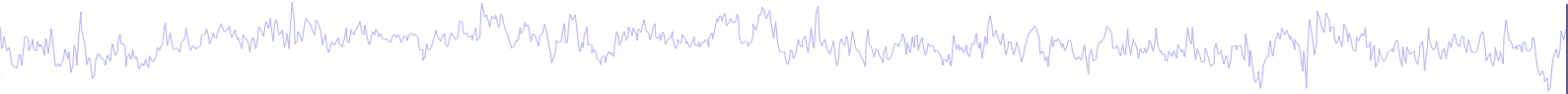


Data preprocessing and epoching



Task 1

- Import raw data
- Re-reference data
- Scroll channel data

Task 2

- Import channel location file

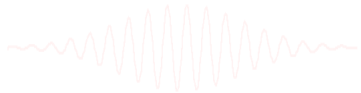
Task 3

- Import data events

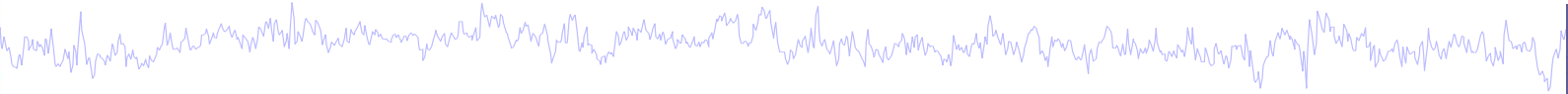
Task 4

- Extract data epochs
- Select epochs/events

Exercise...



Data preprocessing and epoching



Task 1

- Import raw data
- Re-reference data
- Scroll channel data

Task 2

- Import channel location file

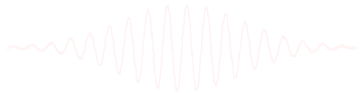
Task 3

- Import data events

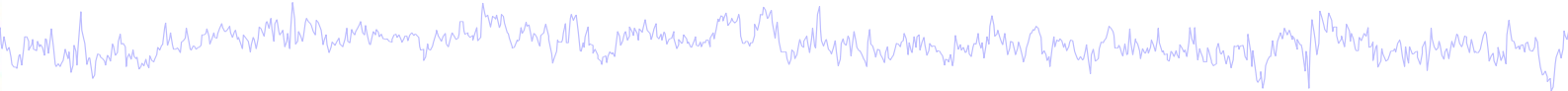
Task 4

- Extract data epochs
- Select epochs/events

Exercise...



The EEGLAB Matlab software



main graphic interface

EEGLAB Shell - Konsole

Session Edit View Bookmarks Settings Help

```
/home/arno> matlab -nodesktop
```

```

      < M A T L A B >
  Copyright 1984-2002 The MathWorks, Inc.
    Version 6.5.0.180913a Release 13
      Jun 18 2002

Using Toolbox Path Cache. Type "help toolbox_path_cache" for

To get started, type one of these: helpwin, helpdesk, or demo.
For product information, visit www.mathworks.com.

>> eeglab
```

EEGLAB v5.03

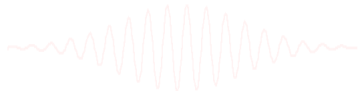
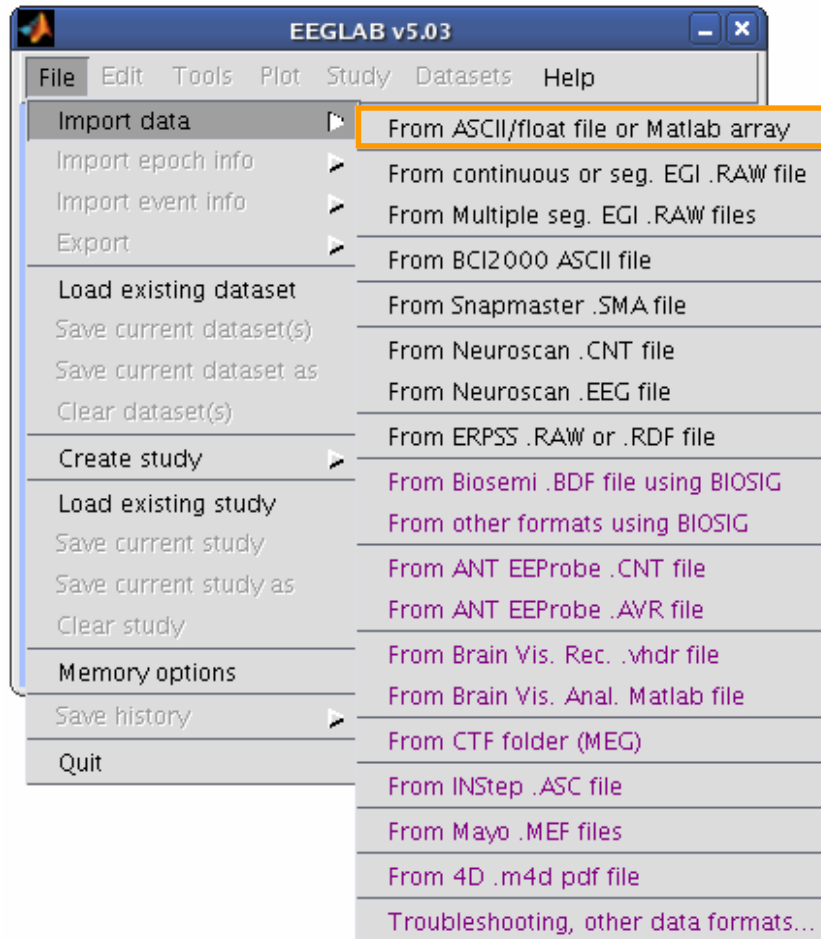
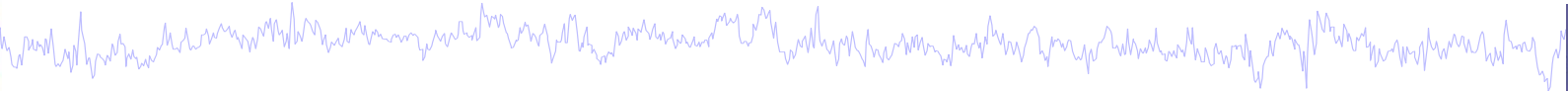
File Edit Tools Plot Study Datasets Help

No current dataset

- Create a new or load an existing dataset:
Use "File > Import data" (new)
Or "File > Load existing dataset" (old)
- If new,
"File > Import epoch info" (data epochs) else
"File > Import event info" (continuous data)
"Edit > Dataset info" (add/edit dataset info)
"File > Save dataset" (save dataset)
- Prune data: "Edit > Select data"
- Reject data: "Tools > Reject continuous"
- Epoch data: "Tools > Extract epochs"
- Remove baseline: "Tools > Remove"
- Run ICA: "Tools > Run ICA"

60 menus, more than 300 Matlab functions and more than 50,000 lines of code

Importing a dataset



Import raw data



Import dataset info -- pop_importdata()

Data file/array (click on the selected option)

Dataset name

Data sampling rate (Hz) Subject code

Time points per epoch (0->continuous) Task condition

Start time (sec)(only for data epochs) Session number

Number of channels (0->set from data) Subject group

Ref. channel indices or mode (see help) About this dataset

Channel location file or info

(note: autodetect file format using file extension; use menu "Edit > Channel locations" for more importing options)

ICA weights array or text/binary file (if any):

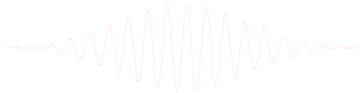
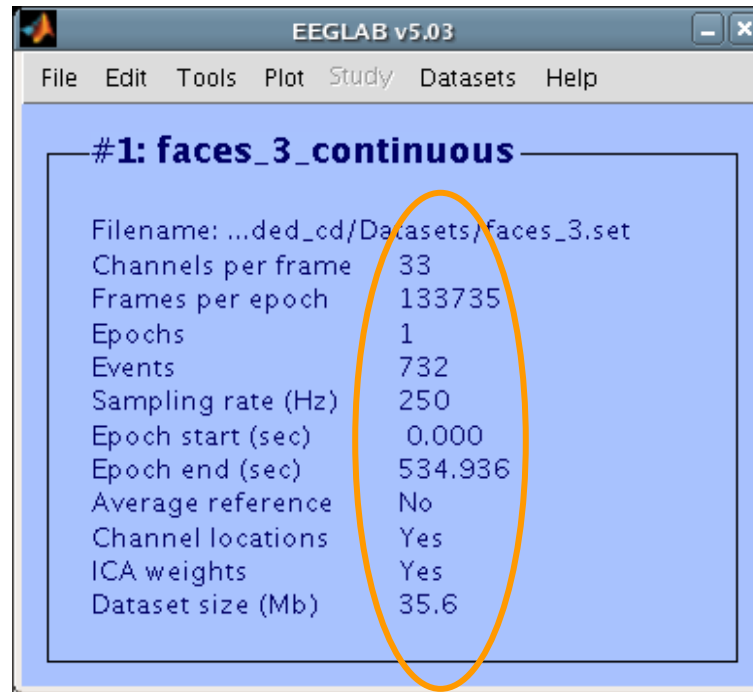
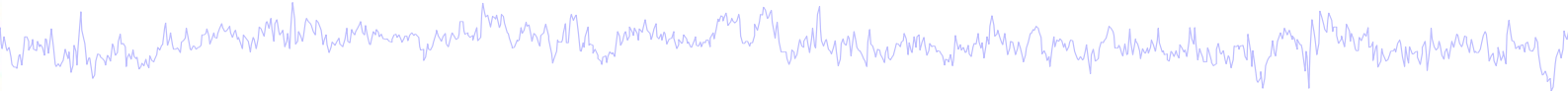
ICA sphere array or text/binary file (if any):

```
pop_importdata() - import data from a Matlab variable or disk file by calling
importdata().

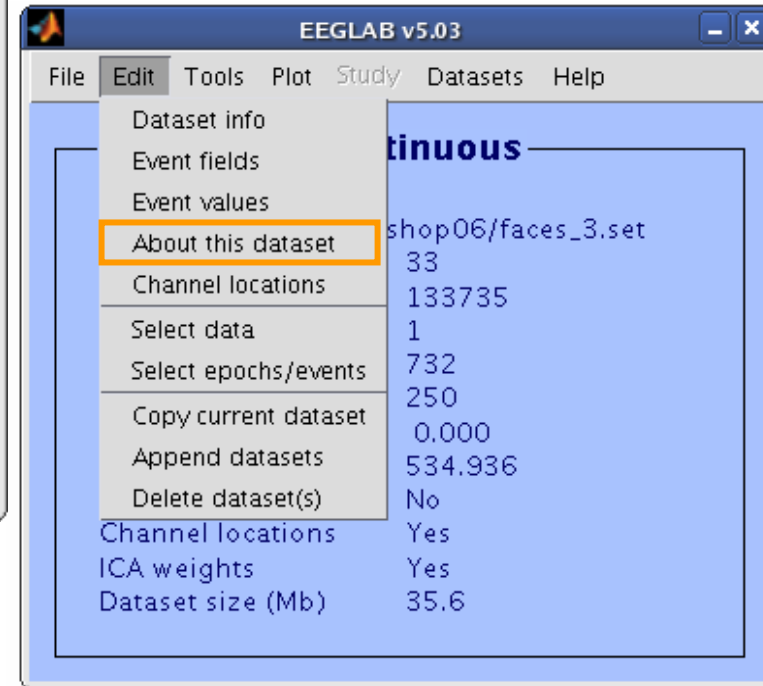
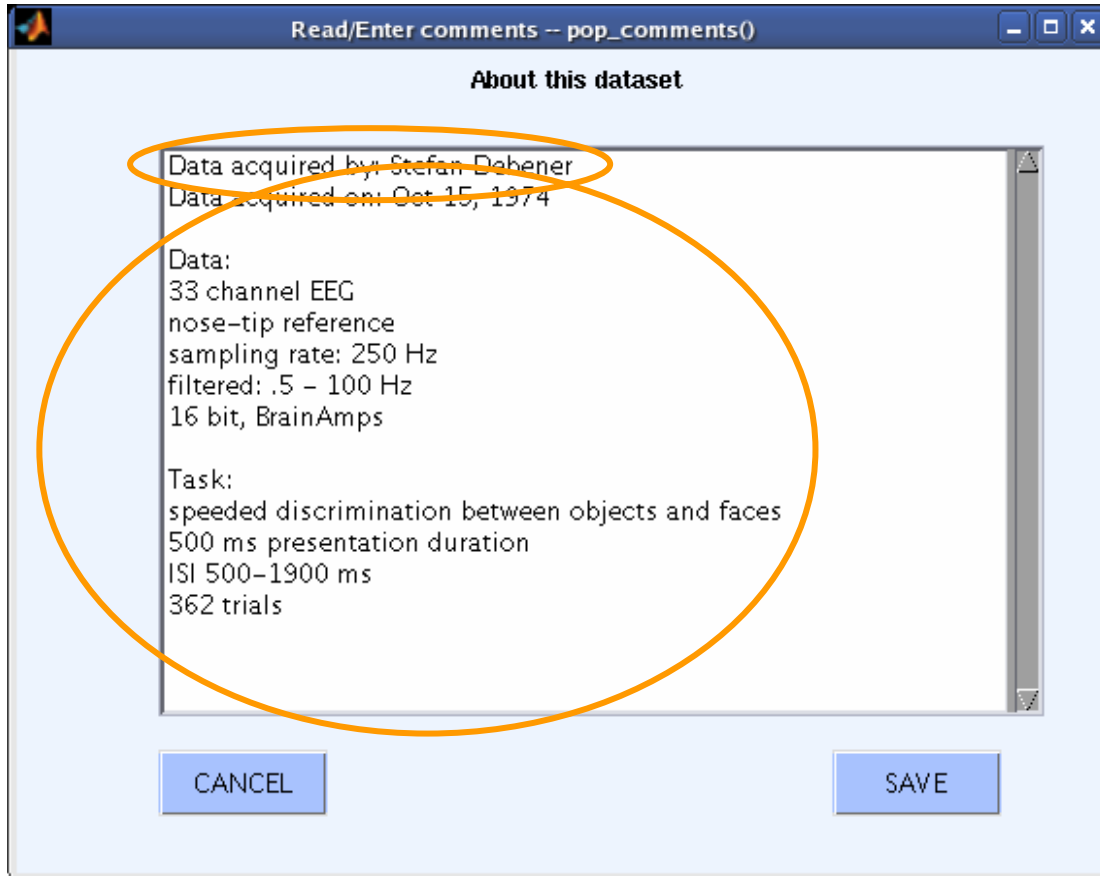
Usage:
>> EEGOUT = pop_importdata( EEG ); % pop-up a data entry window
>> EEGOUT = pop_importdata( 'key', val,...); % no pop-up window

Graphic interface:
"EEGLAB dataset name" - [Edit box] name for the new dataset.
    Command line equivalent: 'setname'
"Data file/array" - [Edit box] Data file or Matlab variable name to import
to EEGLAB. Command line equivalent: 'data'
"Data file/array" - [list box] select data format from listbox. If you
browse for a data file, the graphical interface might be
able to detect the file format from the file extension and
his list box accordingly. Note that you have to click on
the option to make it active. Command line equivalent:
'dataformat'
"Number of channels" - [Edit box] Number of data channels.
    Command line equivalent: 'nbchan'
"Time points per epoch" - [Edit box] Number of points per data epoch.
Irrelevant for continuous data. Command line equivalent: 'pnts'
```

