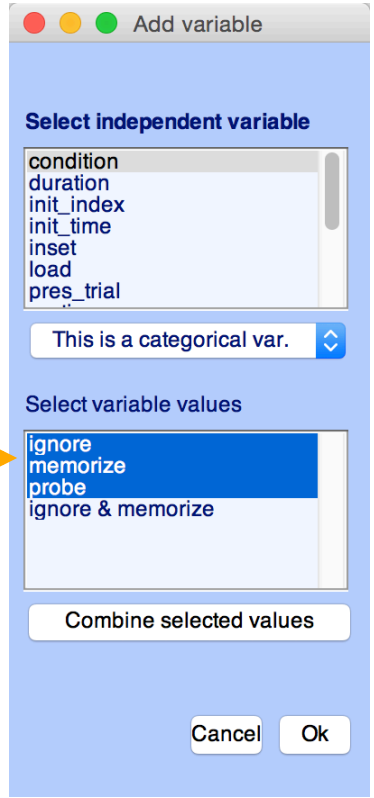
2x2 paired & unpaired

	Patients	Controls
Drug A		
Drug B		

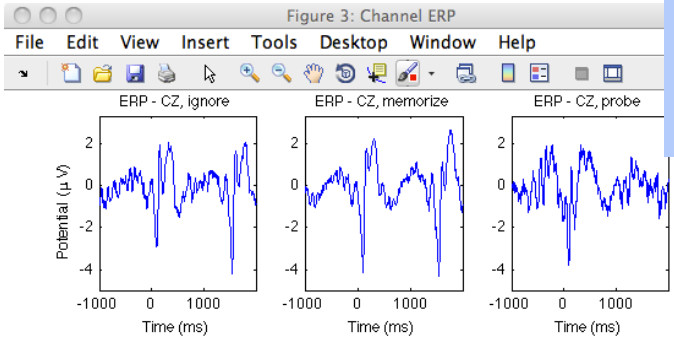
Create design

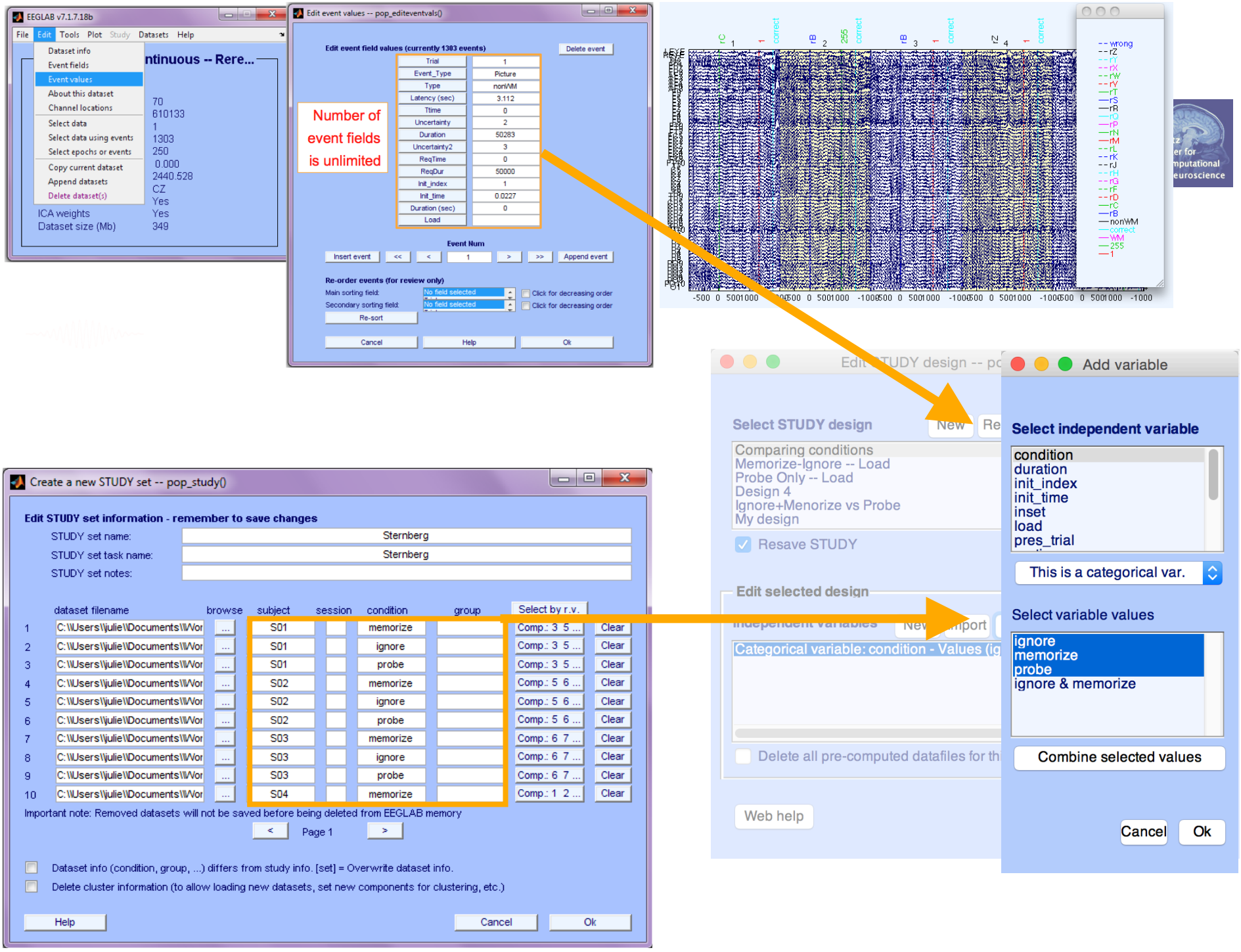




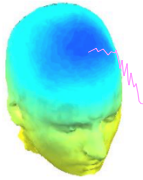


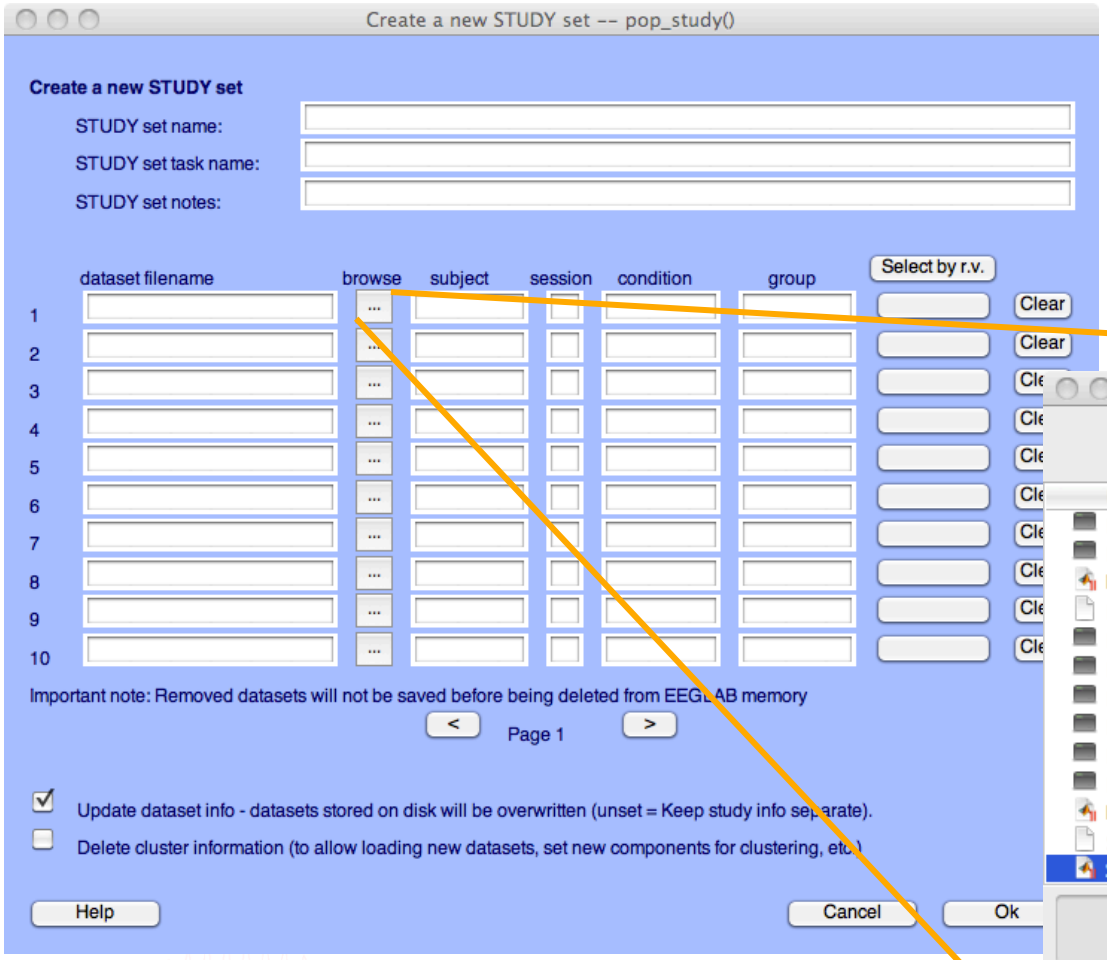
1x3 design

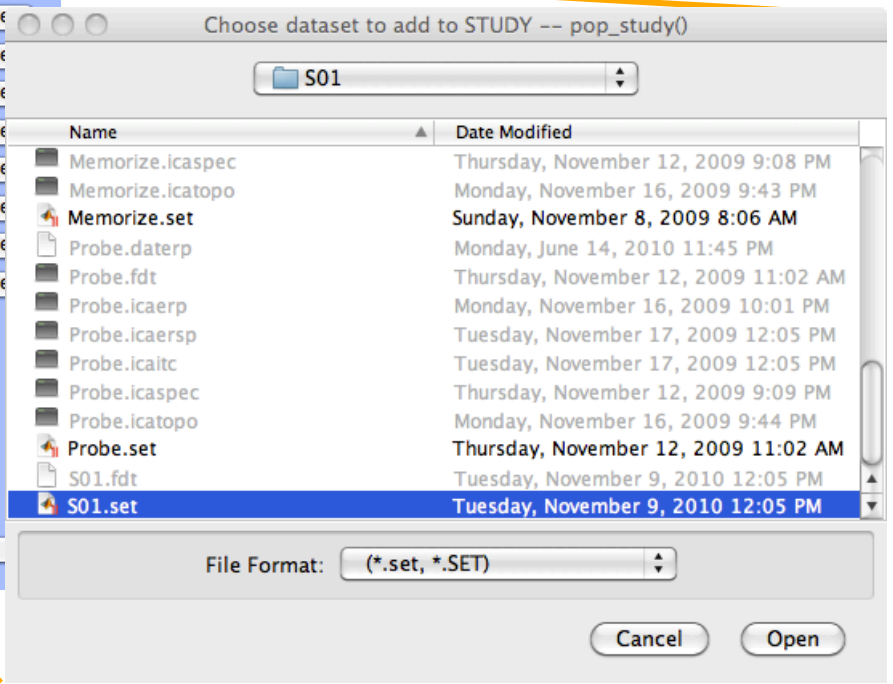



EEGLAB v7.1.7.18b
File Edit Tools Plot Study Datasets Help
Dataset info
Event fields
Event values
About this dataset
Channel locations
Select data
Select data using events
Select epochs or events
Copy current dataset
Append datasets
Delete dataset(s)
ntinuous -- Rere...
70
610133
1
1303
250
0.000
2440.528
CZ
Yes
Yes
349
ICA weights
Dataset size (Mb)
Edit event values -- pop_editeventvals()
Edit event field values (currently 1303 events)
Delete event
Trial 1
Event_Type Picture
Type nonWM
Latency (sec) 3.112
Ttime 0
Uncertainty 2
Duration 50283
Uncertainty2 3
ReqTime 0
ReqDur 50000
Init_index 1
Init_time 0.0227
Duration (sec) 0
Load
Number of event fields is unlimited
Event Num
Insert event
Append event
Re-order events (for review only)
Main sorting field:
Secondary sorting field:
No field selected
Click for decreasing order
Re-sort
Cancel
Help
Ok
wrong
rZ
rY
rW
rV
rT
rS
rR
rQ
rP
rN
rM
rL
rK
rJ
rH
rG
rF
rD
rC
rB
nonWM
correct
WM
255
1
-500 0 5001000
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
< Page 1 >
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
Select STUDY design
New
Comparing conditions
Memorize-Ignore -- Load
Probe Only -- Load
Design 4
Ignore+Menorize vs Probe
My design
Resave STUDY
Edit selected design
Categorical variable: condition - Values (ig
Delete all pre-computed datafiles for th
Web help
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

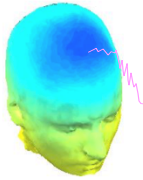
Build a STUDY, alternative method







Edit dataset info



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	/Volumes/donnees/data/STU[:	...	S01				Comp.: 1 2 ...	Clear
2	/Volumes/donnees/data/STU[:	...	S02				Comp.: 1 2 ...	Clear
3	/Volumes/donnees/data/STU[:	...	S03				Comp.: 1 2 ...	Clear
4	/Volumes/donnees/data/STU[:	...	S04				Comp.: 1 2 ...	Clear
5	/Volumes/donnees/data/STU[:	...	S05				Comp.: 1 2 ...	Clear
6	/Volumes/donnees/data/STU[:	...	S06				Comp.: 1 2 ...	Clear
7	/Volumes/donnees/data/STU[:	...	S07				Comp.: 1 2 ...	Clear
8	/Volumes/donnees/data/STU[:	...	S08				Comp.: 1 2 ...	Clear
9	/Volumes/donnees/data/STU[:	...	S09				Comp.: 1 2 ...	Clear
10	/Volumes/donnees/data/STU[:	...	S10				Comp.: 1 2 ...	Clear

