

CTagger v3.4.0

File

Tagging field: event_type

Field levels

- sound_beep
- show_dash
- show_letter
- left_click
- show_cross
- right_click
- sound_buzz

HED tags Show HED schema Create definition Validate string

Sensory-event, Auditory-presentation, Beep

Using BIDS and HED with EEGLAB

Dung “Young” Truong, Scott Makeig

2022

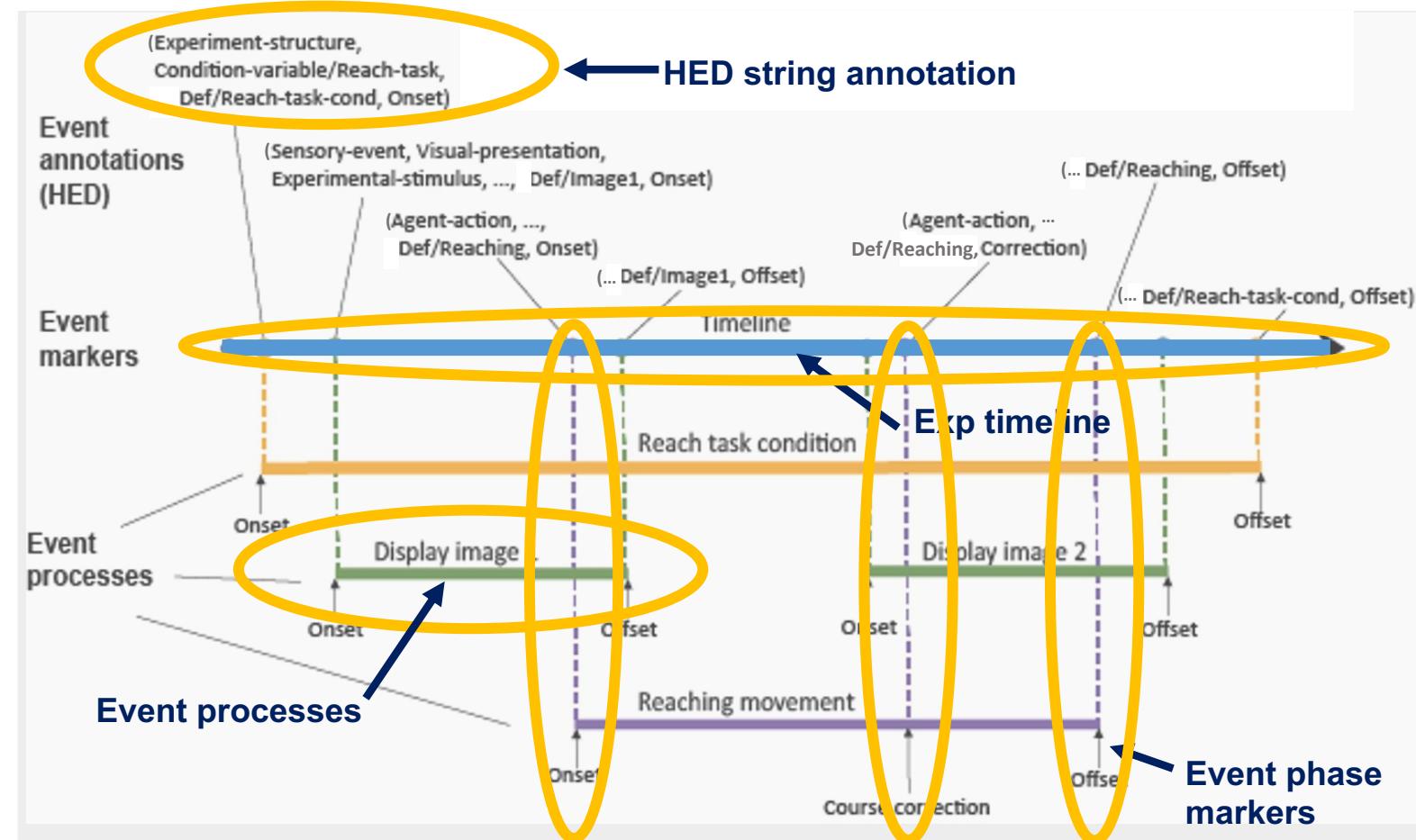
Cancel Finish

**How to record
the natures
of events
experienced by
participant(s) in a
neuroimaging
experiment?**

**Three
base
concepts:**



The Hierarchical Event Descriptors (HED) annotation ecosystem



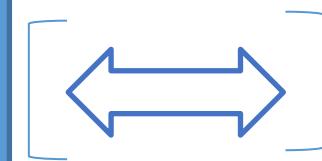
Talk outline

Import BIDS dataset
into EEGLAB
STUDY



Example dataset: **Sternberg Working Memory**
OpenNeuro dataset ID: [ds004117](https://openneuro.org/datasets/ds004117)
NEMAR access path:
https://nemar.org/dataexplorer/detail?dataset_id=ds004117
Example single recording:
[sub-001_ses-01_task-WorkingMemory_run-1_eeg.set](https://nemar.org/dataexplorer/detail?dataset_id=ds004117&file=sub-001_ses-01_task-WorkingMemory_run-1_eeg.set)

Review BIDS and
HED metadata



Extract epochs
using HED tags for
further analyses

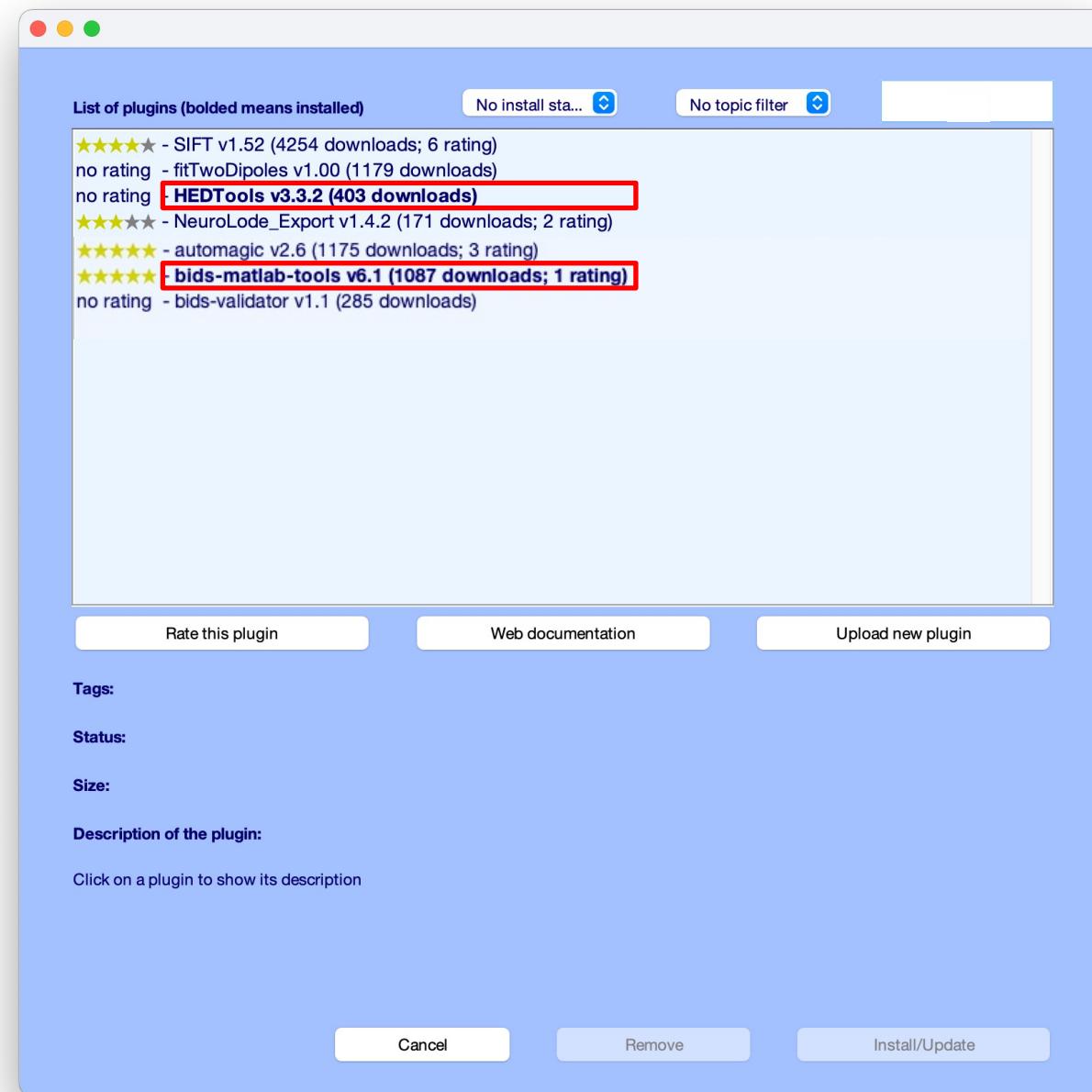
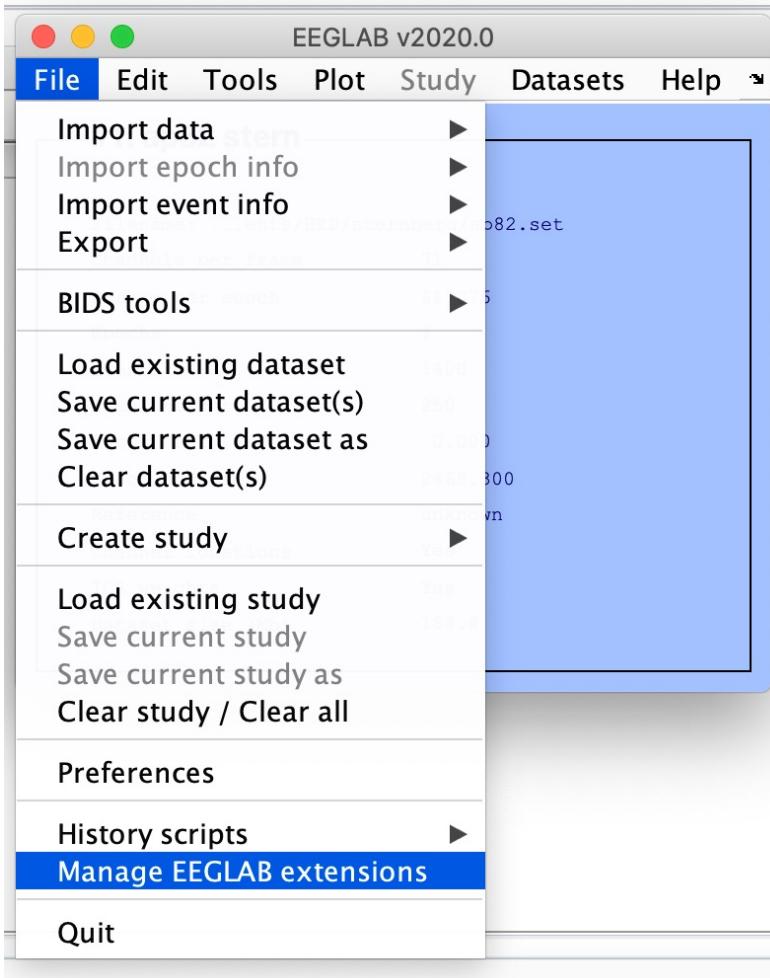
Add/edit HED
annotations using
CTagger