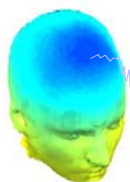
Imported EEG data



Comments



Re-reference data



Specify the reference scheme of imported data

EEGLAB v5.03

File Edit Tools Plot Study Datasets Help

Change sampling rate
Filter the data
Re-reference
Reject continuous data by event

Initial reference - pop_reref()

THIS SCREEN IS USED TO ENTER CURRENT REFERENCE AND WILL ONLY APPEAR ONCE

Data are in average reference

OR

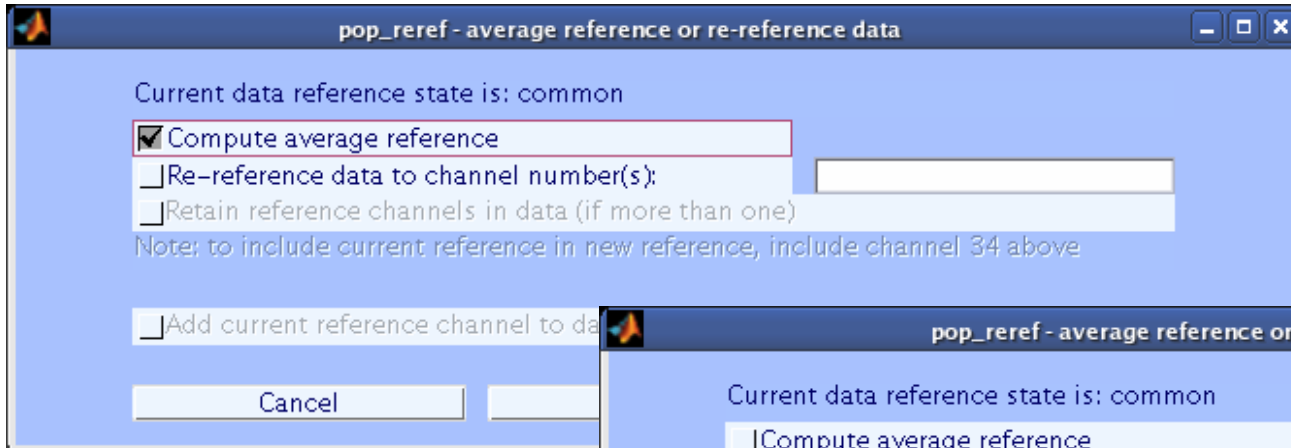
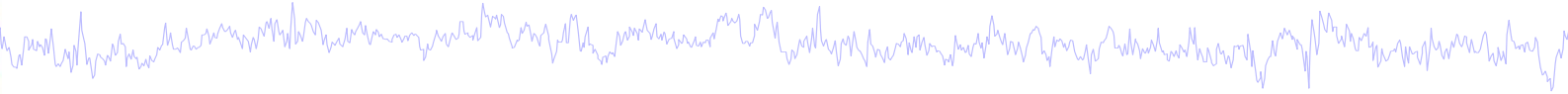
Data are referenced to one site (default)
Reference channel number(s), if present in data (default: []):

Include current reference channel in data

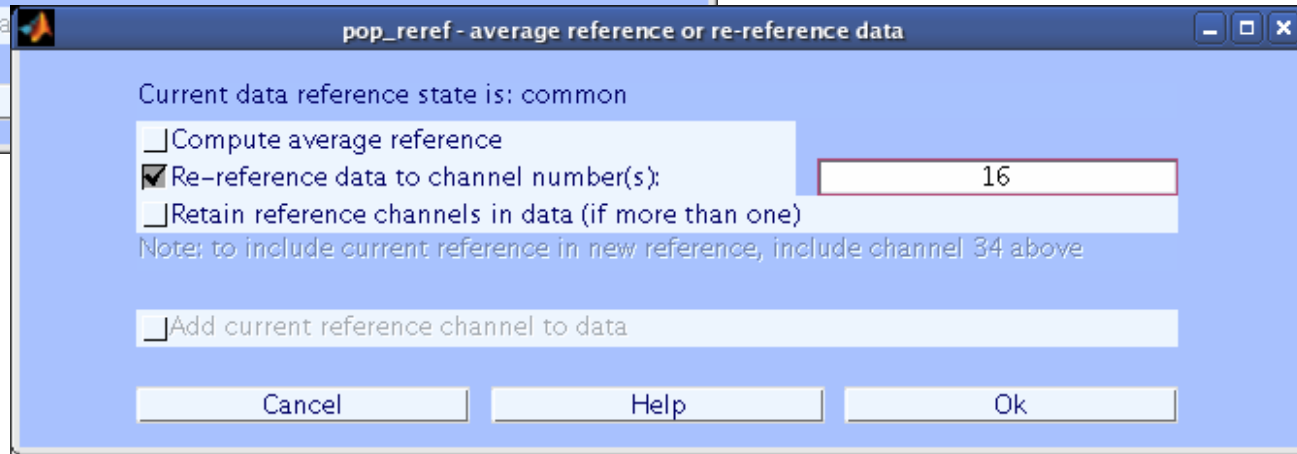
Note: by including a reference channel in your data (above), its potential may be computed when you re-reference the data. If you have polar coordinates of the reference channel, enter them above; If the dataset has no channel locations yet, you may leave the label and location fields empty; If you have 3-D location coordinates only, then Cancel and create a new channel 34 in Edit > Channel locations. Then return to Tools > Re-reference.

Cancel Help Ok

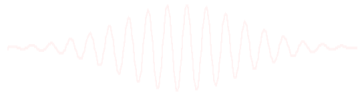
Rereferencing, cont'd



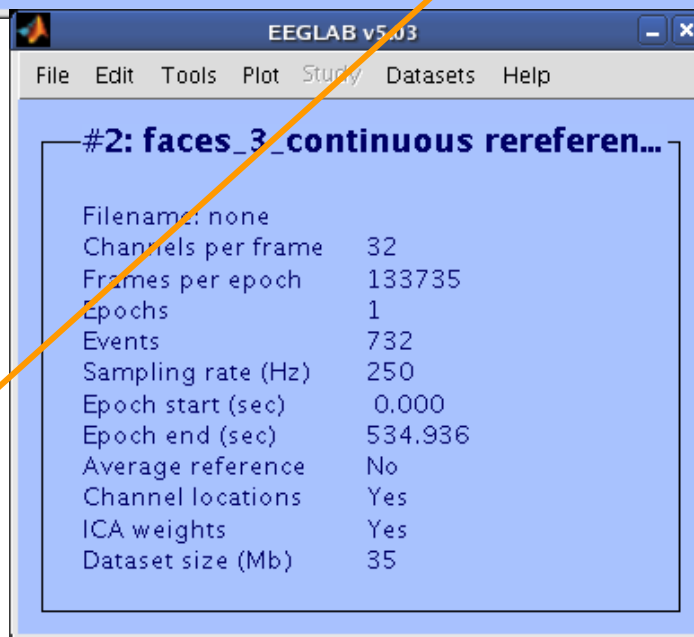
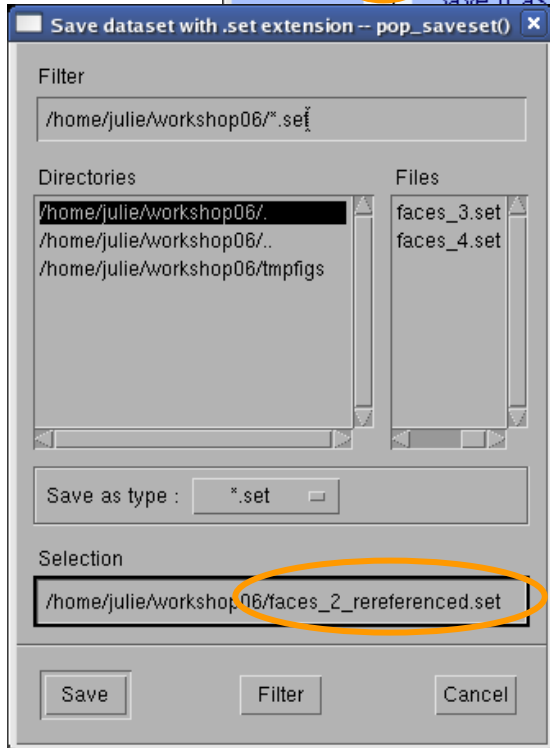
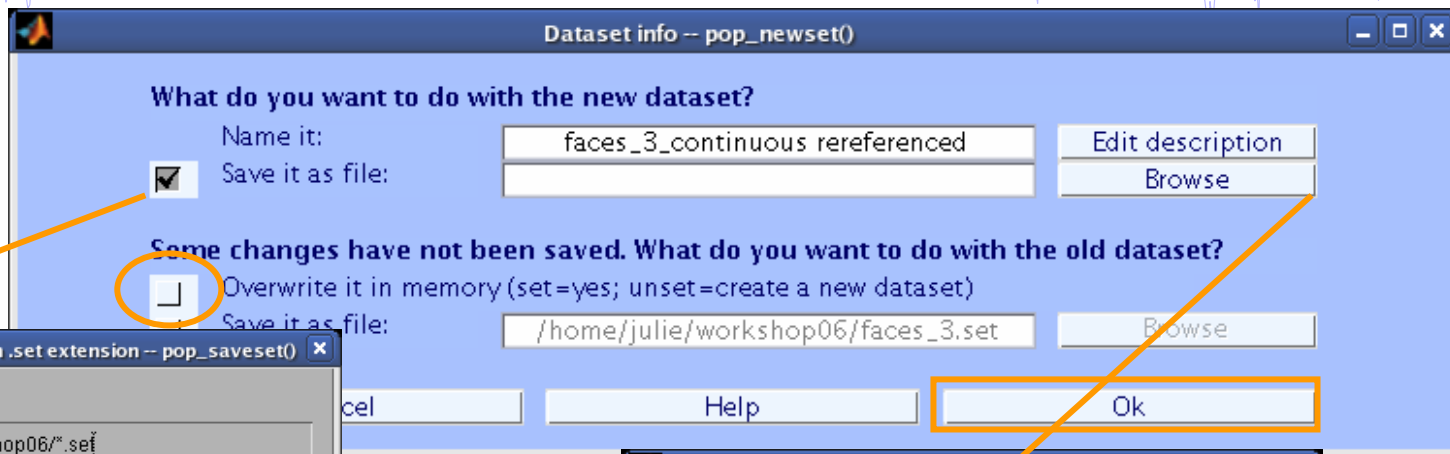
2 re-reference
choices



```
EEG = pop_reref( EEG, 16, 'refstate',0);
```

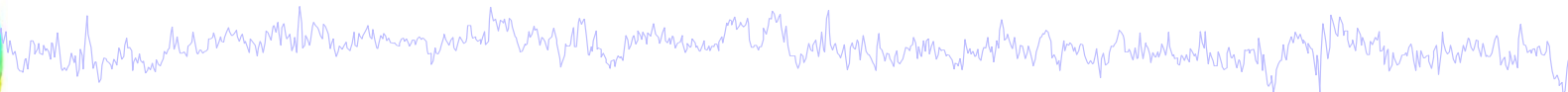
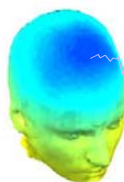


Save new dataset, keep old one



```
[ALLEEG EEG CURRENTSET] = pop_newset(ALLEEG,...  
EEG, 1, 'setname', 'rereferenced data');
```

Multiple active datasets (ALLEEG)



EEGLAB v5.03

File Edit Tools Plot Study Datasets Help

#1: faces_3_continuous

Filename:	...ulie/workshop06/faces_3.set
Channels per frame	33
Frames per epoch	133735
Epochs	1
Events	732
Sampling rate (Hz)	250
Epoch start (sec)	0.000
Epoch end (sec)	534.936
Average reference	No
Channel locations	Yes
ICA weights	Yes
Dataset size (Mb)	35.6