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

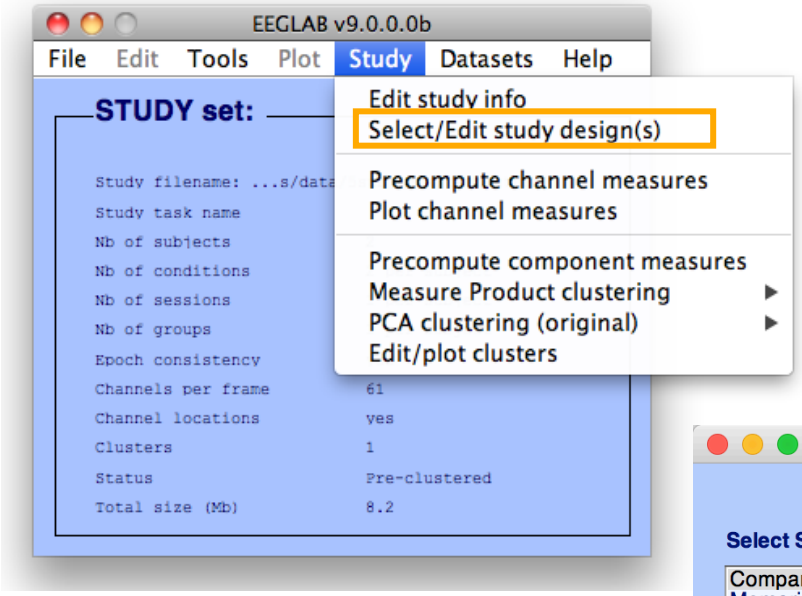
< Page 1 >

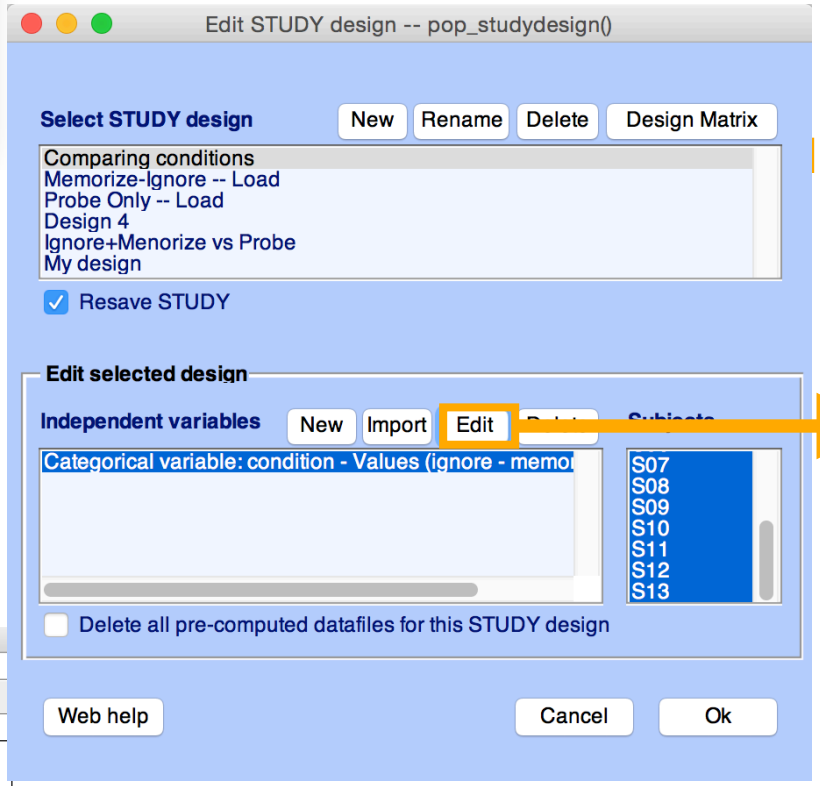
☑ Update dataset info - datasets stored on disk will be overwritten (unset = Keep study info separate).

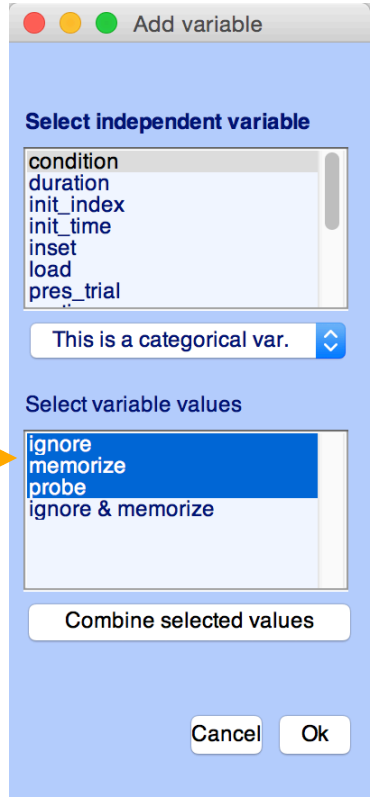
☐ Delete cluster information (to allow loading new datasets, set new components for clustering, etc.)

Help Cancel Ok

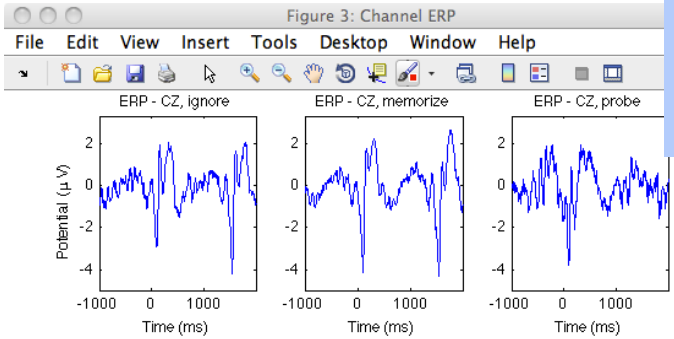
Create design



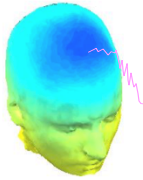


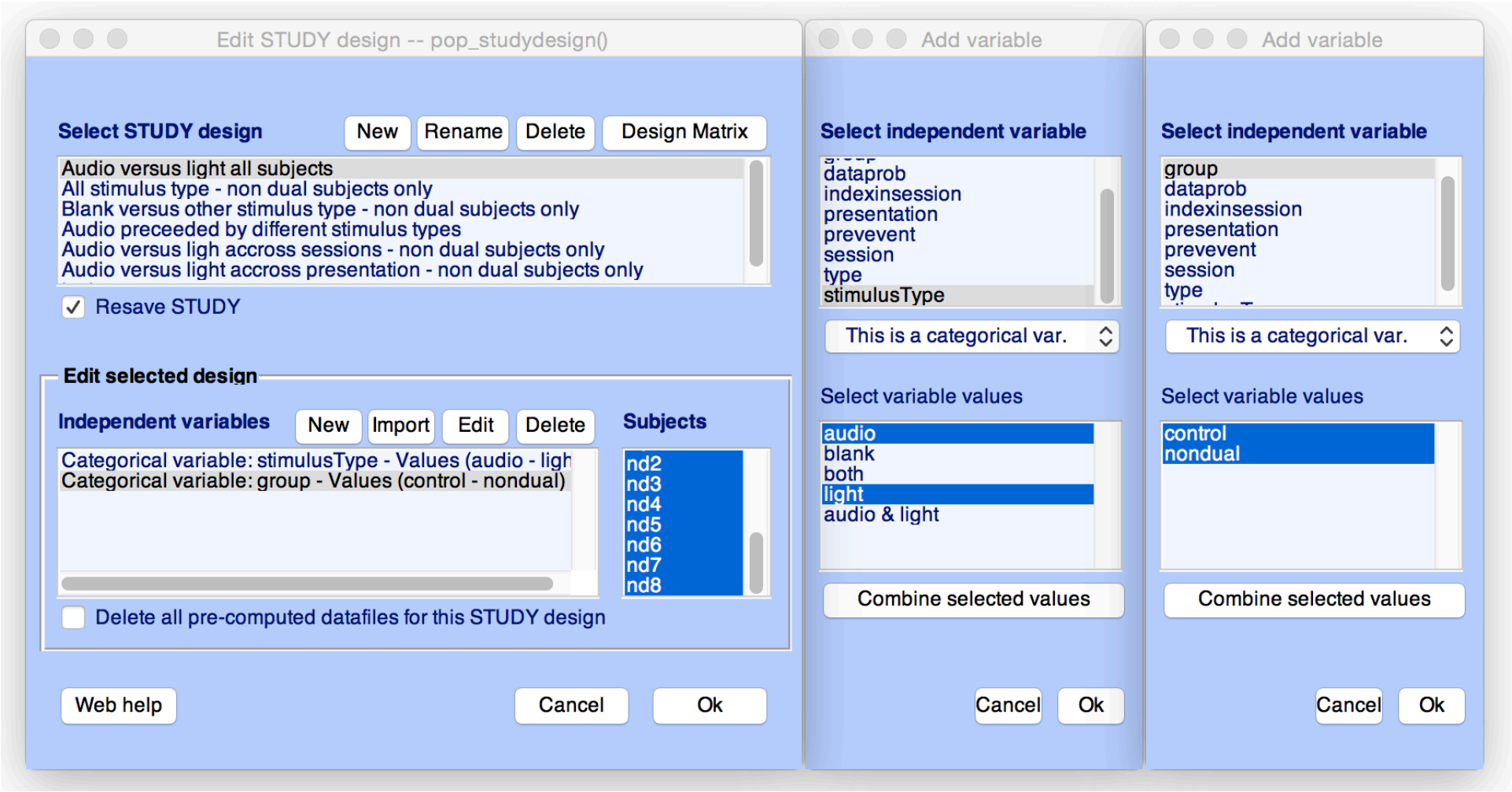


1x3 design

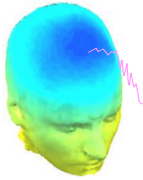


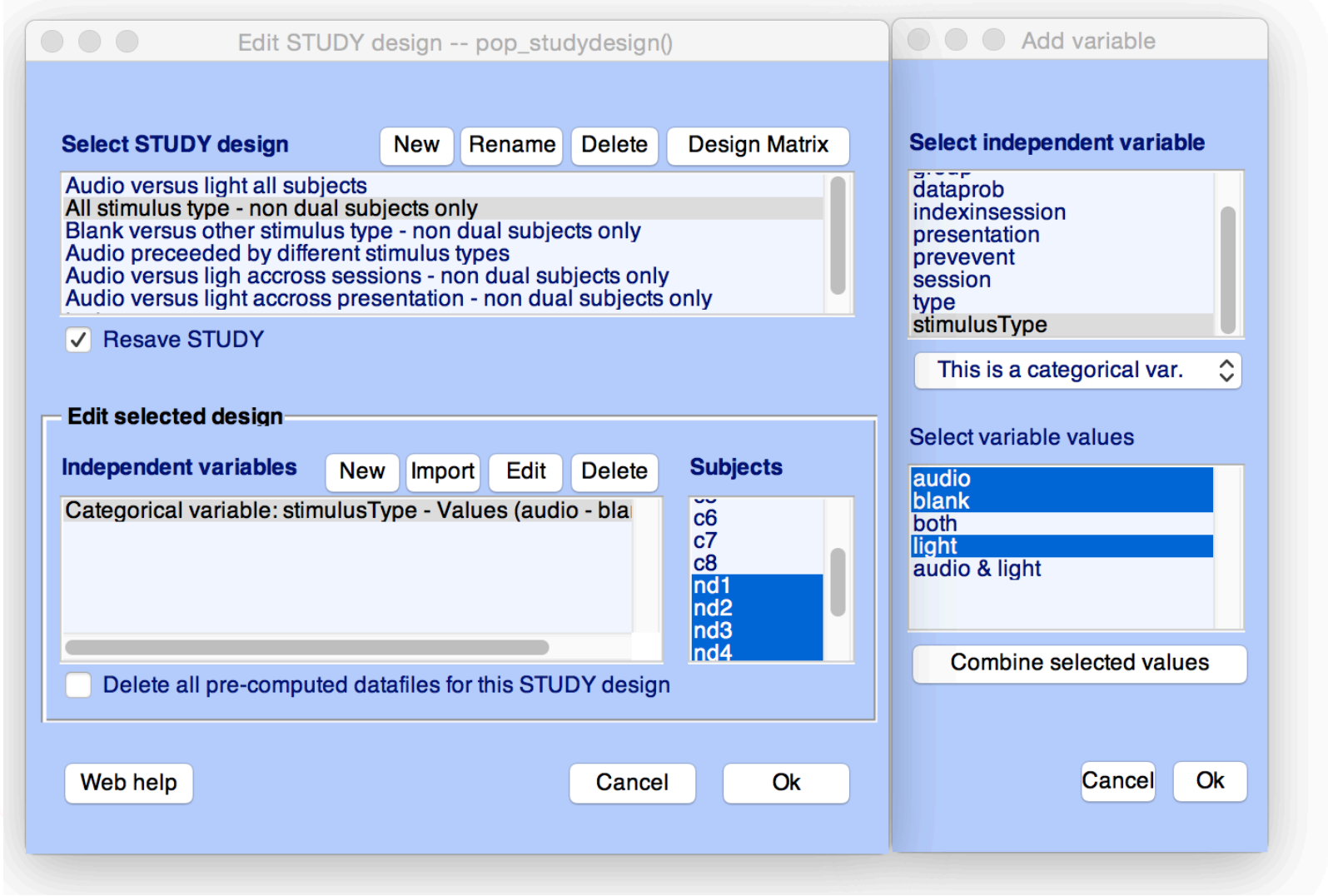
Other design examples



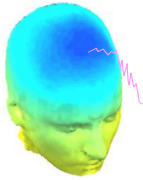


Other design examples





Other design examples



Edit STUDY design -- pop_studydesign()

Select STUDY design | New | Rename | Delete | Design Matrix

Audio versus light all subjects
All stimulus type - non dual subjects only
Blank versus other stimulus type - non dual subjects only
Audio preceeded by different stimulus types
Audio versus ligh accross sessions - non dual subjects only
Audio versus light accross presentation - non dual subjects only

☑ Resave STUDY

Edit selected design

Independent variables | New | Import | Edit | Delete

Categorical variable: stimulusType - Values (audio & lig

Subjects

c6
c7
c8
nd1
nd2
nd3
nd4

☐ Delete all pre-computed datafiles for this STUDY design

Web help | Cancel | Ok

Add variable

Select independent variable

dataprob
indexinsession
presentation
prevevent
session
type
stimulusType

This is a categorical var.