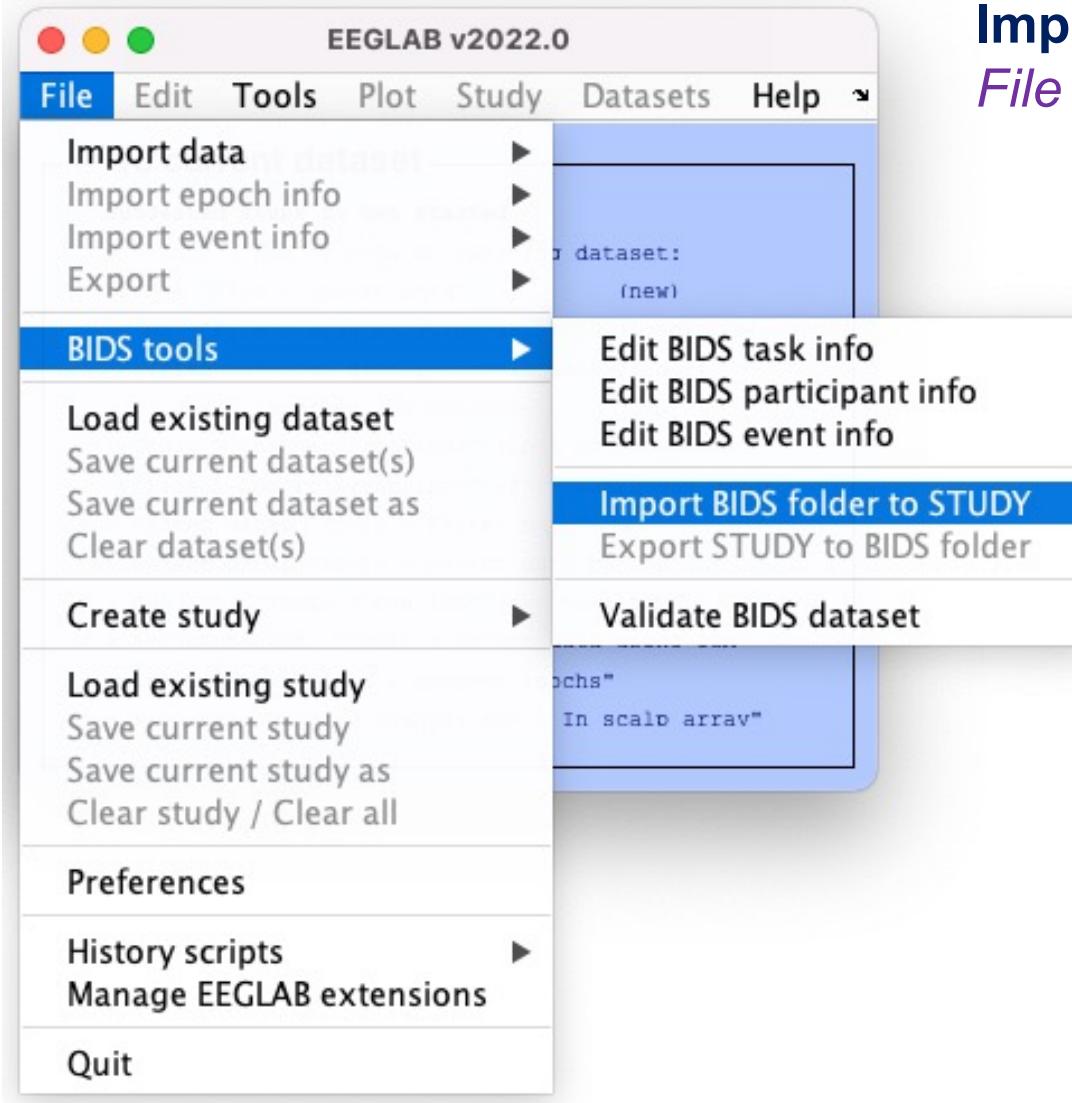
Installation

From EEGLAB menu, choose:
File → Manage EEGLAB extension

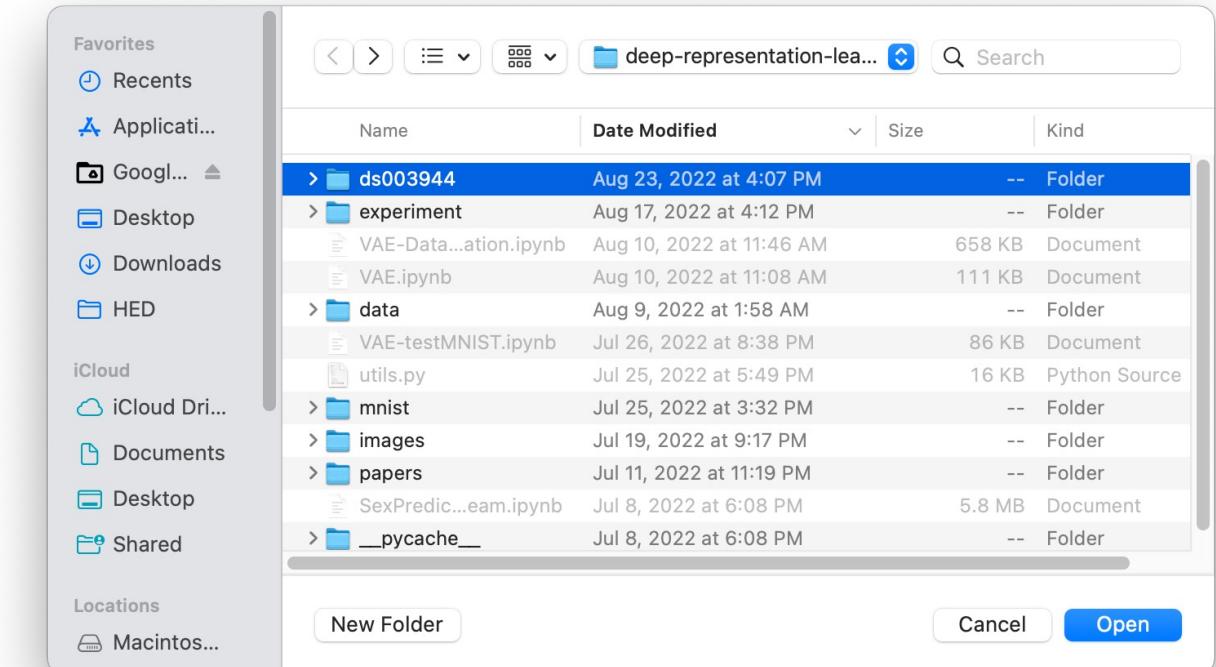




BIDS in EEGLAB

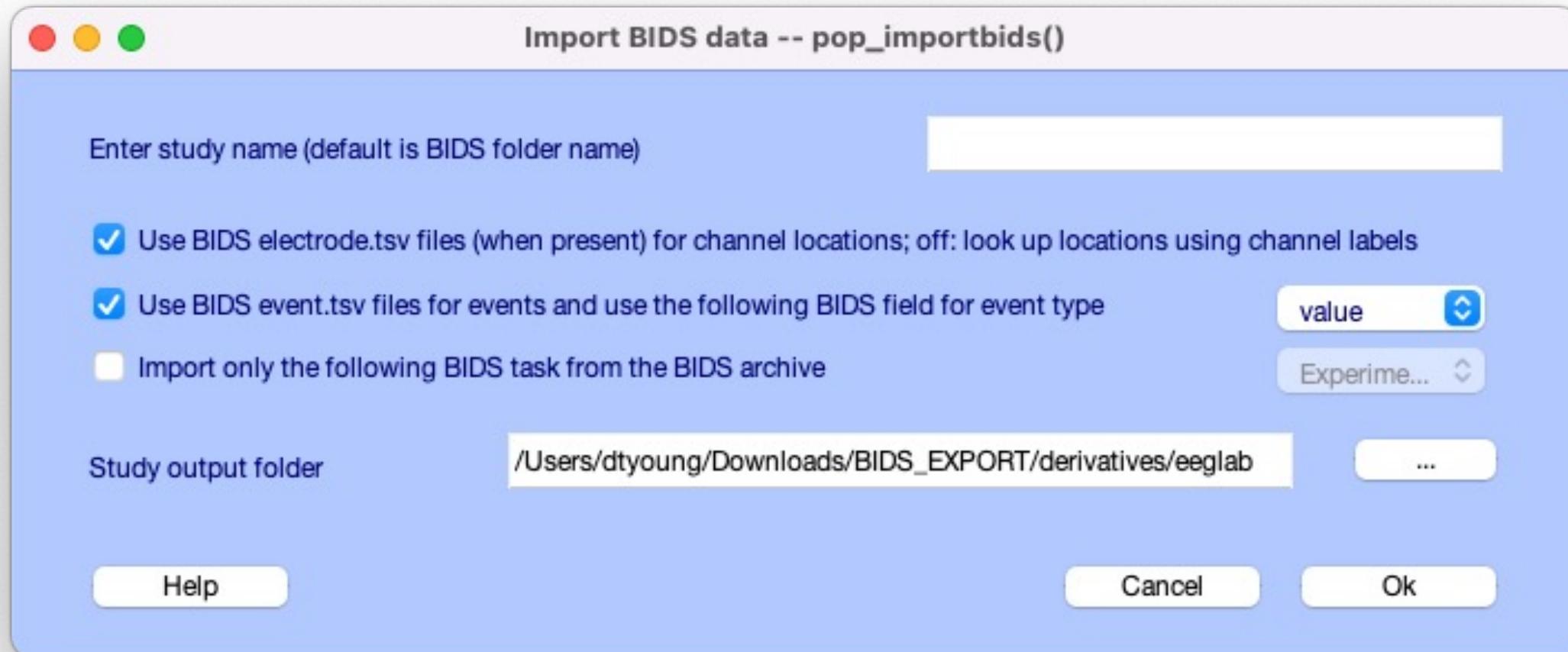


Import BIDS dataset as EEGLAB STUDY:
File → BIDS tools → Import BIDS folder to STUDY



