

Neural Networks to Consumer Networks: EEG in Research and Marketing

Introduction to ERP Analysis using EEGLAB

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PART III

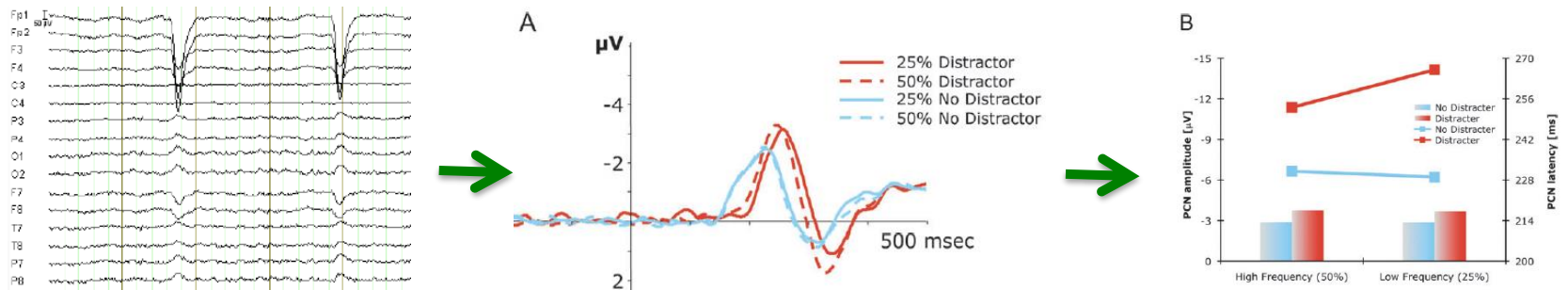
MUNICH-ÇANAKKALE 2026

15.04.2026

ERPLAB

- For the next seminar, we will mostly be working with the ERPLAB plugin for EEGLAB. Please, find instructions here:
<https://github.com/lucklab/erplab/wiki/Installation>

Final steps ...



How to average condition?

How to plot the data?

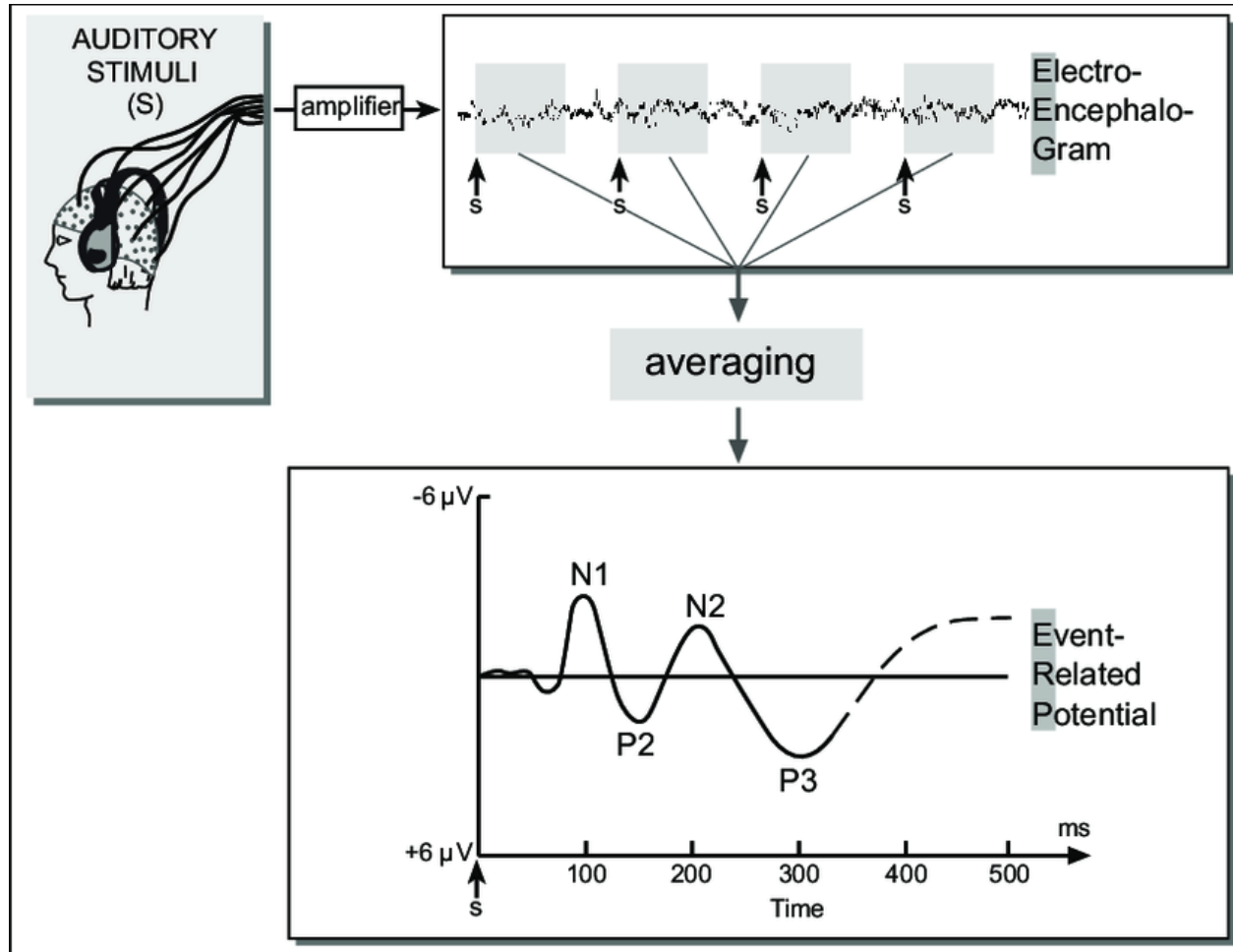
How to measure the components?

How to conduct statistical analyses?

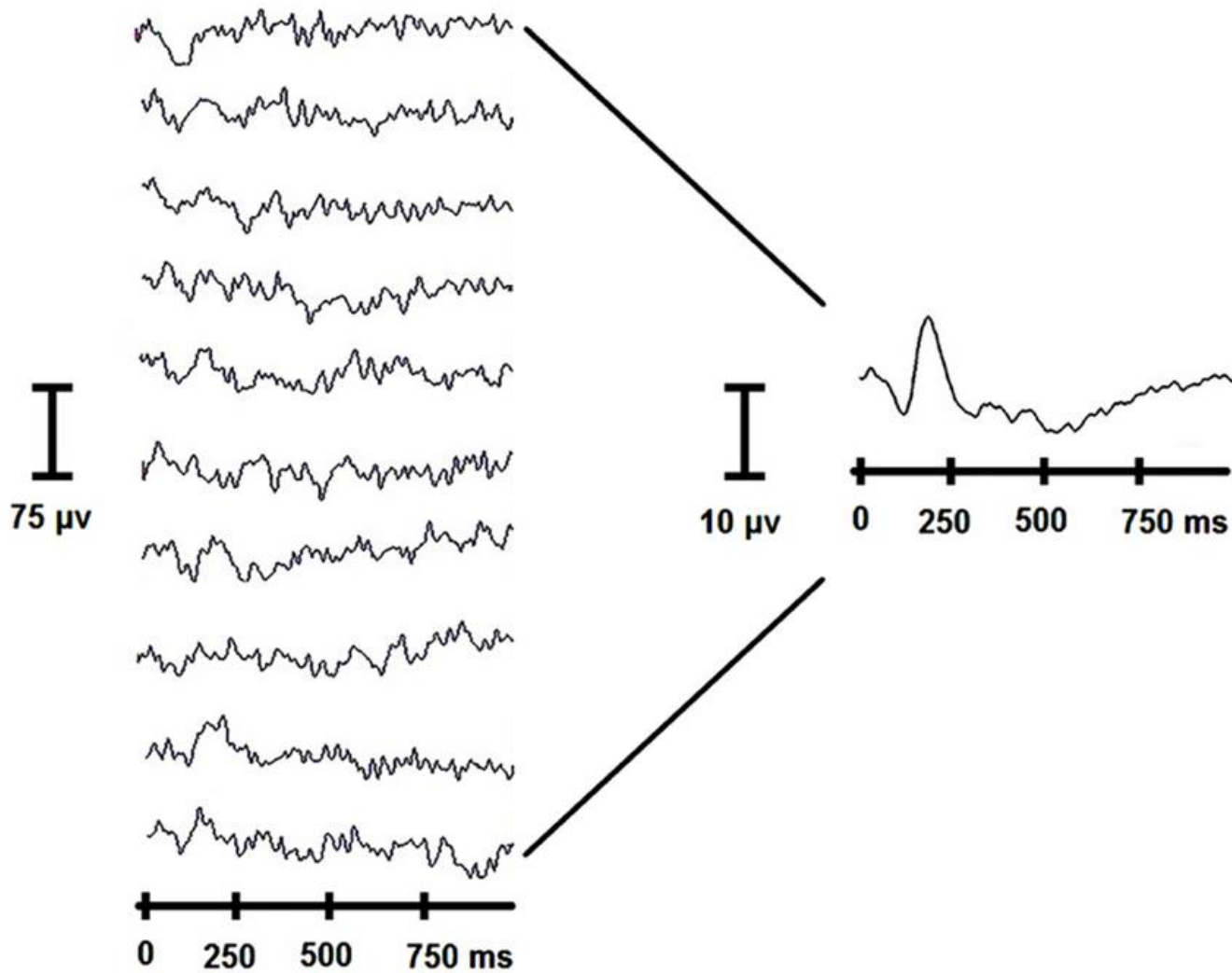
Overview

1. Averaging single trials into specific conditions
2. Plotting ERP data
3. Measuring ERP amplitudes
4. Measuring ERP latencies
5. Computing lateralized components
6. Statistical analysis (SPSS/R/Python)

Averaging



Averaging



Event list

The event codes are embedded in a dataset within EEGLAB's **EEG** structure, which is pretty complicated.

To make it easier to see and manipulate the event codes, ERPLAB creates an EventList, which is a list of all of the event codes and associated information.

Create an event list

The screenshot shows the EEGLAB v2020.0 interface. The main window displays a list of dataset parameters on the left and their values on the right. The 'ERPLAB' menu is open, showing a list of options. The 'EventList' option is selected, which has opened a submenu with various event-related functions.

Dataset Parameters:

Parameter	Value
Filename: ...d_01_70 pruned with ICA.s	
Channels per frame	
Frames per epoch	
Epochs	
Events	
Sampling rate (Hz)	
Epoch start (sec)	
Epoch end (sec)	
Reference	
Channel locations	
ICA weights	
Dataset size (Mb)	1254.6

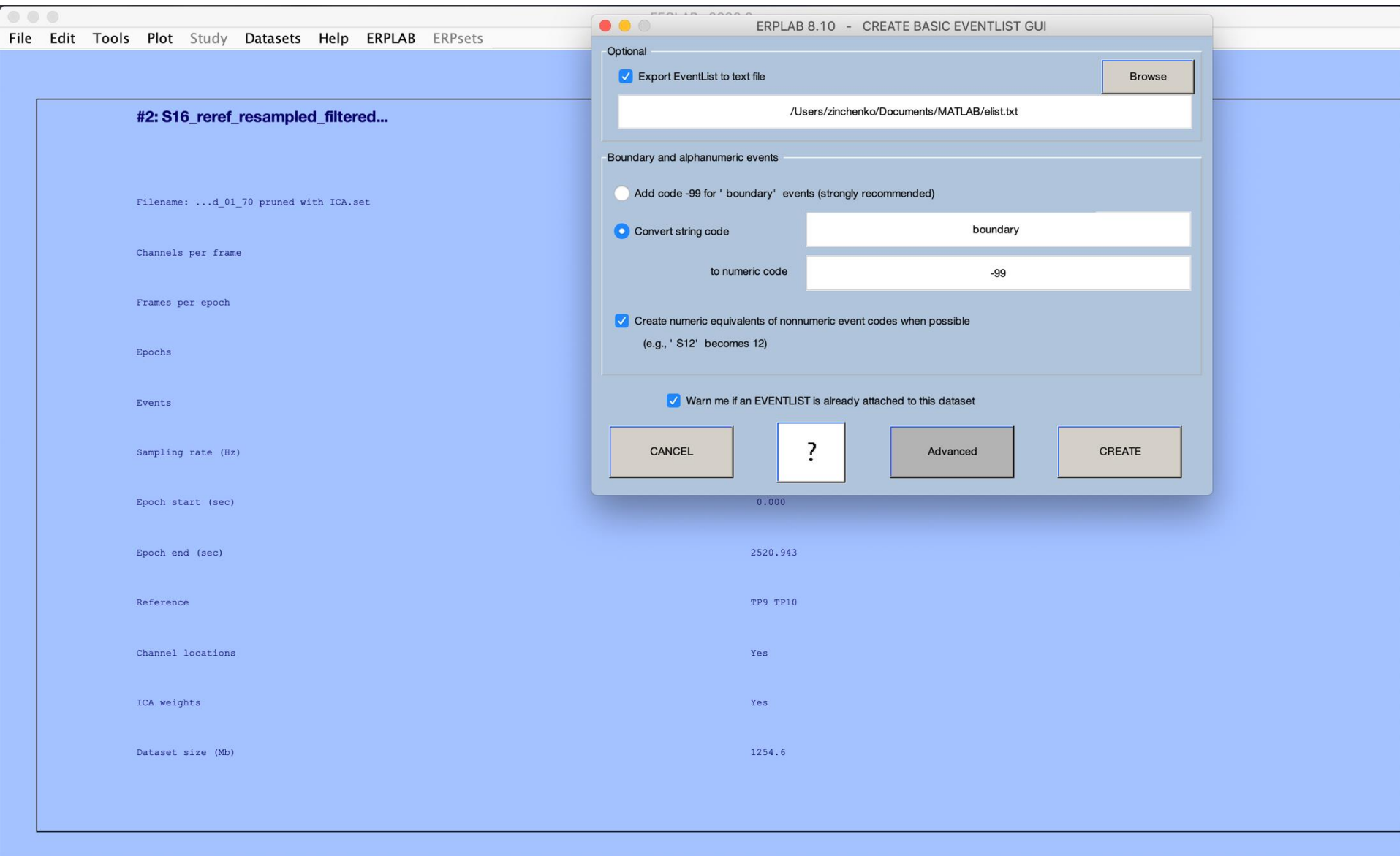
ERPLAB Menu Options:

- *** ERPLAB v8.10 ***
- Preprocess EEG
- EventList** (selected)
- Assign bins (BINLISTER)
- BDF Visualizer
- Extract bin-based epochs
- EEG Channel operations
- Filter & Frequency Tools
- Artifact detection in epoched data
- Summarize artifact detection
- Compute averaged ERPs
- ERP Operations
- Plot ERP
- Export & Import ERP
- Load existing ERPset
- Clear ERPset(s)
- Save current ERPset
- Save current ERPset as
- Duplicate or rename current ERPset
- ERP Measurement Tool
- ERP Viewer
- Average across ERPsets (Grand Average)
- Datatype Transformations
- Data Quality options
- Utilities
- Settings
- Help

EventList Submenu Options:

- Create EEG EVENTLIST
- Import EEG EVENTLIST from text file
- Export EEG EVENTLIST to text file
- Shuffle events/bins/samples
- Summarize current EEG event codes (output at command window)
- Export reaction times to text
- Import ERP EVENTLIST from text file
- Export ERP EVENTLIST to text file
- Transfer eventinfo to EEG.event (optional)

Create an event list



```
# Non-editable header begin -----
#
# data format.....: continuous
# setname.....: S16_reref_resampled_filtered_01_70_elist
# filename.....: S16_reref_resampled_filtered_01_70_ICA.set
# filepath.....: /Users/zinchenko/Dropbox/EEG_course/EEG_RAW/EEG_preprocessed_s16/
# nchan.....: 62
# npts.....: 1290724
# srate.....: 512
# nevents.....: 2410
# generated by (bdf).....:
# generated by (set).....: S16_reref_resampled_filtered_01_70_elist
# reported in .....:
# prog Version.....: 8.10
# creation date.....: 20-Jan-2021 12:38:06
# user Account.....:
#
# Non-editable header end -----
```