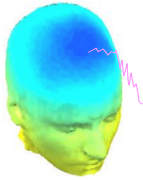
Select variable values

audio
blank
both
light
audio & light

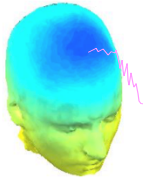
Combine selected values

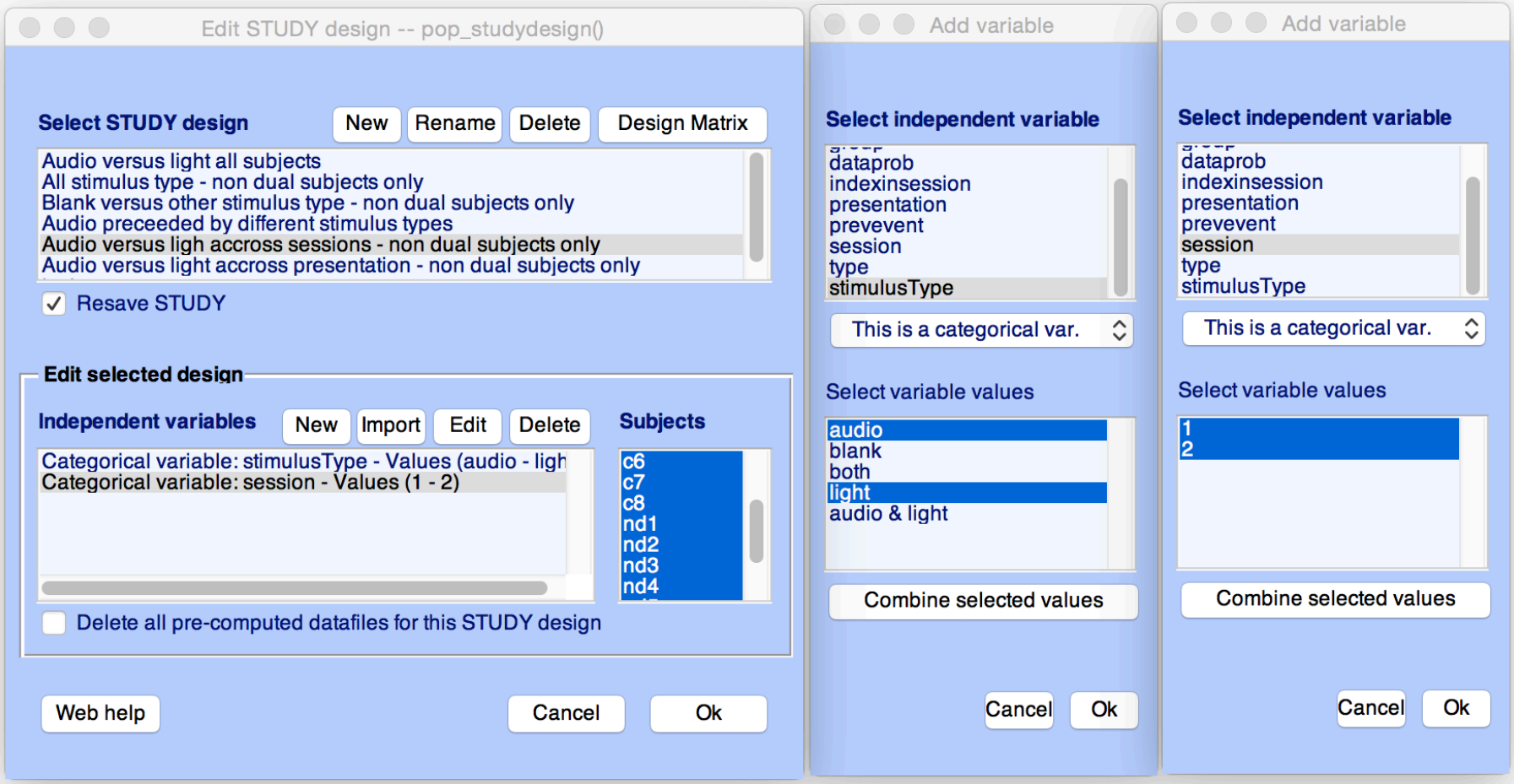
Cancel | Ok

Other design examples

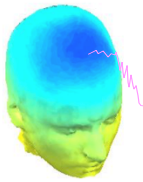


Other design examples





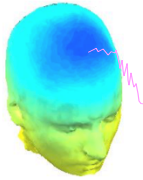
Exercises



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 STUDY folder)
4. In the column for “letter-memorize” select datasets “probe.set” for 3 subjects S01, S02, S03 (in the STUDY folder)
5. Press OK.

STUDY design and plotting overview



STEP 1

Build a STUDY

STEP 2

Build design(s)

STEP 3

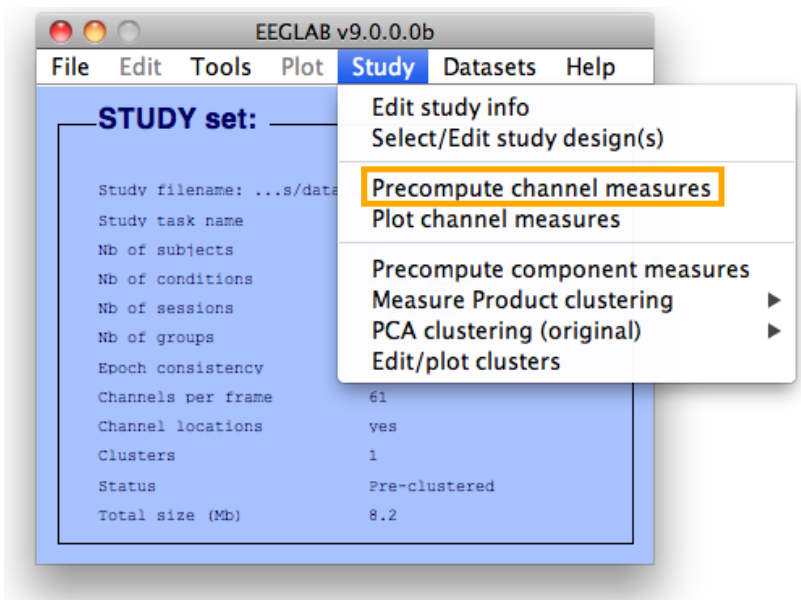
Precompute the data

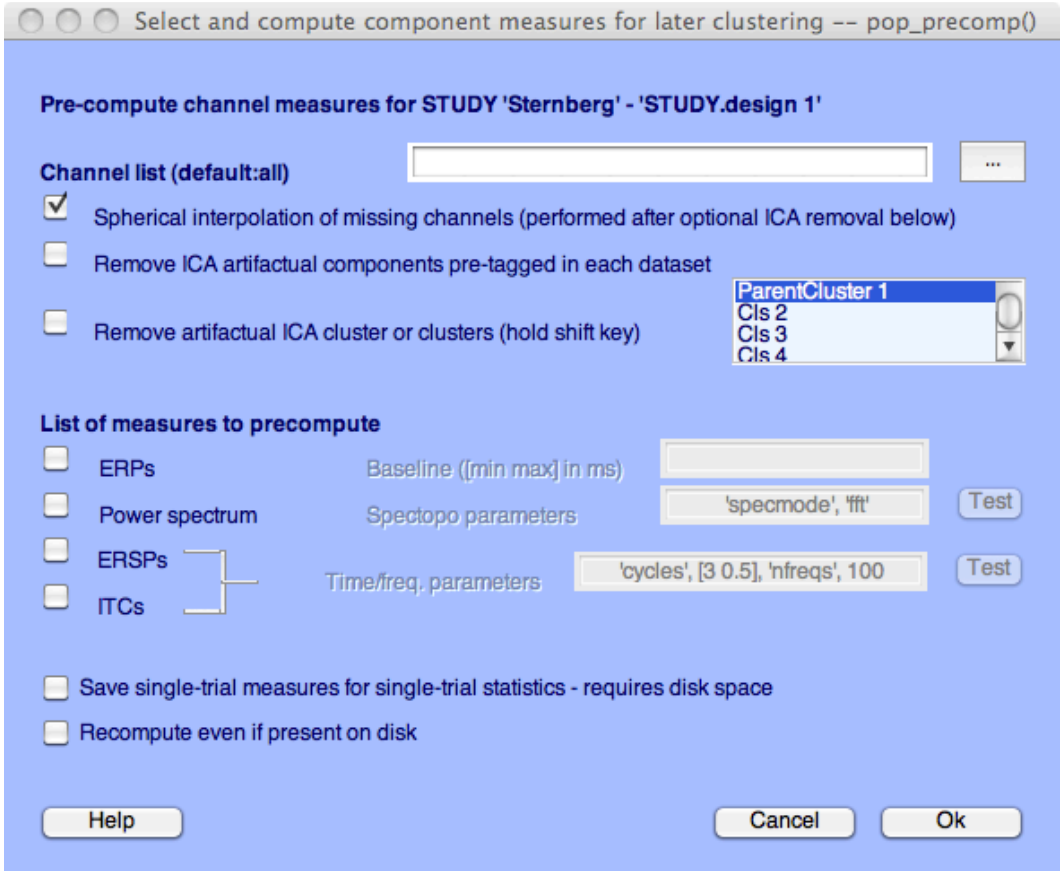
STEP 4

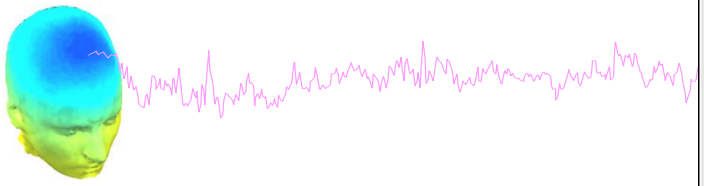
Plot the data

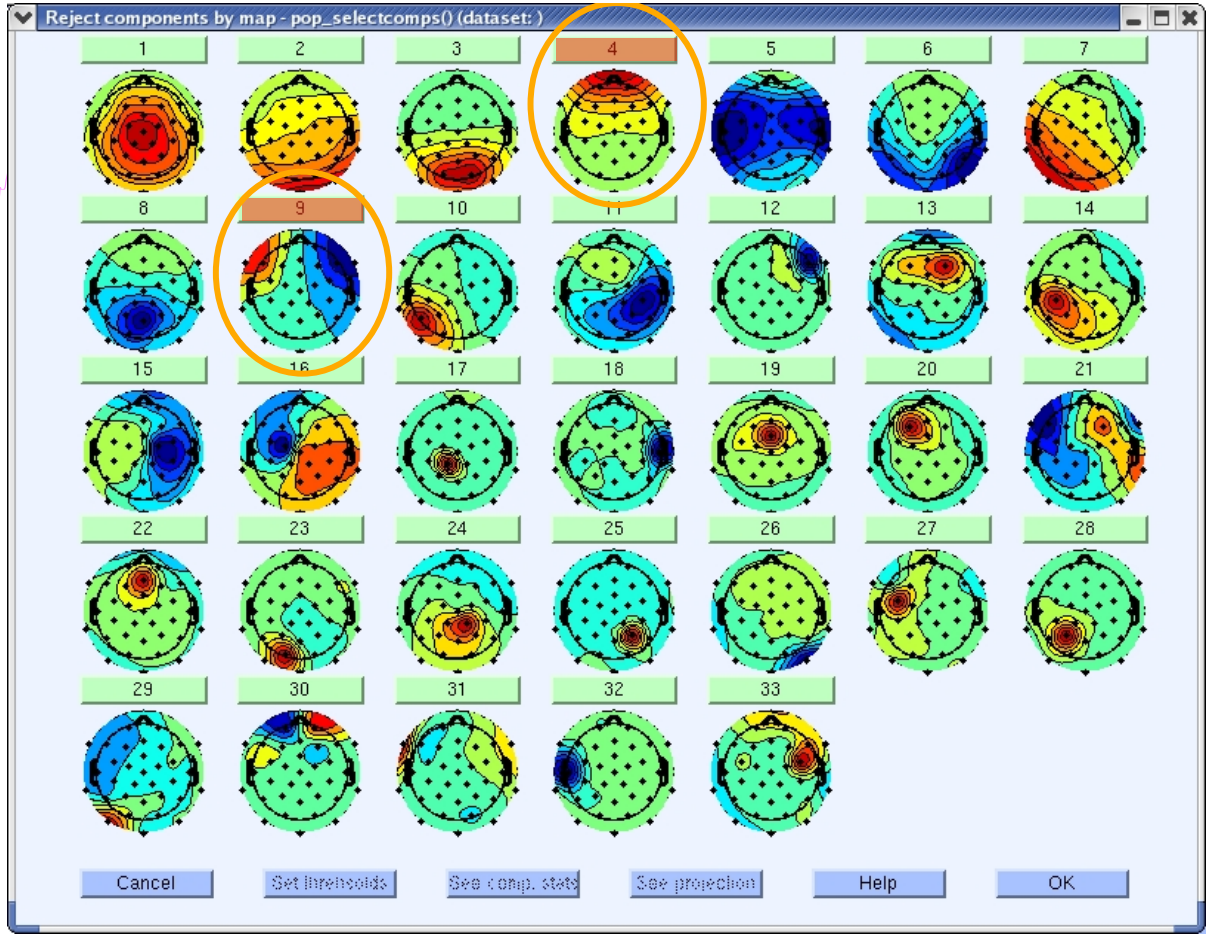
Exercise...