Import BIDS dataset to EEGLAB STUDY

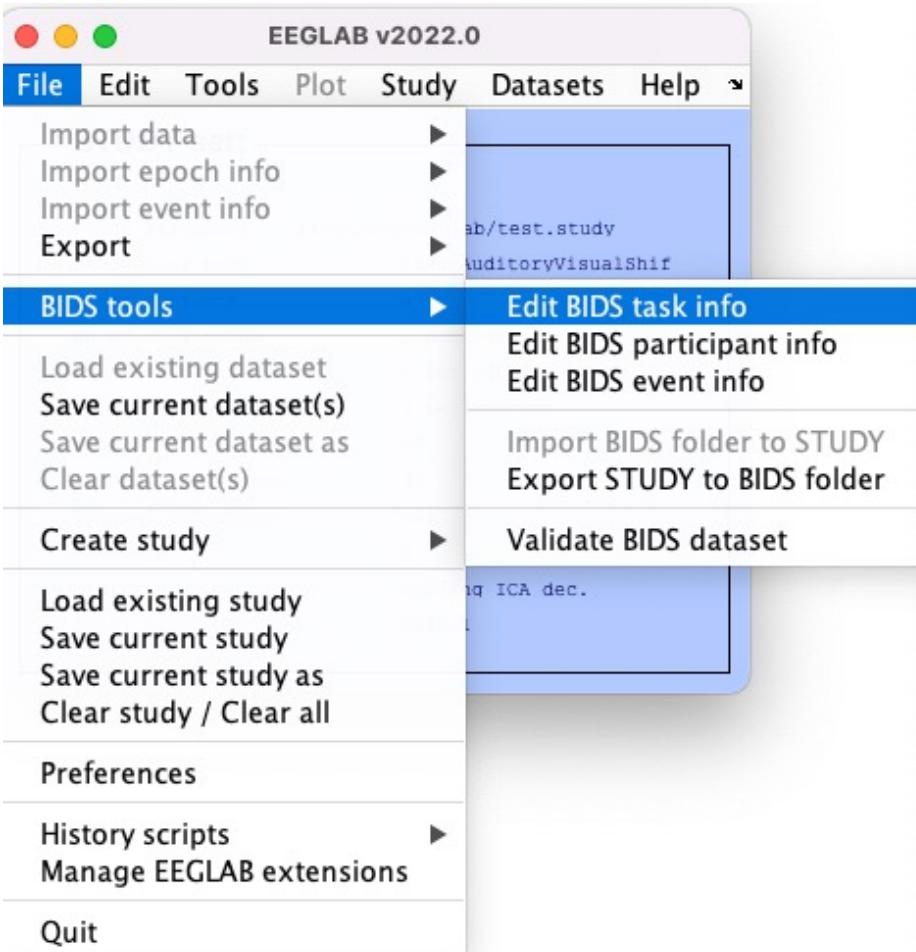
Import window options let you choose how to import channel, events, and task information



View BIDS information

View task information:

File → BIDS tools → Edit BIDS task info

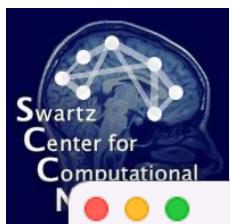


BIDS task information -- pop_taskinfo()

BIDS task information		BIDS EEG acquisition information	
Dataset name*	Auditory-Visual Shift Study	Cap manufacturer	SA Instruments
Task name (no space)	AuditoryVisualShift	Cap model	Electro-Cap International
For several tasks, use bids_export.m from the command line			
README (short introduction to the experiment):			
<p>The purpose behind conducting the Auditory-Visual Shift study is to explore the effects of aging on the processing of sensory auditory and visual stimuli. The study is comprised of data collected from 38 healthy adult subjects covering both young adults and elderly adults. For each subject, the experiment begins with one Focus Auditory (FA) block and one Focus Visual (FV) block, followed by 12 Shift (SH) blocks and another 3 FA and FV blocks each, where the order of the FA and FV sequences was randomized across subjects. In the Shift condition, subjects must shift their attention between the visual modality and the auditory modality based on the presentation of 'Look' and 'Hear' cues. In the Focus condition, subjects are told prior to the start of the block which modality (auditory or visual) to attend to. The stimuli is presented in blocks of 264 for duration of</p>			
Participant task description (description of the experiment):			
<p>For each subject, the experiment begins with one Focus Auditory (FA) block and one Focus Visual (FV) block, followed by 12 Shift (SH) blocks and another 3 FA and FV blocks each, where the order of the FA and FV sequences was randomized across subjects. In the Shift condition, subjects must shift their attention between the visual modality and the auditory modality based on the presentation of 'Look' and 'Hear' cues. In the Focus condition, subjects are told prior to the start of the block which modality (auditory or visual) to attend to. The stimuli is presented in blocks of 264 for duration of</p>			
Participant instructions (as exact as possible):			
<p>In the Shift condition, not reported in this paper, the subjects shifted their attention following the cue. In the Focus condition, reported in this paper, subjects ignored the cues and attended to the same modality during the whole block. The modality to attend was indicated prior to each block. The subjects' task was to press a button upon a detection of a relevant-modality target. At all times, subjects had to fixate on a cross continuously presented in the middle of the computer monitor. They were visually monitored to ensure proper fixation.</p>			
Authors	Marissa Westerfield		
References and links	Ceponiene R., Westerfield M., Torki M., Townsend J., "Modality-s		
Task-relevant Cognitive Atlas term			
Task-relevant CogPO term			
Institution	Institute for Neural Computation		
Department	Swartz Center for Computational Neuroscience		
Institution location	9500 Gilman Dr, Dept 0523, La Jolla, CA 92093, USA		
Hardware filters			
Software filters*			
Line frequency (Hz)*			
.01 Hz and 60 Hz (high- and low-pass, respectively)			
60			

* Required field

Help Cancel Ok



View BIDS information



BIDS task information -- pop_taskinfo()

BIDS task information

Dataset name*

Auditory-Visual Shift Study

Task name (no space)

AuditoryVisualShift

For several tasks, use bids_export.m from the command line

README (short introduction to the experiment):

The purpose behind conducting the Auditory-Visual Shift study is to explore the effects of aging on the processing of sensory auditory and visual stimuli. The study is comprised of data collected from 38 healthy adult subjects covering both young adults and elderly adults. For each subject, the experiment begins with one Focus Auditory (FA) block and one Focus Visual (FV) block, followed by 12 Shift (SH) blocks and another 3 FA and FV blocks each, where the order of the FA and FV sequences

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Authors

Marissa Westerfield

BIDS EEG acquisition information

Cap manufacturer

SA Instruments

Cap model

Electro-Cap International

EEG reference location*

average of the left- and right-mastoid

EEG ground electrode location

EEG montage system (10-20, 10-10, custom)

10-20

EEG amplifier maker

Biosemi

EEG amplifier model

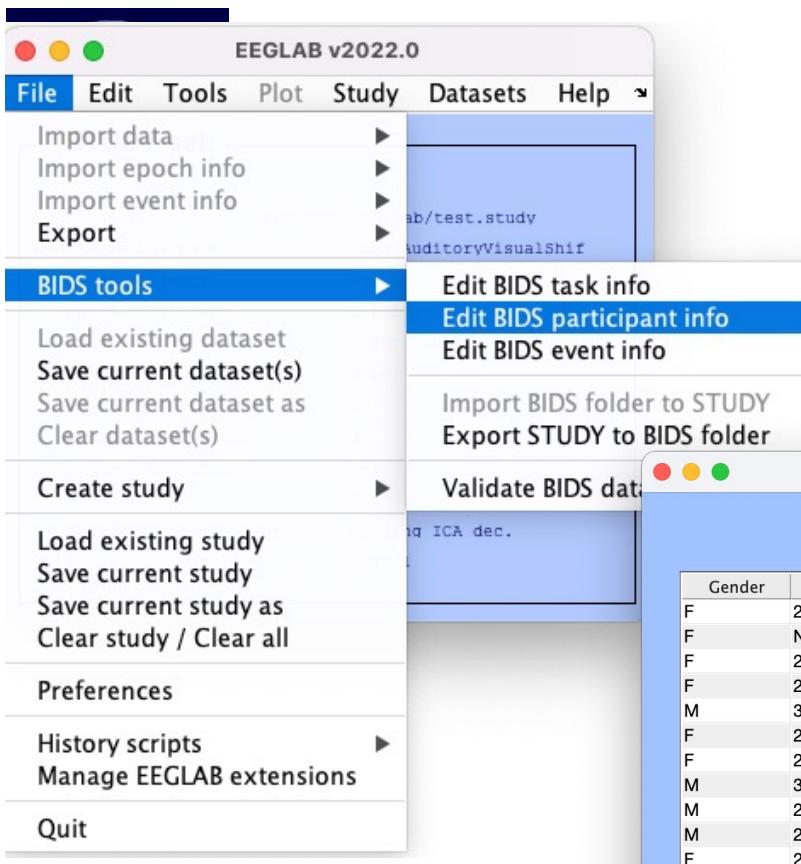
EEG amplifier serial #

EEG acquisition software version

Hardware filters

Dung Truong, 2022

View BIDS information



View participant information: Edit BIDS participant info

Figure 2: Edit BIDS participant info - pop_participantinfo

Participant information

Gender	Age	Group	YearOfBirth	participant_id	HeadCircumference
F	20	young	1981	sub-001	
F	NA	young	NA	sub-002	
F	23	young	1981	sub-003	
F	22	young	1982	sub-004	
M	37	young	1965	sub-005	
F	28	young	1973	sub-006	
F	20	young	1981	sub-007	
M	30	young	1971	sub-008	
M	24	young	1978	sub-009	
M	27	young	1975	sub-010	
F	22	young	1980	sub-011	
F	22	young	1980	sub-012	
F	34	young	1968	sub-013	
F	22	young	1980	sub-014	
M	21	young	1981	sub-015	
M	23	young	1979	sub-016	
M	22	young	1979	sub-017	
F	40	young	1962	sub-018	
M	25	young	1976	sub-019	
F	59	elderly	1943	sub-020	
F	63	elderly	1939	sub-021	
F	64	elderly	1938	sub-022	
F	59	elderly	1942	sub-023	
M	NA	elderly	NA	sub-024	
F	64	elderly	1939	sub-025	
F	53	elderly	1950	sub-026	

Import column(s) Add/Edit column Remove column

BIDS metadata for participant fields

	Description	Levels	Units
Gender	Participant gender	F,M	n/a
Age	Participant age (years)	n/a	years
Group	Participant group label	young,elderly	n/a
YearOfBirth	Participant year of birth	Click to specify	years
participant_id	Unique participant label	n/a	n/a

Cancel Ok

View BIDS information

View general event information: Edit BIDS event info

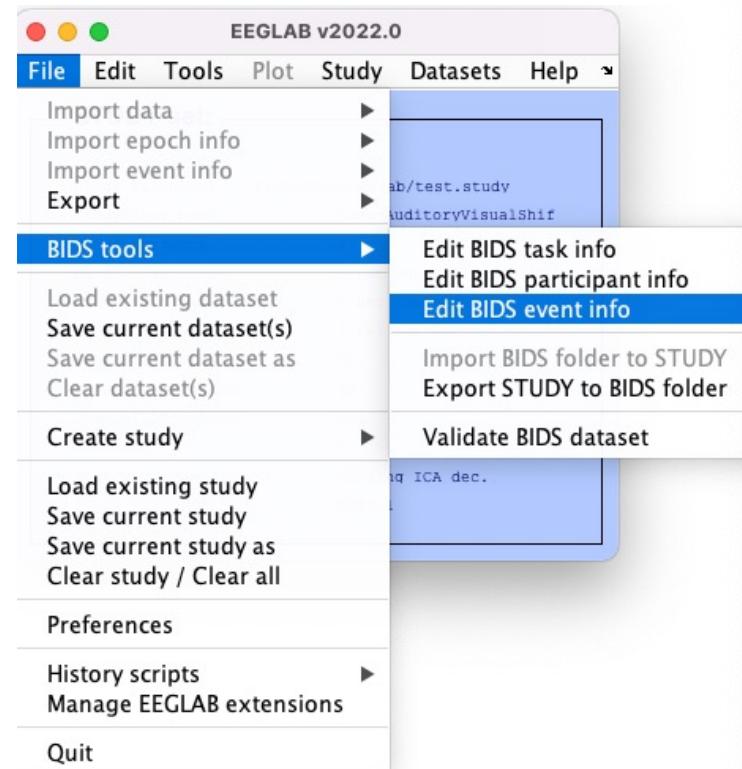


Figure 3: Edit BIDS event info - pop_eventinfo

BIDS information for EEG.event fields

BIDS Field	EEGLAB Field	Levels	LongName	Description	Unit Name	Unit Prefix
duration	duration	n/a	Event duration	Duration of the event (measure...	second	⌚
trial_type	trial_type	x1,x2,x3				⌚
value	type	x11,x202,x12,...	Event marker	Marker value associated with t...		⌚
onset	From sample	n/a	Event onset	Onset of the event measured fr...	millisecond	⌚
HED	HED	Click to specif...	Hierarchical Event Descriptor	Tags describing the nature of t...		⌚
sample	latency	n/a	Sample offset	Onset of the event according t...		⌚
response_time		Click to specif...				⌚
stim_file		Click to specif...				⌚