EEGLAB v5.03

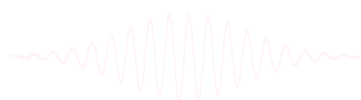
File Edit Tools Plot Study Datasets Help

#2: faces_3_conti

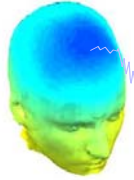
Filename:	none
Channels per frame	33
Frames per epoch	133735
Epochs	1
Events	732
Sampling rate (Hz)	250
Epoch start (sec)	0.000
Epoch end (sec)	534.936
Average reference	No
Channel locations	Yes
ICA weights	Yes
Dataset size (Mb)	35

Dataset 1:faces_3_continuous
✓ Dataset 2:faces_3_continuous rereferenced

Select multiple datasets



Scroll data

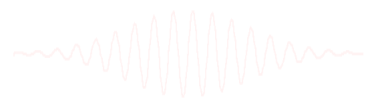
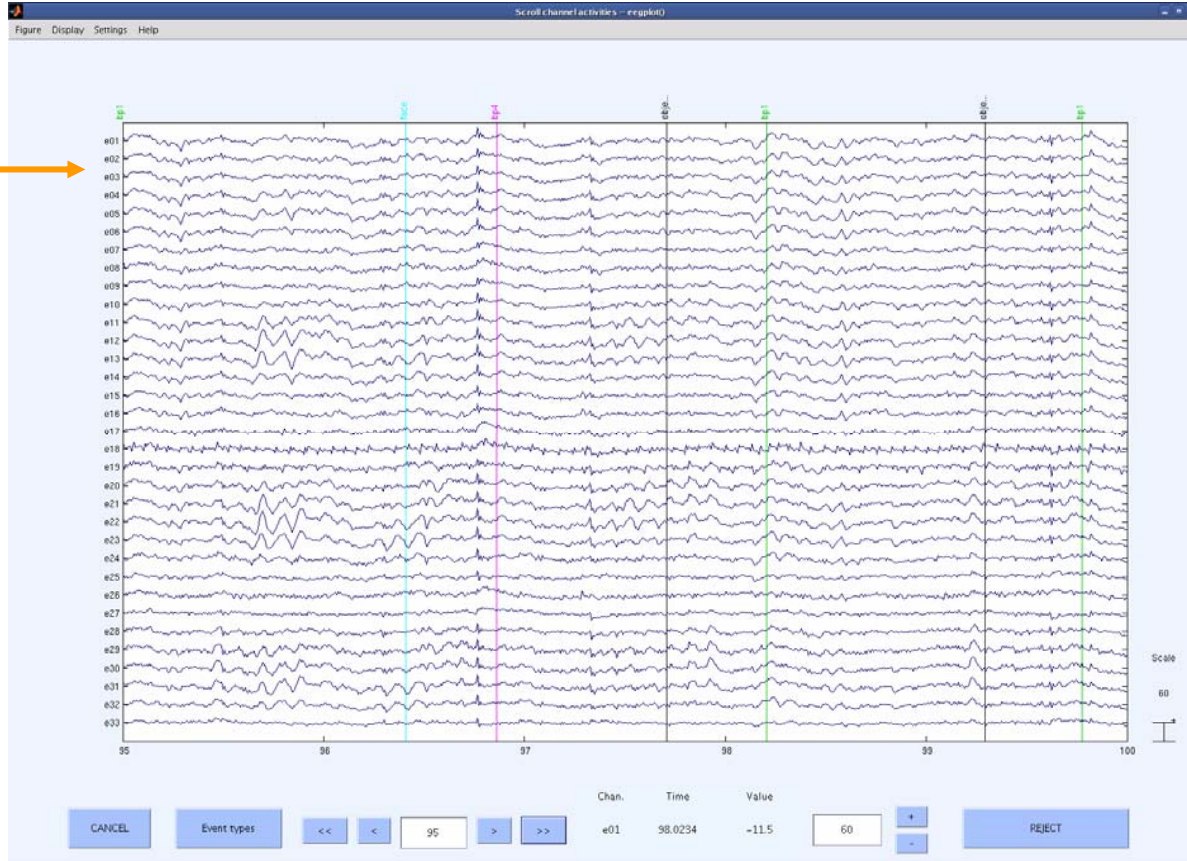


EEGLAB v5.03

File Edit Tools **Plot** Study Datasets Help

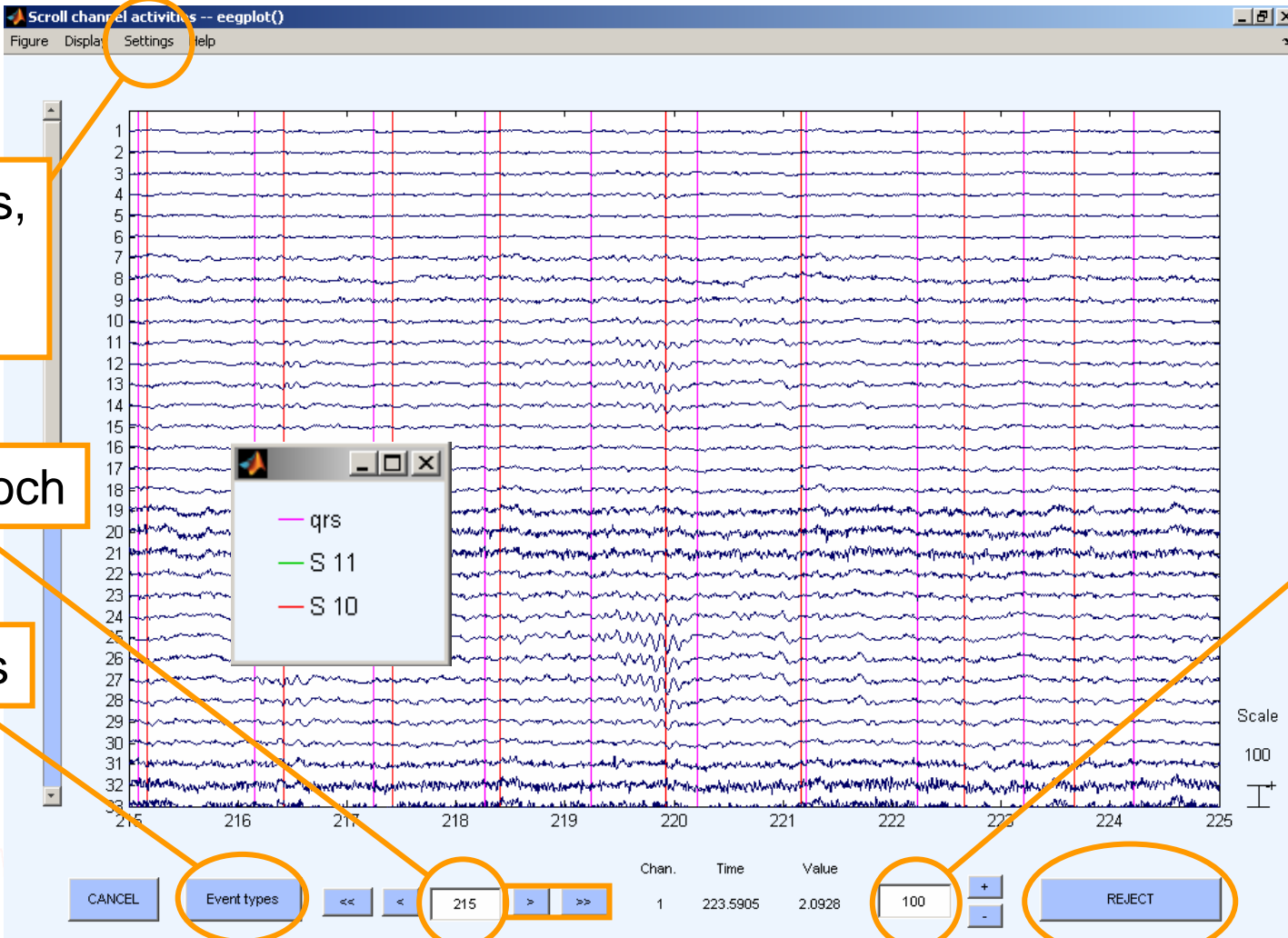
#1: faces

- Channel locations
- Channel data (scroll)**
- Channel spectra and maps
- Channel properties
- Channel ERP image
- Channel ERPs
- ERP map series
- Sum/Compare ERPs
- Component activations (scroll)
- Component spectra and maps
- Component maps
- Component properties
- Component ERP image
- Component ERPs
- Sum/Compare comp. ERPs
- Data statistics
- Time-frequency transforms
- Average time-frequency
- New Time-freq. transforms



```
>> pop_eegplot(EEG,1,1,1);
```

Scroll channel data



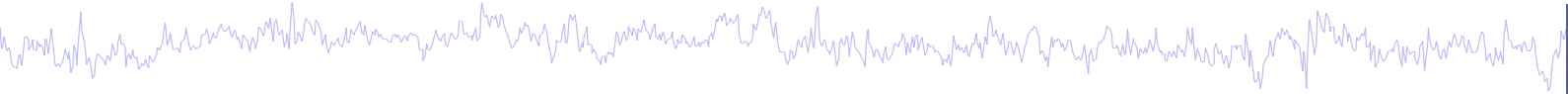
channels,
time,
events

sec/epoch

events

scaling

Data preprocessing and epoching



Task 1

Import raw data
Re-reference data
Scroll channel data

Task 2

Import channel location file

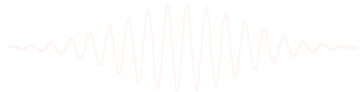
Task 3

Import data events

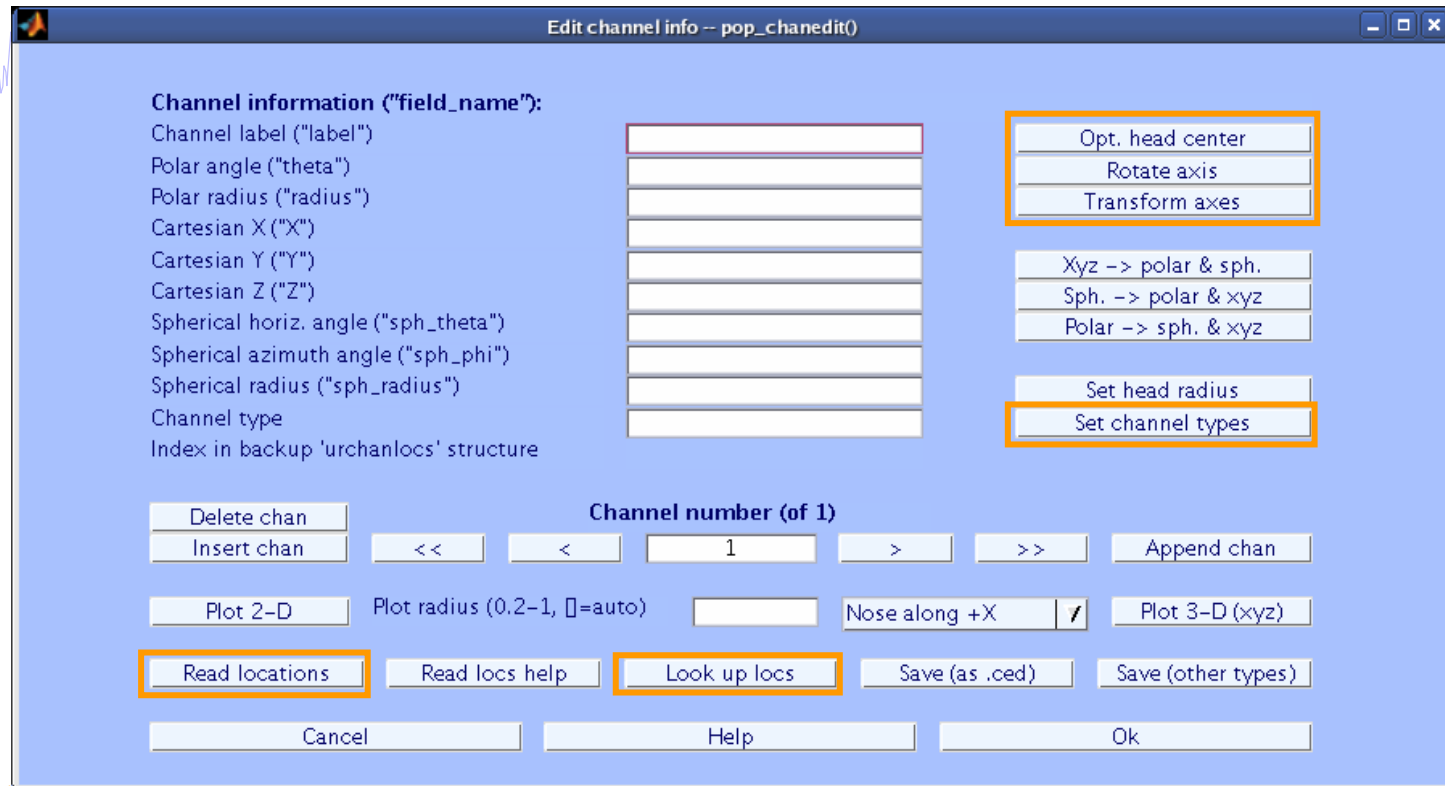
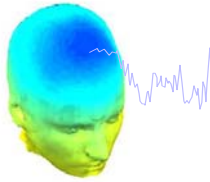
Task 4

Extract data epochs
Select epochs/events

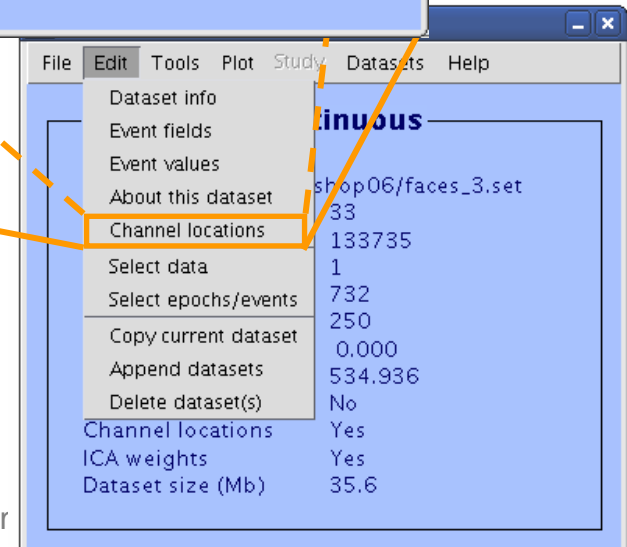
Exercise...