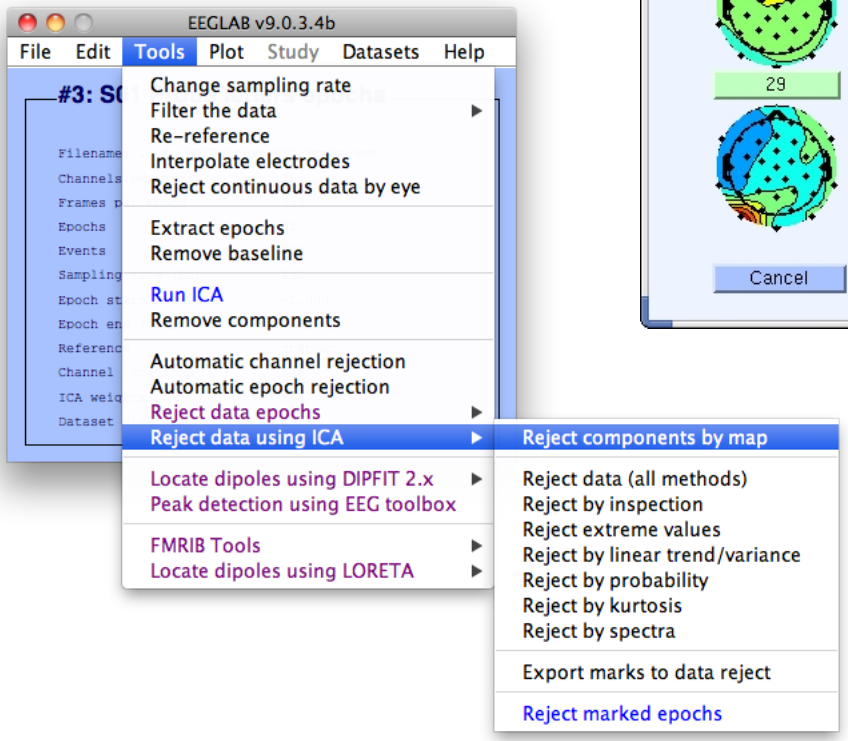
Precompute data measures

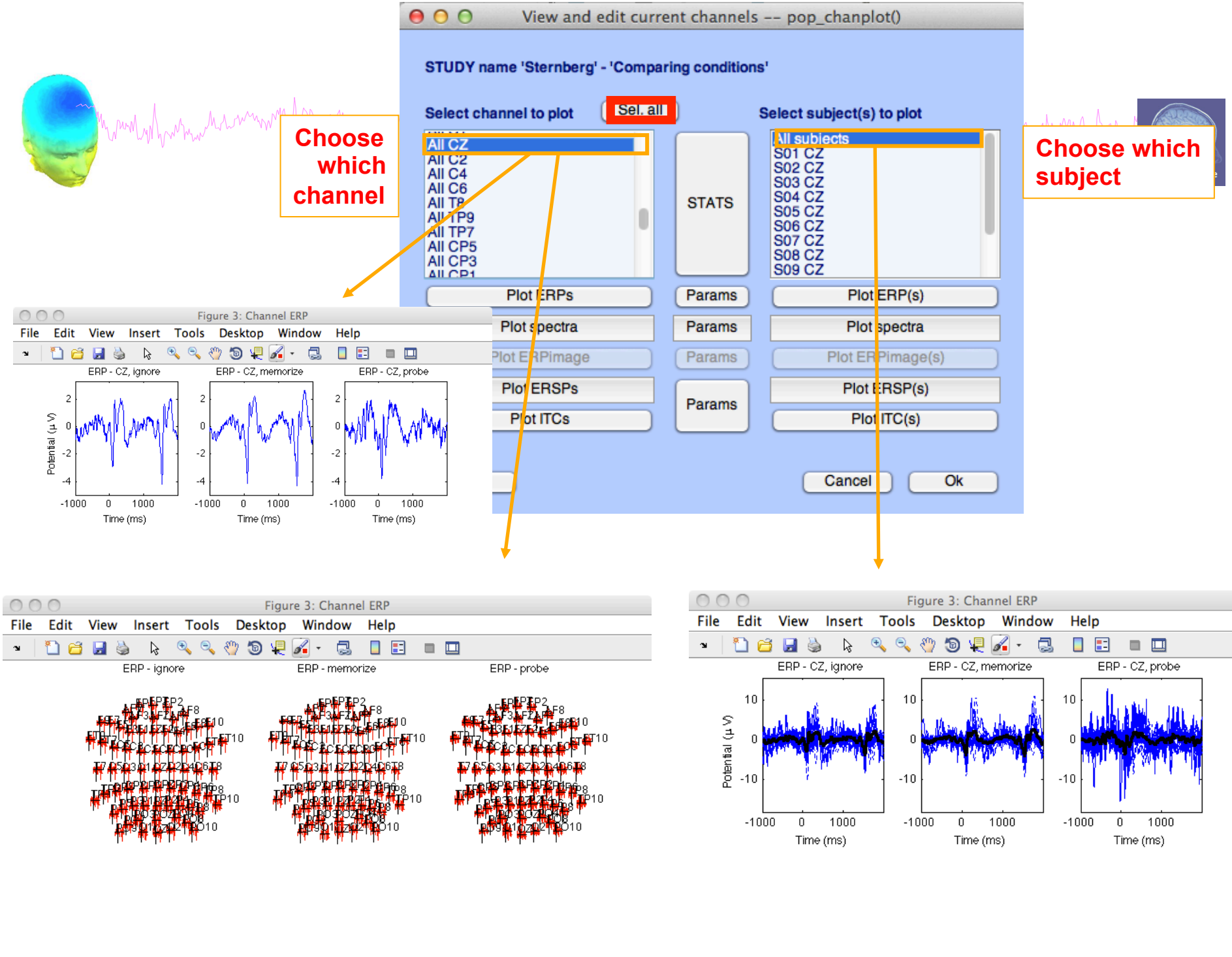


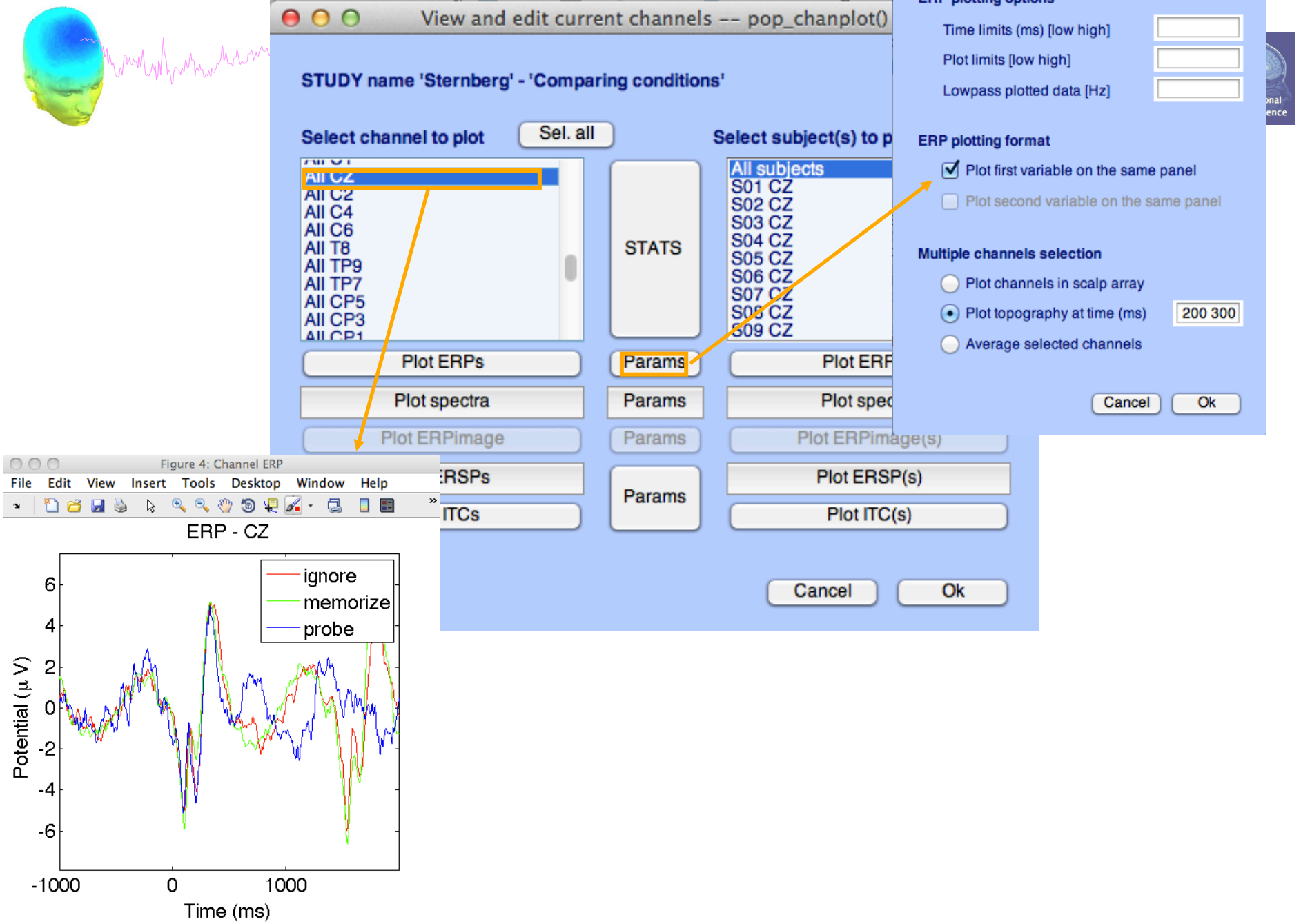


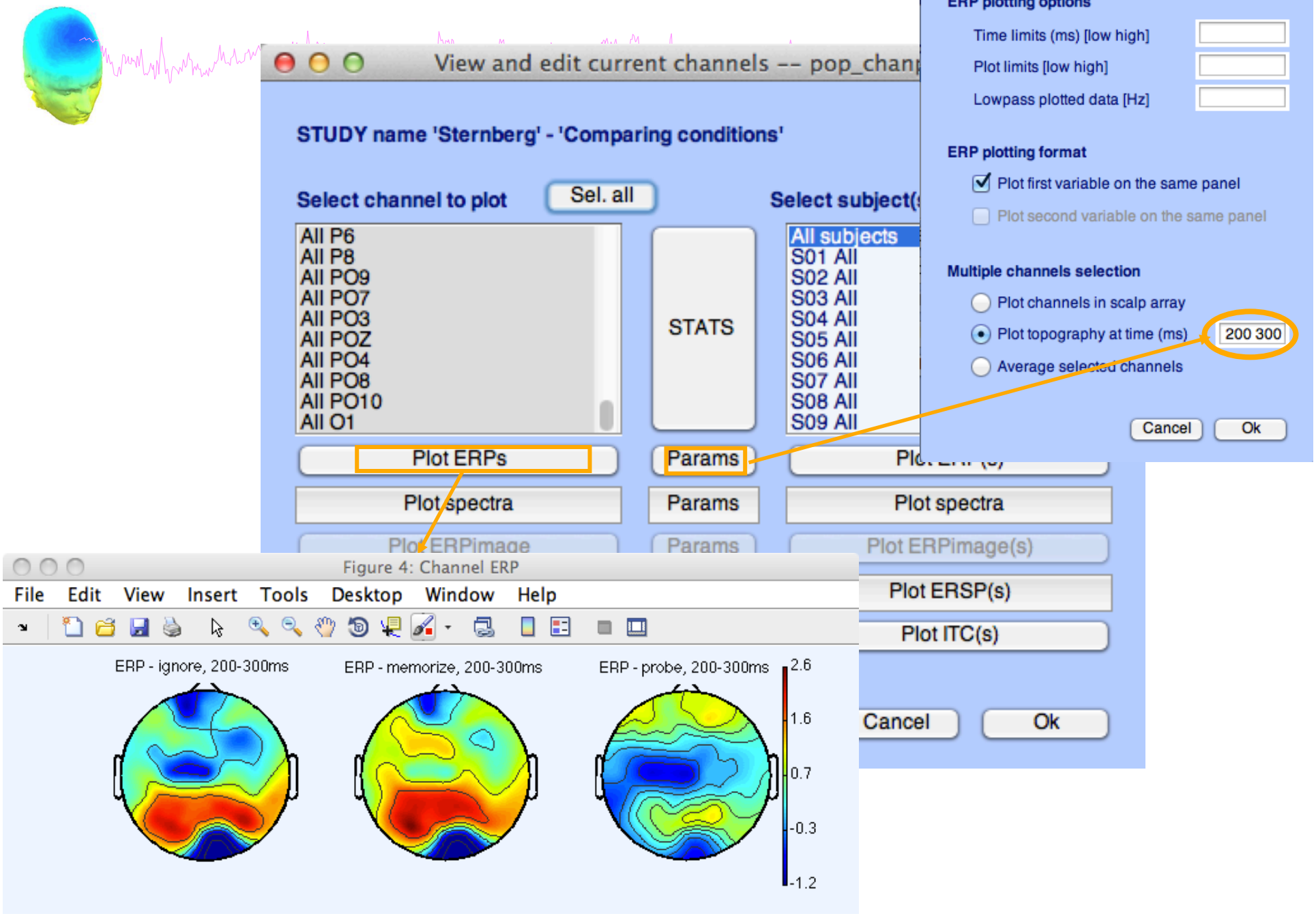


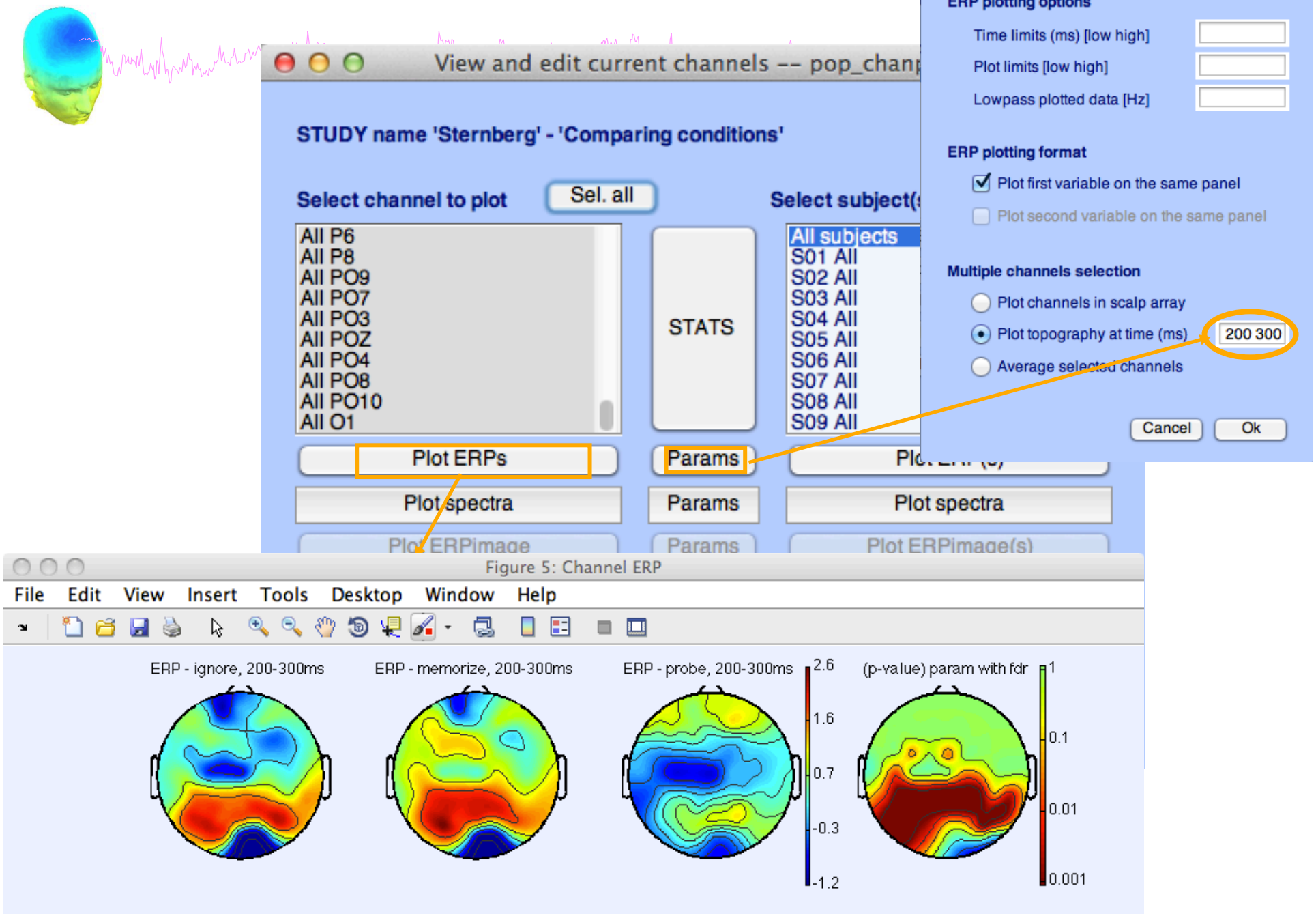

Reject components by map - pop_selectcomps() (dataset:)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
Cancel
Set thresholds
See comp. stats
See projection
Help
OK


EEGLAB v9.0.3.4b
File
Edit
Tools
Plot
Study
Datasets
Help
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

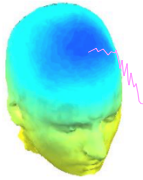

Choose which channel
View and edit current channels -- pop_chanplot()
STUDY name 'Sternberg' - 'Comparing conditions'
Select channel to plot
Sel. all
All CZ
All C2
All C4
All C6
All T8
All TP9
All TP7
All CP5
All CP3
STATS
Select subject(s) to plot
All subjects
S01 CZ
S02 CZ
S03 CZ
S04 CZ
S05 CZ
S06 CZ
S07 CZ
S08 CZ
S09 CZ
Plot ERPs
Plot spectra
Plot ERPimage
Plot ERSPs
Plot ITCs
Params
Plot ERP(s)
Plot spectra
Plot ERPimage(s)
Plot ERSP(s)
Plot ITC(s)
Cancel
Ok
Choose which subject
Figure 3: Channel ERP
File Edit View Insert Tools Desktop Window Help
ERP - CZ, ignore
ERP - CZ, memorize
ERP - CZ, probe
Potential (μ V)
Time (ms)
ERP - ignore
ERP - memorize
ERP - probe


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
STATS
Select subject(s) to p
All subjects
S01 CZ
S02 CZ
S03 CZ
S04 CZ
S05 CZ
S06 CZ
S07 CZ
S08 CZ
S09 CZ
Plot ERPs
Params
Plot ERP
Plot spectra
Params
Plot spec
Plot ERPimage
Params
Plot ERPimage(s)
ERSPs
Params
Plot ERSP(s)
ITCs
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)
200 300
Average selected channels
Cancel
Ok
Figure 4: Channel ERP
File Edit View Insert Tools Desktop Window Help
ERP - CZ
ignore
memorize
probe
Potential (μ V)
6
4
2
0
-2
-4
-6
-1000
0
1000
Time (ms)


View and edit current channels -- pop_chanp
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 spectra
Params
Plot ERPimage
Params
Plot spectra
Plot ERPimage(s)
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)
200 300
Average selected channels
Cancel
Ok
Figure 4: Channel ERP
File Edit View Insert Tools Desktop Window Help
ERP - ignore, 200-300ms
ERP - memorize, 200-300ms
ERP - probe, 200-300ms
2.6
1.6
0.7
-0.3
-1.2


View and edit current channels -- pop_chanp
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 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
Figure 5: Channel ERP
File Edit View Insert Tools Desktop Window Help
ERP - ignore, 200-300ms
ERP - memorize, 200-300ms
ERP - probe, 200-300ms
2.6
1.6
0.7
-0.3
-1.2
(p-value) param with fdr
1
0.1
0.01
0.001

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) [ ] [...]