Add BIDS field Remove BIDS field

Describing levels of value

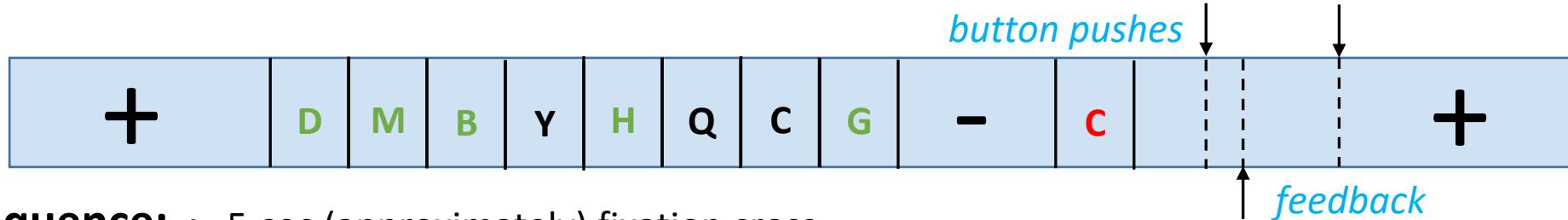
BIDS allows you to describe the levels for each of your categorical fields. Describing levels helps other researchers understand your experiment better

	Description
x11	Focus Auditory Block. A 200-ms word 'Hear' that instructs subjects to attend t...
x12	Focus Auditory Block. A 200-ms word 'Look' that instructs subjects to attend t...
x13	Focus Auditory Block. Auditory target. A 100-ms 550-Hz sine wave tone, ampli...
x14	Focus Auditory Block. Visual target. A light blue 8.4 cm ² filled square visual sti...
x15	Focus Auditory Block. A 500-Hz sine-wave tone, amplitude-modulated at 5 Hz,...
x16	Focus Auditory Block. A dark-blue 8.4 cm ² filled square visual stimulus is pres...
x17	
x18	
x19	
x21	Focus Visual Block. A 200-ms word 'Hear' that instructs subjects to attend to t...

Cancel Ok

Sternberg memory task

Goal: Investigate event-related EEG dynamics a during short-term memory task.

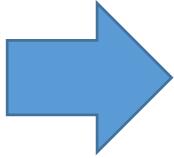


- Event sequence:**
- 5-sec (approximately) fixation cross.
 - A sequence of 8 letters (between 3 and 7 black target letters with others in green).
 - Dash during a 2-4 sec delay.
 - Red probe letter.
 - Subject clicks right mouse button if letter was target and left if non-target.
 - A beep sounds if correct response and a buzz if an incorrect response.
 - Subject clicks either button to go to next trial.

- Variations:**
- Condition A: letter presentations 1.2 secs
 - Condition B: letter presentations short
 - Additional task: alternating between opening and closing eyes for 2 minute intervals.

Rethink how to express events:

latency	type
1430	nonWM
2741	gD
3102	gM
3462	gB
3822	Y
4183	gH
4543	Q
4903	C
5264	gG
5624	WM
6521	rC
6849	1
6968	correct
7594	1
7611	nonWM
8922	J
9283	C
9643	F



latency	type	task_role	letter
1430	show_cross	fixation	n/a
2741	show_letter	non_target	D
3102	show_letter	non_target	M
3462	show_letter	non_target	B
3822	show_letter	target	Y
4183	show_letter	non_target	H
4543	show_letter	target	Q
4903	show_letter	target	C
5264	show_letter	non_target	G
5624	show_dash	working_memory	n/a
6521	show_letter	probe	C
6849	right_click	in_group	n/a
6968	sound_beep	correct_feedback	n/a
7594	right_click	ready	n/a
7611	show_cross	fixate	n/a
8922	show_letter	target	J
9283	show_letter	target	C
9643	show_letter	target	F

• • •

• • •

type:

- show_cross
- show_letter
- show_dash
- left_click
- right_click
- sound_beep
- sound_buzz

task_role:

- fixation
- non_target
- target
- working_memory
- probe
- correct_feedback
- incorrect_feedback
- ready
- in_group
- out_group

Separate *what the event is* from its *role in the experiment*.

The (7) types and (10) task_role are independent w.r.t. annotation.



Event structure in EEGLAB

EEG.event

PLOTS VARIABLE VIEW

EEG.event

Fields	latency	duration	sample	type	task_role	letter	trial	memory_cond	value	urevent
1	1430	1.2571e+03	1430	'show_cr...	'fixate'	'+'	'1'	'3'	'nonWM'	1
2	2.7416e...	305.9500	2742	'show_let...	'to_ignore'	'D'	'1'	'3'	'gD'	2
3	3.1020e...	305.7250	3102	'show_let...	'to_ignore'	'M'	'1'	'3'	'gM'	3
4	3.4622e...	305.9500	3462	'show_let...	'to_ignore'	'B'	'1'	'3'	'gB'	4
5	3.8226e...	305.9500	3823	'show_let...	'to_remem...	'Y'	'1'	'3'	'Y'	5
6	4.1831e...	305.9500	4183	'show_let...	'to_ignore'	'H'	'1'	'3'	'gH'	6
7	4.5435e...	305.7000	4544	'show_let...	'to_remem...	'Q'	'1'	'3'	'Q'	7
8	4.9037e...	305.9500	4904	'show_let...	'to_remem...	'C'	'1'	'3'	'C'	8
9	5.2642e...	305.9000	5264	'show_let...	'to_ignore'	'G'	'1'	'3'	'gG'	9
10	5.6246e...	842.1250	5625	'show_da...	'work_mem...	'-'	'1'	'3'	'WM'	10
11	6.5212e...	305.9500	6521	'show_let...	'probe_targ...	'C'	'1'	'3'	'rC'	11
12	6.8607e...	0	6861	'right_cli...	'remember...	'n/a'	'1'	'3'	'1'	12
13	6.9608e...	0	6961	'sound_b...	'feedback_...	'n/a'	'1'	'3'	'correct'	13

HED enables sharing & storing of “analysis-ready” data

HED 8.1.0

Event
Sensory-event
Agent-action
Data-feature
Experiment-control
Experiment-procedure
Experiment-structure
Measurement-event
Agent
Action
Item
Property
Relation

- **HED (Hierarchical Event Descriptors)** uses a controlled vocabulary, grammar, and tool infrastructure for annotation of time series (or other) data.
- **HED tags** are paths in the **HED schema** (the controlled HED vocabulary) used in the annotation.
- **HED string** annotations consist of parenthesized groupings of comma-separated HED tags.
- **HED is explicitly accepted under the BIDS standards** to support event markers (and other) annotation.

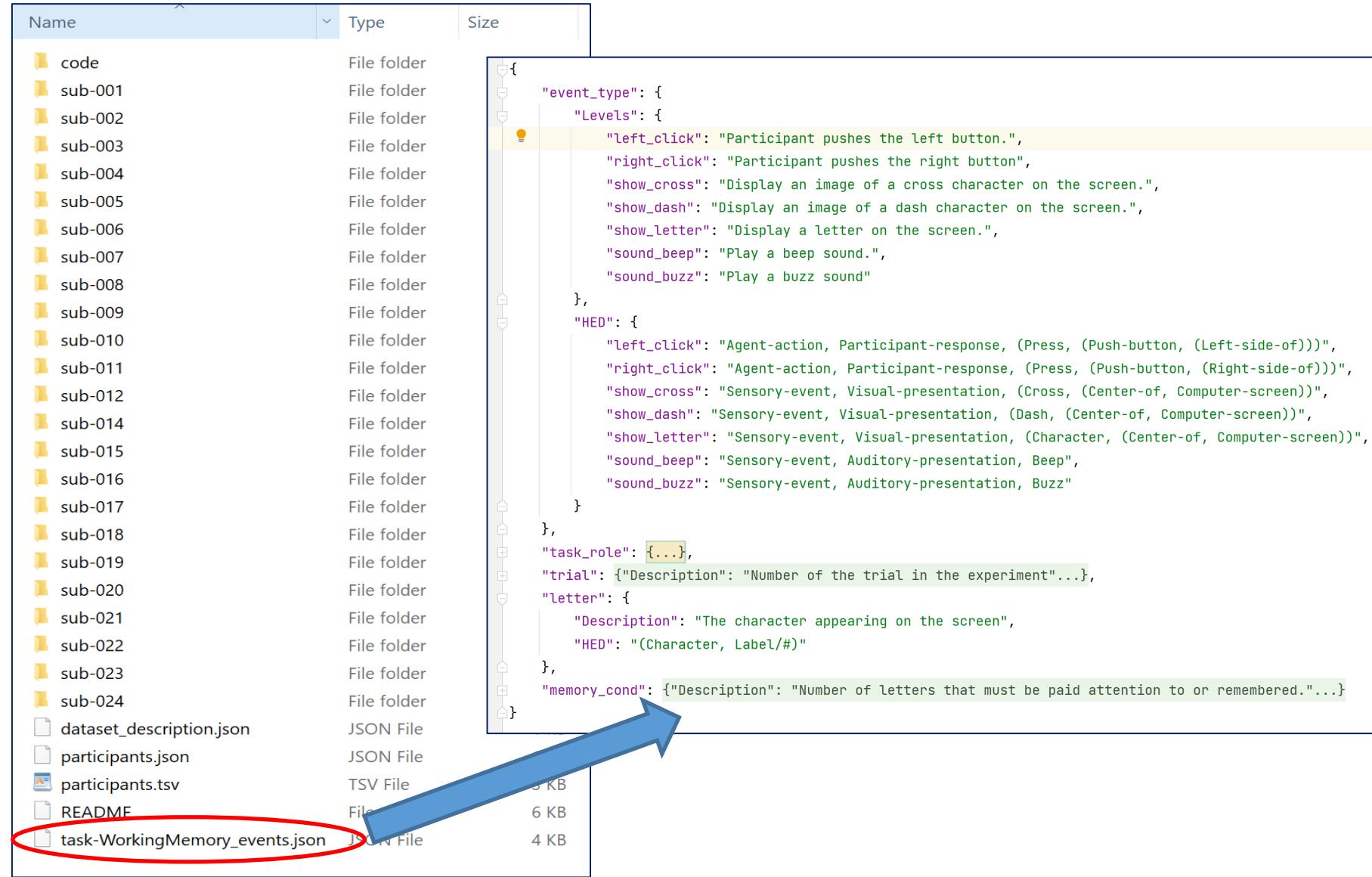


New developments in HED have significantly expanded HED's capabilities and usability.