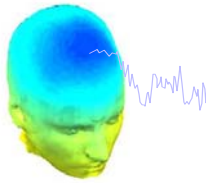


Import channel locations



- Use channel names and automatically assign channel location
- Import channel location file
- Modify/stretch/rotate channel locations
- Set channel types...





Channel information ("field_name"):

Channel label ("label")

Polar angle ("theta")

Polar radius ("radius")

Cartesian X ("X")

Cartesian Y ("Y")

Cartesian Z ("Z")

Spherical horiz. angle ("sph_theta")

Spherical azimuth angle ("sph_phi")

Spherical radius ("sph_radius")

Channel type

Index in backup 'urchanlocs' structure

Opt. head center

Rotate axis

Transform axes

XYZ -> polar & sph.

Sph. -> polar & xyz

Polar -> sph. & xyz

Set head radius

Set channel types

Delete chan

Insert chan

Channel number (of 1)

<< < 1 > >>

Append chan

Plot 2-D

Plot radius (0.2-1, []=auto)

Nose along +X

Plot 3-D (xyz)

Read locations

Read locs help

Look up locs

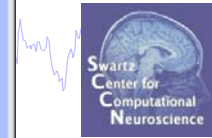
Save (as .ced)

Save (other types)

Cancel

Help

Ok



Load a channel location file

Filter

/home/julie/workshop06/

Directories

Files

- faces_3.eeg
- faces_3.locs
- faces_3.set
- faces_3.vhdr
- faces_3.vmrk
- faces_4.set
- practicum_4.m
- practicum_5.m

Files of type: *

Selection

/home/julie/workshop06/

Open

Filter

Cancel

Read electrode file

File format:

Autodetect file format from file extension

autodetect

- Polhemus native .elp file
- BESA spherical .elp file
- Matlab .xyz file
- BESA or EGI 3-D cartesian .
- EEGLAB polar .loc file

Cancel

Help

Ok

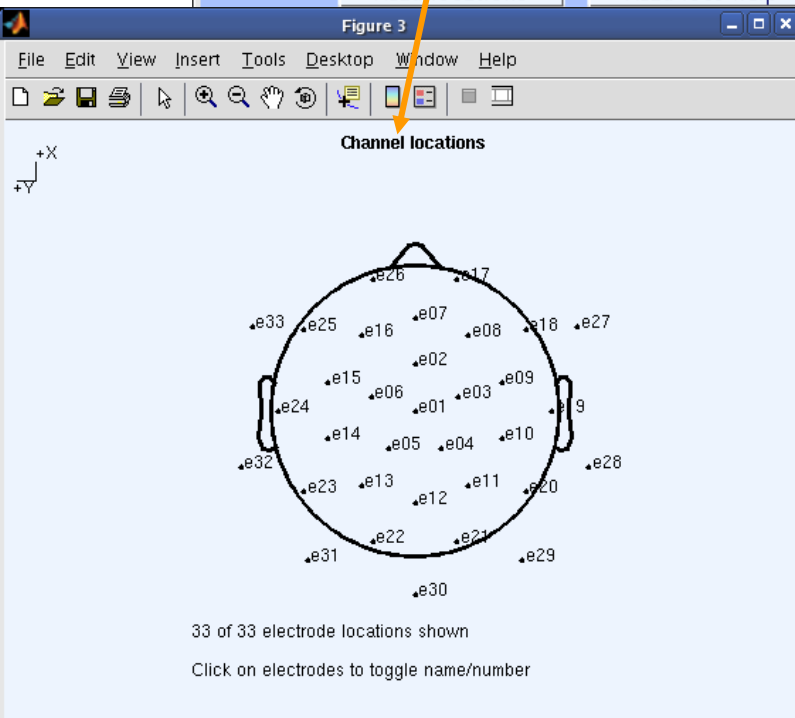
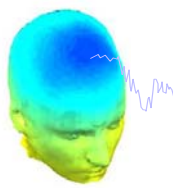
7 file formats supported (Polhemus, BESA, ...)

Channel information ("field_name"):

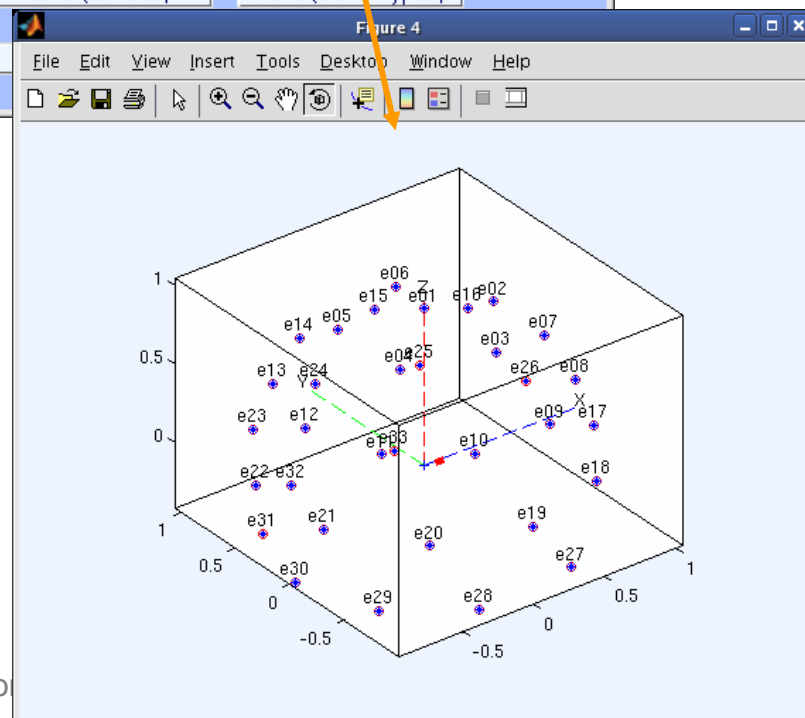
Channel label ("label")
 Polar angle ("theta")
 Polar radius ("radius")
 Cartesian X ("X")
 Cartesian Y ("Y")
 Cartesian Z ("Z")
 Spherical horiz. angle ("sph_theta")
 Spherical azimuth angle ("sph_phi")
 Spherical radius ("sph_radius")
 Channel type
 Index in backup 'urchanlocs' structure

e01
90
0
3.7494e-33
-6.1232e-17
1
-90
90
1

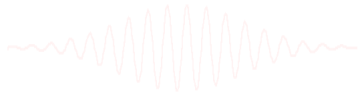
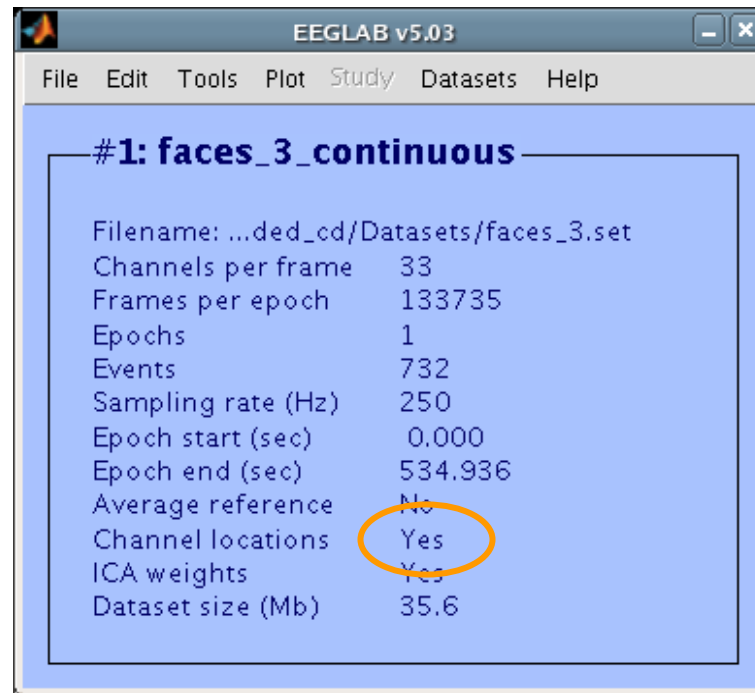
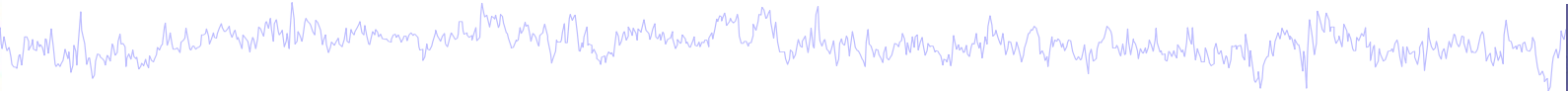
- Opt. head center
- Rotate axis
- Transform axes
-
- XYZ -> polar & sph.
- Sph. -> polar & xyz
- Polar -> sph. & xyz
-
- Set head radius
- Set channel types



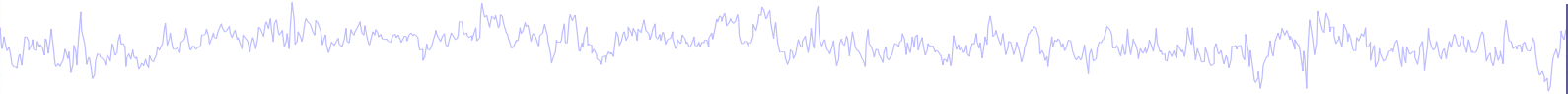
Help



Import channel locations



Data preprocessing and epoching



Task 1

Import raw data
Re-reference data
Scroll channel data

Task 2

Import channel location file

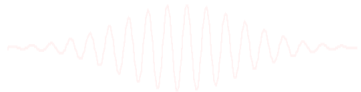
Task 3

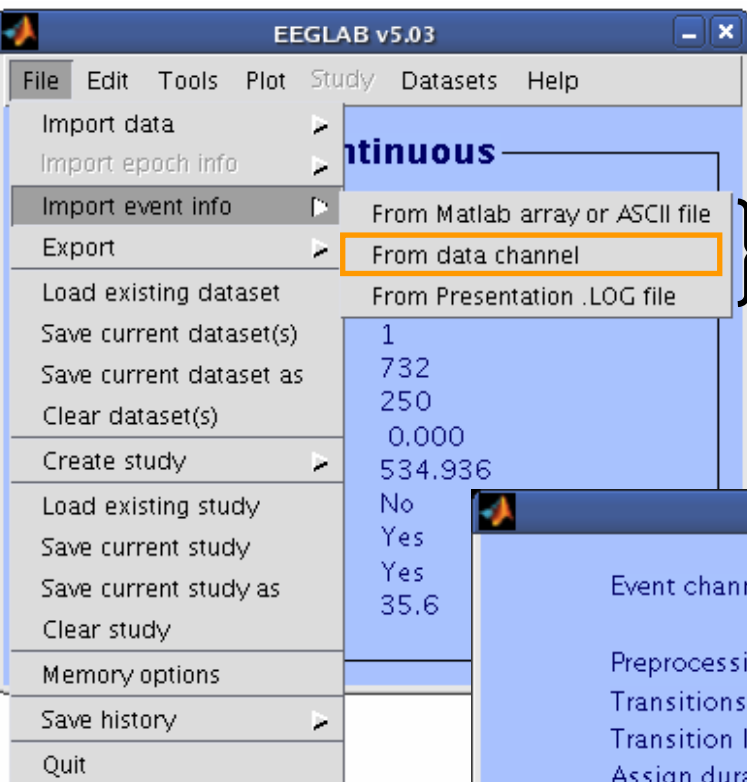
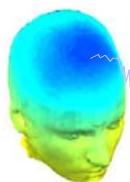
Import data events