#	item	bepoch	ecode	label	onset (sec)	diff (msec)	dura (binary)	b_flags (binary)	a_flags	enable	bin
1	0	-99		boundary	0.0000	0.00	NaN	00000000	00000000	1	[]
2	0	-88		noUSBConnectiontoactiCAP	0.0000	0.00	NaN	1.0 00000000	00000000	1	[]
3	0	-99		boundary	1.1602	1160.16	NaN	00000000	00000000	1	[]
4	0	-88		noUSBConnectiontoactiCAP	1.1602	0.00	NaN	1.0 00000000	00000000	1	[]
5	0	1		S1	3.0432	1883.00	1.0	00000000	00000000	1	[]
6	0	102		S102	3.8212	778.00	1.0	00000000	00000000	1	[]
7	0	92		S92	4.3392	518.00	1.0	00000000	00000000	1	[]
8	0	1		S1	5.3882	1049.00	1.0	00000000	00000000	1	[]
9	0	101		S101	6.1192	731.00	1.0	00000000	00000000	1	[]
10	0	81		S81	7.0022	883.00	1.0	00000000	00000000	1	[]
11	0	1		S1	8.5522	1550.00	1.0	00000000	00000000	1	[]
12	0	103		S103	9.2862	734.00	1.0	00000000	00000000	1	[]
13	0	92		S92	9.8352	549.00	1.0	00000000	00000000	1	[]
14	0	1		S1	10.8852	1050.00	1.0	00000000	00000000	1	[]
15	0	100		S100	11.6192	734.00	1.0	00000000	00000000	1	[]
16	0	92		S92	12.3682	749.00	1.0	00000000	00000000	1	[]
17	0	1		S1	13.4182	1050.00	1.0	00000000	00000000	1	[]
18	0	103		S103	14.1532	735.00	1.0	00000000	00000000	1	[]
19	0	91		S91	14.7072	554.00	1.0	00000000	00000000	1	[]
20	0	1		S1	15.7522	1045.00	1.0	00000000	00000000	1	[]
21	0	100		S100	16.4862	734.00	1.0	00000000	00000000	1	[]
22	0	92		S92	17.0422	556.00	1.0	00000000	00000000	1	[]
23	0	1		S1	18.0842	1042.00	1.0	00000000	00000000	1	[]
24	0	100		S100	18.8192	735.00	1.0	00000000	00000000	1	[]
25	0	92		S92	19.2742	455.00	1.0	00000000	00000000	1	[]
26	0	1		S1	20.3172	1043.00	1.0	00000000	00000000	1	[]
27	0	100		S100	21.0522	735.00	1.0	00000000	00000000	1	[]
28	0	92		S92	21.8512	799.00	1.0	00000000	00000000	1	[]
29	0	1		S1	22.9002	1049.00	1.0	00000000	00000000	1	[]
30	0	103		S103	23.6352	735.00	1.0	00000000	00000000	1	[]
31	0	91		S91	24.4012	766.00	1.0	00000000	00000000	1	[]
32	0	1		S1	25.4492	1048.00	1.0	00000000	00000000	1	[]
33	0	102		S102	26.1852	736.00	1.0	00000000	00000000	1	[]
34	0	92		S92	26.8582	673.00	1.0	00000000	00000000	1	[]
35	0	1		S1	27.9002	1042.00	1.0	00000000	00000000	1	[]
36	0	102		S102	28.6352	735.00	1.0	00000000	00000000	1	[]
37	0	82		S82	29.2902	655.00	1.0	00000000	00000000	1	[]
38	0	1		S1	30.8342	1544.00	1.0	00000000	00000000	1	[]
39	0	101		S101	31.5692	735.00	1.0	00000000	00000000	1	[]
40	0	81		S81	32.2172	648.00	1.0	00000000	00000000	1	[]

Bins

A *bin* is a set of averaged ERP waveforms, one for each electrode site, which were created by averaging together a specific set of EEG epochs.

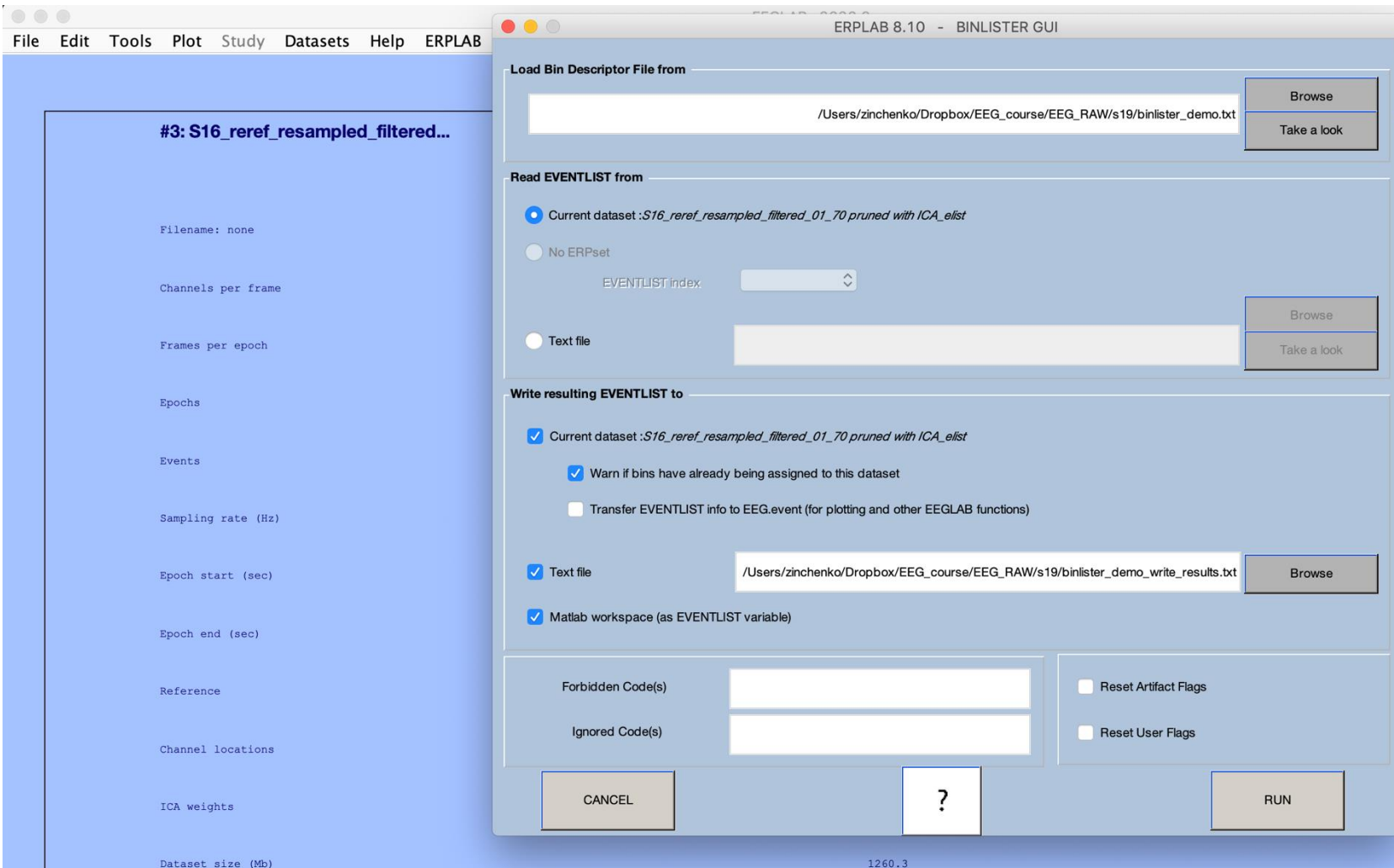
A simple oddball experiment, for example, might have one bin for the infrequent targets and another bin for the frequent standards.

In ERPLAB, an ERPset can contain an unlimited number of bins, and each data processing operation is typically applied to all of the bins in the currently active ERPset.

Assigning Events to Bins with BINLISTER



```
binlister_demo  
Bin 1  
. {100} {t<200-3000>91;92}  
  
Bin 2  
. {101} {t<200-3000>91;92}  
  
Bin 3  
. {102} {t<200-3000>91;92}  
  
Bin 4  
. {103} {t<200-3000>91;92}
```

Creating Bin Based EEG Epochs

EEGLAB v2020.0

File Edit Tools Plot Study Datasets Help **ERPLAB** ERPsets

*** ERPLAB v8.10 ***

Preprocess EEG ▶

EventList ▶

Assign bins (BINLISTER)

BDF Visualizer

Extract bin-based epochs

EEG Channel operations

Filter & Frequency Tools ▶

Artifact detection in epoched data ▶

Summarize artifact detection ▶

Compute averaged ERPs

ERP Operations ▶

Plot ERP ▶

Export & Import ERP ▶

Load existing ERPset

Clear ERPset(s)

Save current ERPset

Save current ERPset as

Duplicate or rename current ERPset

ERP Measurement Tool

ERP Viewer

Average across ERPsets (Grand Average)

Datatype Transformations ▶

Data Quality options ▶

Utilities ▶

Settings ▶

Help ▶

#3: S16_reref_resampled_filter

Filename: none

Channels per frame

Frames per epoch

Epochs

Events

Sampling rate (Hz)

Epoch start (sec)

Epoch end (sec)

Reference

Channel locations

ICA weights

Dataset size (Mb)

62

1290724

1

2410

512

0.000

2520.943

TP9 TP10

Yes

Yes

1260.3

Creating Bin Based EEG Epochs

EEGLAB v2020.0

File Edit Tools Plot Study Datasets Help ERPLAB ERPsets

#3: S16_reref_resampled_filtered...

Filename: none	
Channels per frame	62
Frames per epoch	12907
Epochs	1
Events	2410
Sampling rate (Hz)	512
Epoch start (sec)	0.000
Epoch end (sec)	2520.943
Reference	TP9 TP10
Channel locations	Yes
ICA weights	Yes
Dataset size (Mb)	1260.3

ERPLAB 8.10 - EXTRACT BINEPOCHS GUI

Bin-based epoch time range (ms)

-200 1000 Hint

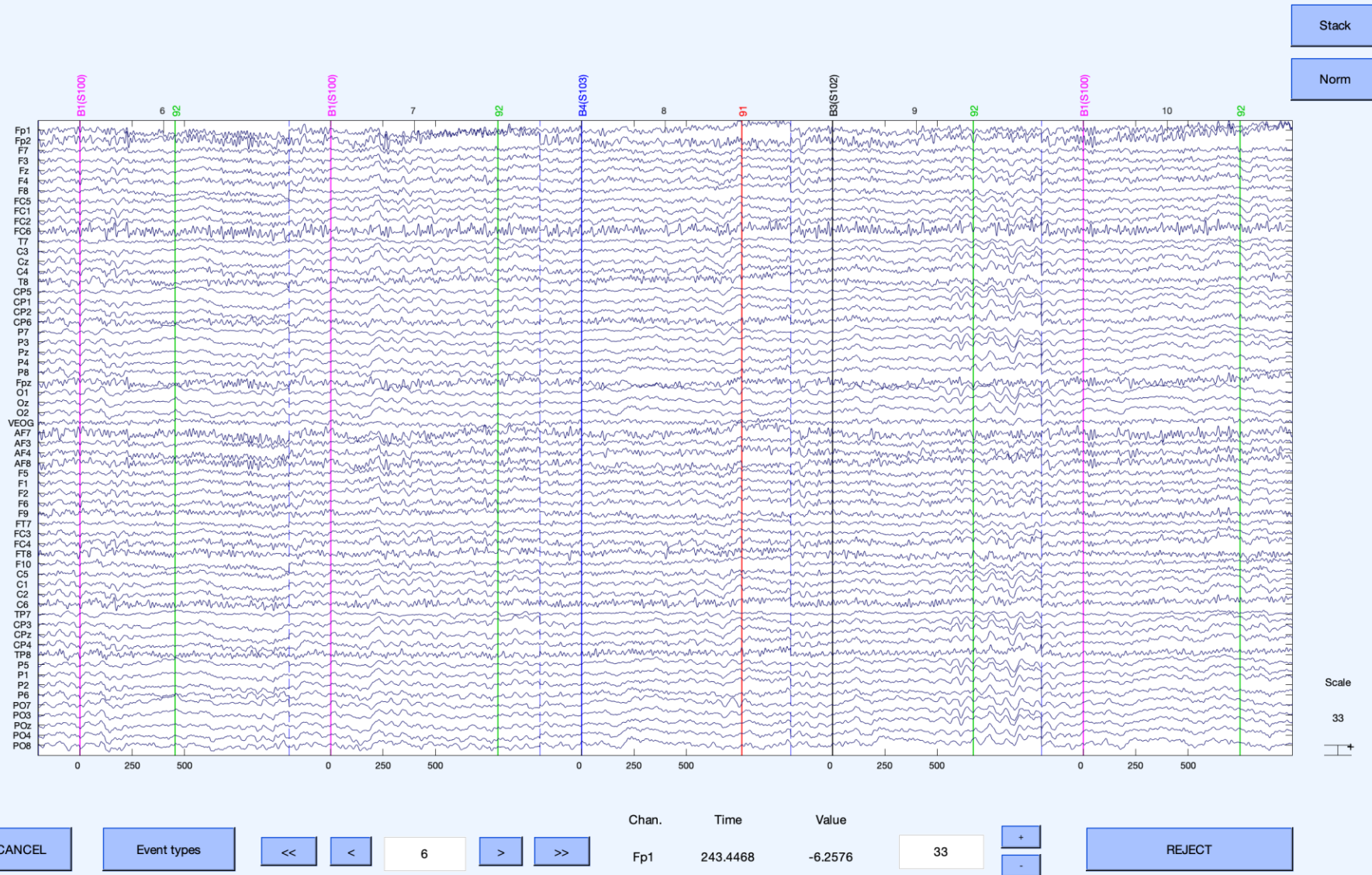
Baseline Correction

☐ None ☐ Post ☐ Custom (ms) start stop

☒ Pre ☐ Whole

CANCEL ? RUN

Creating Bin Based EEG Epochs



Averaging

EEGLAB v2020.0

File Edit Tools Plot Study Datasets Help **ERPLAB** ERPsets

*** ERPLAB v8.10 ***

Preprocess EEG ▶

EventList ▶
Assign bins (BINLISTER)
BDF Visualizer

Extract bin-based epochs

EEG Channel operations

Filter & Frequency Tools ▶ 62

Artifact detection in epoched data ▶
Summarize artifact detection ▶ 614

Compute averaged ERPs

ERP Operations ▶ 352

Plot ERP ▶ 701

Export & Import ERP ▶

Load existing ERPset 512
Clear ERPset(s)
Save current ERPset
Save current ERPset as
Duplicate or rename current ERPset -0.199

ERP Measurement Tool 0.998
ERP Viewer

Average across ERPsets (Grand Average) TP9 TP10

Datatype Transformations ▶
Data Quality options ▶ Yes
Utilities ▶
Settings ▶
Help ▶ Yes

#5: S16_reref_resampled_filter

Filename: none

Channels per frame

Frames per epoch

Epochs

Events

Sampling rate (Hz)

Epoch start (sec)

Epoch end (sec)