- [x] 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

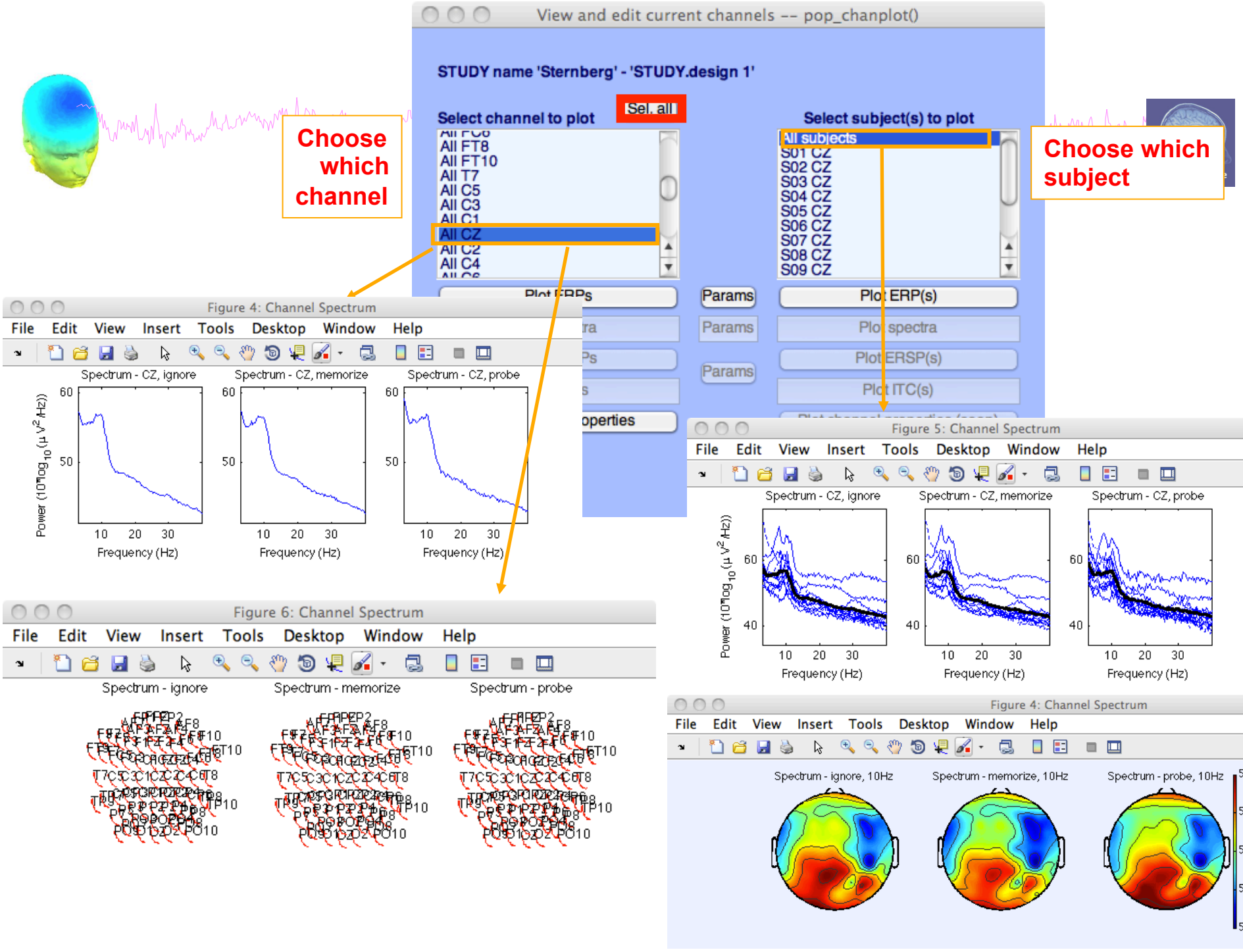
List of measures to precompute

- [ ] ERPs — Baseline ([min max] in ms)
- [x] Power spectrum — Spectopo parameters: 'specmode', 'fft' [Test]
- [ ] ERSPs
- [ ] ITCs

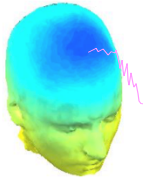
Time/freq. parameters: 'cycles', [3 0.5], 'nfreqs', 100 [Test]

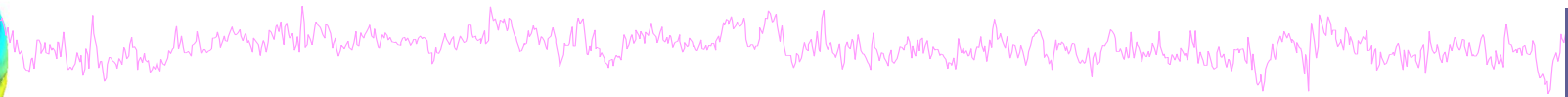
- [ ] Save single-trial measures for single-trial statistics - requires disk space
- [ ] Recompute even if present on disk

[Help] [Cancel] [Ok]

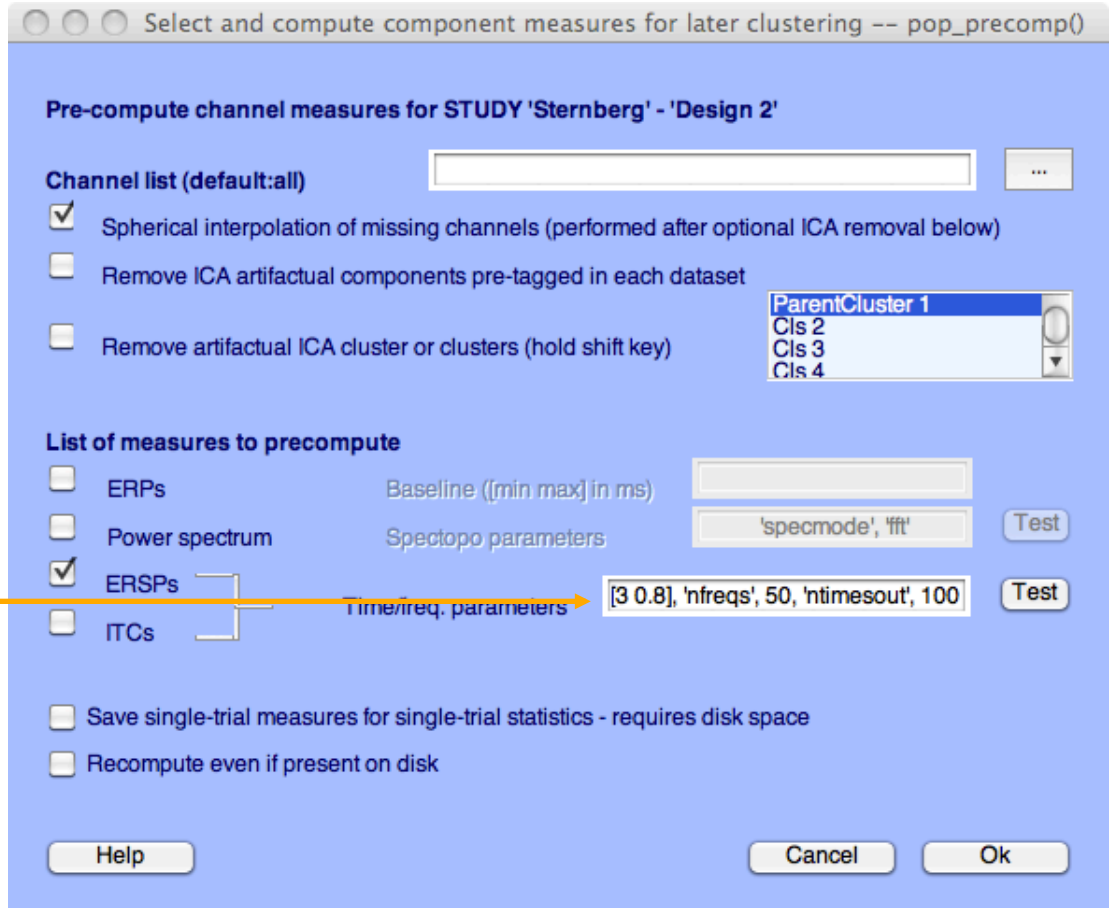

View and edit current channels -- pop_chanplot()
STUDY name 'Sternberg' - 'STUDY.design 1'
Select channel to plot
Sel. all
All FT8
All FT10
All T7
All C5
All C3
All C1
All CZ
All C4
Select subject(s) to plot
All subjects
S01 CZ
S02 CZ
S03 CZ
S04 CZ
S05 CZ
S06 CZ
S07 CZ
S08 CZ
S09 CZ
Params
Plot ERP(s)
Plot spectra
Plot ERSP(s)
Plot ITC(s)
Choose which channel
Choose which subject
Figure 4: Channel Spectrum
File Edit View Insert Tools Desktop Window Help
Spectrum - CZ, ignore
Spectrum - CZ, memorize
Spectrum - CZ, probe
Power (10*log10 (μ V2/Hz))
Frequency (Hz)
Figure 5: Channel Spectrum
Figure 6: Channel Spectrum
Spectrum - ignore
Spectrum - memorize
Spectrum - probe
Figure 4: Channel Spectrum
Spectrum - ignore, 10Hz
Spectrum - memorize, 10Hz
Spectrum - probe, 10Hz