Add/View HED annotations

- We will be preparing annotations using a single ***events.json*** file placed at the top level in the hierarchy of a BIDS dataset
- HED annotations in this file, as well as descriptions of the ***events.tsv*** columns, will be applied to all event files in the dataset

Name	Type	Size
code	File folder	3 KB
sub-001	File folder	6 KB
sub-002	File folder	4 KB
sub-003	File folder	
sub-004	File folder	
sub-005	File folder	
sub-006	File folder	
sub-007	File folder	
sub-008	File folder	
sub-009	File folder	
sub-010	File folder	
sub-011	File folder	
sub-012	File folder	
sub-014	File folder	
sub-015	File folder	
sub-016	File folder	
sub-017	File folder	
sub-018	File folder	
sub-019	File folder	
sub-020	File folder	
sub-021	File folder	
sub-022	File folder	
sub-023	File folder	
sub-024	File folder	
dataset_description.json	JSON File	
participants.json	JSON File	
participants.tsv	TSV File	
README	File	
task-WorkingMemory_events.json	JSON File	



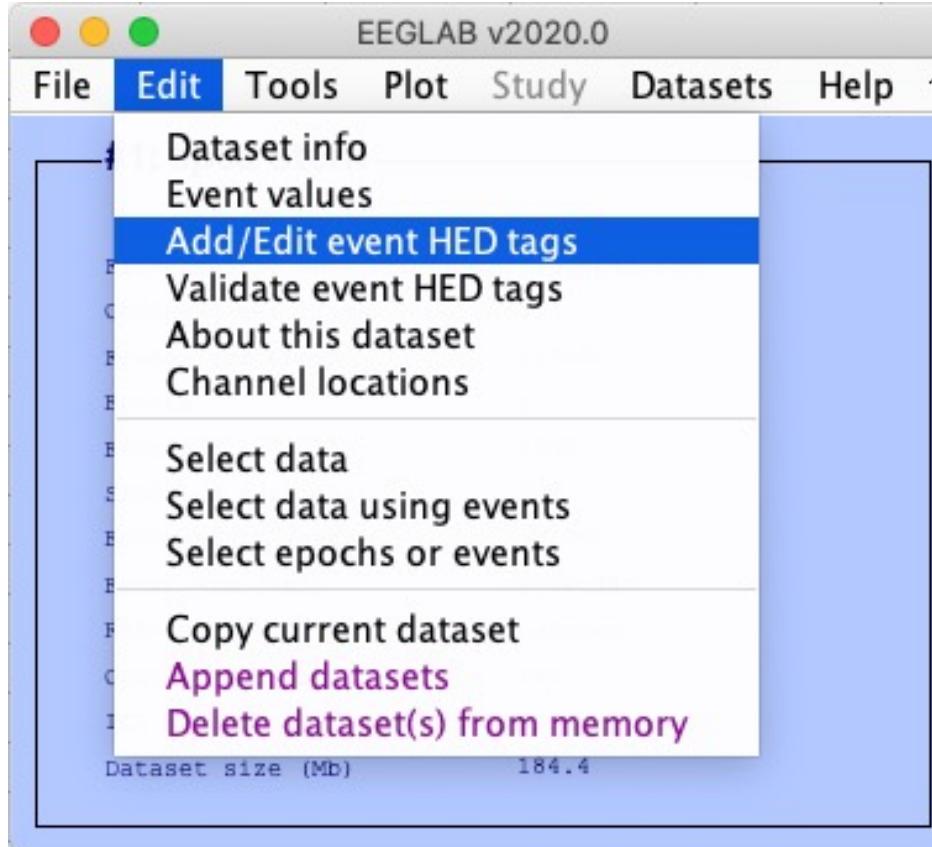
```

{
  "event_type": {
    "Levels": {
      "left_click": "Participant pushes the left button.",
      "right_click": "Participant pushes the right button",
      "show_cross": "Display an image of a cross character on the screen.",
      "show_dash": "Display an image of a dash character on the screen.",
      "show_letter": "Display a letter on the screen.",
      "sound_beep": "Play a beep sound.",
      "sound_buzz": "Play a buzz sound"
    },
    "HED": {
      "left_click": "Agent-action, Participant-response, (Press, (Push-button, (Left-side-of)))",
      "right_click": "Agent-action, Participant-response, (Press, (Push-button, (Right-side-of)))",
      "show_cross": "Sensory-event, Visual-presentation, (Cross, (Center-of, Computer-screen))",
      "show_dash": "Sensory-event, Visual-presentation, (Dash, (Center-of, Computer-screen))",
      "show_letter": "Sensory-event, Visual-presentation, (Character, (Center-of, Computer-screen))",
      "sound_beep": "Sensory-event, Auditory-presentation, Beep",
      "sound_buzz": "Sensory-event, Auditory-presentation, Buzz"
    }
  },
  "task_role": {...},
  "trial": {"Description": "Number of the trial in the experiment..."},
  "letter": {
    "Description": "The character appearing on the screen",
    "HED": "(Character, Label/#)"
  },
  "memory_cond": {"Description": "Number of letters that must be paid attention to or remembered...."}
}

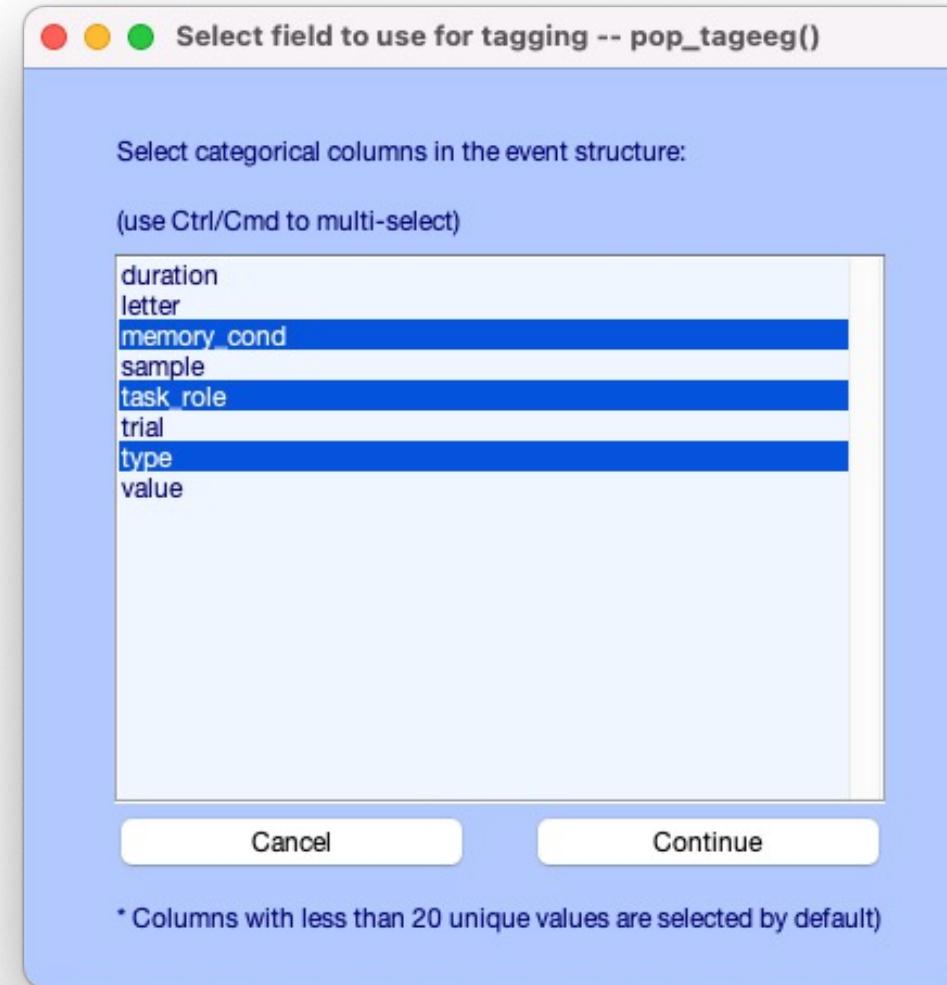
```

Add/View HED annotations

Once the *HEDTools* plug-in is installed, select: *Edit → Add/Edit event HED tags*. If the dataset is an EEGLAB STUDY, all event fields and field values will be extracted for annotation

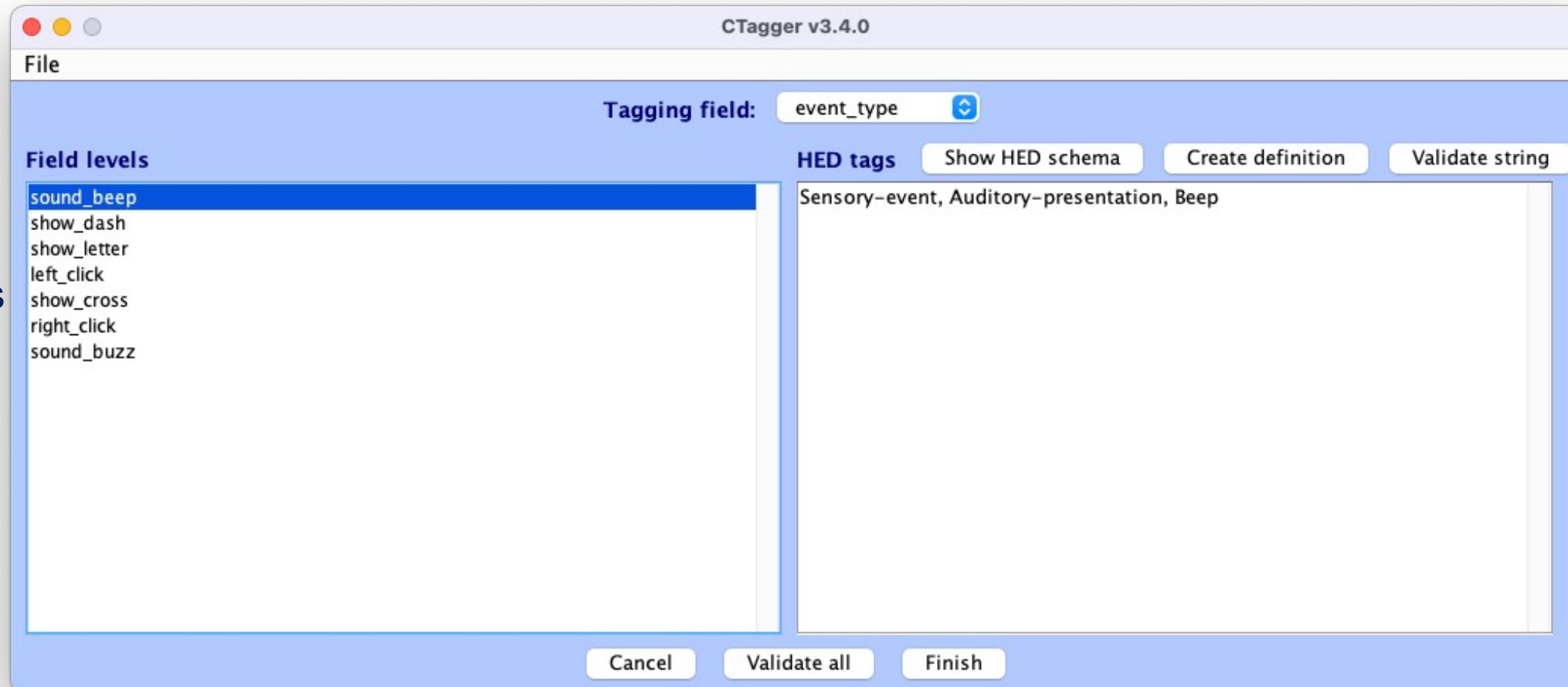


If it is the first time you are adding HED annotations, you will be prompted to choose categorical column headings:



CTagger

- **CTagger**
=“Community Tagger”
- Can be used as a standalone app as well as from the EEGLAB **HEDTools** plug-in
- Various features to assist with the tagging process

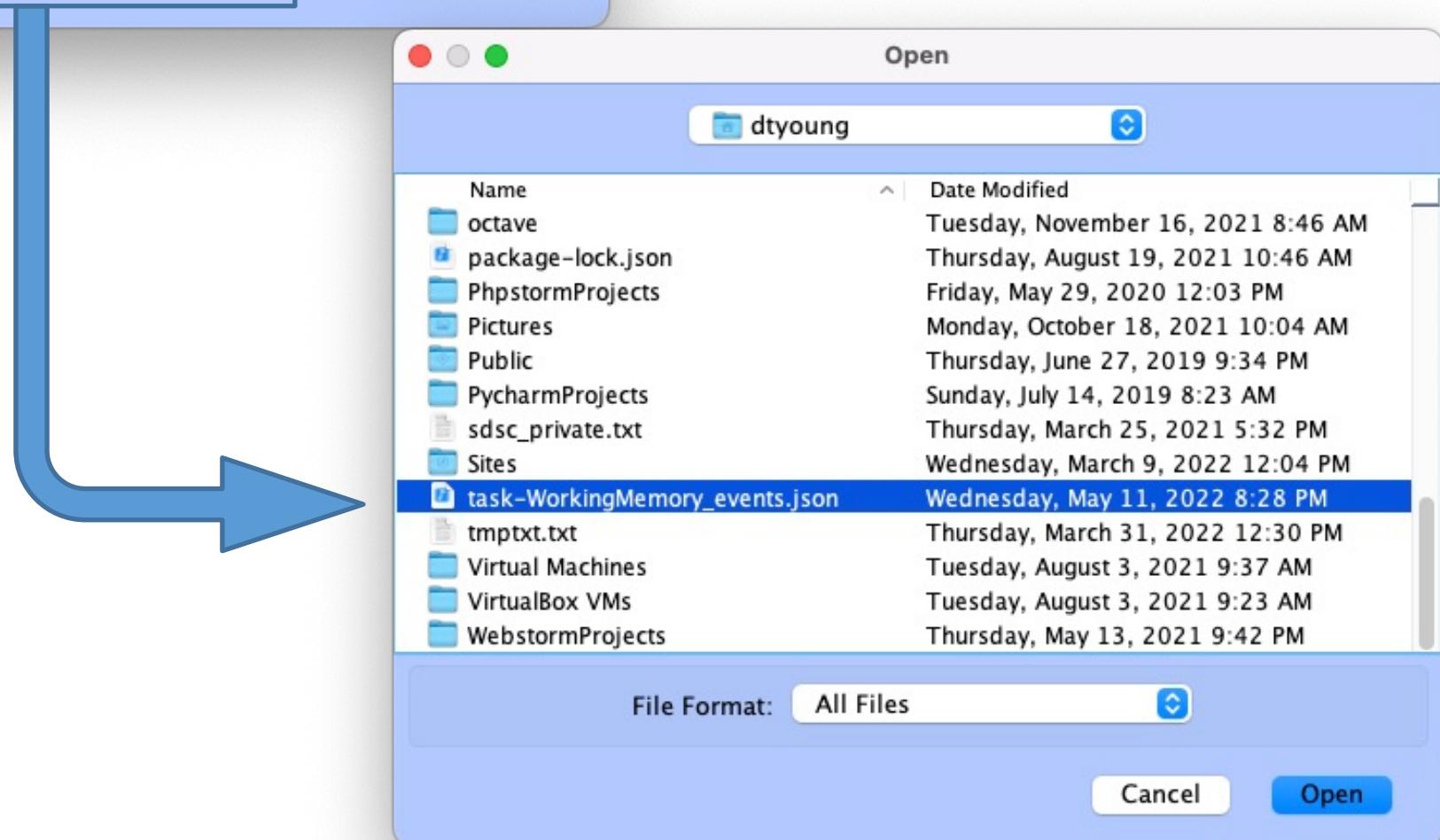




Using Ctagger stand-alone

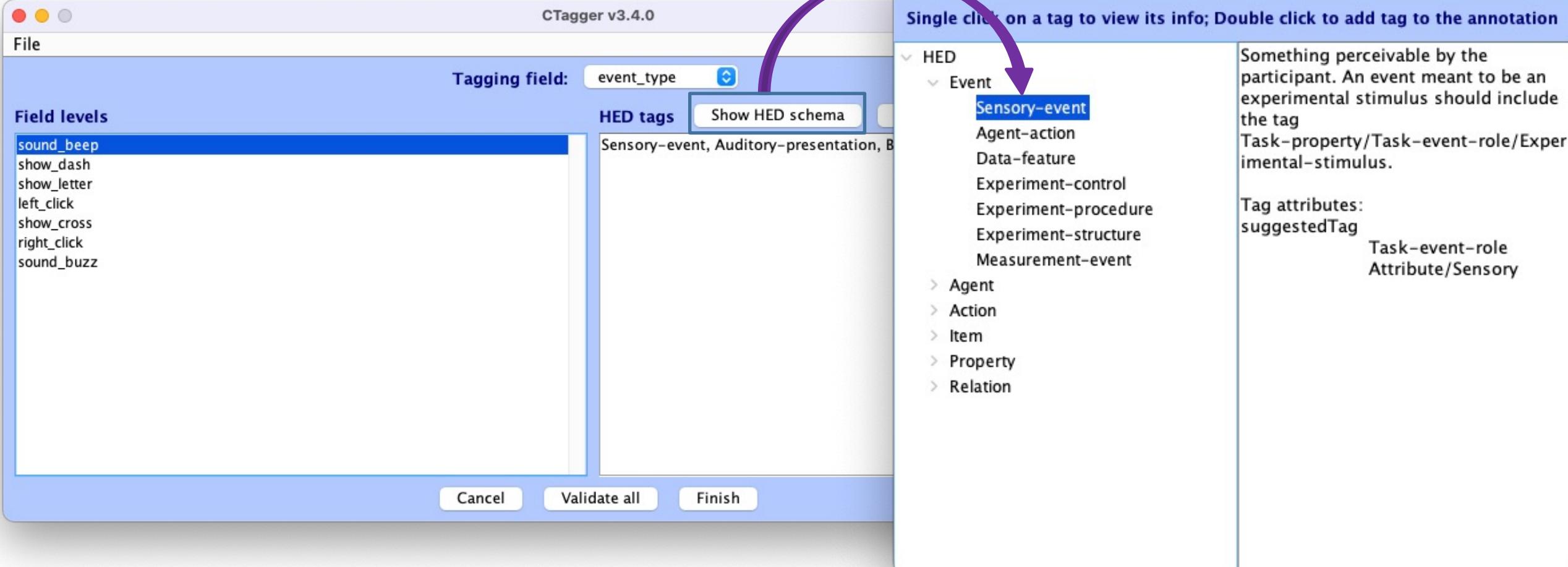


Run the **CTagger.jar** application, then choose (the skeleton) BIDS **events.json** file to import ...



Show and choose tag from HED Schema

Click the **Show HED schema** button to view and choose tags directly from the HED vocabulary:



The screenshot shows the CTagger v3.4.0 application interface. On the left, there's a sidebar with 'Field levels' containing items like 'sound_beep', 'show_dash', etc. In the center, there's a 'Tagging field:' dropdown set to 'event_type' and a 'HED tags' dropdown showing 'Sensory-event, Auditory-presentation, B...'. A purple arrow points from the 'Show HED schema' button in the 'HED tags' dropdown to the 'HED Schema 8.0.0' window on the right.

HED Schema 8.0.0

Single click on a tag to view its info; Double click to add tag to the annotation

HED

Event

Sensory-event

Agent-action

Data-feature

Experiment-control

Experiment-procedure

Experiment-structure

Measurement-event

> Agent

> Action

> Item

> Property

> Relation

Something perceptible by the participant. An event meant to be an experimental stimulus should include the tag Task-property/Task-event-role/Experimental-stimulus.

Tag attributes:
suggestedTag

Task-event-role
Attribute/Sensory



Fully-featured online schema browser



Online HED schema browser provides more flexible term look-up and schema browsing assistance:

https://www.hedtags.org/display_hed.html

HED Schema Browser

HED (Hierarchical Event Descriptor) is a structured vocabulary for annotating events. HED and the HED schema have evolved over several generations; the current generation (HED-3G) HED base schema, begins with version 8.0.0. For more information, see hedtags.org.

Expand/Collapse all Search term **Visual** Expand to level Show another version ▾

HED 8.1.0

- Event
 - Sensory-event
 - Agent-action
 - Data-feature
 - Experiment-control
 - Experiment-procedure
 - Experiment-structure
 - Measurement-event
- Agent
- Action
- Item
- Property
- Relation

Audiovisual-clip
Visualization
Outline-visualization
Point-light-visualization
Stick-figure-visualization
Visual-attribute
Visual-presentation

/Event/Sensory-event
Short form: undefined

Something perceivable by the participant. An event meant to be an experimental stimulus should include the tag Task-property/Task-event-role/Experimental-stimulus.