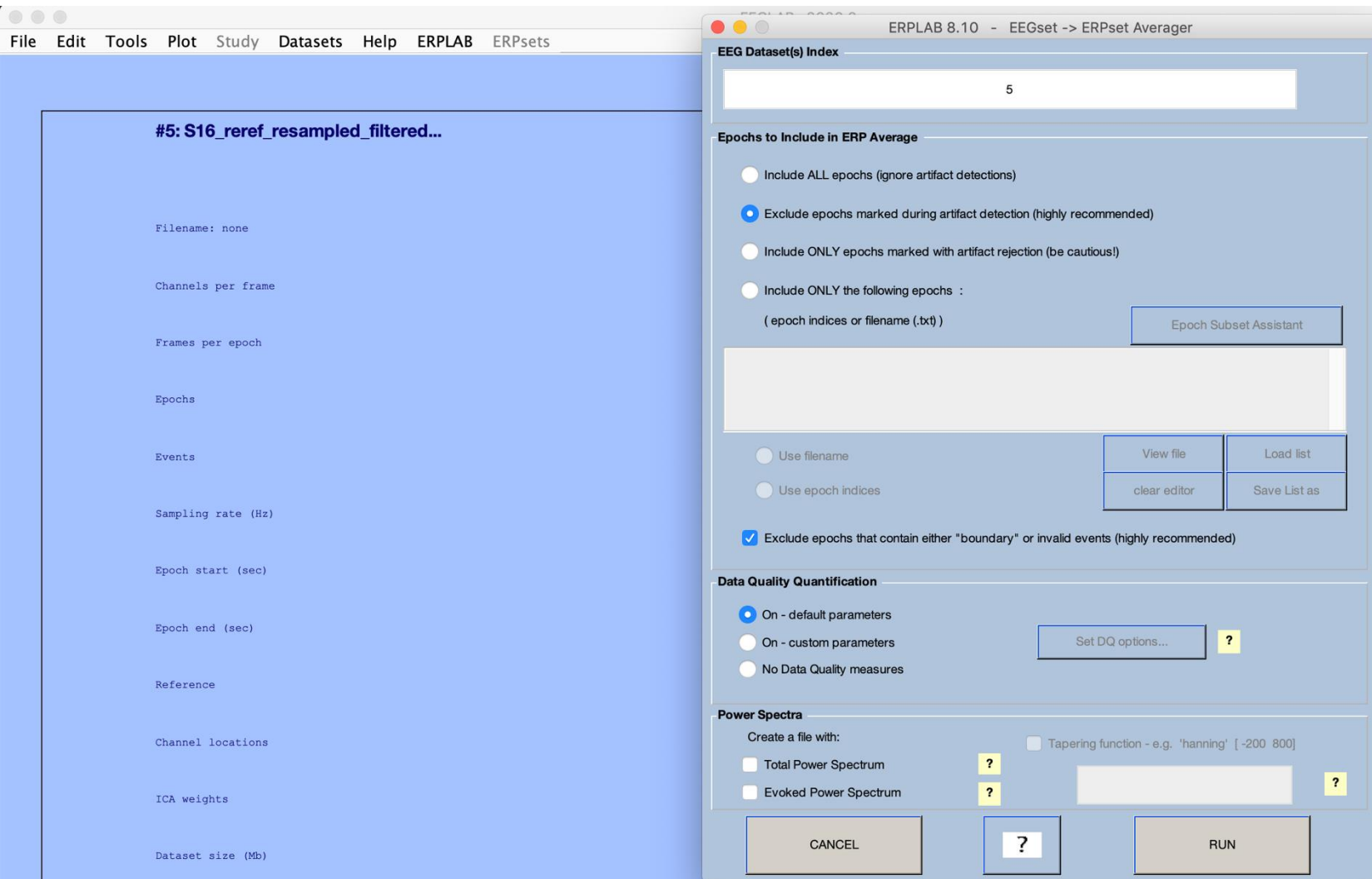
Reference

Channel locations

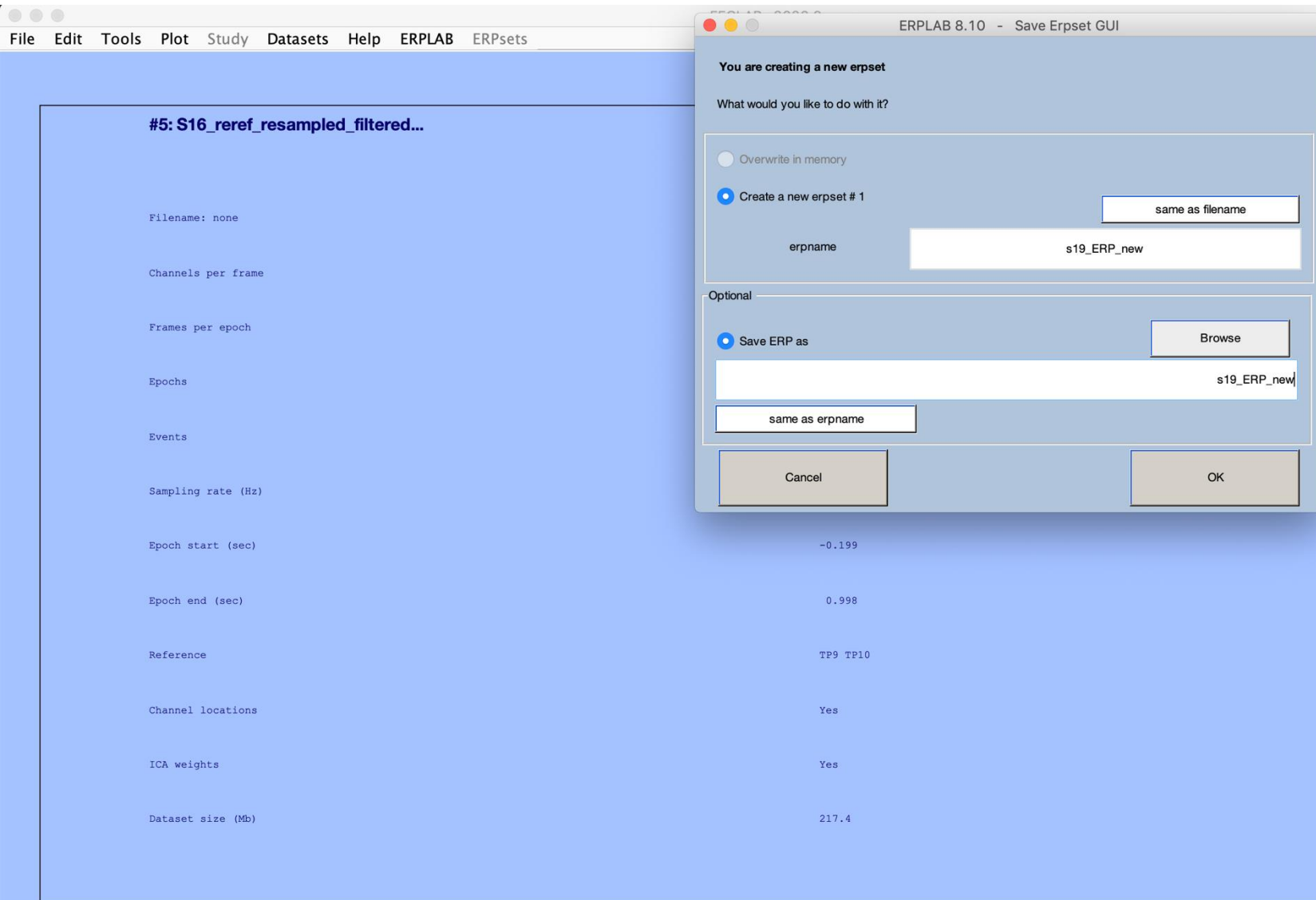
ICA weights

Dataset size (Mb) 217.4

Averaging



Averaging



Averaging



The screenshot shows the EEGLAB v2020.0 software interface. The top menu bar includes File, Edit, Tools, Plot, Study, Datasets, Help, ERPLAB, and ERPsets. The ERPsets menu is currently open, displaying a list of datasets. The first dataset, '#5: S16_reref_resampled_filtered...', is selected and highlighted in blue. Below the menu bar, a dropdown menu shows '✓ Erpset 1: s19_ERP_new'. The main window displays a list of datasets with their respective parameters.

Dataset Name	Parameters
#5: S16_reref_resampled_filtered...	Filename: none Channels per frame: 62 Frames per epoch: 614 Epochs: 352 Events: 701 Sampling rate (Hz): 512 Epoch start (sec): -0.199 Epoch end (sec): 0.998 Reference: TP9 TP10 Channel locations: Yes ICA weights: Yes Dataset size (Mb): 217.4

Overview

1. Averaging single trials into specific conditions
2. **Plotting ERP data**
3. Measuring ERP amplitudes
4. Measuring ERP latencies
5. Computing lateralized components
6. Statistical analysis (SPSS/R/Python)

Society for Psychophysiological Research guidelines

„The presentation of averaged ERP waveforms that illustrate the principal phenomena is mandatory“

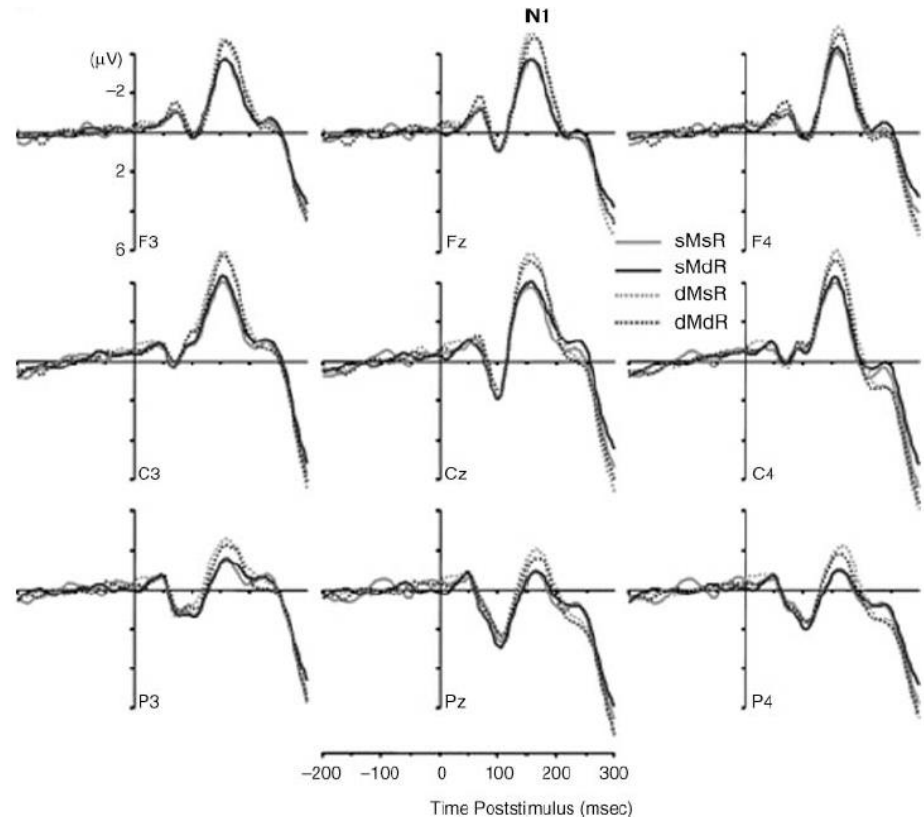
Picton et al., 2002, p. 139

You must show plots of the key ERP waveforms!

General Recommendations

1. show data from multiple electrode sites

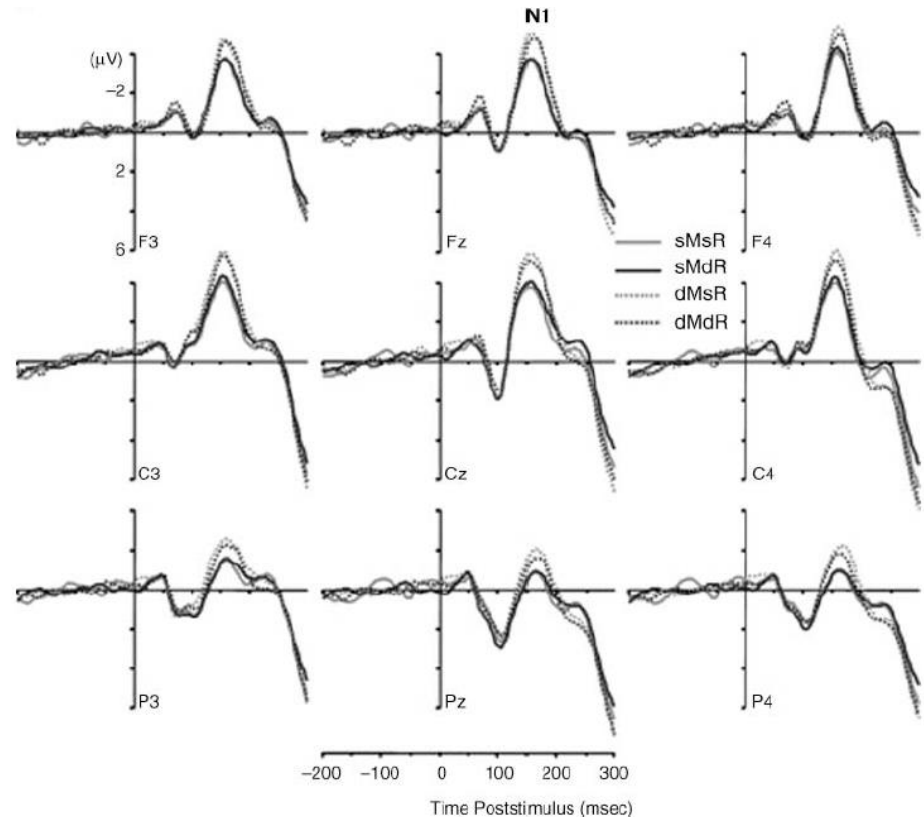
- spanning the region of the scalp (with equal distances) where the effects of interest are present
- helps to determine underlying component structure: lateralized?
- avoid showing more than 8-10 sites per figure



General Recommendations

1. show data from multiple electrode sites

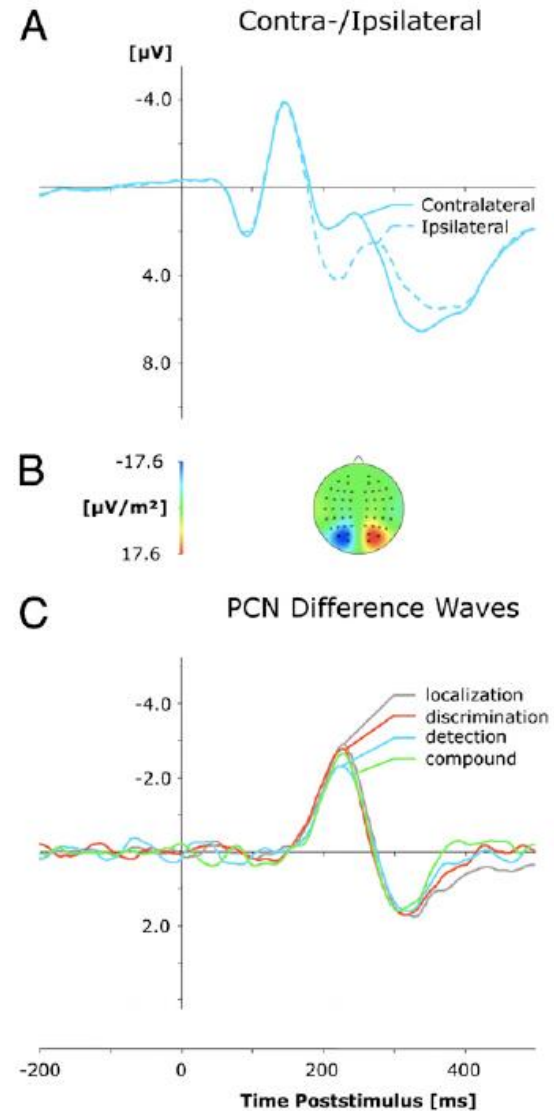
- however, exact number of electrode sites depends on expected audience:
- broad selection for ERP-oriented journals (e.g., Psychophysiology)
- only key sites for journals that are not specifically ERP-oriented



General Recommendations

1. show data from multiple electrode sites

- EXCEPTION: just one site for well-established event-related lateralizations (PCN, CDA, LRP)
- in this case, show both original and difference waves

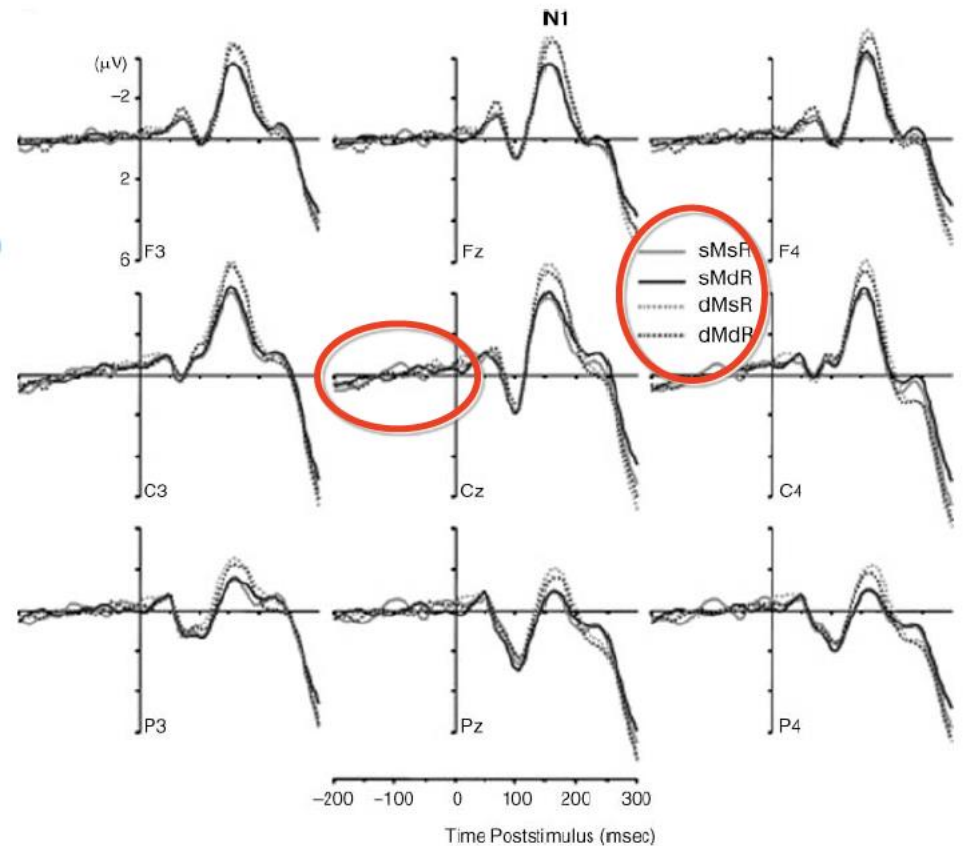


General Recommendations

3. A pre-stimulus baseline must be shown

- typically 200 ms (minimum: 100 ms)
- baseline needs to show 0 μV (in average)