Task 4

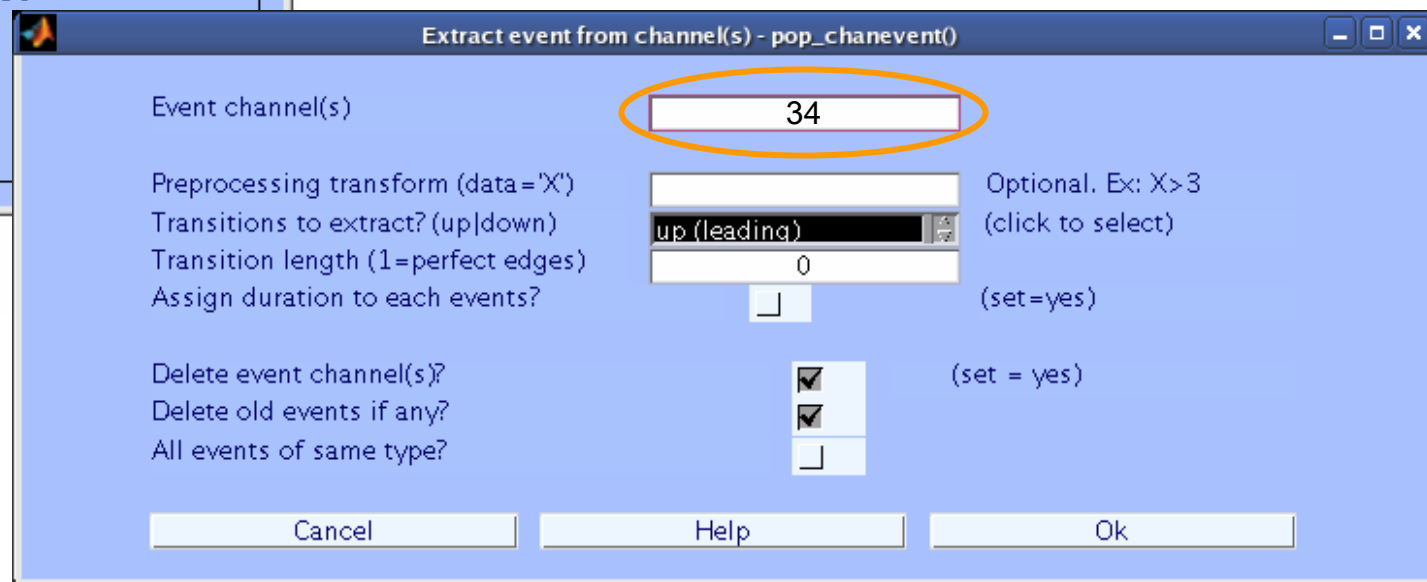
Extract data epochs
Select epochs/events

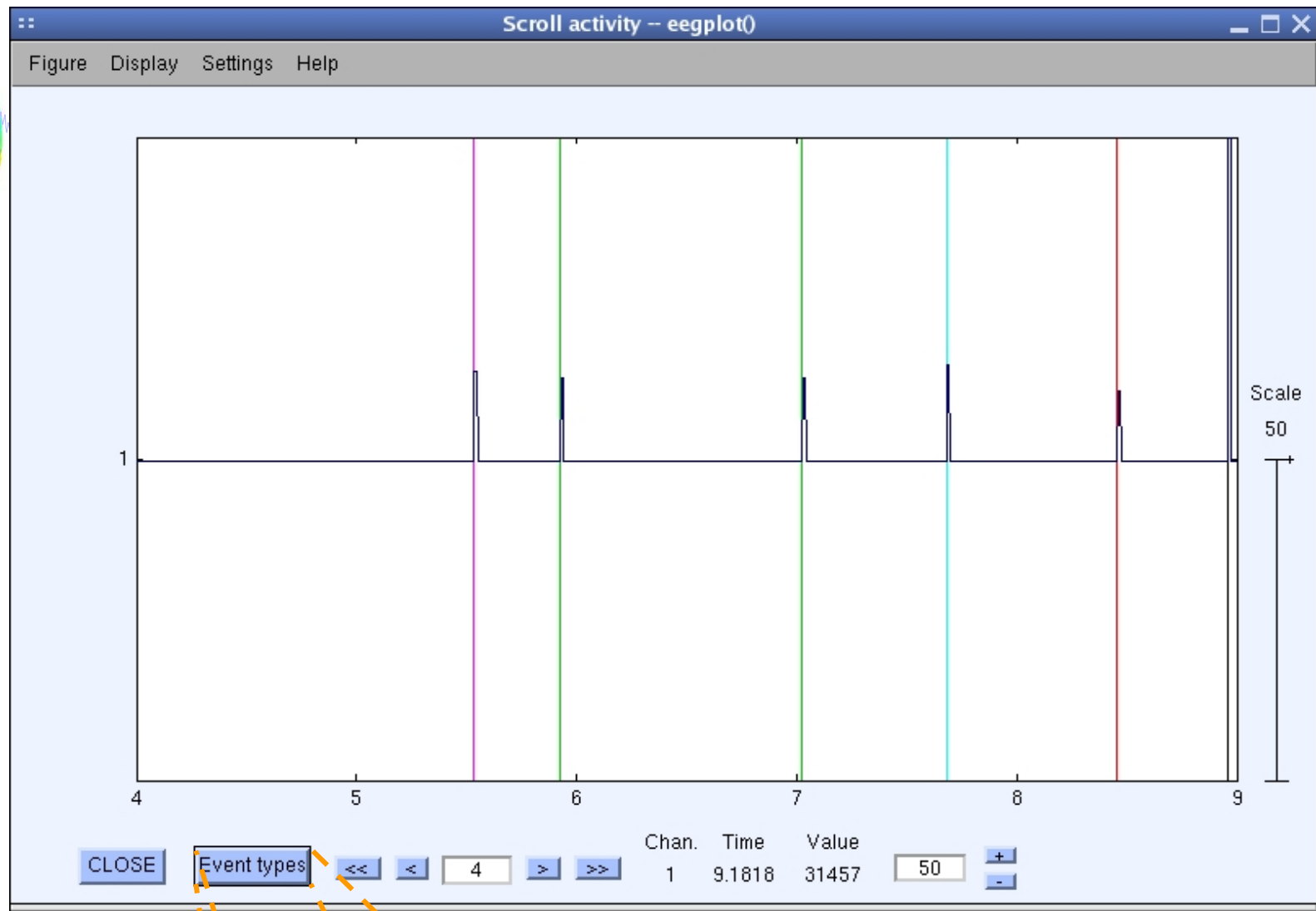
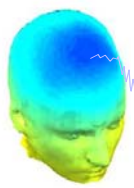
Exercise...





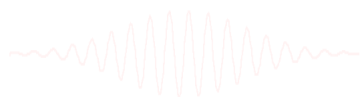
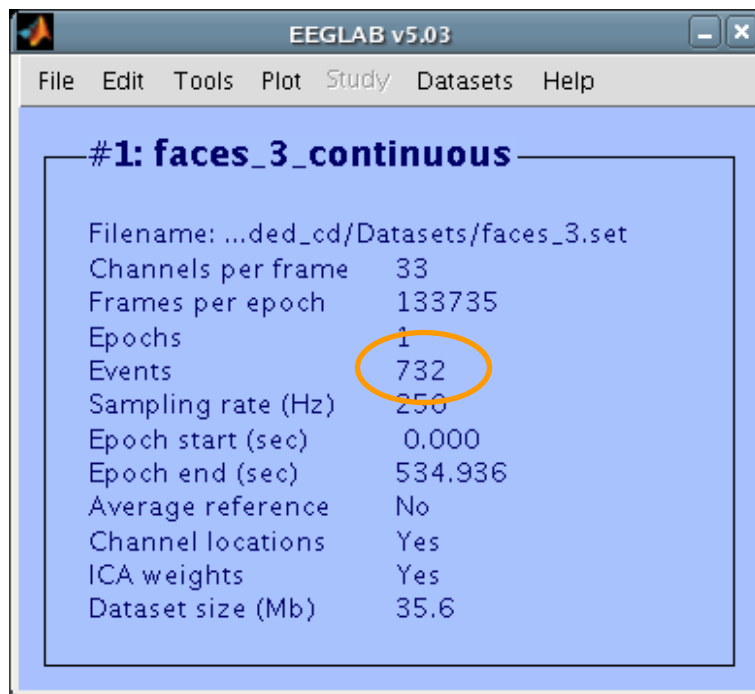
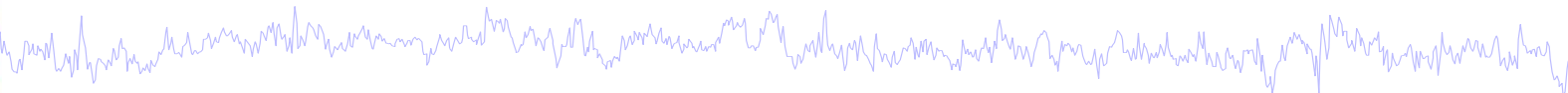
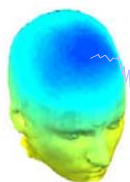
- Import event from Matlab array or ASCII file
- **Import event from data channel**
- Import event from Presentation event file



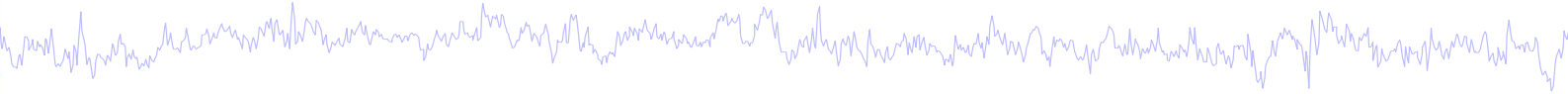


- 3145929
- 3145743
- 3145742
- 3145741
- 3145739

Import data events



Review/edit event values



EEGLAB v5.03

File Edit Tools Plot Study Datasets Help

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

shop06/faces_3.set
33
133735
1
732
250
0.000
534.936
No
Yes
Yes
35.6

Event 'type' and 'latency' are recognized fields

Edit event values -- pop_editeventvals()

Edit event field values (currently 732 events) Delete event

Latency (sec)	4.964
Type	object

Event Num

Insert event << < 2 > >> Append event

Re-order events (for review only)

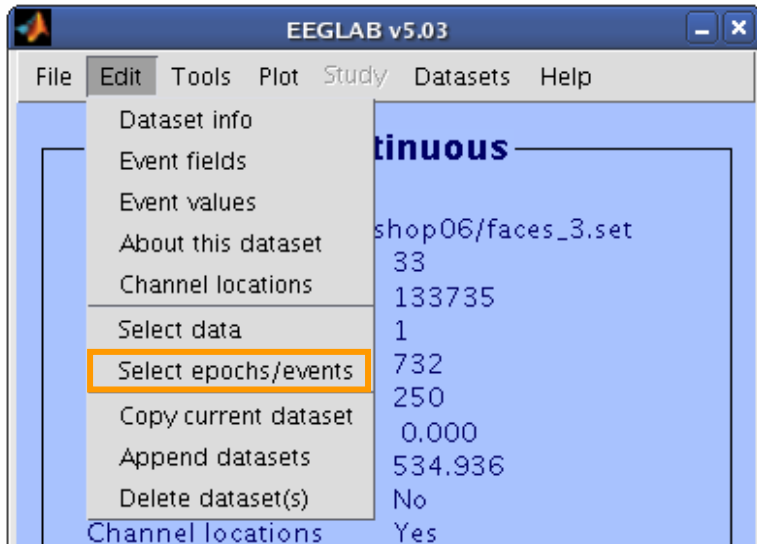
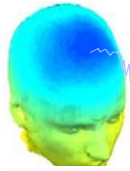
Main sorting field: No field selected Click for decreasing order

Secondary sorting field: No field selected Click for decreasing order

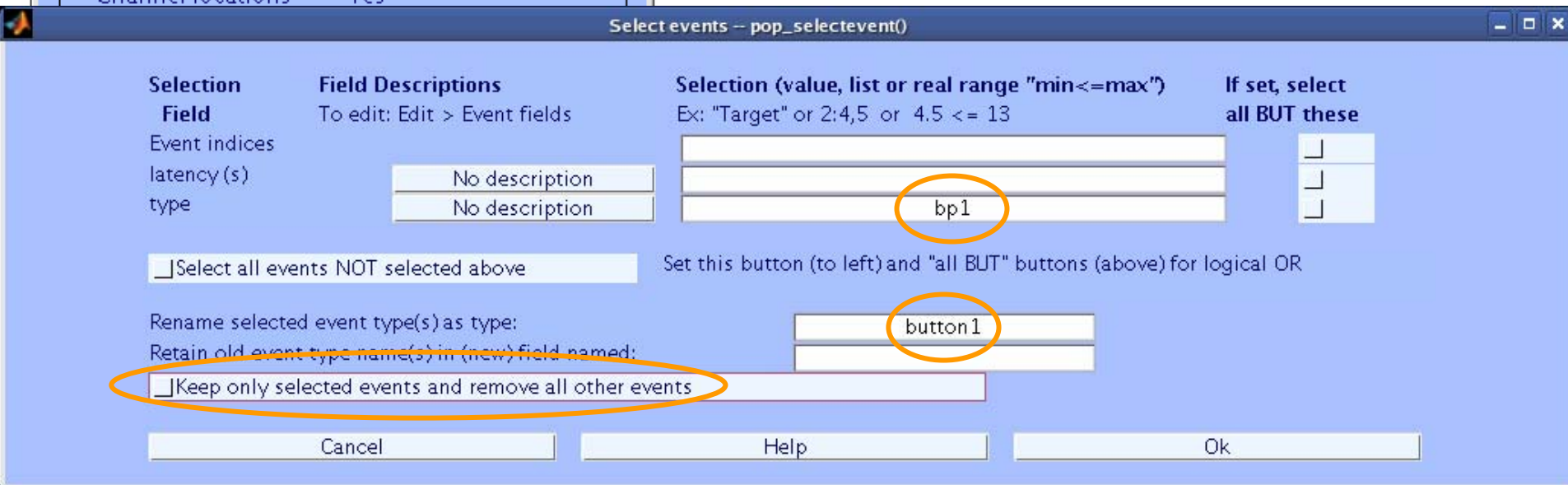
Re-sort

Cancel Help Ok

Renaming events



- 1) input original 'type' code
- 2) input new 'type' code
- 3) keep all other events!