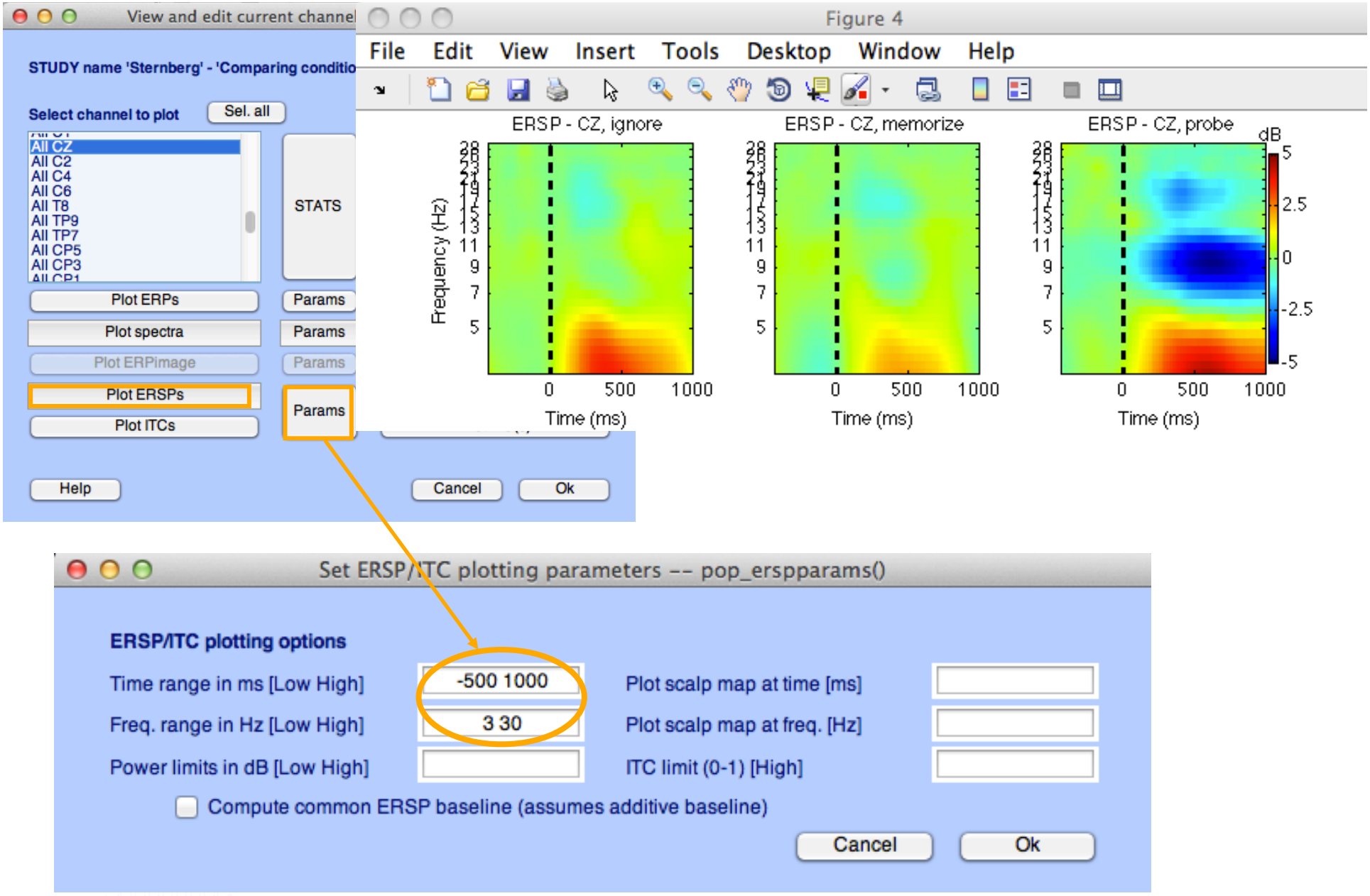
Computing ERSP



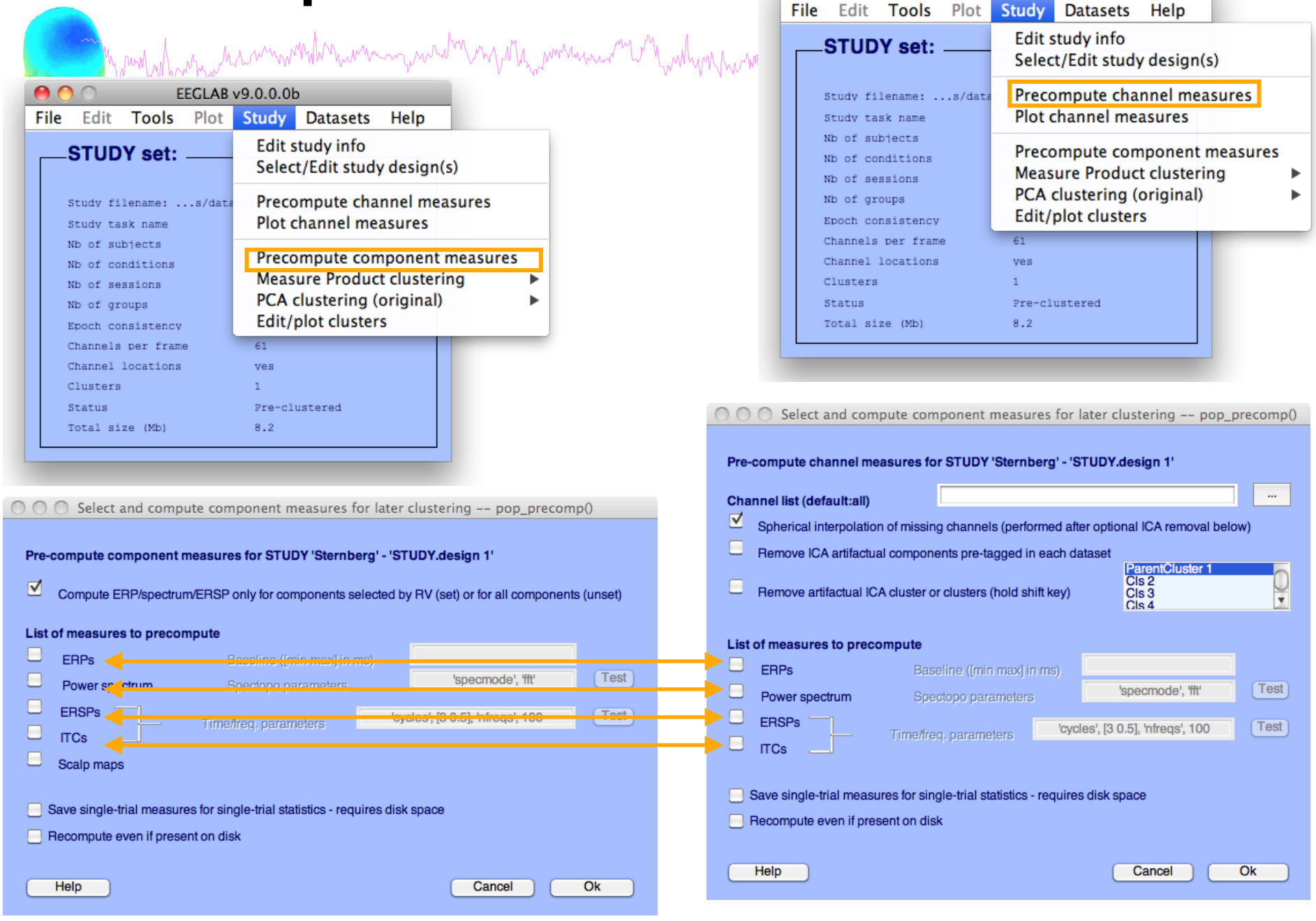


'cycles', [3 0.8], 'nfreqs', 50, 'ntimesout', 100

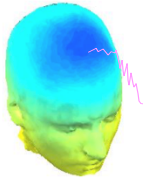


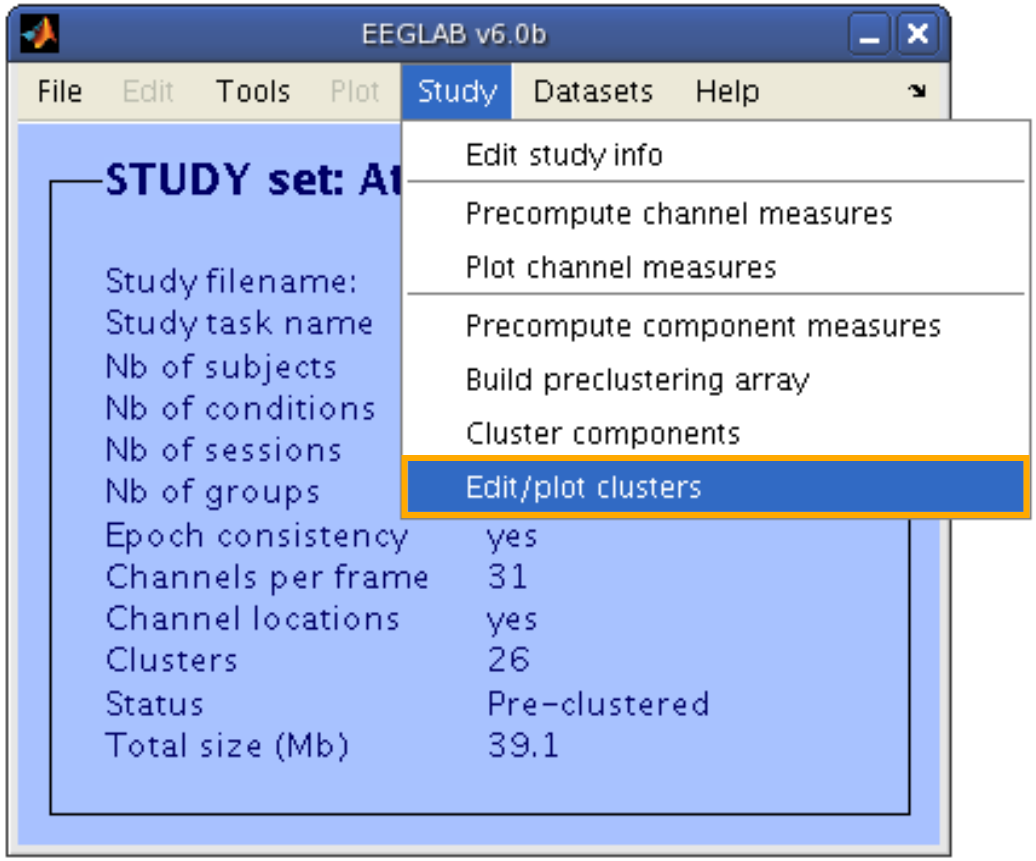

View and edit current channel
STUDY name 'Sternberg' - 'Comparing conditio
Select channel to plot
Sel. all
All CZ
All C2
All C4
All C6
All T8
All TP9
All TP7
All CP5
All CP3
STATS
Plot ERPs
Params
Plot spectra
Params
Plot ERPimage
Params
Plot ERSPs
Params
Plot ITCs
Help
Cancel
Ok
Figure 4
File Edit View Insert Tools Desktop Window Help
ERSP - CZ, ignore
ERSP - CZ, memorize
ERSP - CZ, probe
dB
Frequency (Hz)
Time (ms)
Set ERSP/ITC plotting parameters -- pop_erspparams()
ERSP/ITC plotting options
Time range in ms [Low High]
-500 1000
Freq. range in Hz [Low High]
3 30
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