4. Provide figure legend to indicate experimental conditions



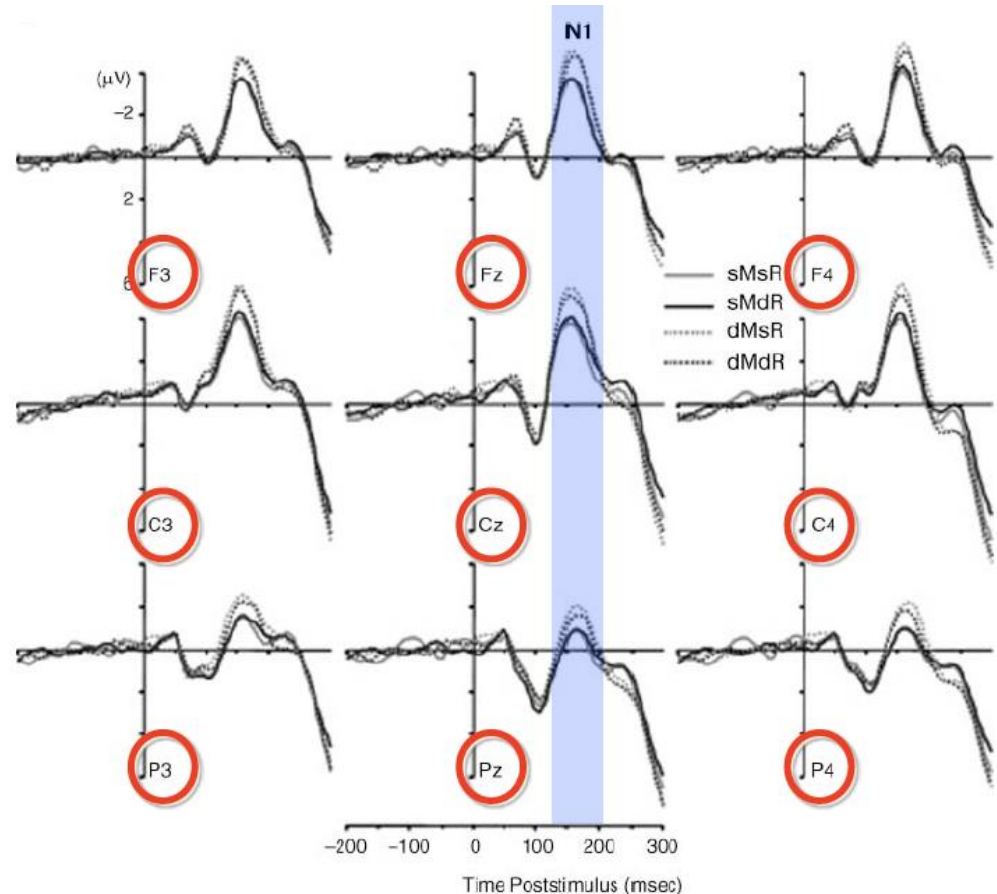
TÖLLNER ET AL., 2009, JOCN

General Recommendations

5. Label electrode sites

6. ERP waveforms should be overlapping (max. 4)

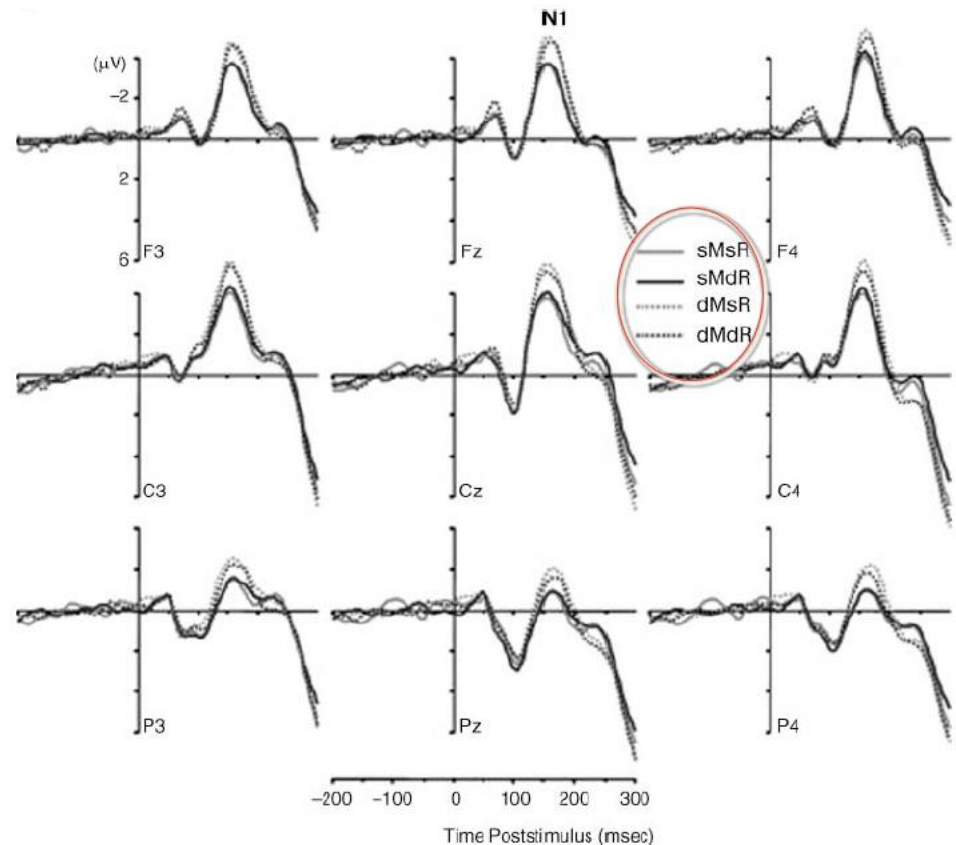
7. Eventually highlight time window (or component) of interest



TÖLLNER ET AL., 2009, JOCN

8. use easy-to-distinguish line types for conditions

- to differentiate: use solid, dashed, dotted (or differently colored) lines ...
- use reasonably thick lines (1-2 points width)
- but, avoid different line thicknesses



TÖLLNER ET AL., 2009, JOCN

Plotting ERP data

The screenshot displays the EEGLAB v2020.0 software interface. The main window is titled "EEGLAB v2020.0" and features a menu bar with "File", "Edit", "Tools", "Plot", "Study", "Datasets", "Help", "ERPLAB", and "ERPsets". The "ERPLAB" menu is open, showing a list of options. The "Plot ERP" option is highlighted, and its sub-menu is also open, showing options like "Plot ERP waveforms", "Plot ERP scalp maps", "Print plotted figure(s) to a file", "Edit ERP channel location table", "Load ERP channel location file", "Load ERP channel location info using EEGLAB", "Clear ERP channel location info", and "Close all ERPLAB figures".

The main window displays the following information:

- Filename:** none
- Channels per frame:** 62
- Frames per epoch:** 614
- Epochs:** 352
- Events:** (empty list)
- Sampling rate (Hz):** (empty field)
- Epoch start (sec):** (empty field)
- Epoch end (sec):** (empty field)
- Reference:** TP9 TP10
- Channel locations:** Yes
- ICA weights:** Yes
- Dataset size (Mb):** 217.4

Plotting ERP data

File Edit Tools Plot Study Datasets Help ERP

#5: S16_reref_resampled_filtered.

Filename: none

Channels per frame

Frames per epoch

Epochs

Events

Sampling rate (Hz)

Epoch start (sec)

Epoch end (sec)

Reference

Channel locations

ICA weights

Dataset size (Mb)

ERPLAB 8.10 - ERP Plotting GUI - s19_ERP_new

Bins to plot

☒ include number of bin in legends
☒ all bins

1:4

Browse

Scales

Time range (min max, in ms)

-199.0 998.0

time ticks

☒ auto time-ticks

Y range (min max, e.g. -10 20)

-15.7931 19.1796

Y ticks

☒ auto Y-ticks

☒ auto Y-scale

☐ show standard error x

0

transparency

0

positive is up

LINE SPEC

Channels to plot

☐ show number of channel instead of label
☒ all channels

1:62

Browse

☐ include MGFP from these channels:

same

Baseline Correction (only for plotting purpose)

☐ None
☐ Post
☐ Custom (min max, in ms)

-199.0 0

☒ Pre
☐ Whole

Style

Classic ERP

w

0.05

h

0.08

☒ maximize figure

Legend pos

bottom

Background

White

Set Font Size

Channel(s)

10

Legend(s)

12

Axis tick labels

10

Set frame(s)

Row(s)

8

Column(s)

8

CANCEL

Close Figures

RESET

?

Scalp map

PLOT

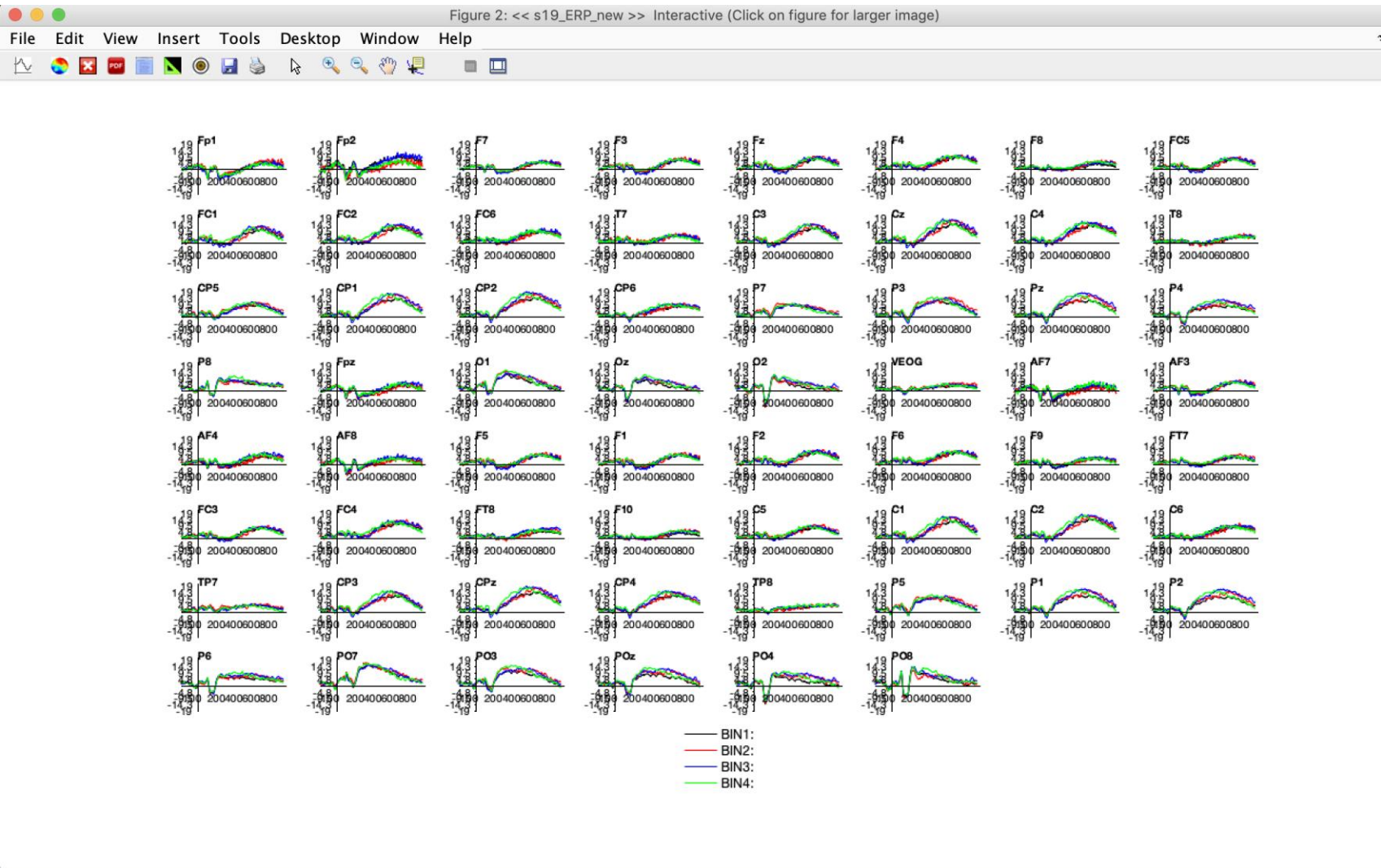
TP9 TP10

Yes

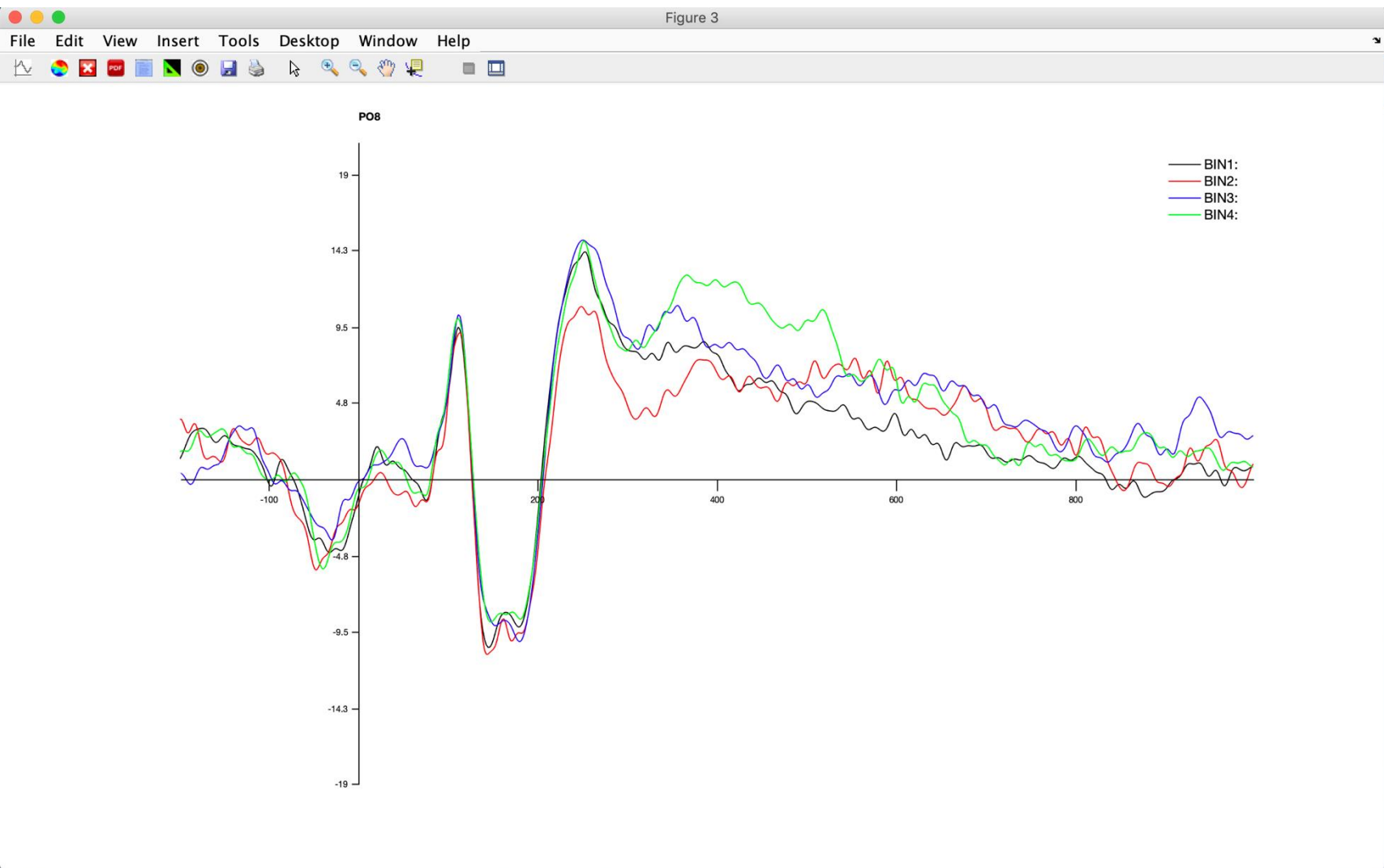
Yes

217.4

Plotting ERP data



Plotting ERP data



Overview

1. Averaging single trials into specific conditions
2. Plotting ERP data
- 3. Measuring ERP amplitudes**
4. Measuring ERP latencies
5. Computing lateralized components
6. Statistical analysis (SPSS/R/Python)

Main Goal (challenge) is ...