Renaming events



EEGLAB v5.03

File Edit Tools Plot Study Datasets Help

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

shop06/faces_3.set
33
133735
1
732
250
0.000
534.936
No
Yes
Yes
35.6

Edit event values -- pop_editeventvals()

Edit event field values (currently 732 events) Delete event

Latency (sec) 5.724
Type **button1**

Event Num

Insert event << < 3 > >> Append event

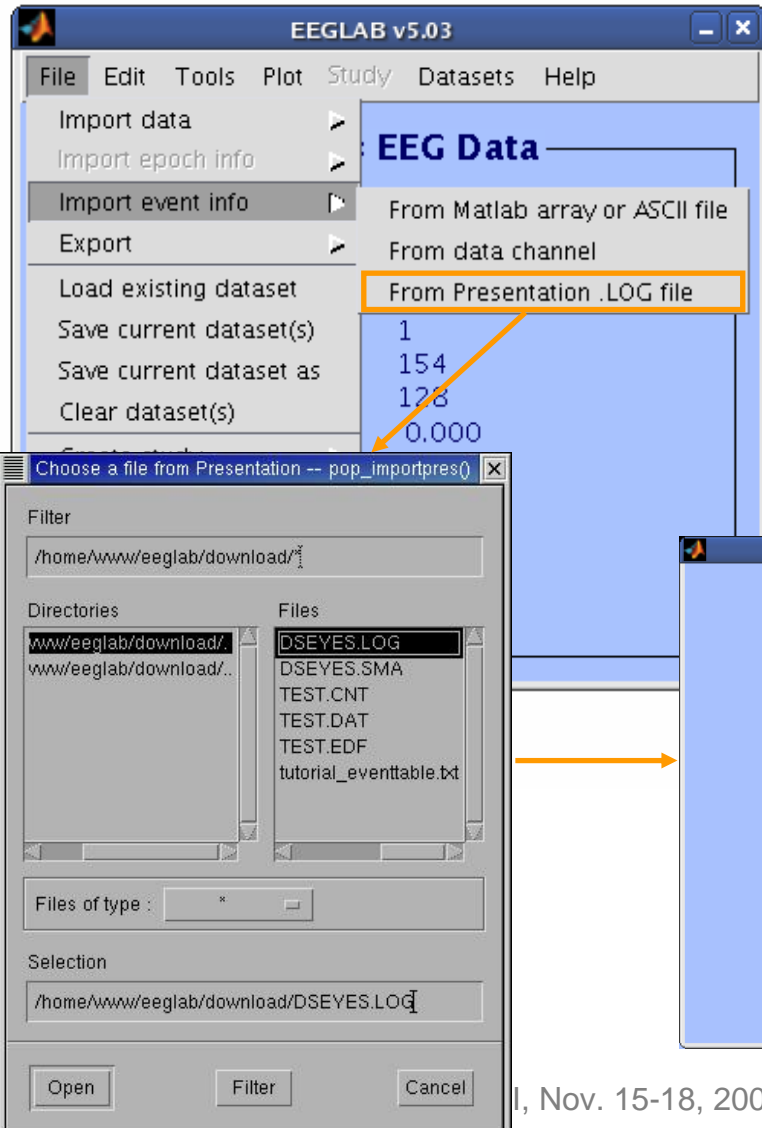
Re-order events (for review only)

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

Alternative method for importing events: Import events from event file



...

Check alignment between pre-existing (old) and loaded event latencies:

Old event latencies (10 first): 10789 21315 31375 41902 51962 62489 ...

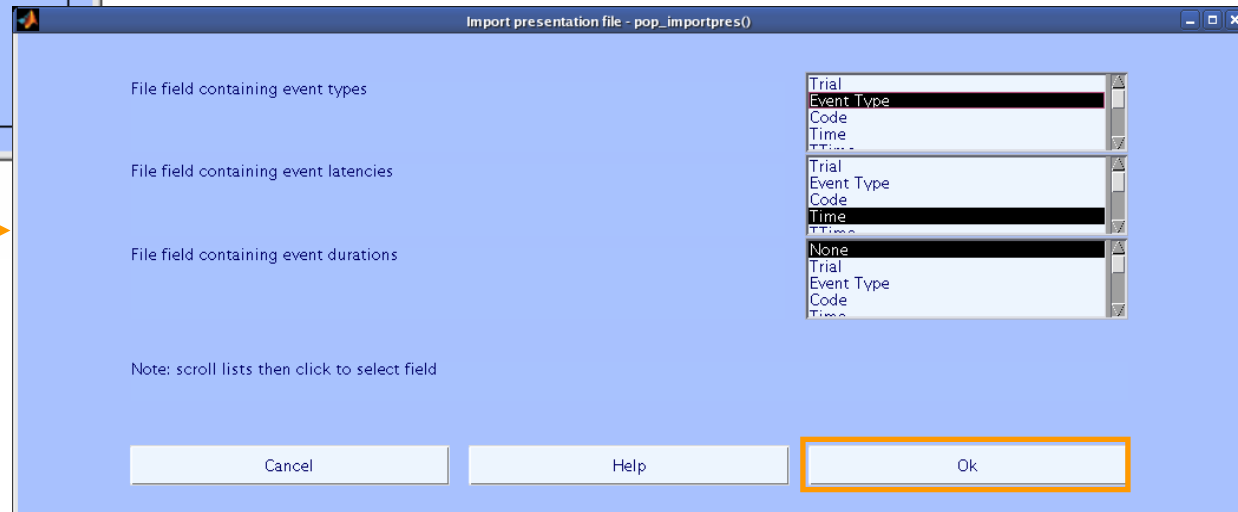
New event latencies (10 first): 10789 21315 31376 41902 51963 62489 ...

Best sampling rate ratio found is 0.9999895. Below latencies after adjustment

Old event latencies (10 first): 10789 21315 31376 41902 51963 62488 ...

New event latencies (10 first): 10789 21315 31375 41902 51962 62489 ...

...



Scroll data with events



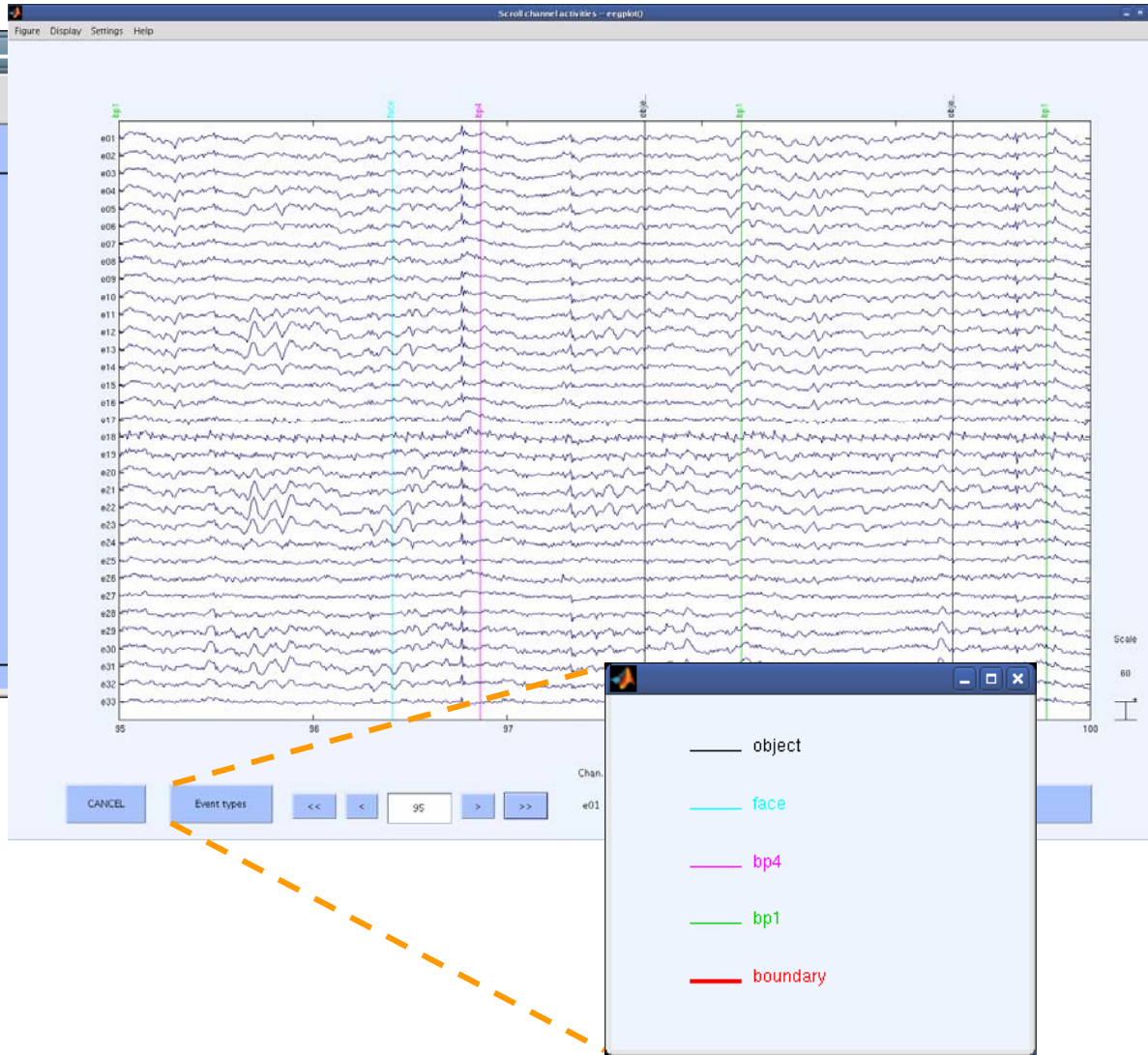
EEGLAB v5.03

File Edit Tools Plot Study Datasets Help

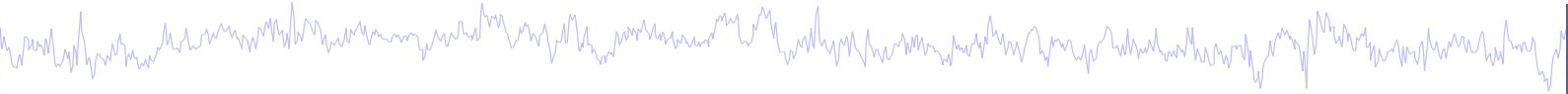
#1: faces

Filename: ...
Channels per ...
Frames per e...
Epochs
Events
Sampling rat...
Epoch start (...)
Epoch end (s...)
Average refe...
Channel loca...
ICA weights
Dataset size

- Channel locations
- Channel data (scroll)**
- Channel spectra and maps
- Channel properties
- Channel ERP image
- Channel ERPs
- ERP map series
- Sum/Compare ERPs
- Component activations (scroll)
- Component spectra and maps
- Component maps
- Component properties
- Component ERP image
- Component ERPs
- Sum/Compare comp. ERPs
- Data statistics
- Time-frequency transforms
- Average time-frequency
- New Time-freq. transforms



Data preprocessing and epoching



Task 1

- Import raw data
- Re-reference data
- Scroll channel data

Task 2

- Import channel location file

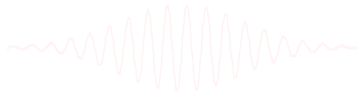
Task 3

- Import data events

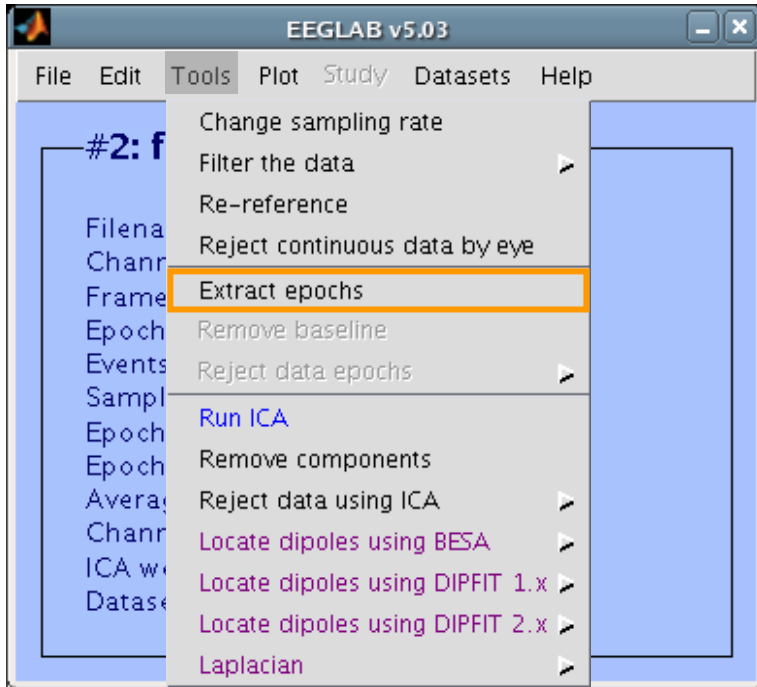
Task 4

- Extract data epochs
- Select epochs/events

Exercise...