Attribute
suggestedTag: Task-event-role, Sensory-presentation

**Press enter/return to freeze the info board*

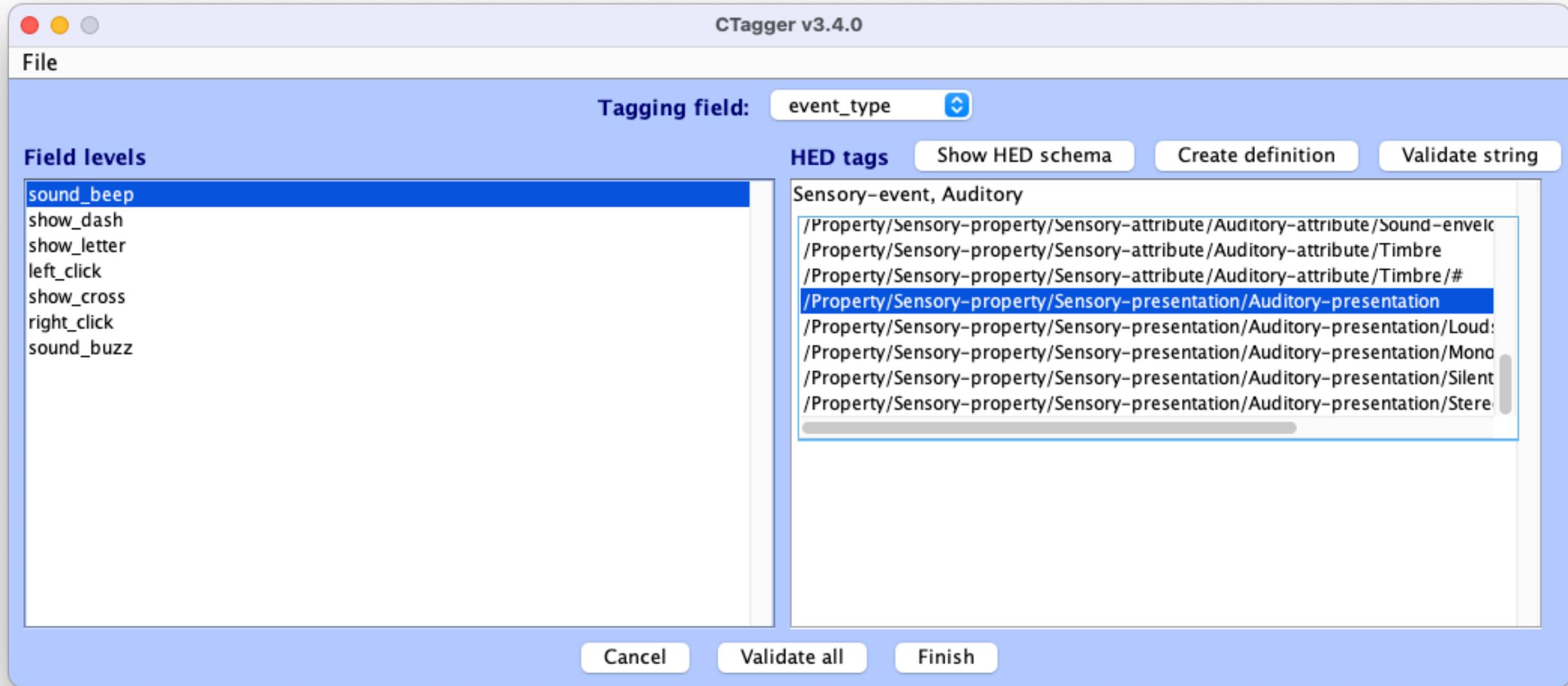
Additional schema properties

Unit class definitions

Unit modifier definitions

Direct typing and automatic lookup

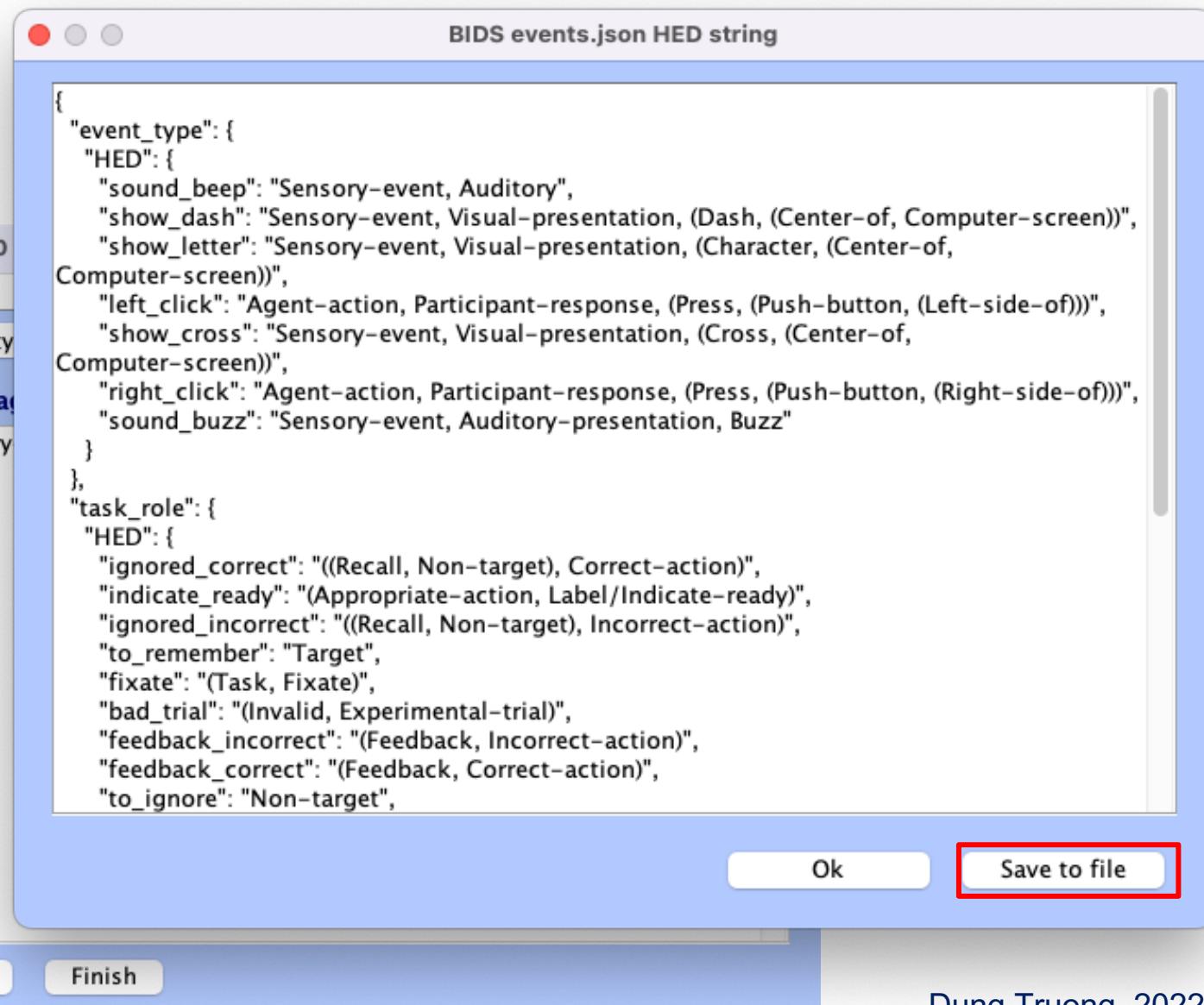
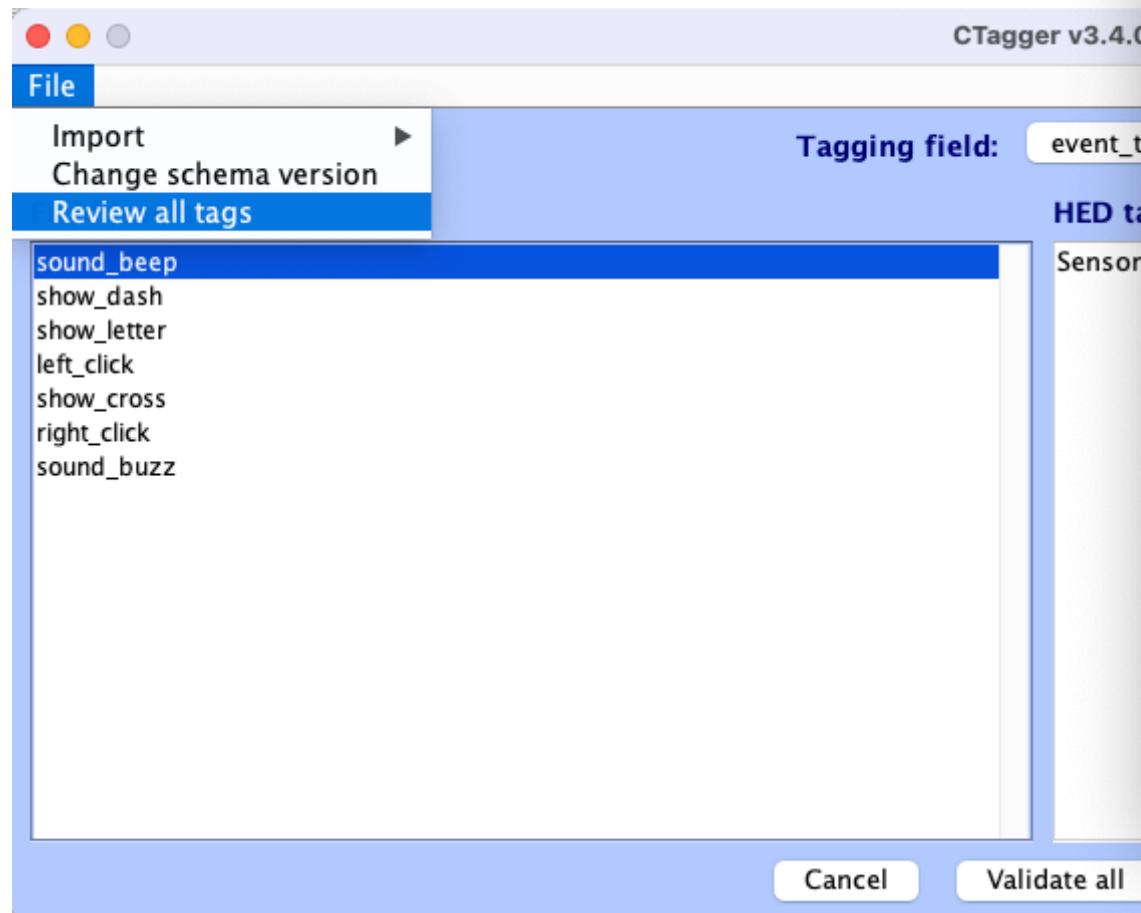
CTagger looks up partial matches for whatever the user types into the editor window



The screenshot shows the CTagger v3.4.0 application interface. At the top, it displays "CTagger v3.4.0". Below the title bar, there's a "File" menu. The main area has a "Tagging field:" dropdown set to "event_type". To the right of the dropdown are four buttons: "HED tags", "Show HED schema", "Create definition", and "Validate string". A "Field levels" section on the left contains a list of tags: "sound_beep", "show_dash", "show_letter", "left_click", "show_cross", "right_click", and "sound_buzz". The "sound_beep" item is highlighted with a blue selection bar. On the right, a list of HED tags is shown under the heading "Sensory-event, Auditory". The list includes: "/Property/Sensory-property/Sensory-attribute/Auditory-attribute/Sound-envelope", "/Property/Sensory-property/Sensory-attribute/Auditory-attribute/Timbre", "/Property/Sensory-property/Sensory-attribute/Auditory-attribute/Timbre/#", "/Property/Sensory-property/Sensory-presentation/Auditory-presentation", "/Property/Sensory-property/Sensory-presentation/Auditory-presentation/Loud:", "/Property/Sensory-property/Sensory-presentation/Auditory-presentation/Mono", "/Property/Sensory-property/Sensory-presentation/Auditory-presentation/Silent", and "/Property/Sensory-property/Sensory-presentation/Auditory-presentation/Stere". The item "/Property/Sensory-property/Sensory-presentation/Auditory-presentation" is highlighted with a blue selection bar. At the bottom of the interface are three buttons: "Cancel", "Validate all", and "Finish".