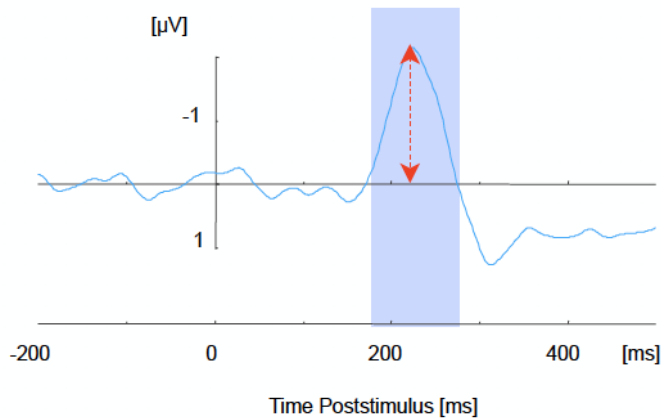


„ ... to provide an accurate measurement of the size of the underlying ERP component“ - Luck, 2005

2 common ways:

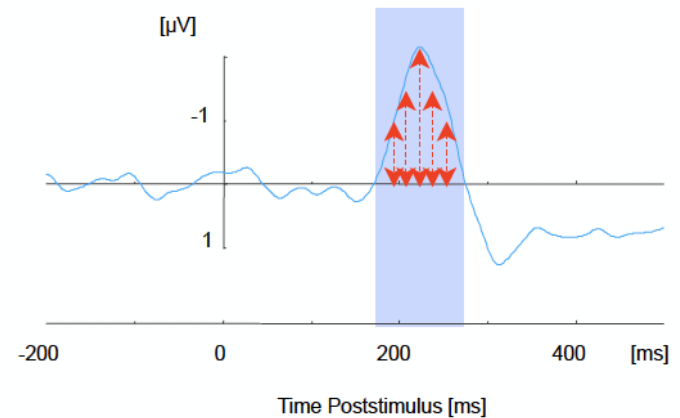
#1 - peak amplitude

- ▶ ... find the maximum amplitude in pre-defined time window

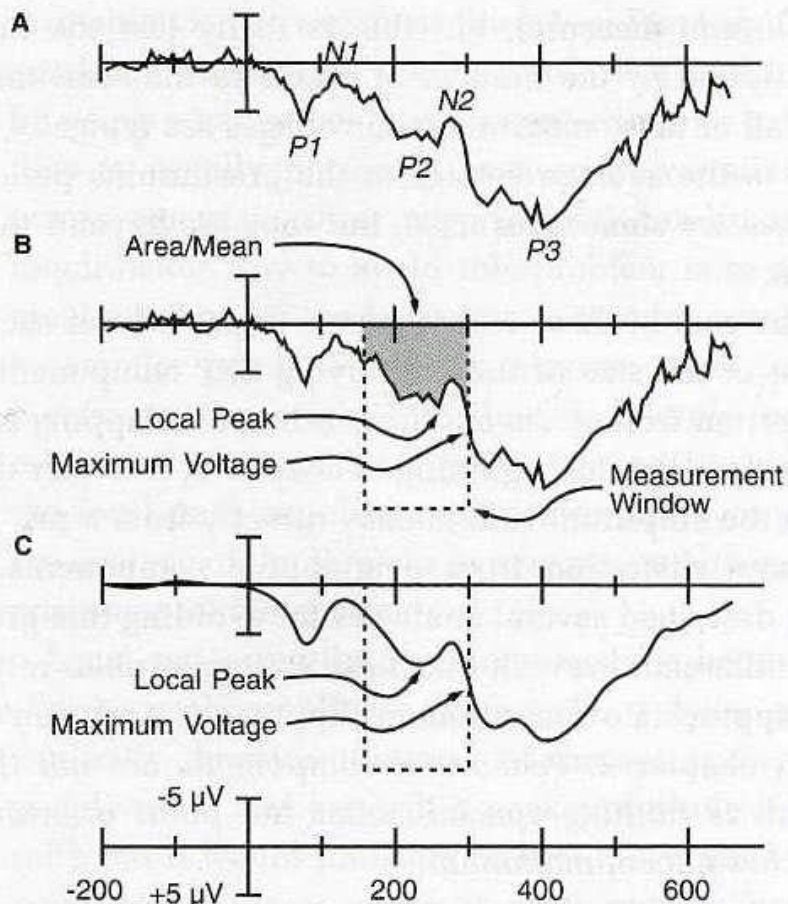


#2 - mean/area amplitude

- ▶ calculate the mean voltage in pre-defined time window



Peak Amplitude: Shortcomings



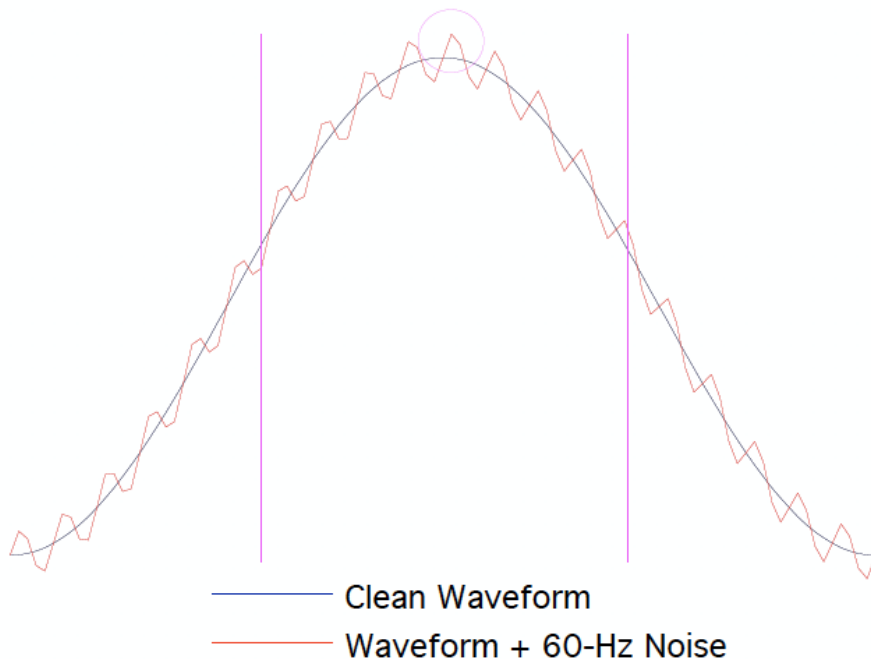
(1) can be affected by overlapping components!!!

- use narrower measurement Window

- but, needs to cover latency variations across electrode sites, conditions, and subjects!

- use local (instead of ,global') peak amplitude detection mode

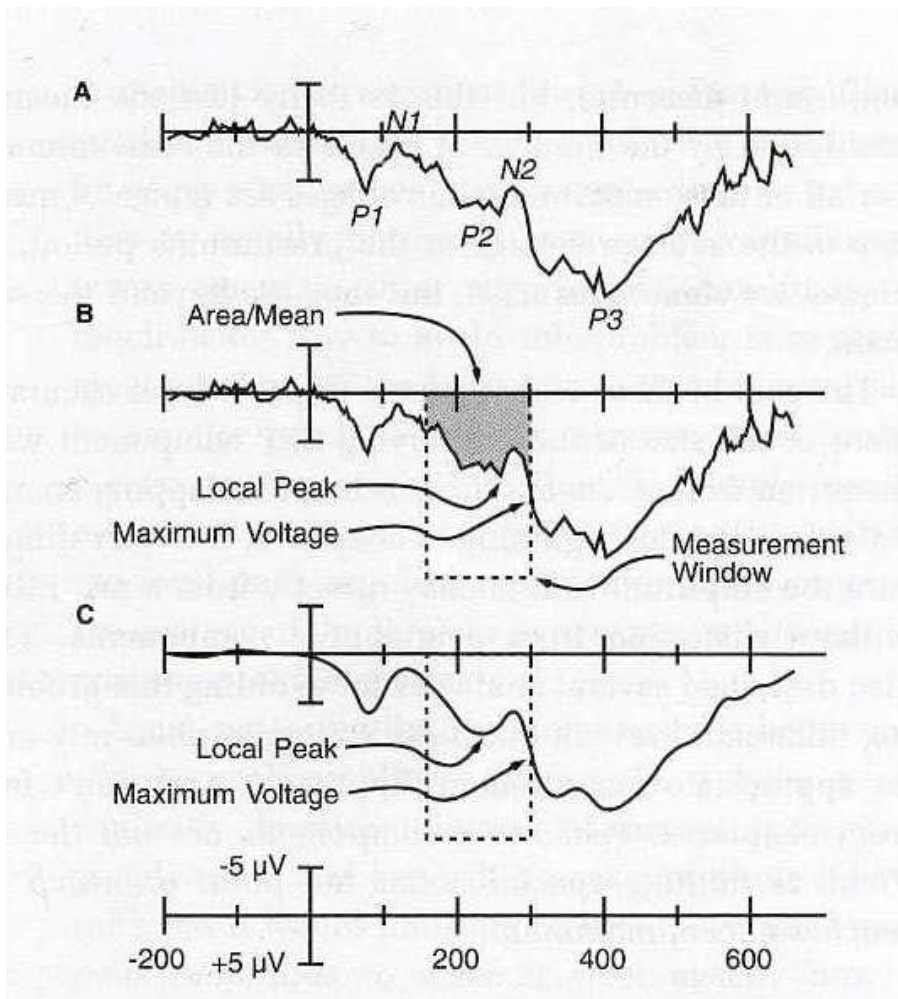
Peak Amplitude: Shortcomings



(2) can be significantly distorted by high-frequency noise!!!

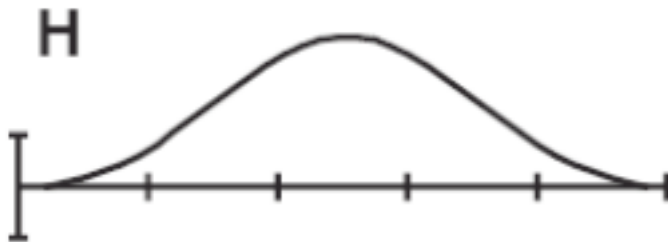
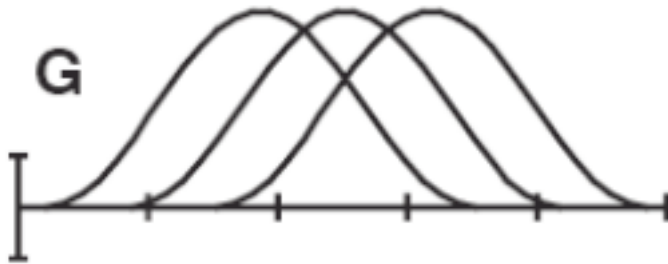
- ... peak amplitudes measures are artificially increased for noisy data ...
- never valid to compare peak amplitudes from averages of different number of trials!
- eventually low pass filter waveforms, if ERPs are too noisy

Peak Amplitude: Shortcomings



(3) uses a single point to re-present a component that may last several hundred milliseconds

Peak Amplitude: Shortcomings



(4) is a non-linear measure that may NOT correspond well with grand-average Waveforms

▸ e.g., latency differences across electrode sites due to the relative amplitudes of the overlapping components

Mean Amplitude: Advantages

(1) allows use of narrower time windows to reduce influence of overlapping components

(2) less sensitive to high frequency
Noise

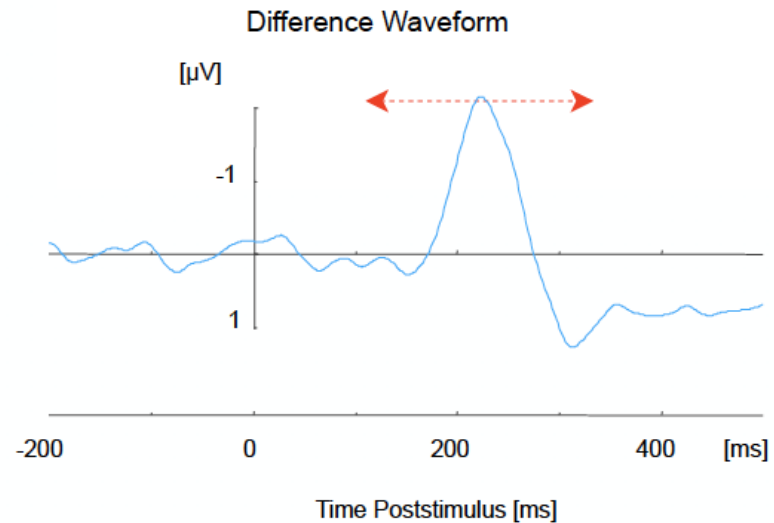
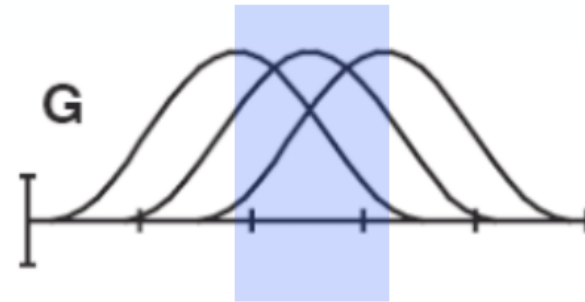
(3) ... is a linear measure >> corresponds well with grand-average waveforms

Mean Amplitude: Disadvantages

(1) fixed windows useless if under-lying process does indeed differ in timing!

(2) Can encourage fishing for significant results by trying different windows

► use symmetric time windows based on grand-averages!



So ... what to choose then?

#1 - peak amplitude

- ... find the maximum amplitude in pre-defined time window



#2 - mean amplitude

- calculate the mean voltage in pre-defined time window

First, find the maximum amplitude in predefined time window based on visual inspection

Second, average plus/minus xxx sample points before and after the maximum deflection

How to find the right measurement window?

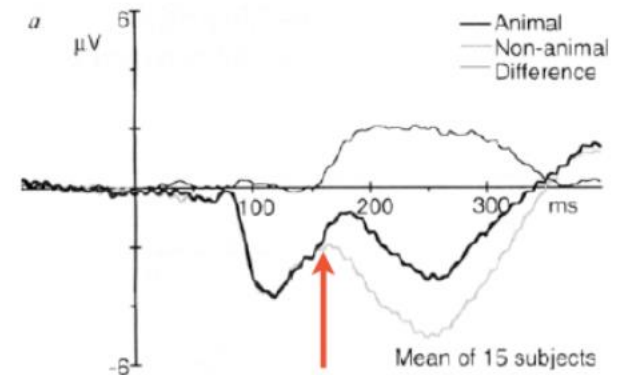
First, make sure whether you want to analyze your data in a component-dependent or component-independent manner (crucial for interpretation)!

For component analysis: use time window - as symmetrical as possible - around the peak of grand-averaged ERPs!

Consider different measurement windows for different subjects (e.g., CDA triggered by young versus old participants ...)



THORPE ET AL., 1996, NATURE



Overview

1. Averaging single trials into specific conditions
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3. Measuring ERP amplitudes
- 4. Measuring ERP latencies**
5. Computing lateralized components
6. Statistical analysis (SPSS/R/Python)

3 ways to reveal the component's timing:

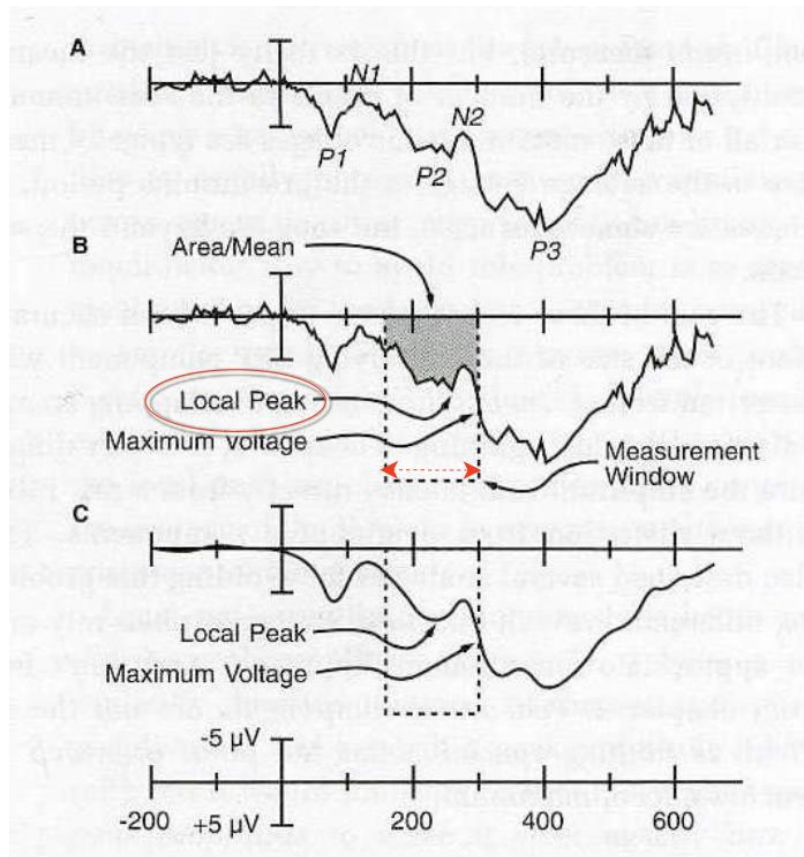
#1 - peak latency

#2 - fractional area latency

#3 - onset latency

Peak Latency: Shortcomings

same shortcomings as for peak amplitude measure:

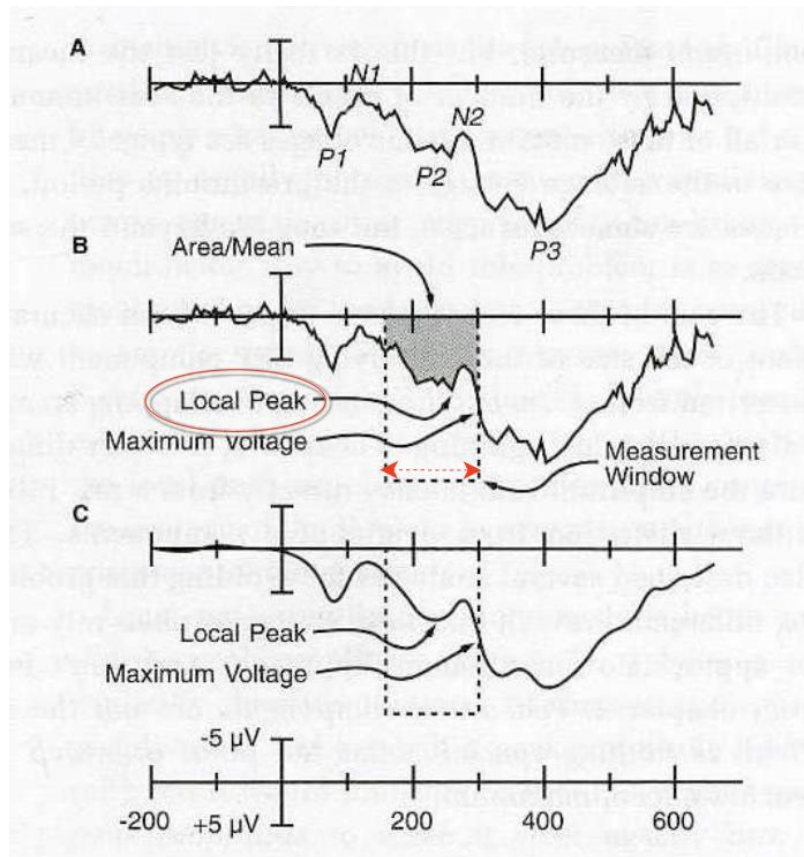


- (1) affected by overlapping Components
- (2) highly sensitive to high frequency Noise
- (3) encourages the mistaken view that peaks and components are the same thing ...