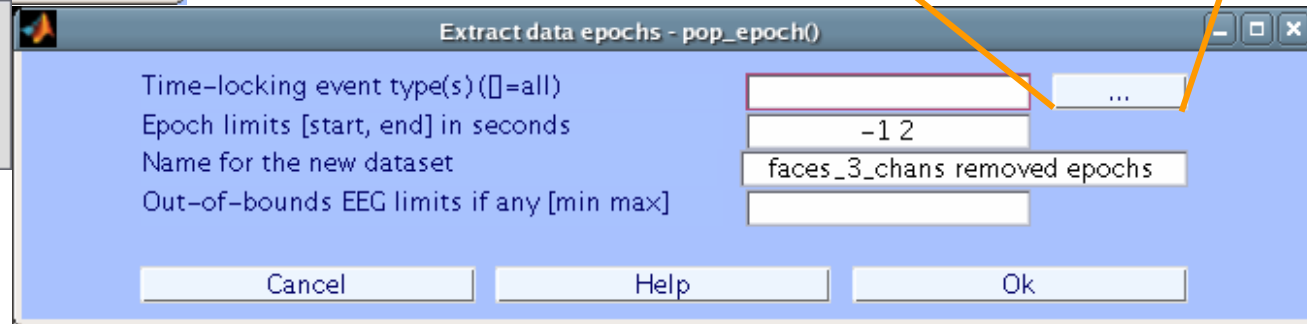
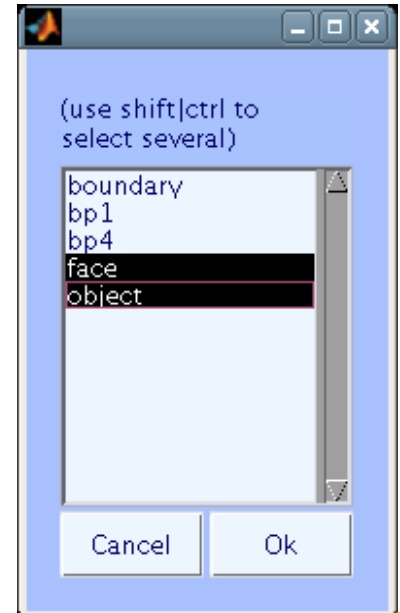


Extract epochs

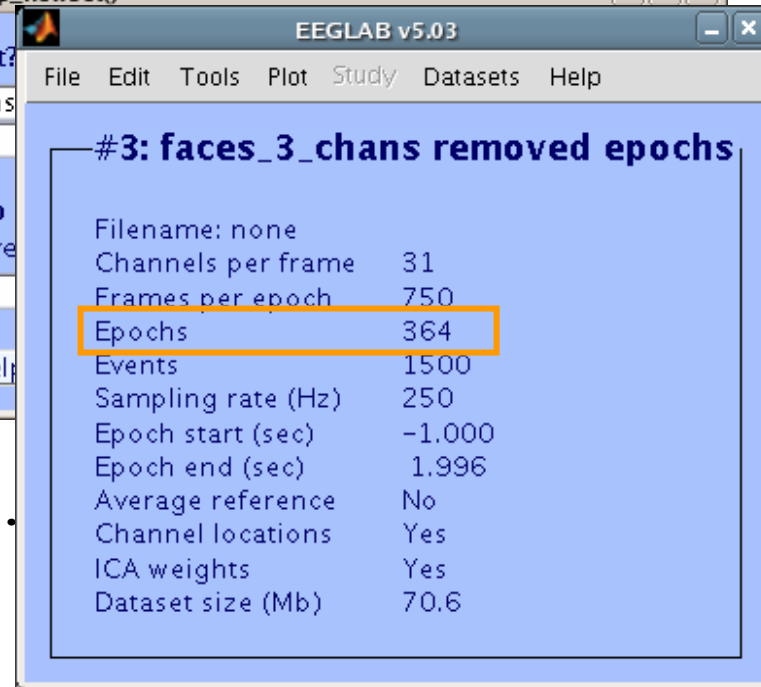
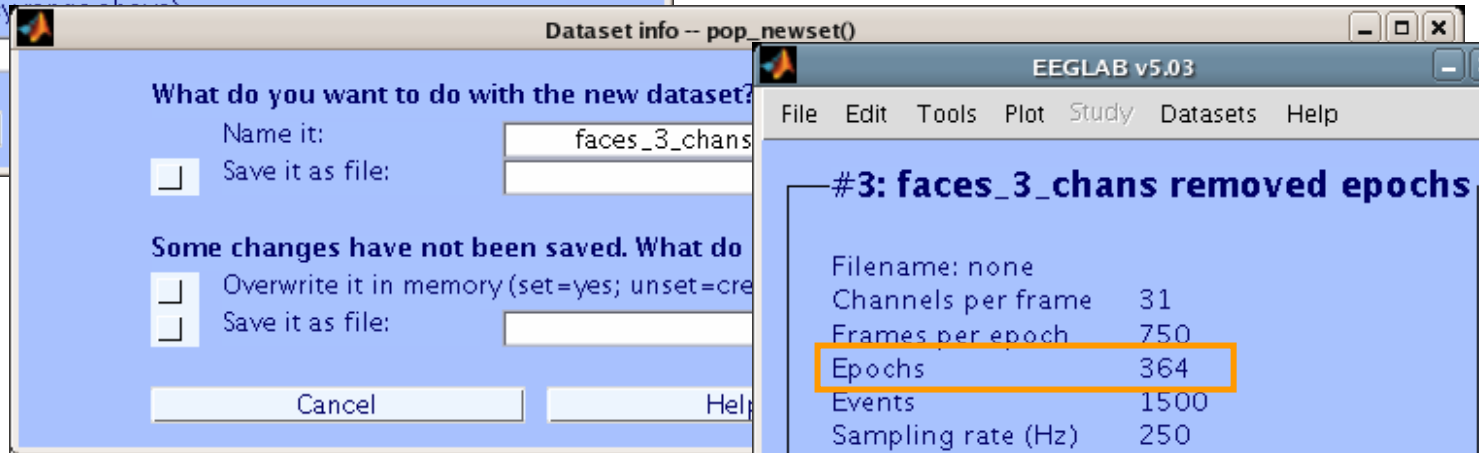
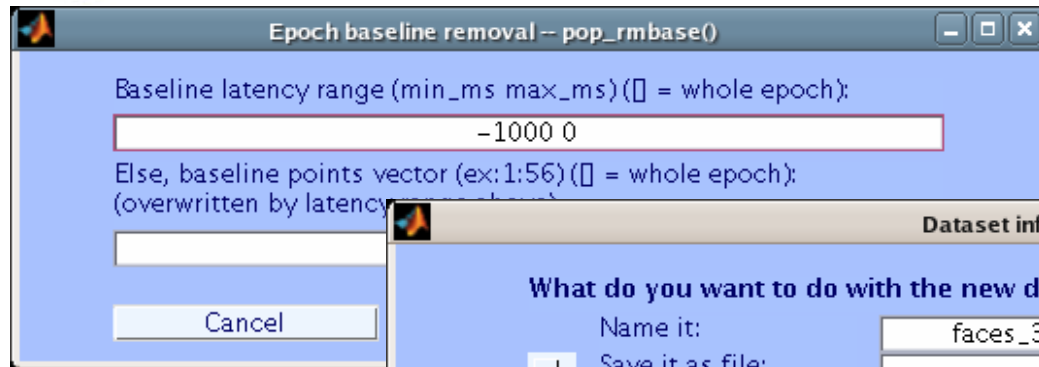
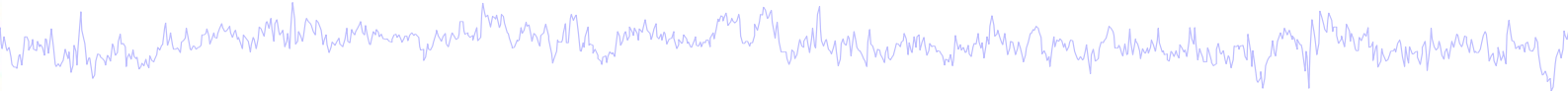


```
>> eeg_eventtypes(EEG)
```

```
boundary    1
bp1         183
bp4         184
face        182
object      182
```

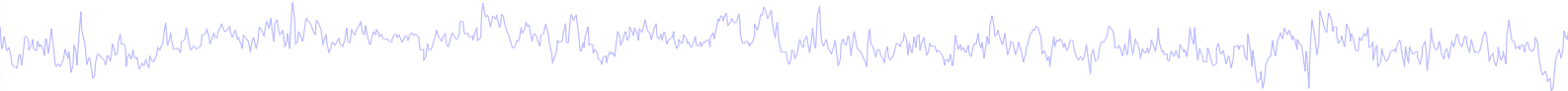


Extract epochs

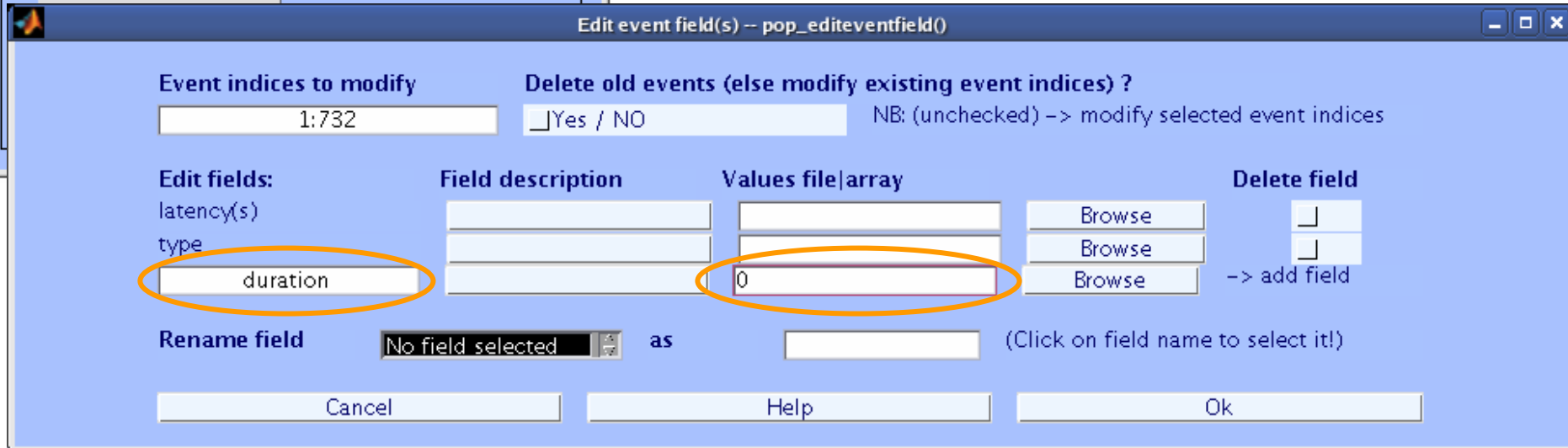
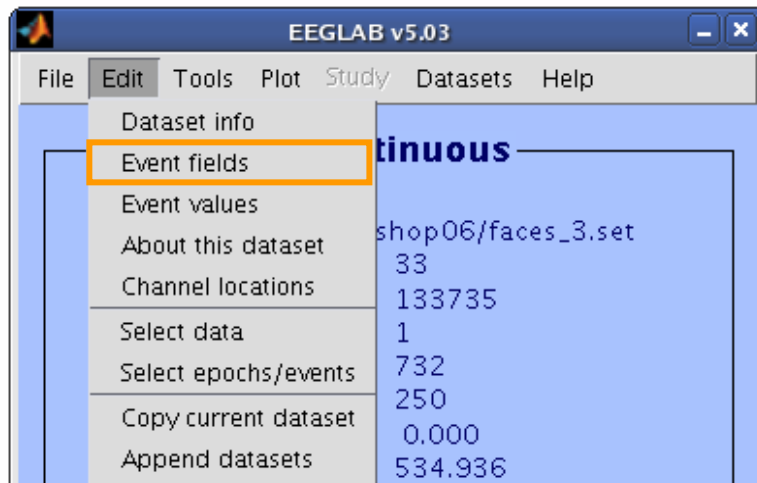


```
>> EEG = pop_epoch(EEG,{'face' 'object'},[-1 2],...  
    'newname','faces_3_chans removed epochs',...  
    'epochinfo','yes');  
>> EEG = pop_rmbase(EEG,[-1000 0]);  
>> [ALLEEG EEG CURRENTSET] = pop_newset(ALLEEG,EEG,...  
    CURRENTSET,'setname','faces_3_chans removed epochs');
```