Pre-compute measures

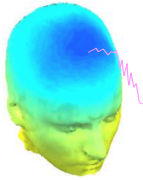


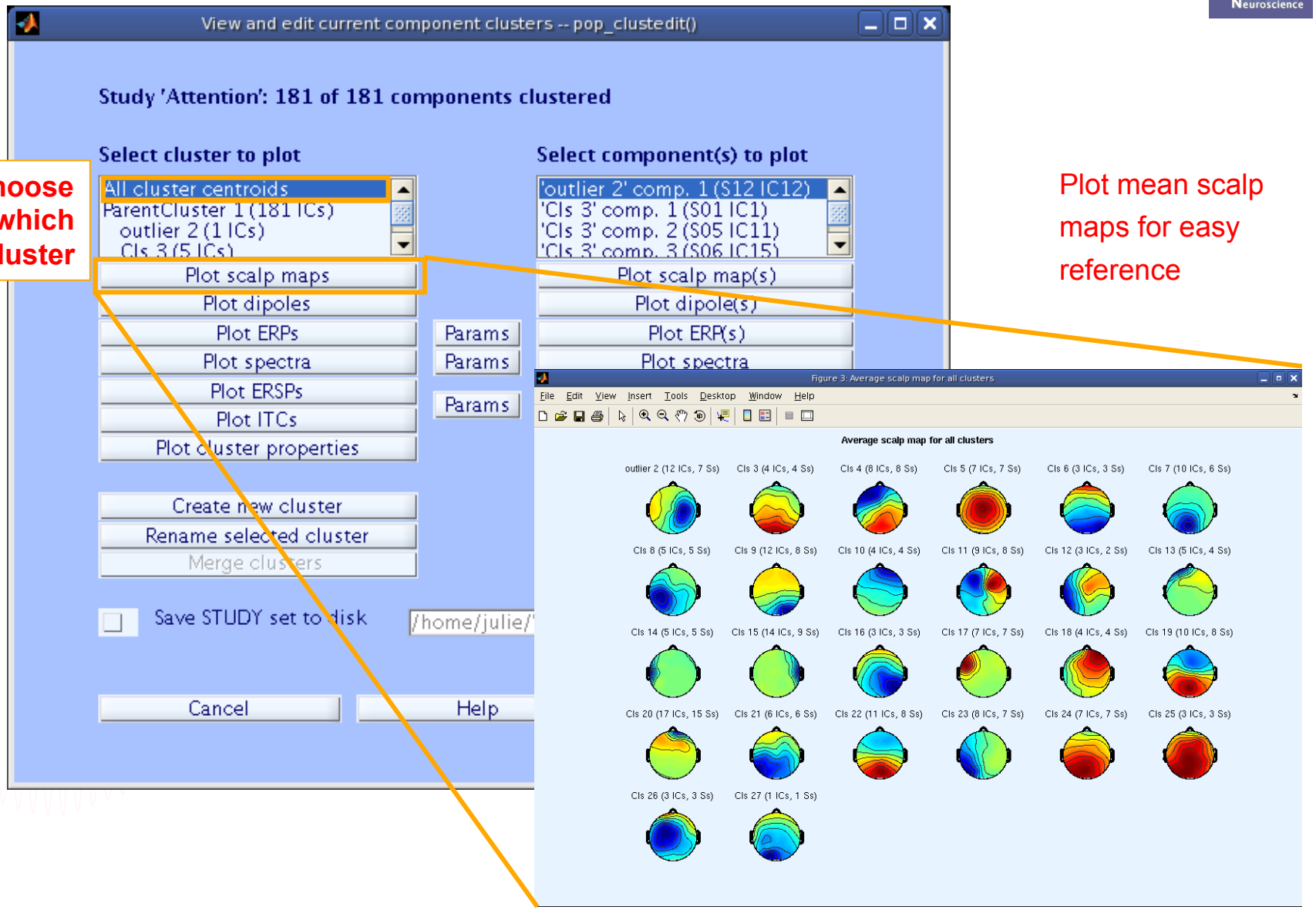
View and edit clusters





Plot cluster data

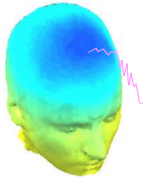


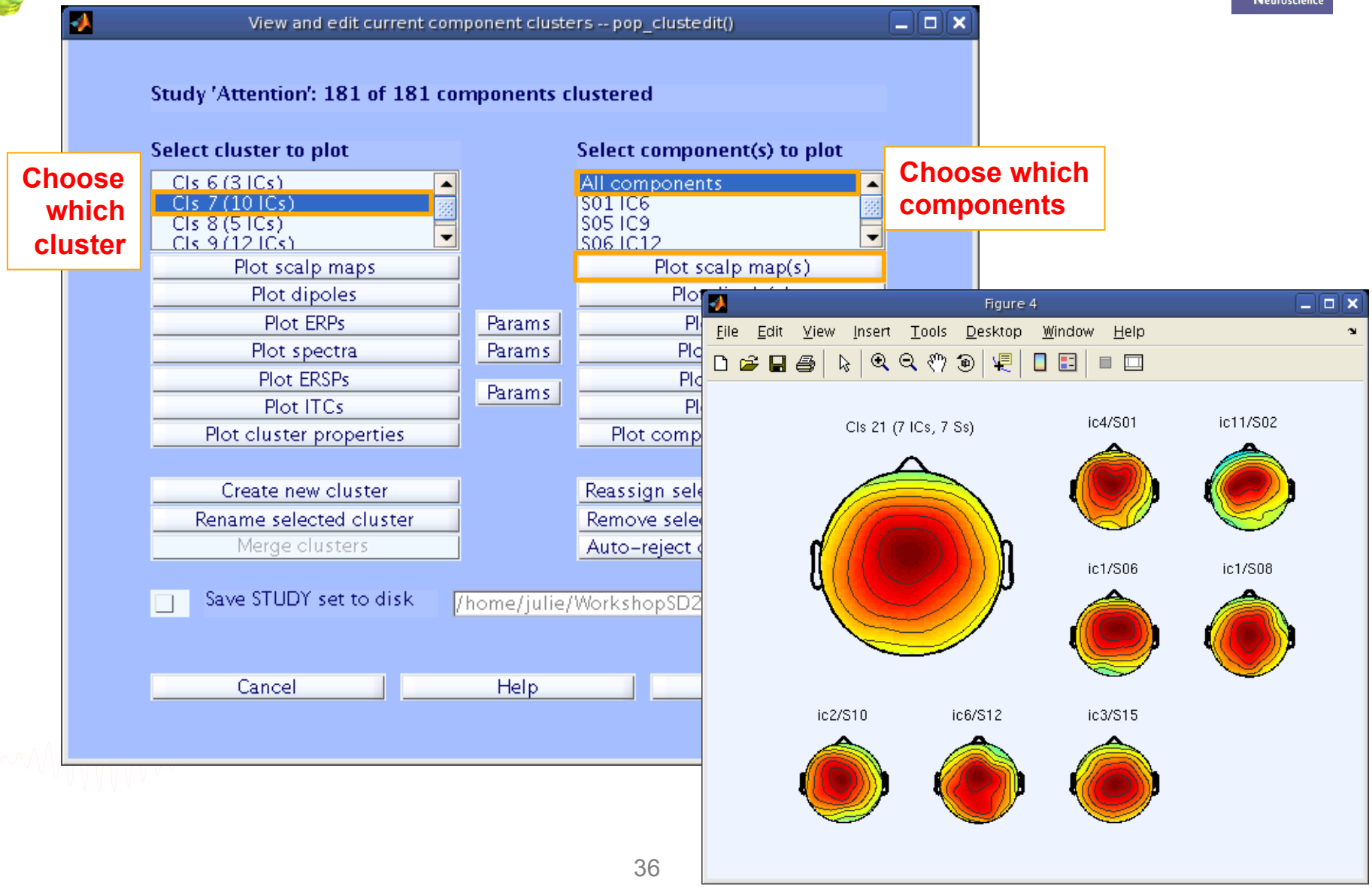


Choose which cluster

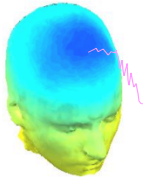
Plot mean scalp maps for easy reference

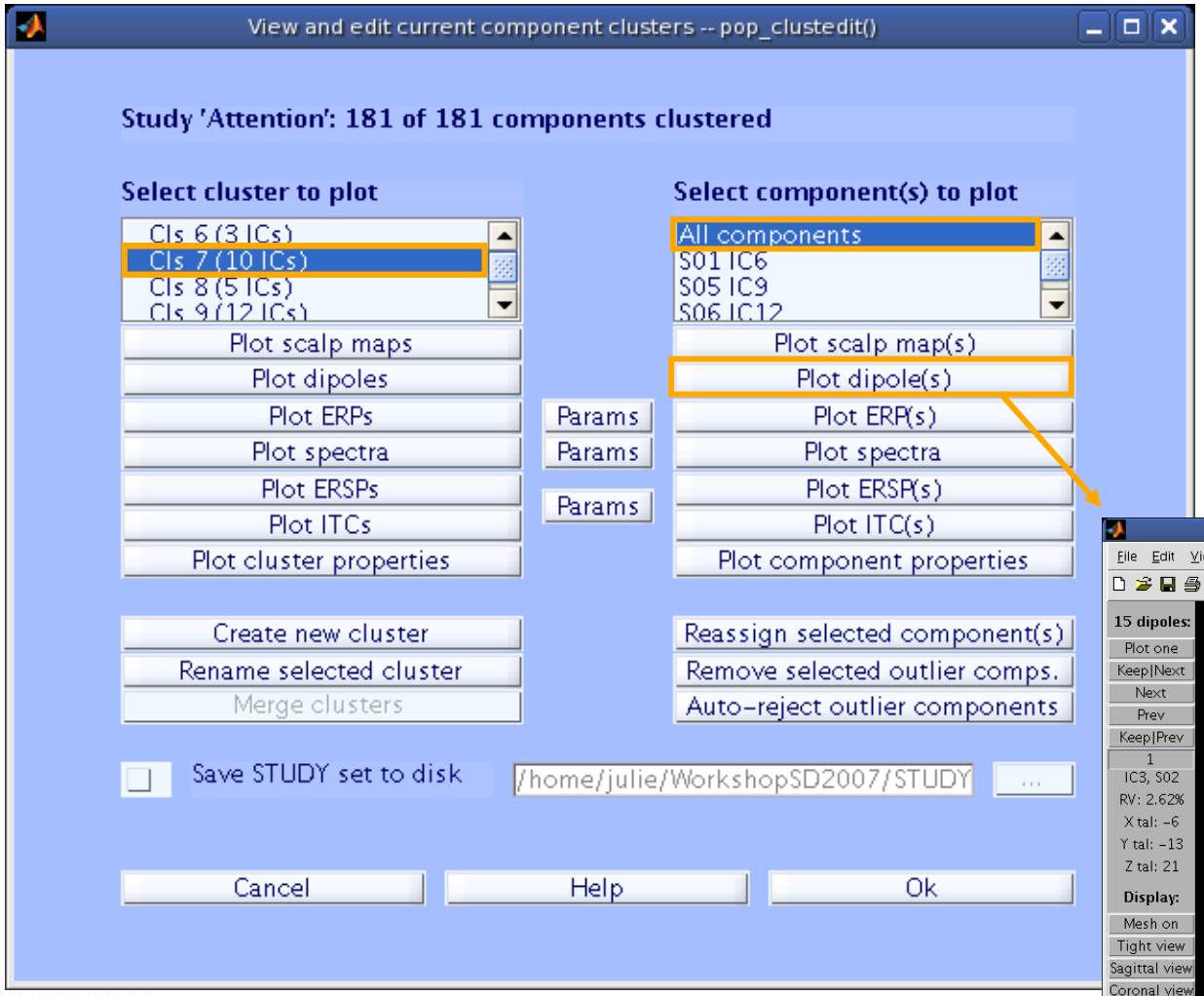
Plot cluster data

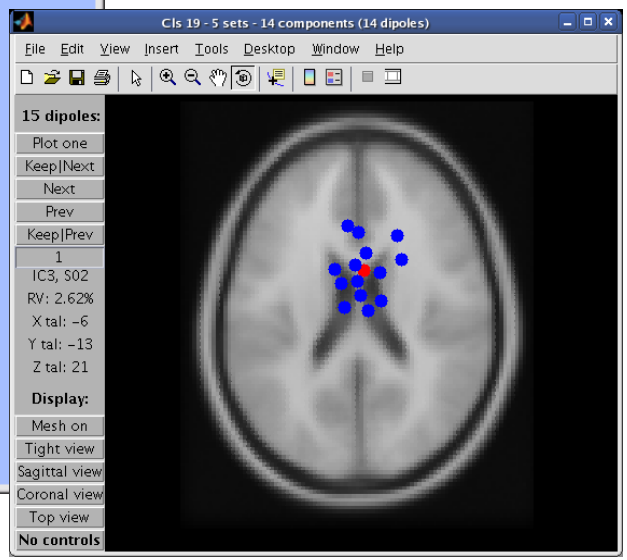




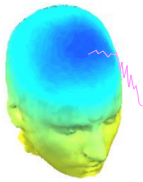
Plot cluster data







Exercises

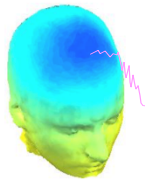


1. Load stern.study in STUDY folder

2. Create a new STUDY **design** to compare two types of conditions
   - Ignore letter **grouped** with Memorize letter
   - Probe letters

3. Recompute spectrum and plot spectrum for electrode Fz. Adjust frequency range for plotting and superpose the two curves on the same plot.

4. Plot scalp topography at 10 Hz for both conditions



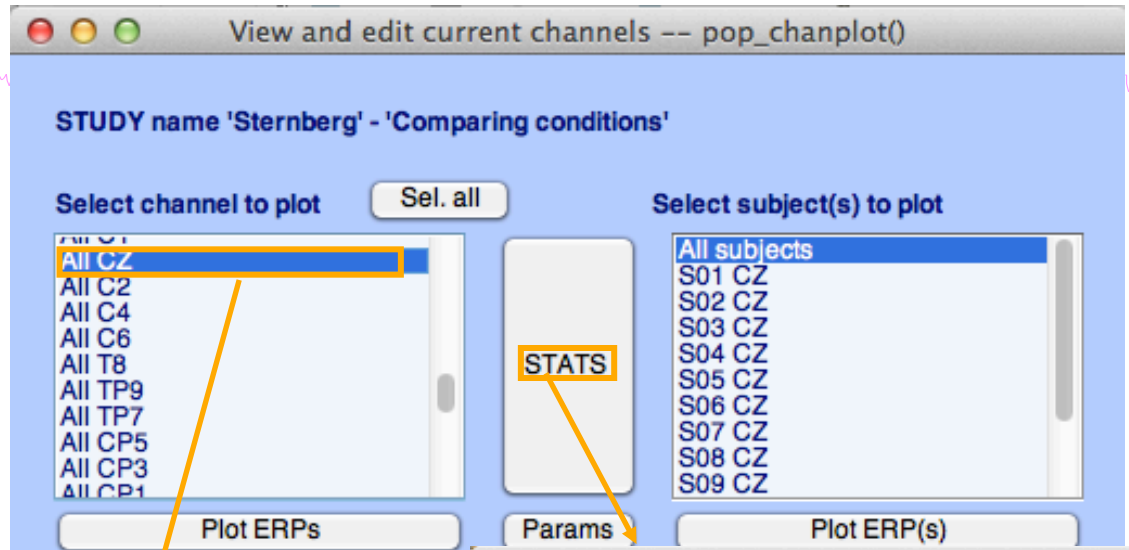
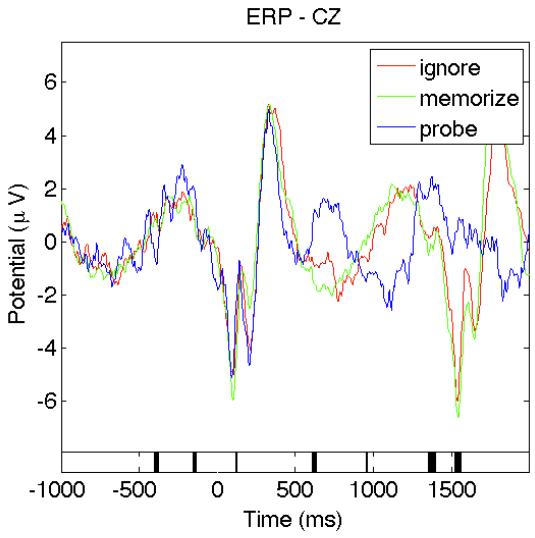
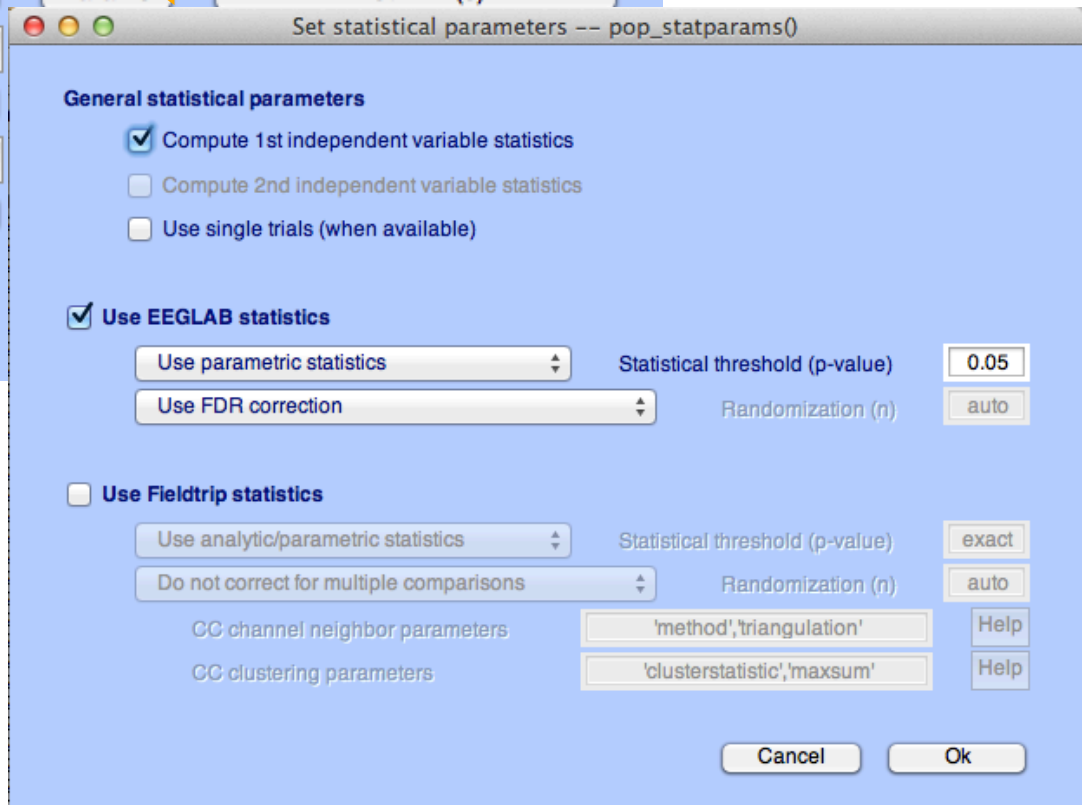
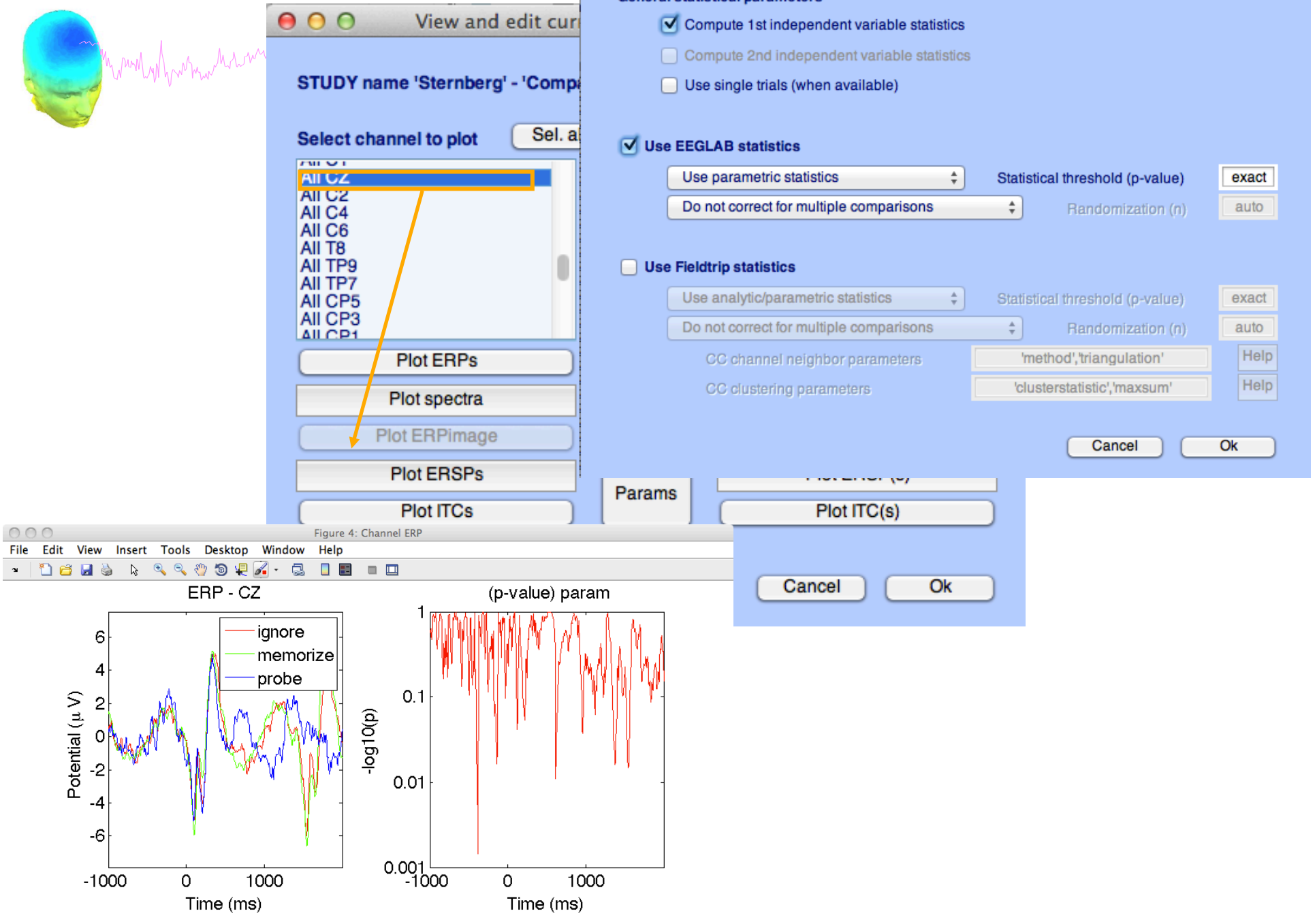

View and edit current channels -- pop_chanplot()
STUDY name 'Sternberg' - 'Comparing conditions'
Select channel to plot
Sel. all
All CZ
All C2
All C4
All C6
All T8
All TP9
All TP7
All CP5
All CP3
STATS
Select subject(s) to plot
All subjects
S01 CZ
S02 CZ
S03 CZ
S04 CZ
S05 CZ
S06 CZ
S07 CZ
S08 CZ
S09 CZ
Plot ERPs
Plot spectra
Plot ERPimage
Params
Plot ERP(s)

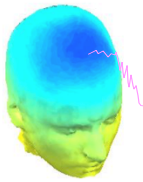
Figure 4: Channel ERP
File Edit View Insert Tools Desktop Window Help