Peak Latency: Precautions

there just aren't many good alternatives ...

Thus:



(1) filter out high-frequency Noise

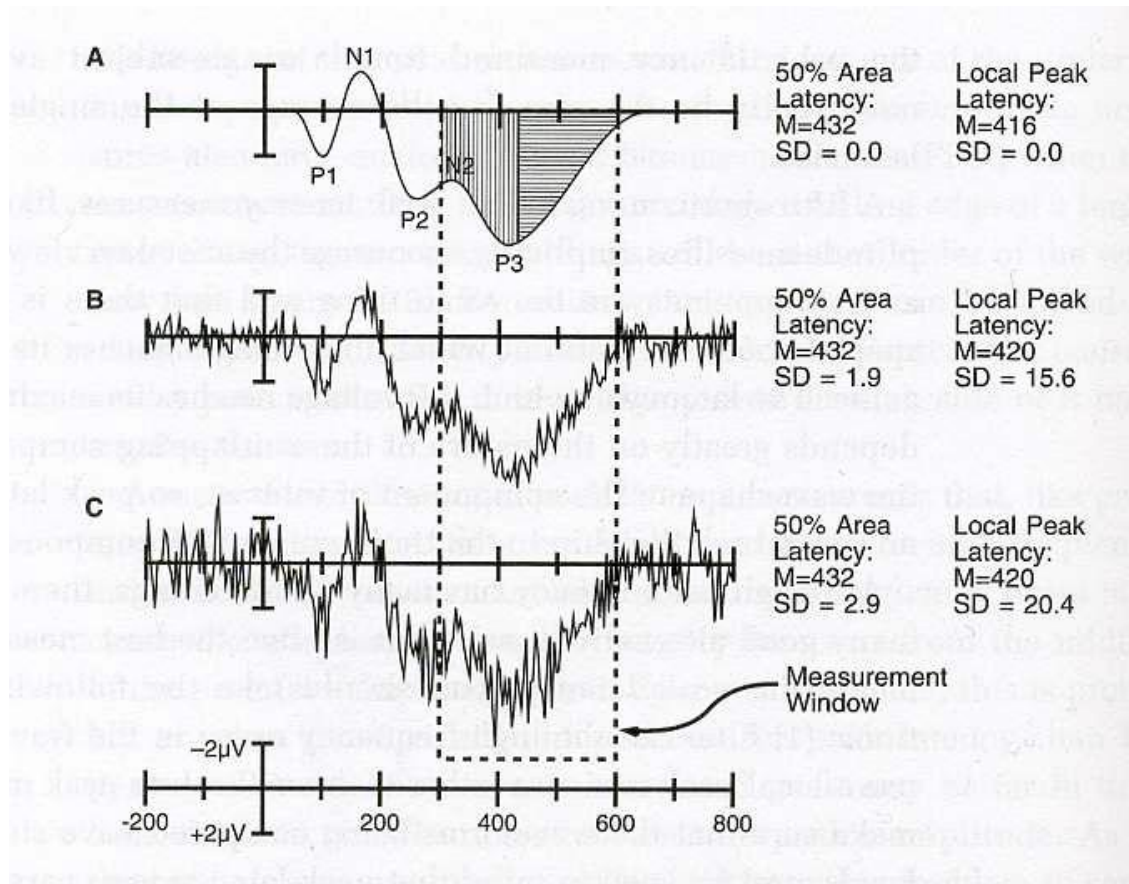
(2) use local rather than absolute peak measure

(3) waveforms being compared should have similar noise levels

(4) Always visually inspect your peak detections!

Fractional area Latency

analogous to mean amplitude measures



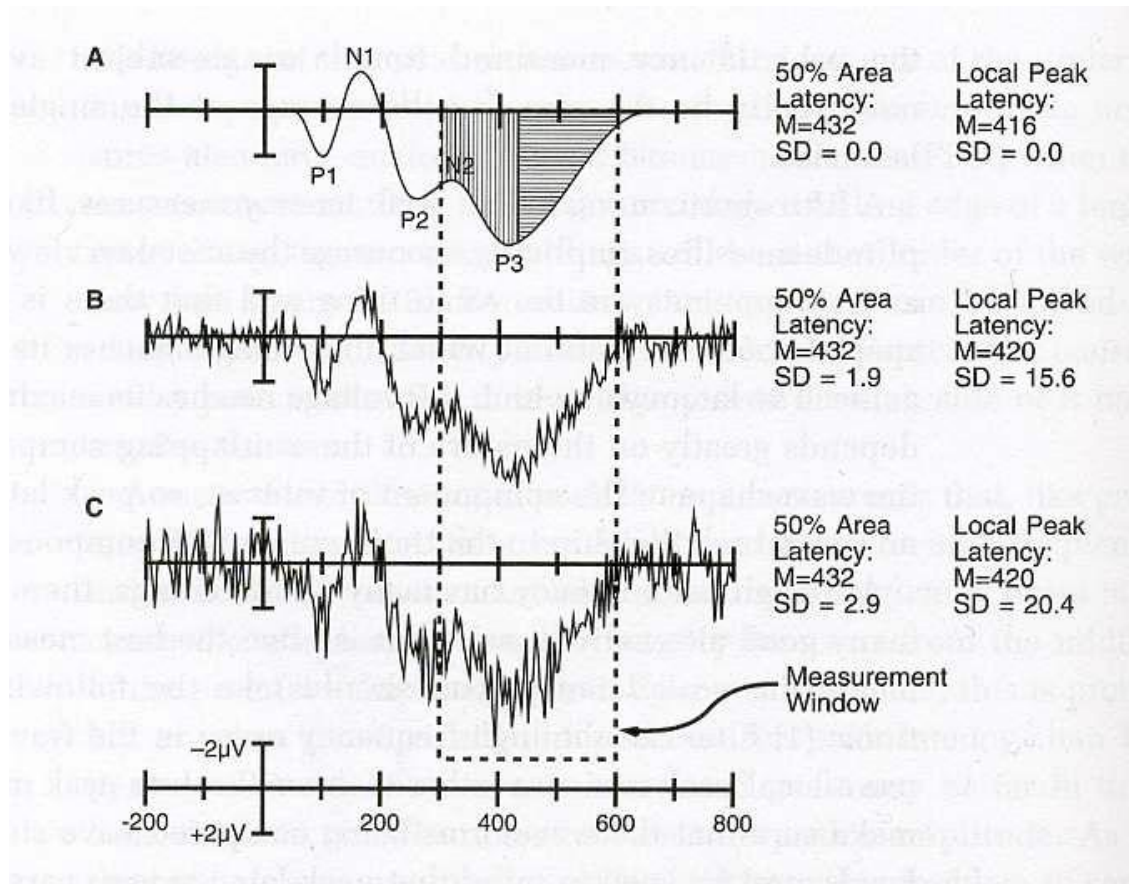
► first used by Hanson & Hillyard, 1980:

► computes the area under the ERP wave over a given time Window

► then, find the time point which divides area into a pre-specified fraction

Fractional area Latency

analogous to mean amplitude measures



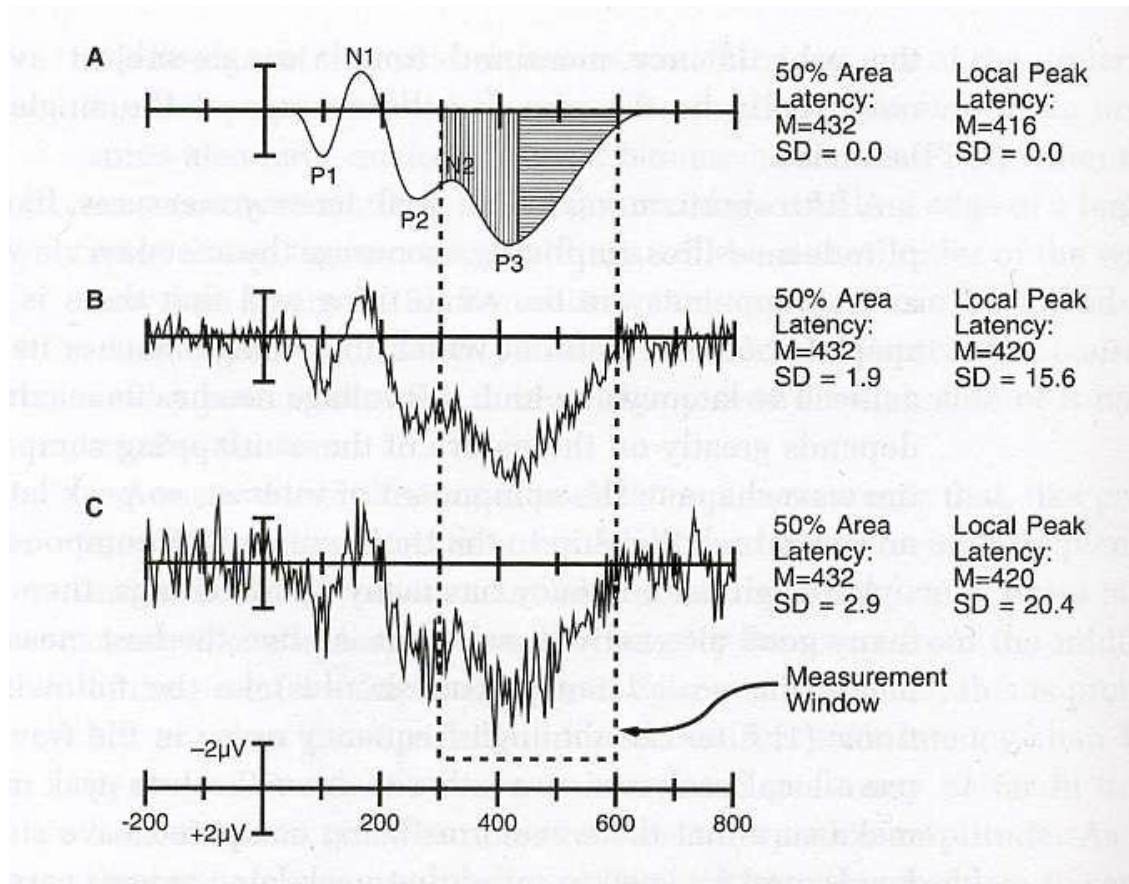
Limitations

rather time-consuming, needs recalculation for each individual Subject

(in BVA) manually, depending on visual inspection

Fractional area Latency

analogous to mean amplitude measures



Disadvantages

distorted when the latency range does not contain most of the ERP component, or ...

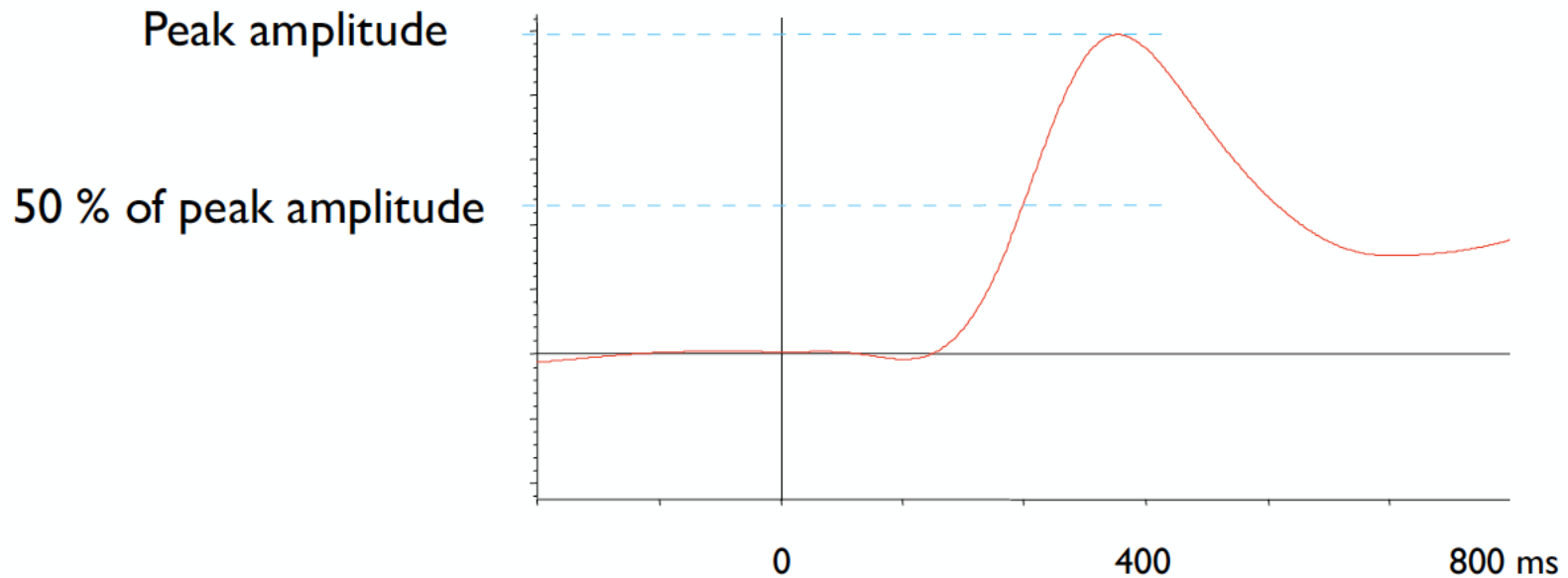
- ... includes large contributions of overlapping components
- more useful for late ERPs (P3, N400) or difference waves than for early ERPs (P1, N1, P2)

Onset Latency

determines onset as point in time when ERP wave reaches a specific criterion:

50% of maximum amplitude for stimulus-locked ERPs

90% of maximum amplitude for response-locked LRP



ERP measurement tool

EEGLAB v2020.0

File Edit Tools Plot Study Datasets Help

ERPLAB ERPsets

#5: S16_reref_resampled_filter

Filename: none

Channels per frame

Frames per epoch

Epochs

Events

Sampling rate (Hz)

Epoch start (sec)

Epoch end (sec)

Reference

Channel locations

ICA weights

Dataset size (Mb)

*** ERPLAB v8.10 ***

Preprocess EEG ▶

EventList ▶

Assign bins (BINLISTER)

BDF Visualizer

Extract bin-based epochs

EEG Channel operations

Filter & Frequency Tools ▶

Artifact detection in epoched data ▶

Summarize artifact detection ▶

Compute averaged ERPs

ERP Operations ▶

Plot ERP ▶

Export & Import ERP ▶

Load existing ERPset

Clear ERPset(s)

Save current ERPset

Save current ERPset as

Duplicate or rename current ERPset

ERP Measurement Tool

ERP Viewer

Average across ERPsets (Grand Average)

Datatype Transformations ▶

Data Quality options ▶

Utilities ▶

Settings ▶

Help ▶

62

614

352

701

512

-0.199

0.998

TP9 TP10

Yes

Yes

217.4

ERP measurement tool

EEGLAB v2020.0

ERPLAB 8.10 - ERP Measurements GUI - Mean amplitude between two fixed latencies

ERPsets must have the same amount of bins and channels.