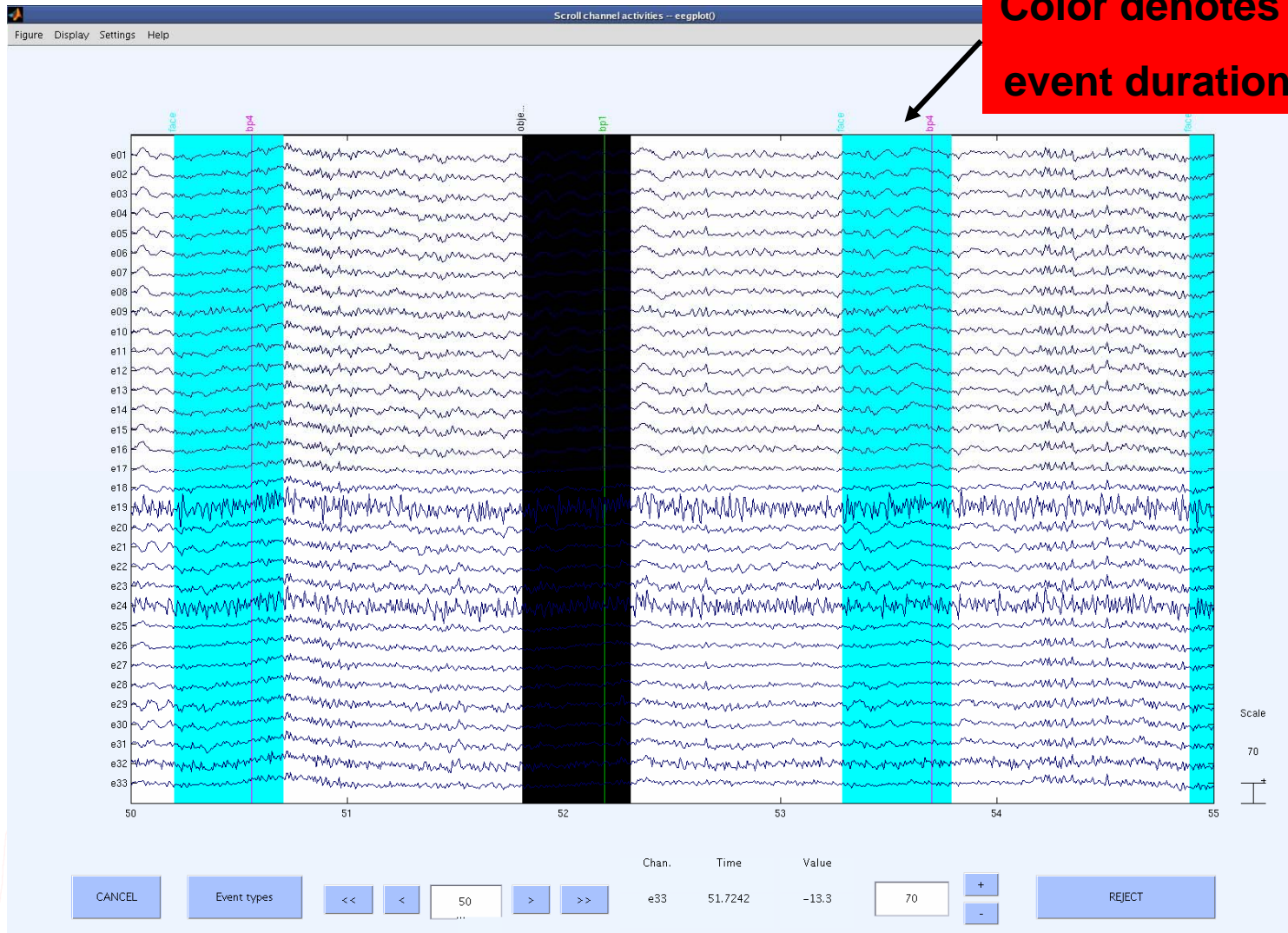
Create new event field



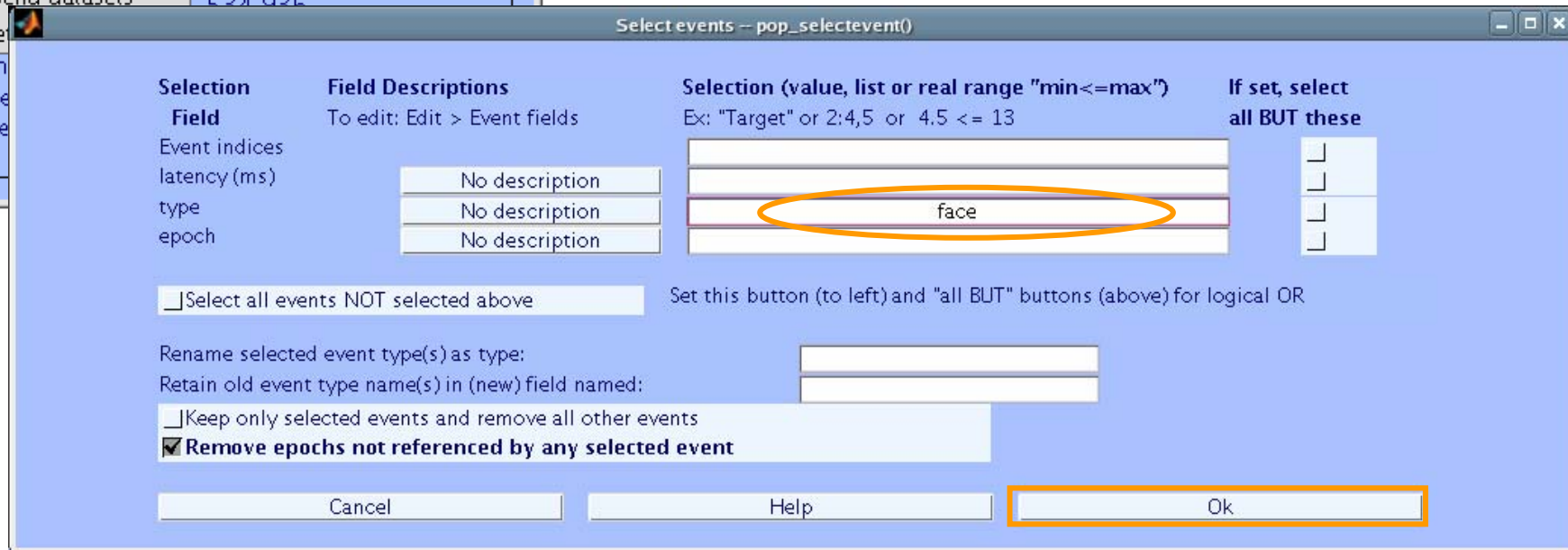
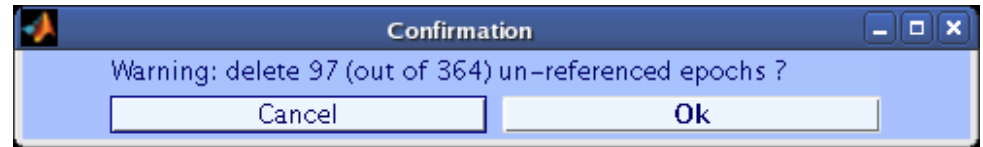
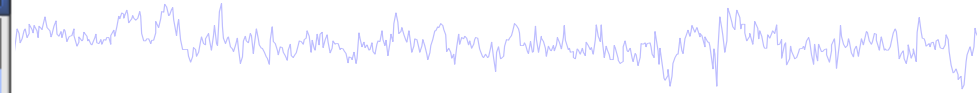
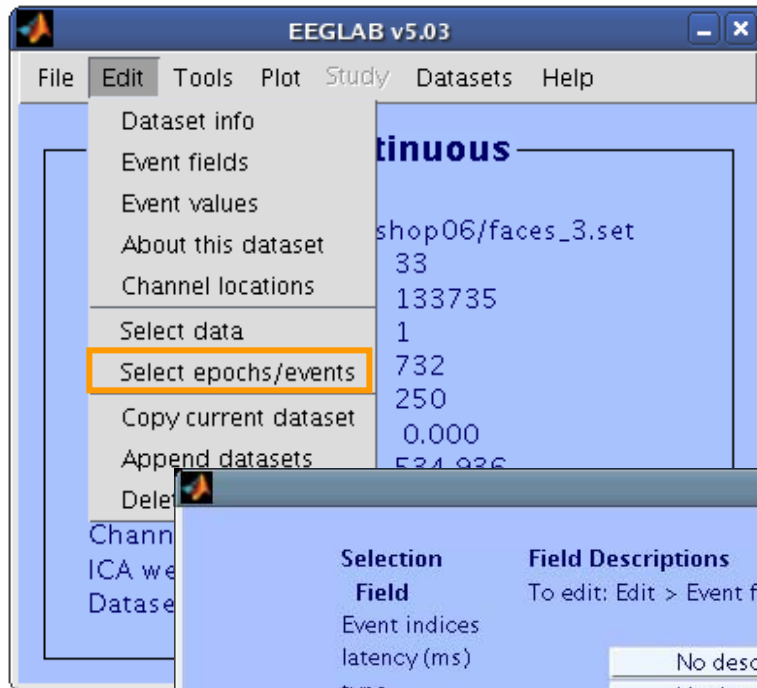
```
EEG = pop_editeventfield( EEG,...  
    'indices','1:732','latencyinfo',...  
    [],'typeinfo',[],'duration','0');  
[ALLEEG EEG] = eeg_store(ALLEEG,...  
    EEG, CURRENTSET);
```



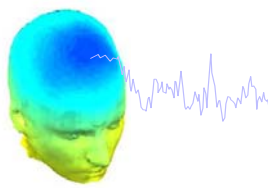
Event durations



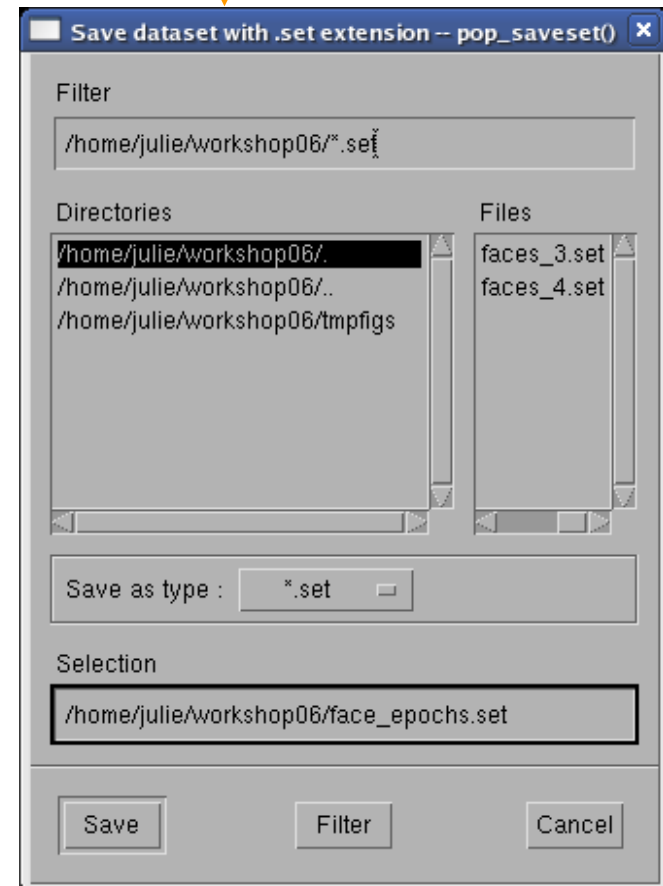
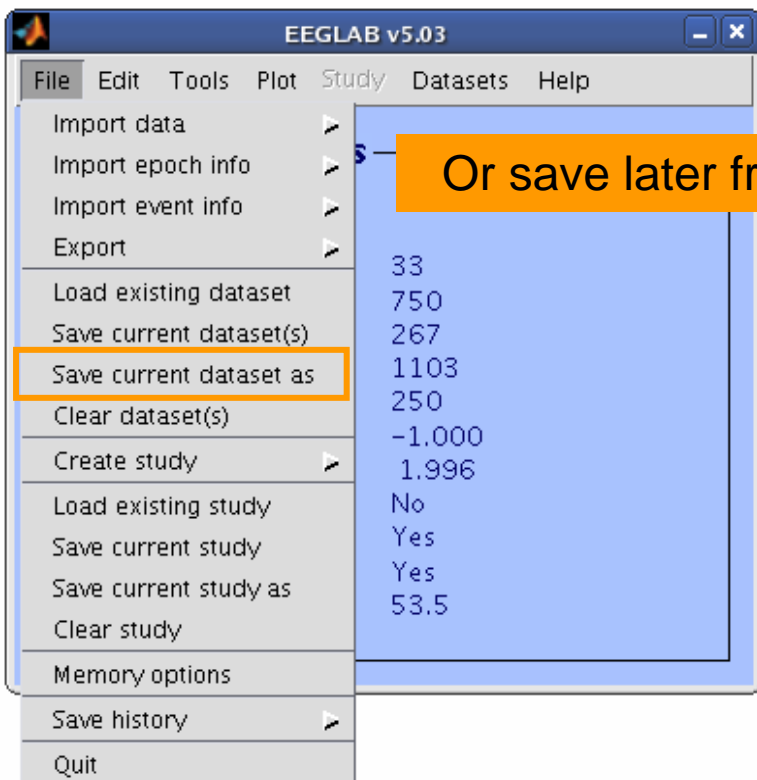
Select epochs

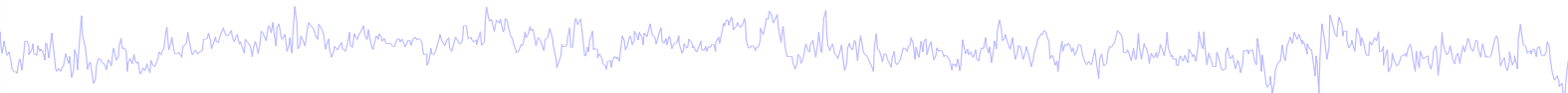
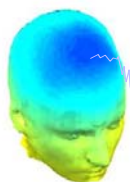


```
>> EEG=pop_selectevent(EEG,'type',{'face'},'deleteevents', ...  
'off','deleteepochs','on');  
>> [ALLEEG EEG CURRENTSET]=pop_newset(ALLEEG,EEG,4,...  
'setname','faces only epochs');
```



Save dataset (optional)





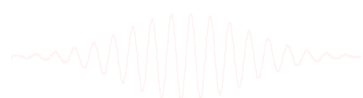
EEGLAB v5.0.3

File Edit Tools Plot Study **Datasets** Help

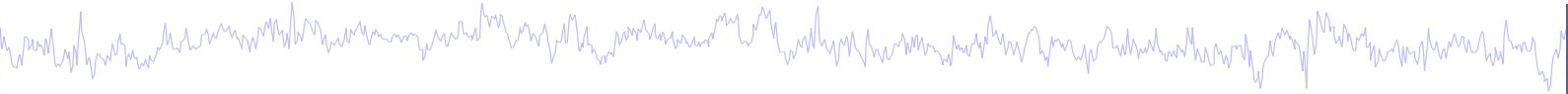
#2: face epochs

- Dataset 1:faces_3_continuous
- Dataset 2:face epochs
- Select multiple datasets

Filename:	none
Channels per frame	33
Frames per epoch	750
Epochs	267
Events	1103
Sampling rate (Hz)	250
Epoch start (sec)	-1.000
Epoch end (sec)	1.996
Average reference	No
Channel locations	Yes
ICA weights	Yes
Dataset size (Mb)	53.5



Exercise



- Load dataset '*.../data/faces_3.set*'
- Scroll channel data
- remove channel location information. Type:
 - `>> EEG.chanlocs = [];`
 - `>> eeglab redraw`
- Import electrode locations '*faces_3.locs*' from '*.../data/*'
 - Plot in channel locations in 2D/3D
 - Try rotating axis
 - Optimize the head center
- Review events in pop_menu (**Edit → Event values**)
 - Practice renaming an event type
- Do **not** save your changes!!