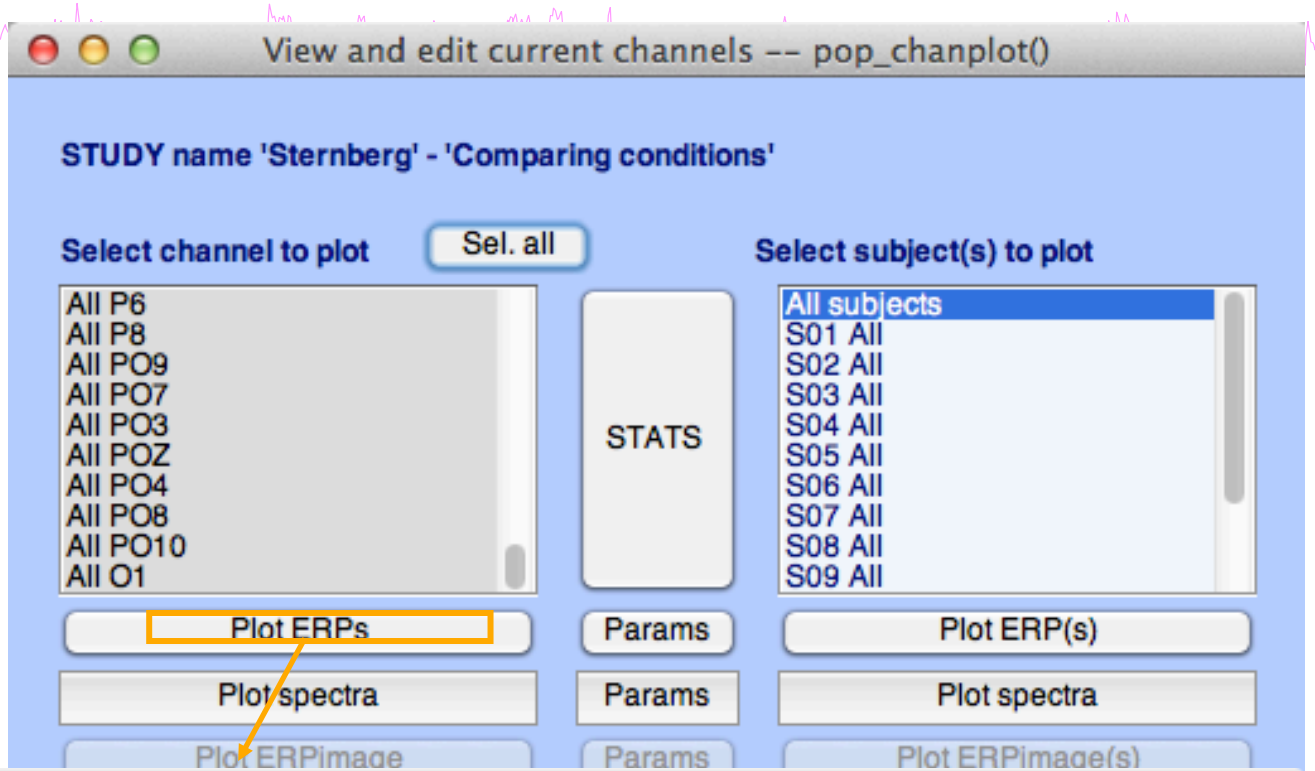

ERP - CZ
ignore
memorize
probe
Potential (μ V)
6
4
2
0
-2
-4
-6
-1000
-500
0
500
1000
1500
Time (ms)


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
Statistical threshold (p-value)
0.05
Use FDR correction
Randomization (n)
auto
Use Fieldtrip statistics
Use analytic/parametric statistics
Statistical threshold (p-value)
exact
Do not correct for multiple comparisons
Randomization (n)
auto
CC channel neighbor parameters
'method','triangulation'
Help
CC clustering parameters
'clusterstatistic','maxsum'
Help
Cancel
Ok

Swartz
Center for
Computational
Neuroscience


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
Statistical threshold (p-value)
exact
Do not correct for multiple comparisons
Randomization (n)
auto
Use Fieldtrip statistics
Use analytic/parametric statistics
Statistical threshold (p-value)
exact
Do not correct for multiple comparisons
Randomization (n)
auto
CC channel neighbor parameters
'method','triangulation'
Help
CC clustering parameters
'clusterstatistic','maxsum'
Help
Cancel
Ok
View and edit cur
STUDY name 'Sternberg' - 'Compa
Select channel to plot
Sel. a
All CZ
All C2
All C4
All C6
All T8
All TP9
All TP7
All CP5
All CP3
Plot ERPs
Plot spectra
Plot ERPimage
Plot ERSPs
Plot ITCs
Params
Plot ITC(s)
Cancel
Ok
Figure 4: Channel ERP
File Edit View Insert Tools Desktop Window Help
ERP - CZ
ignore
memorize
probe
Potential (μ V)
Time (ms)
(p-value) param
-log10(p)
Time (ms)




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
Params
Plot ERP(s)
Plot spectra
Params
Plot spectra
Plot ERPimage
Params
Plot ERPimage(s)

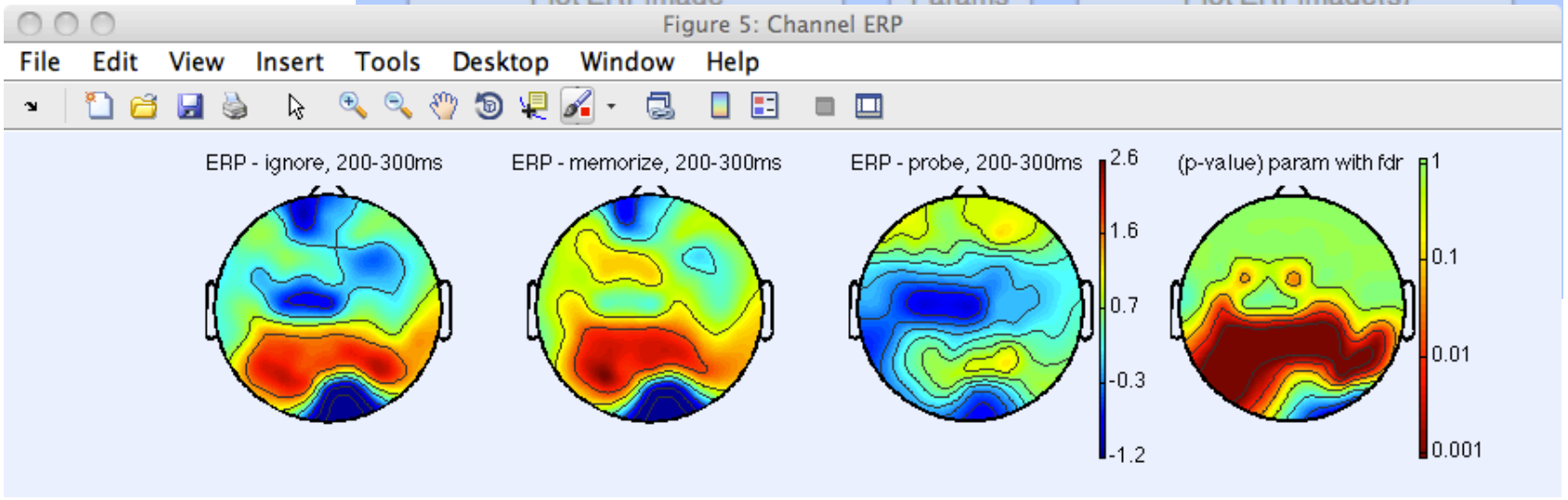
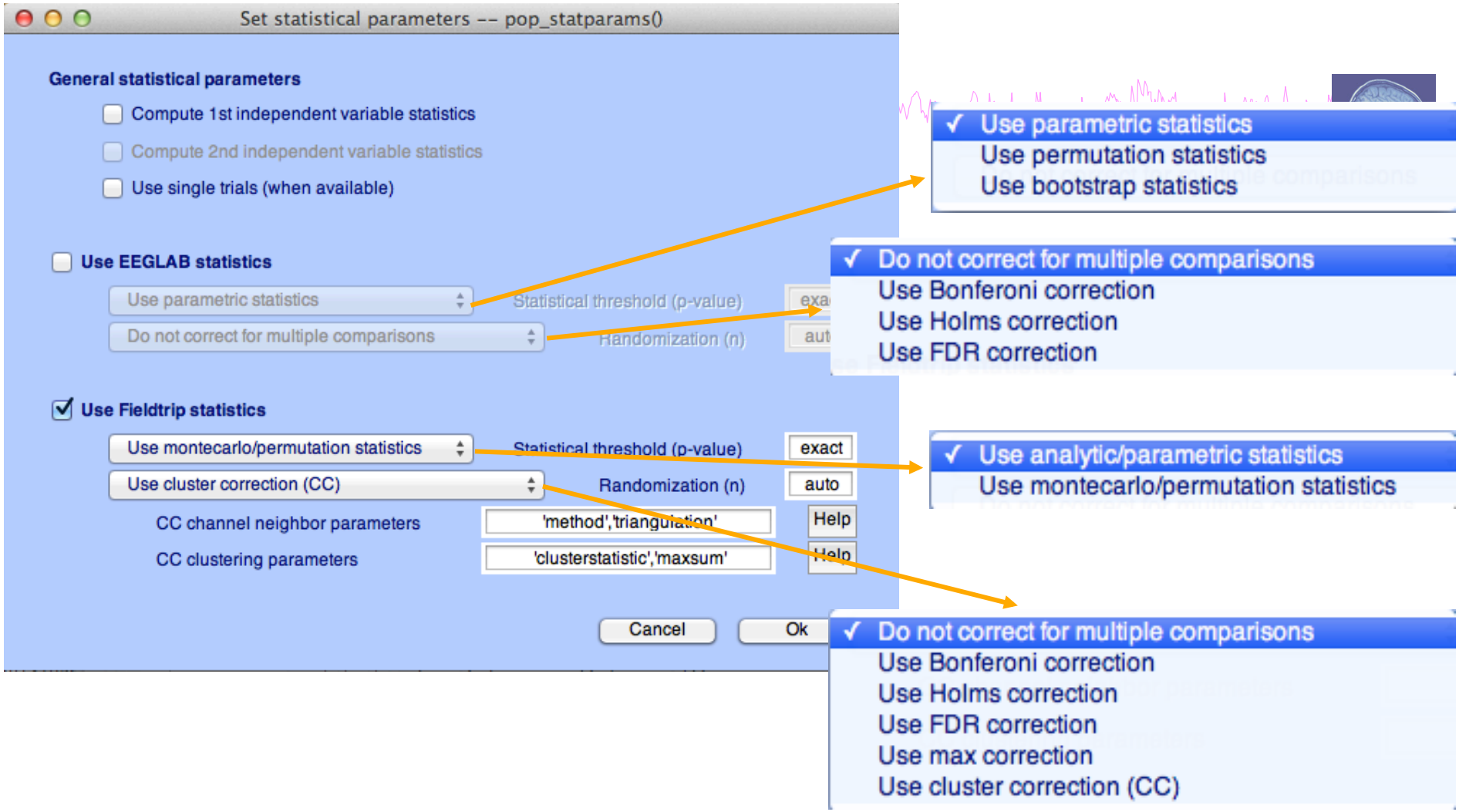
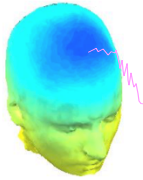


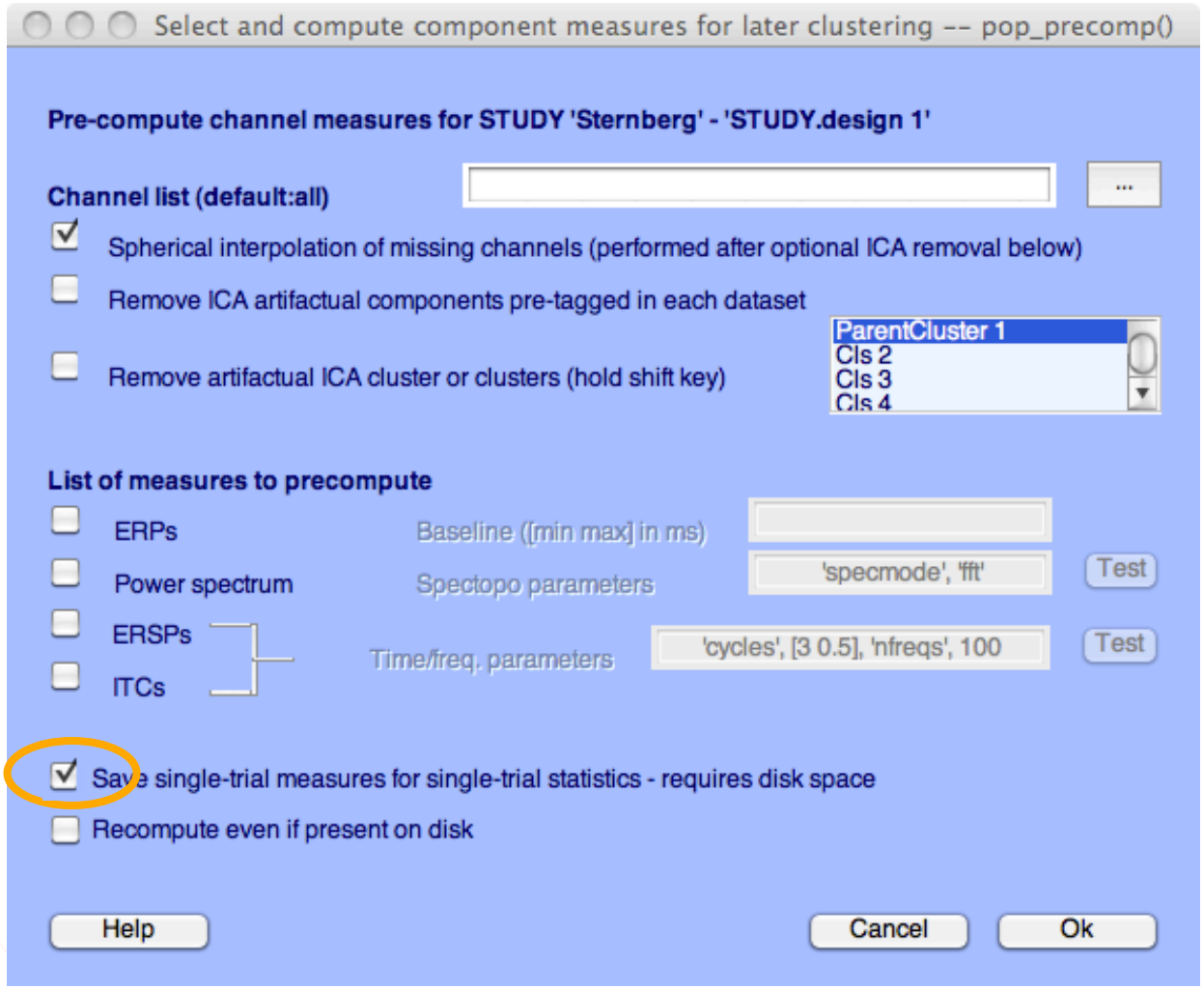
Figure 5: Channel ERP
File Edit View Insert Tools Desktop Window Help
ERP - ignore, 200-300ms
ERP - memorize, 200-300ms
ERP - probe, 200-300ms
2.6
1.6
0.7
-0.3
-1.2
(p-value) param with fdr
1
0.1
0.01
0.001



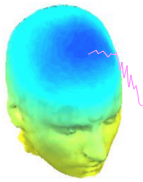
std_stat() function in EEGLAB

Use single trials





Exercices



Experiment with STUDY statistics

- Load the Stern STUDY
- Look at significant difference in the first default design or the second design created in the previous exercice in all channel (spectrum)
- using first parametric EEGLAB methods (and FDR correction for multiple comparisons)
- then using the cluster method (Fieldtrip – statistics)
- **For those with powerful computers:** type “matlabpool” on the command line and pre-compute channel time-frequency decompositions with options 'cycles' [3 0.8] 'nfreqs' 30 'ntimesout' 40 'verbose' 'off' (watch for the quote formatting when copying and pasting)