☐ Current ERPset

☒ From ERPset Menu

☐ From ERPset files

new.erpset

Measurement

Type

Find a local peak that is over points (5.9 ms)

(pre-peak) onset at % of peak

If the requested fraction is not found, use

If no local peak is found, use

Rectified area (negative values become posi...

Interpolation Factor

Measure's label (optional)

Bin(s) & Channel(s)

Bin

Channel

Measurement window ms

(use two latencies)

Baseline period

Precision # decimals

Save output file as

☐ Include actual measurement window ☐ Send values to Workspace

☒ Include bin label as well as bin index



Dataset size (Mb) 217.4

ERP measurement tool

FileEditTools

ERPsets must have the same amount of bins and channels.

Current ERPset

From ERPset Menu

1

From ERPset files

Clear All ERPsets

new ERPset

Edit List

Load List

Save List

Add ERPset

Clear File

Save List as

Remove ERPset

Measurement Type

Find all

Instantaneous amplitude

Mean amplitude between two fixed latencies

Peak amplitude

Peak latency

Fractional Peak latency

Numerical integration/Area between two fixed latencies

Numerical integration/Area between two (automatically detected) zero-crossing latencies

Fractional Area latency

If no local peak is found, use

absolute peak

Rectified area (negative values become posi...

Interpolation Factor

1

Measure's label (optional)

Bin(s) & Channel(s)

Bin

1 2

Browse

Channel

11:13

Browse

Measurement window

80.00 120.00

ms

(use two latencies)

Baseline period

Pre

Precision

2

decimals

Save output file as

measures.txt

One ERPset per line (wide format)

Browse

☐ Include actual measurement window

☐ Send values to Workspace

☒ Include bin label as well as bin index

CANCEL



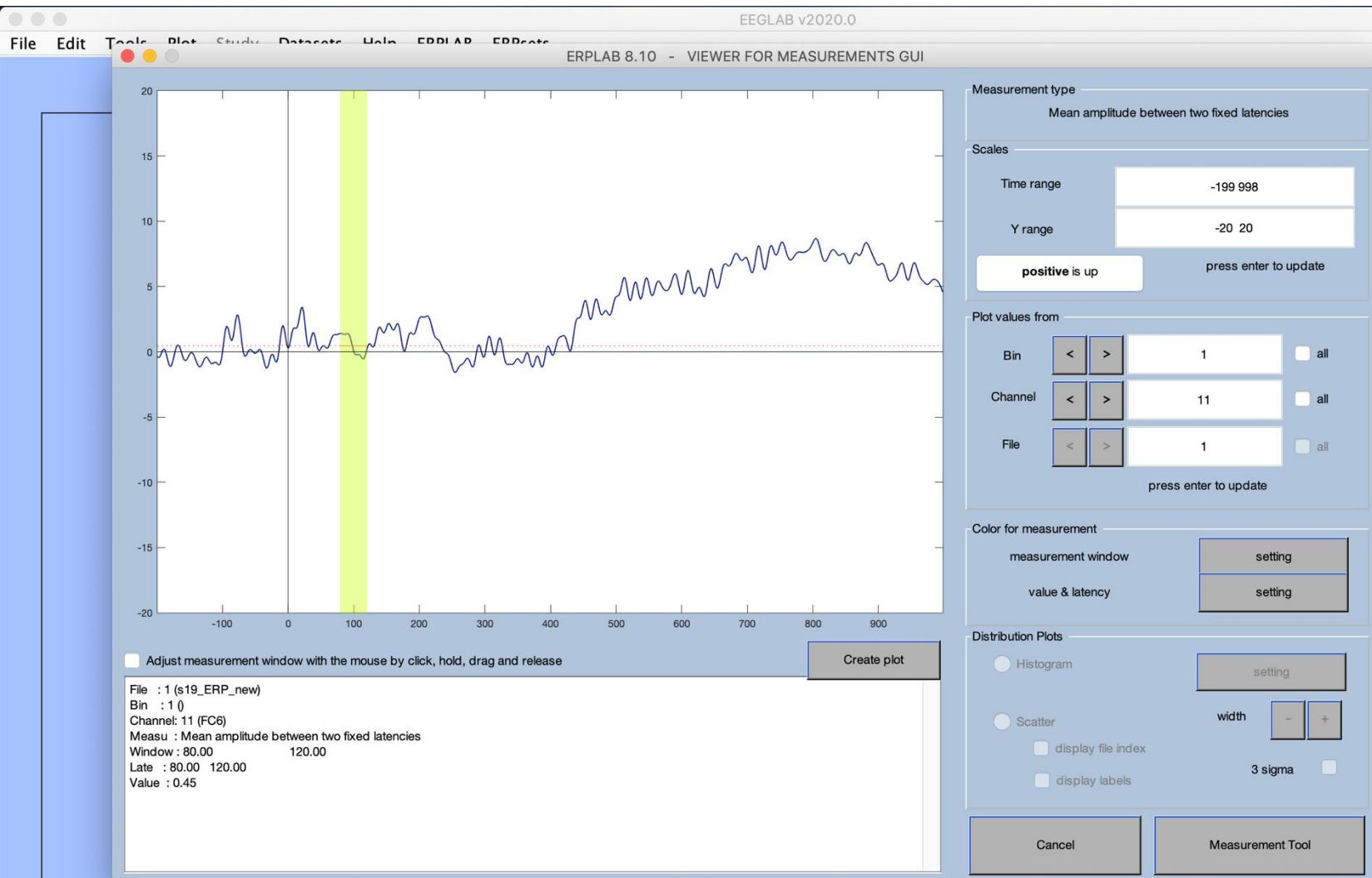
?

RUN

Dataset size (Mb)

217.4

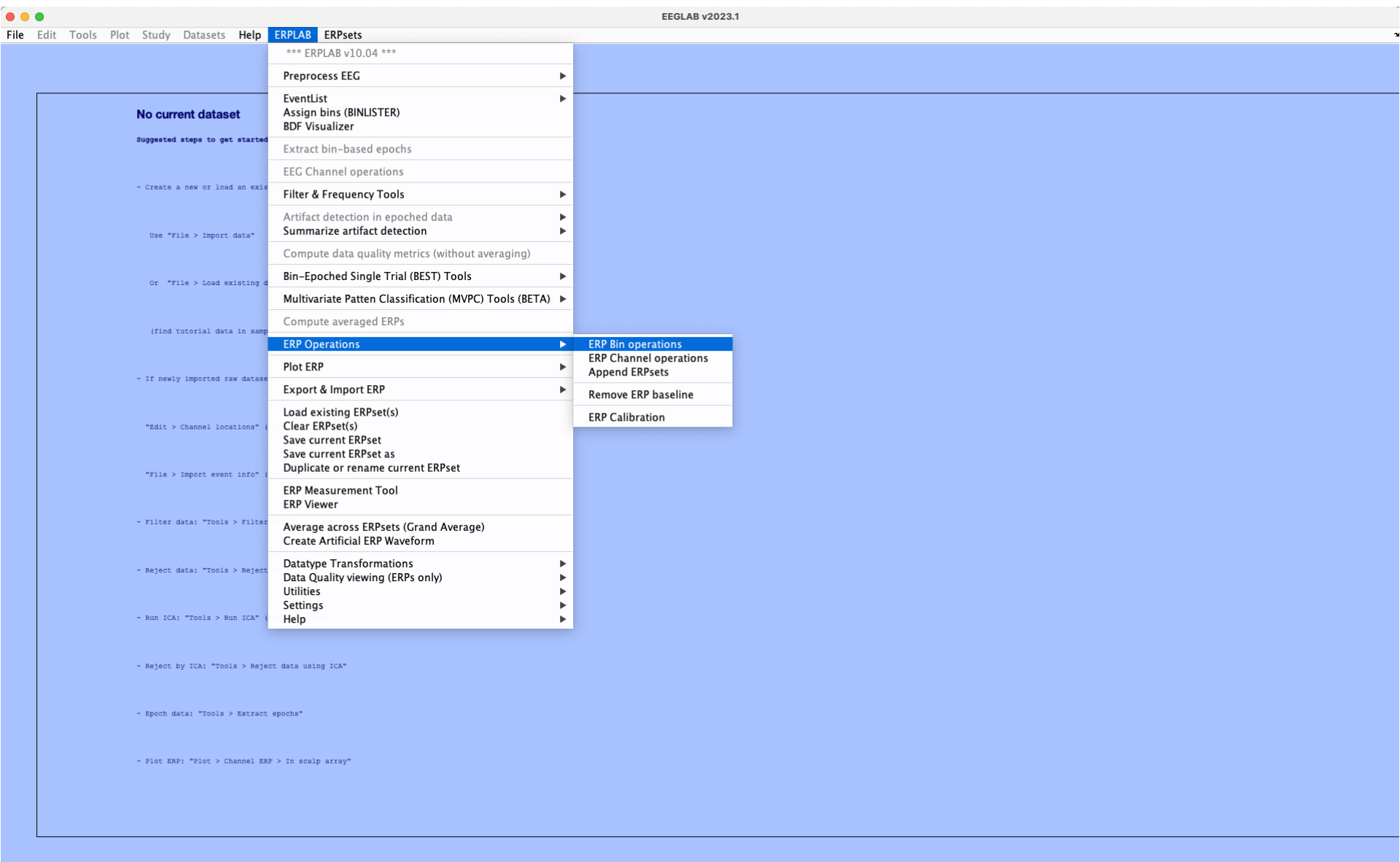
ERP measurement tool



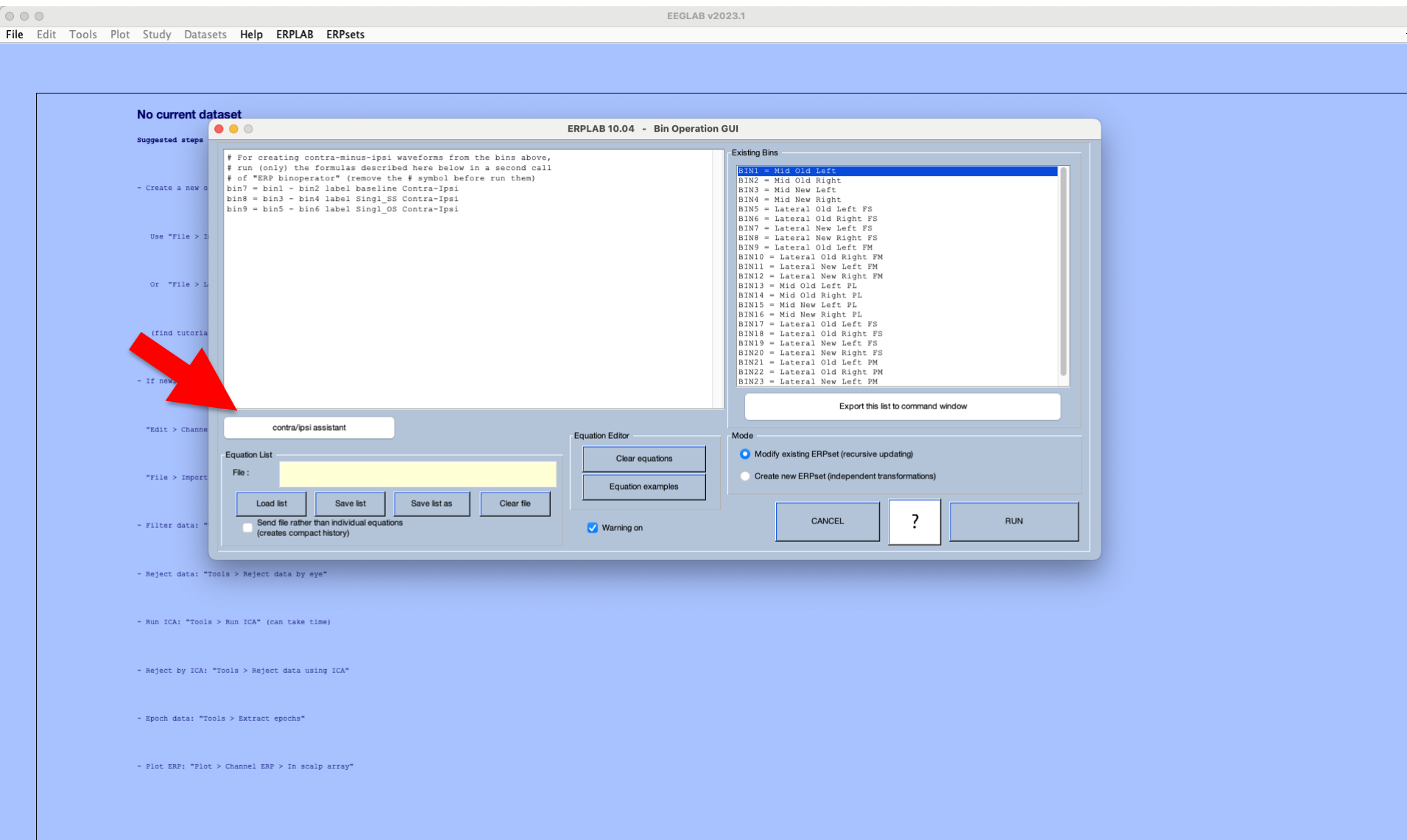
Overview

1. Averaging single trials into specific conditions
2. Plotting ERP data
3. Measuring ERP amplitudes
4. Measuring ERP latencies
5. **Computing lateralized components**
6. Statistical analysis (SPSS/R/Python)

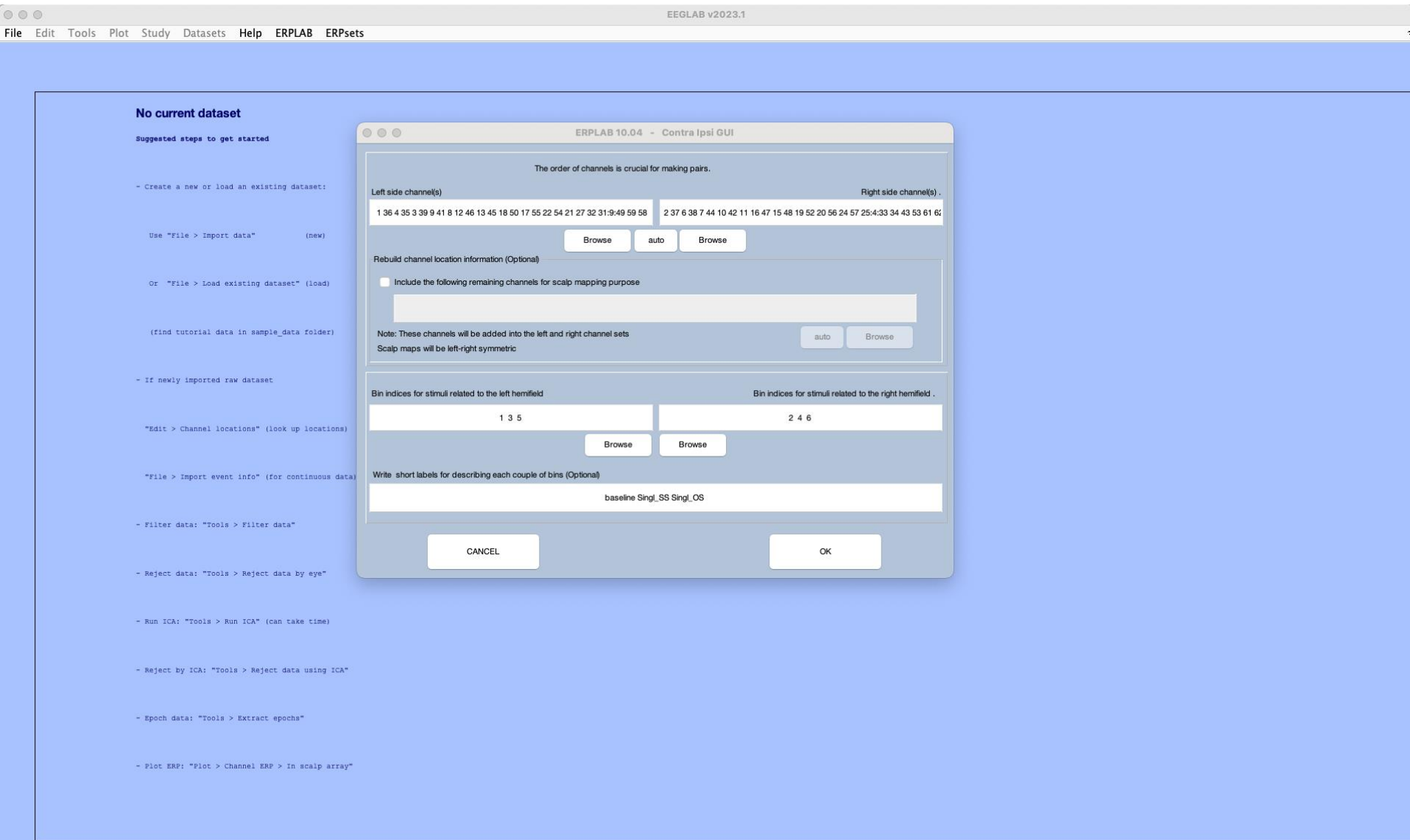
ERP Bin operations



ERP Bin operations



ERP Bin operations



ERP Bin operations

EEGLAB v2023.1

File Edit Tools Plot Study Datasets Help ERPLAB ERPsets

No current dataset

Suggested steps to get started

prepareContraIpsi

Lch = [1 36 4 35 3 39 9 41 8 12 46 13 45 18 50 17 55 22 54 21 27 32 31;9:49 59 58]

Rch = [2 37 6 38 7 44 10 42 11 16 47 15 48 19 52 20 56 24 57 25;4:33 34 43 53 61 62]

nbin1 = 0.5*bin1@Rch + 0.5*bin2@Lch label baseline Contra

nbin2 = 0.5*bin1@Lch + 0.5*bin2@Rch label baseline Ipsi

nbin3 = 0.5*bin3@Rch + 0.5*bin4@Lch label Singl_SS Contra

nbin4 = 0.5*bin3@Lch + 0.5*bin4@Rch label Singl_SS Ipsi

nbin5 = 0.5*bin5@Rch + 0.5*bin6@Lch label Singl_OS Contra

nbin6 = 0.5*bin5@Lch + 0.5*bin6@Rch label Singl_OS Ipsi

For creating contra-minus-ipsi waveforms from the bins above,

run (only) the formulas described here below in a second call

of "ERP binoperator" (remove the # symbol before run them)

#bin7 = bin1 - bin2 label baseline Contra-Ipsi

#bin8 = bin3 - bin4 label Singl_SS Contra-Ipsi

#bin9 = bin5 - bin6 label Singl_OS Contra-Ipsi

contra/ipsi assistant

Equation Editor

Equation List

File:

Load list Save list Save list as Clear file

☐ Send file rather than individual equations (creates compact history)

☒ Warning on

Existing Bins

BIN1 = Mid Old Left

BIN2 = Mid Old Right

BIN3 = Mid New Left

BIN4 = Mid New Right

BIN5 = Lateral Old Left FS

BIN6 = Lateral Old Right FS

BIN7 = Lateral New Left FS

BIN8 = Lateral New Right FS

BIN9 = Lateral Old Left FM

BIN10 = Lateral Old Right FM

BIN11 = Lateral New Left FM

BIN12 = Lateral New Right FM

BIN13 = Mid Old Left PL

BIN14 = Mid Old Right PL

BIN15 = Mid New Left PL

BIN16 = Mid New Right PL

BIN17 = Lateral Old Left FS

BIN18 = Lateral Old Right FS

BIN19 = Lateral New Left FS

BIN20 = Lateral New Right FS

BIN21 = Lateral Old Left PM

BIN22 = Lateral Old Right PM

BIN23 = Lateral New Left PM

Export this list to command window

Mode

☐ Modify existing ERPset (recursive updating)

☒ Create new ERPset (independent transformations)

CANCEL ? RUN

- Create a new or load existing dataset

Use "File > Import > Load dataset" to load an existing dataset

Or "File > Load" to load a dataset from a file

(find tutorial data in the "Tutorial" folder)

- If newly imported

"Edit > Channel locations" to edit the channel locations

"File > Import > Import channels" to import channels from a file

- Filter data: "Tools > Filter data"

- Reject data: "Tools > Reject data by eye"

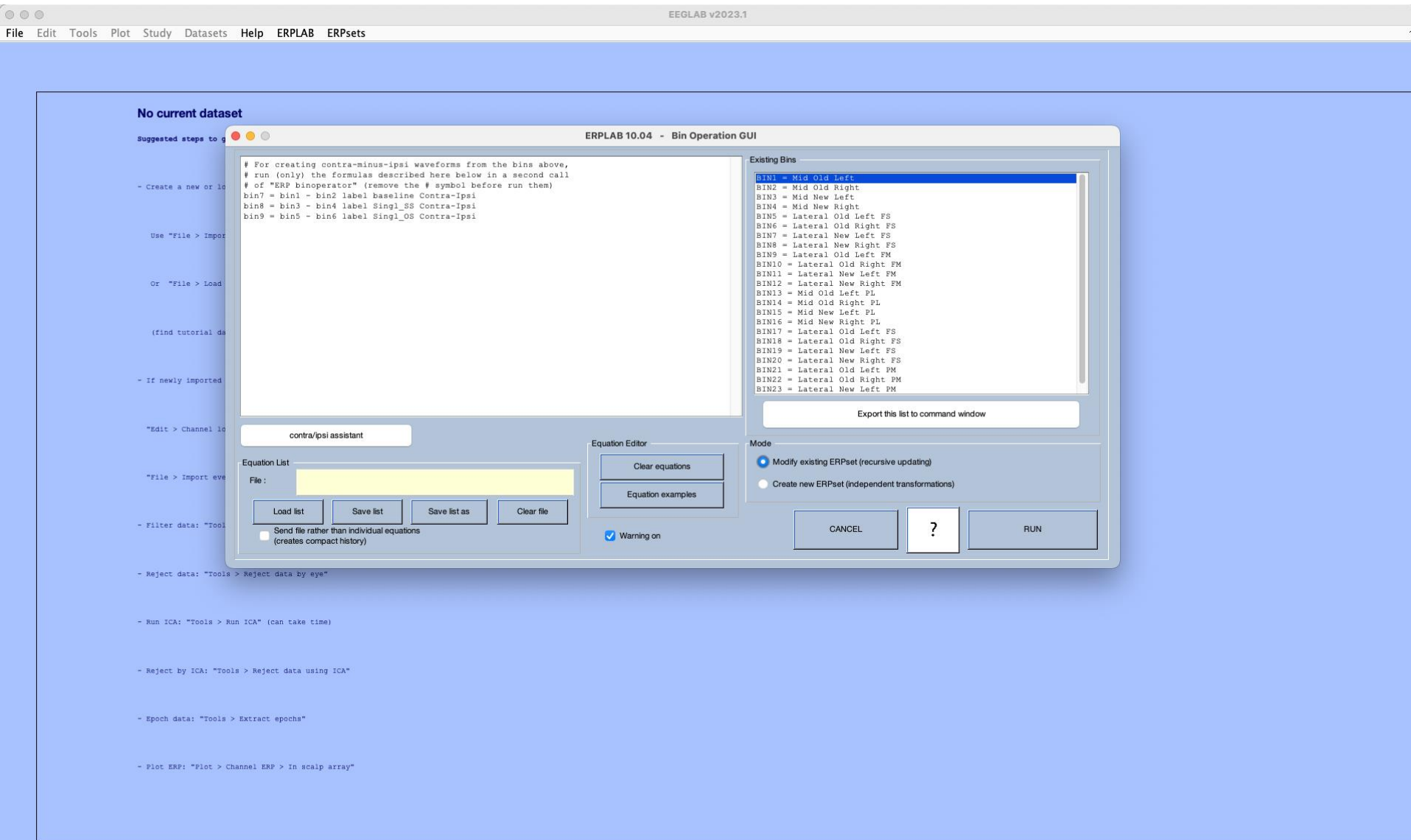
- Run ICA: "Tools > Run ICA" (can take time)

- Reject by ICA: "Tools > Reject data using ICA"

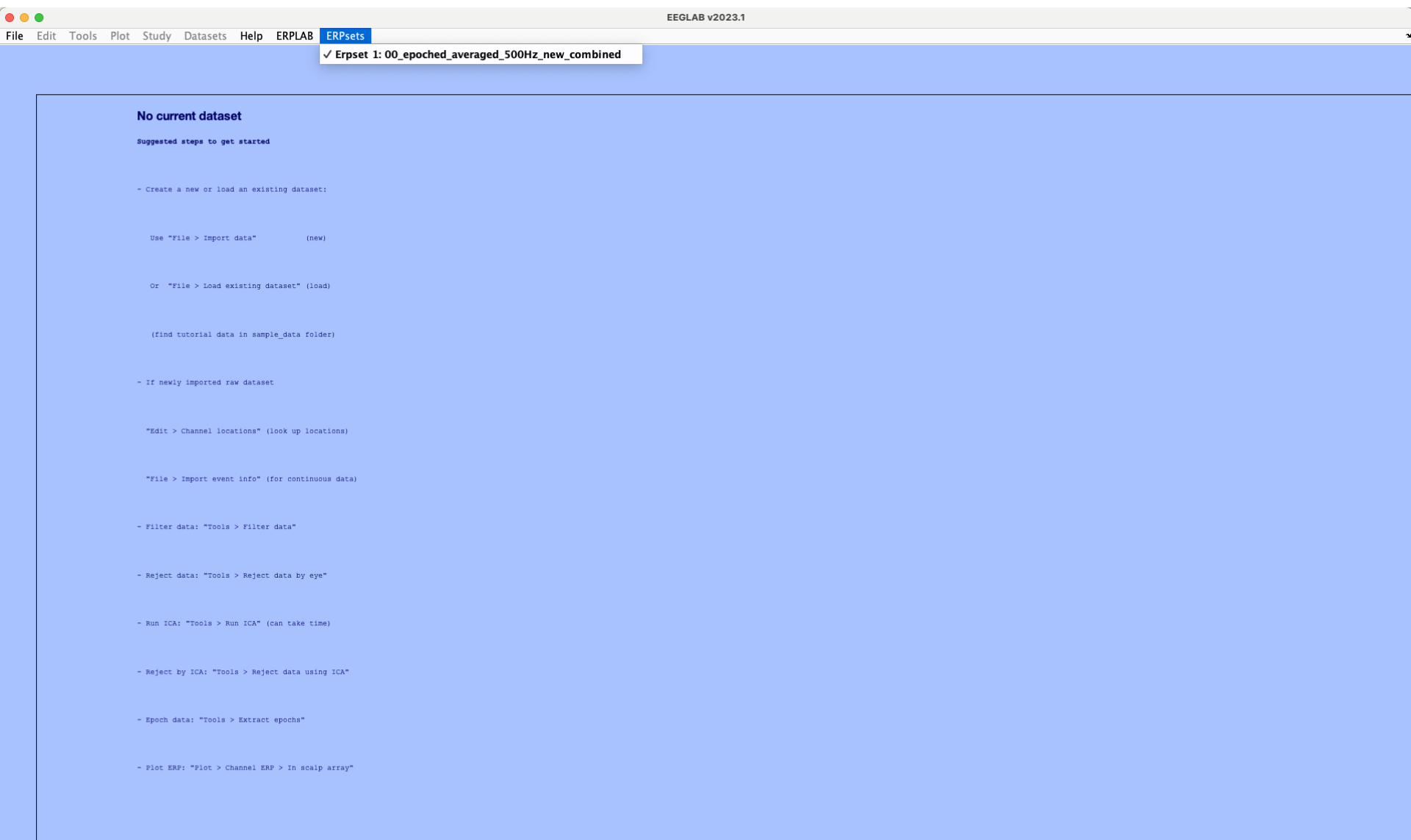
- Epoch data: "Tools > Extract epochs"

- Plot ERP: "Plot > Channel ERP > In scalp array"

ERP Bin operations



ERP Bin operations



Overview

1. Averaging single trials into specific conditions
2. Plotting ERP data
3. Measuring ERP amplitudes
4. Measuring ERP latencies
5. Computing lateralized components
6. Statistical analysis (SPSS/R/Python)

Why do we need statistics?

... to see whether a particular experimental manipulation has a significant effect on a dependent measure (e.g., peak amplitude).

if yes ... then effect might be generalized from the sample to an entire population

typical „magical border“: $p < .05$ (alpha level)

▸ Note, however, that .06 just means there is a 6% probability that the observed effect was due to chance!

Luck's (2005) Recommendations:



1. Design your experiments so that the exp. effects are ‚large‘ relative to the noise level
2. Use the best statistic: replication!
 - effects relatively immune to „bad subjects“
 - run follow-up experiments that replicate the results and also extend it

The Standard Approach

ANOVA

= analysis of variance (ANOVA)

allows to analyze main effects and/or interactions in a completely crossed factorial design

The main idea is to test whether variance between exp. conditions (or groups) is larger than variance within exp. conditions or (groups)

Thus, one can conclude whether partitioning of groups makes sense or, respectively, whether groups differ significantly?

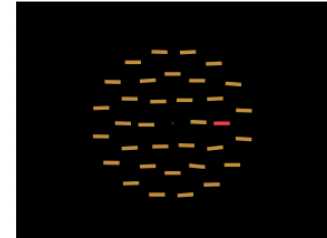
The Standard Approach

ANOVA



First step: collapse across irrelevant factors

- ▶ if conditions are counterbalanced, collapse to avoid physical stimulus differences
- ▶ fewer p-values, spurious interpretations, etc.

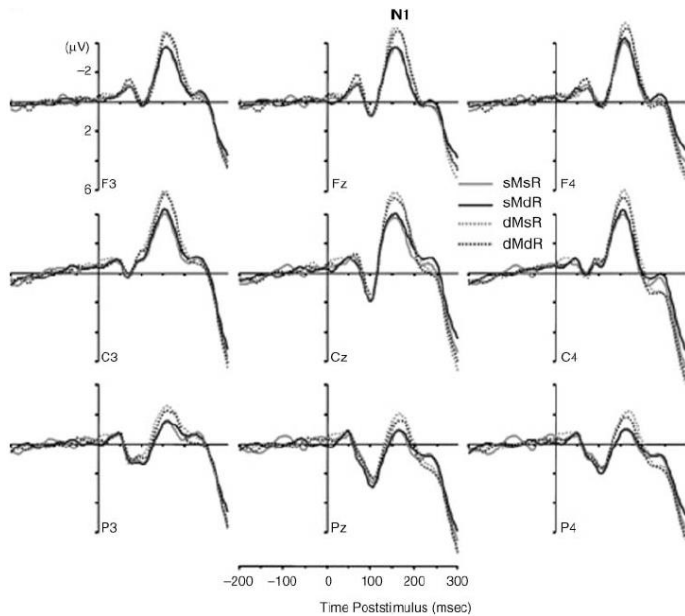


Conduct separate ANOVA for each component

- ▶ Don't use component as a repeated-measure factor
- ▶ Separate ANOVAs for amplitude and latency

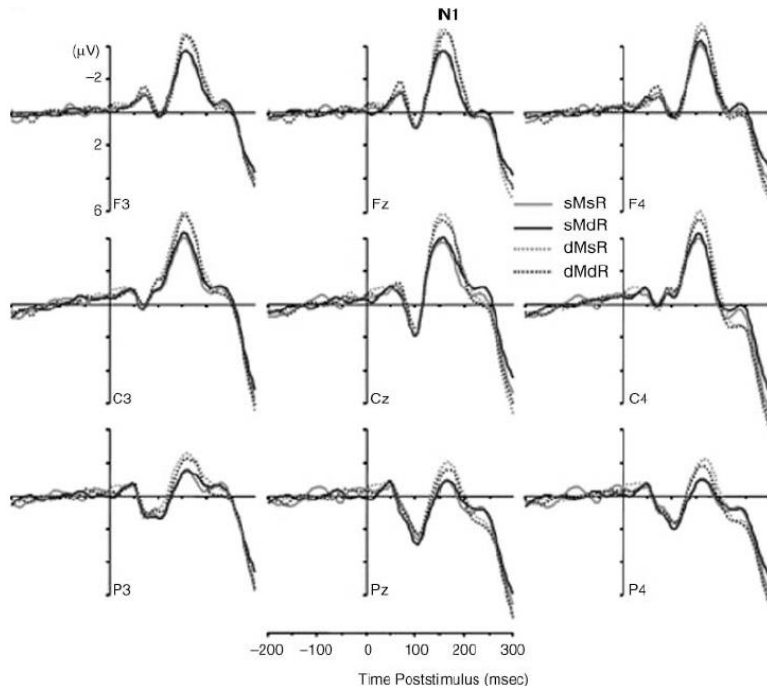
Violations of ANOVA assumptions

homogeneity of covariance (i.e. sphericity)



- (within-subject ANOVAs:) applies only when there are at least three levels of a factor ...
- assumes that degree of correlation between level 1 and level 2 is equal to the degree of correlation between level 2 and level 3, and between level 1 and level 3
- often violated in ERP research when „Electrode Site“ (e.g., Fz, Cz, Pz) is used as a factor
- can be corrected using the „Greenhouse-Geisser“ adjustment

How many electrodes into statistics?



do not artificially increase statistical power by including large number of electrodes!

for well-known components, select only electrode sites where the ERP is known to be most prominent

otherwise, divide electrodes into separate factors representing different spatial dimensions, e.g.,:

„Anterior-posterior Electrode Pos.“
(Frontal, Central, Posterior)

„Left-right Electrode Pos.“ (Left,
Midline, Right)