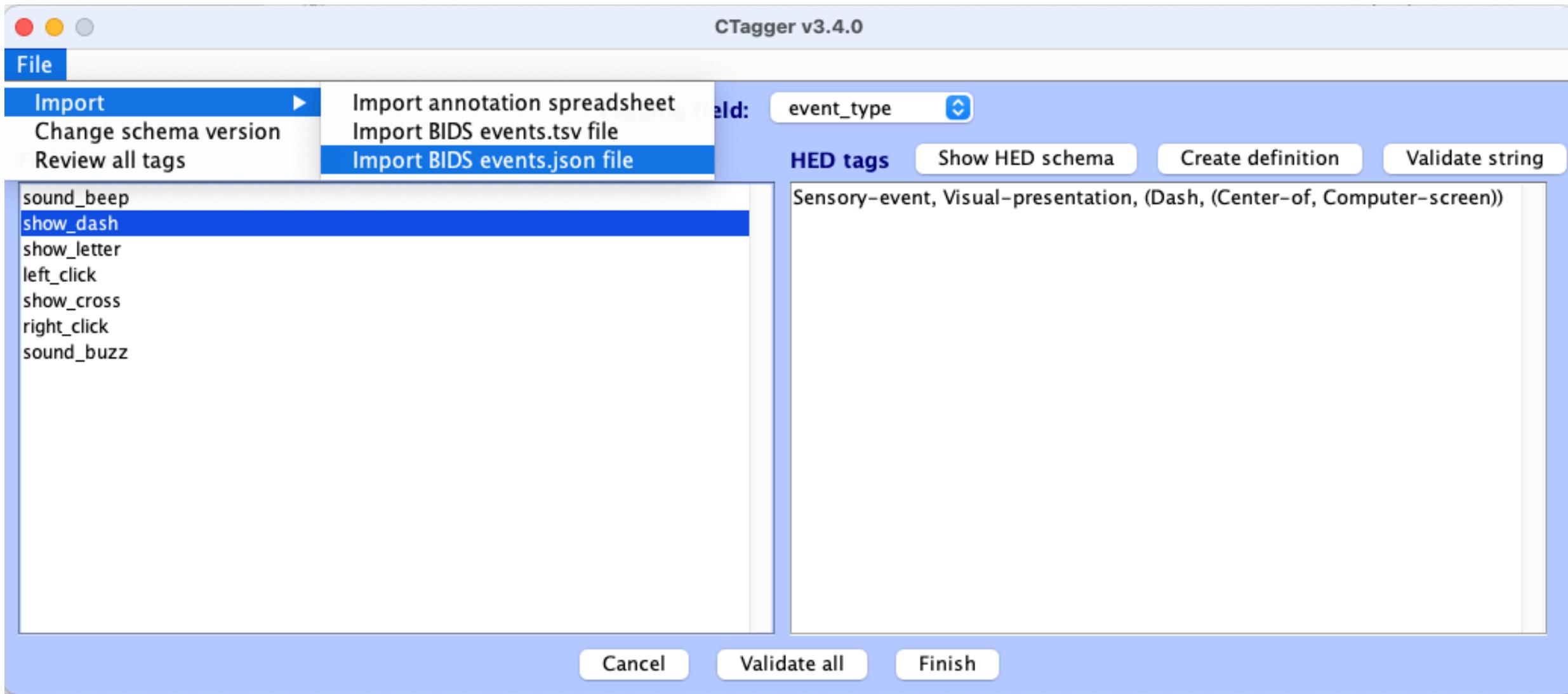
Review and save the tagging process

File → Review all tags will show current annotations for all annotated field and field values. Annotations can be saved to resume and/or share ...



Load saved tags

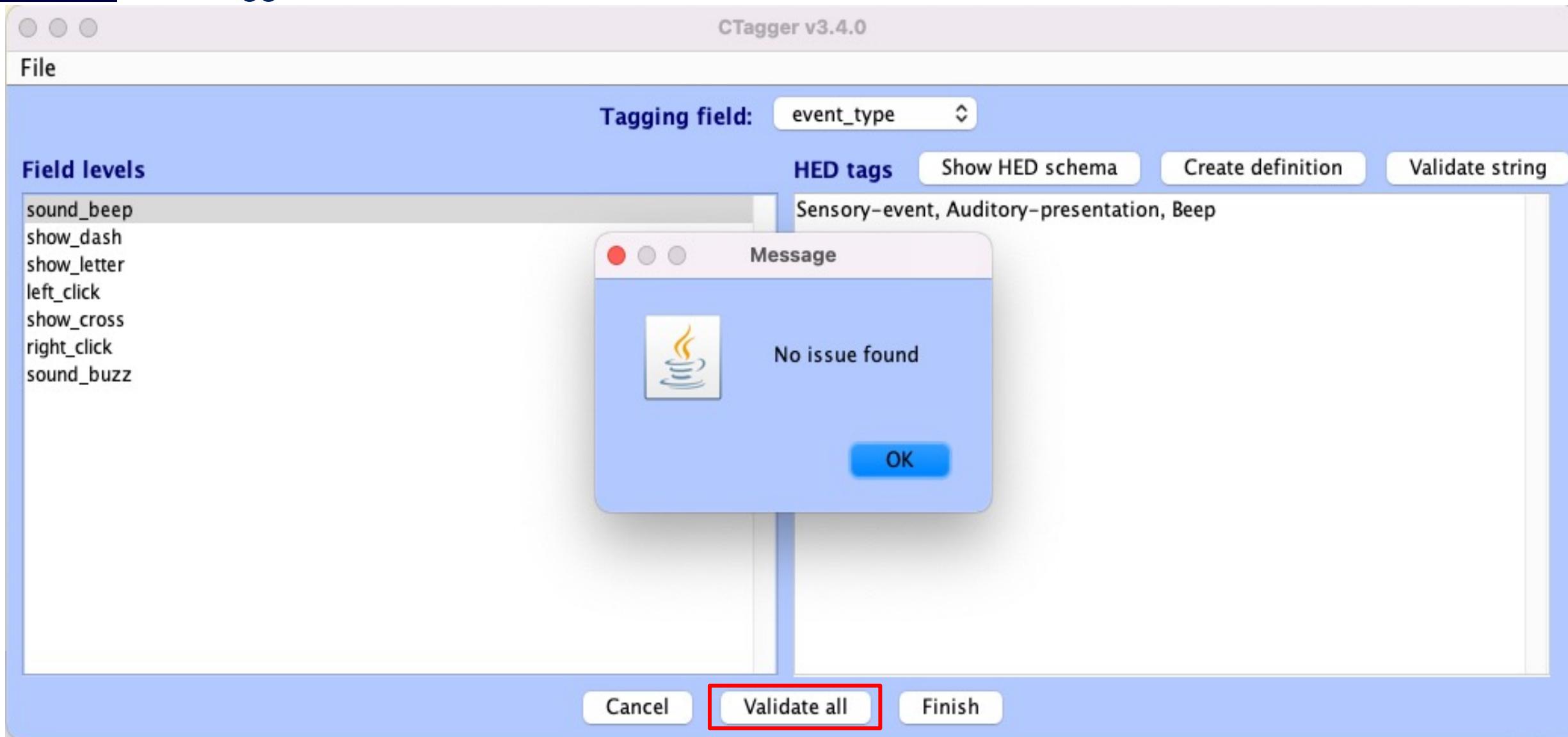
Choose **File → Import → Import BIDS events.json file** to resume annotations



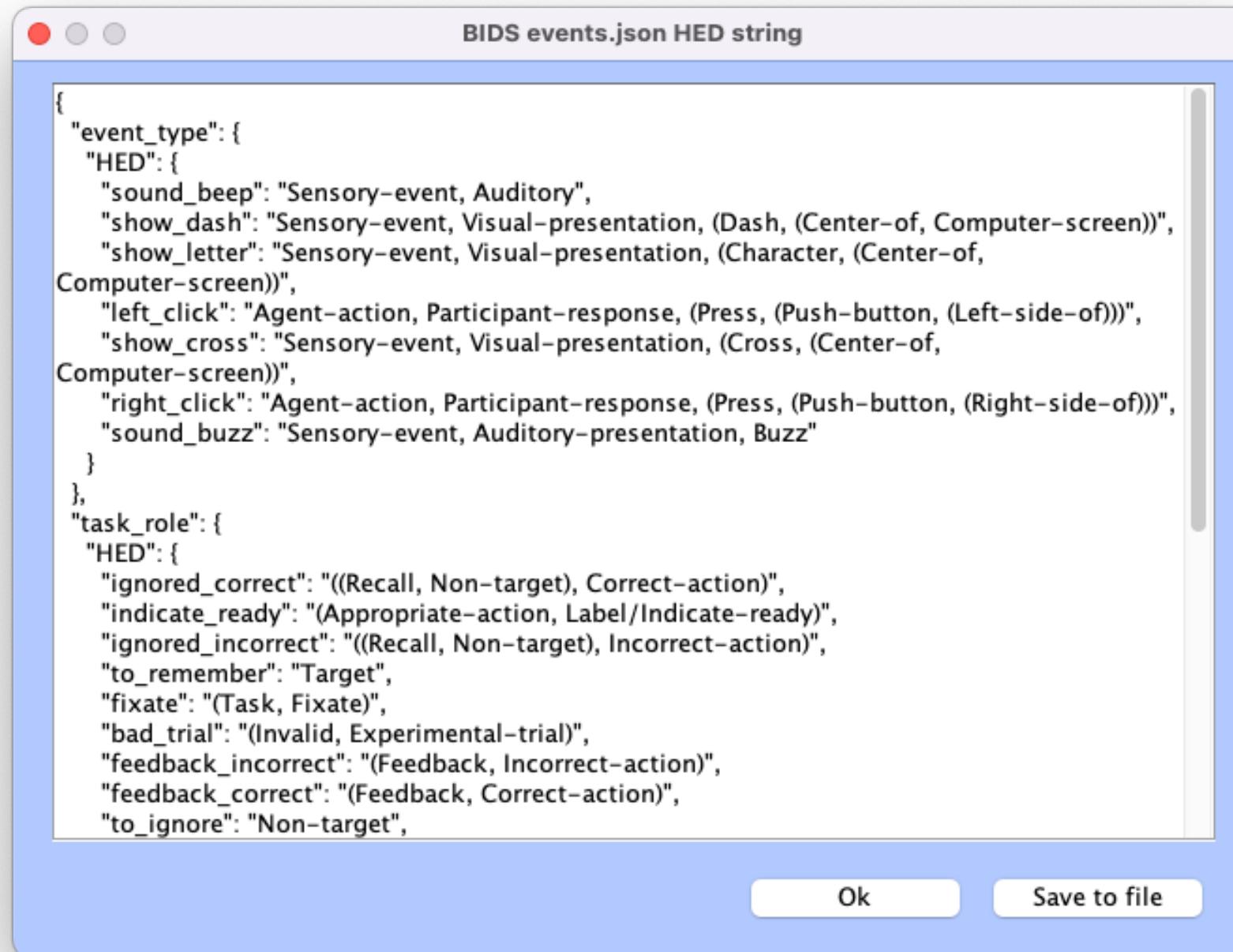
The screenshot shows the CTagger v3.4.0 application window. The menu bar at the top includes File, Import, Change schema version, and Review all tags. The Import menu is currently open, displaying three options: Import annotation spreadsheet, Import BIDS events.tsv file, and Import BIDS events.json file. The Import BIDS events.json file option is highlighted with a blue selection bar. On the right side of the window, there is a search field labeled "Field:" with "event_type" selected. Below it are buttons for "HED tags", "Show HED schema", "Create definition", and "Validate string". A text area displays the HED tag definition: "Sensory-event, Visual-presentation, (Dash, (Center-of, Computer-screen))". At the bottom of the window are three buttons: Cancel, Validate all, and Finish.

Validate the annotations

CTagger communicates with the *online HEDTools API* to validate the annotations



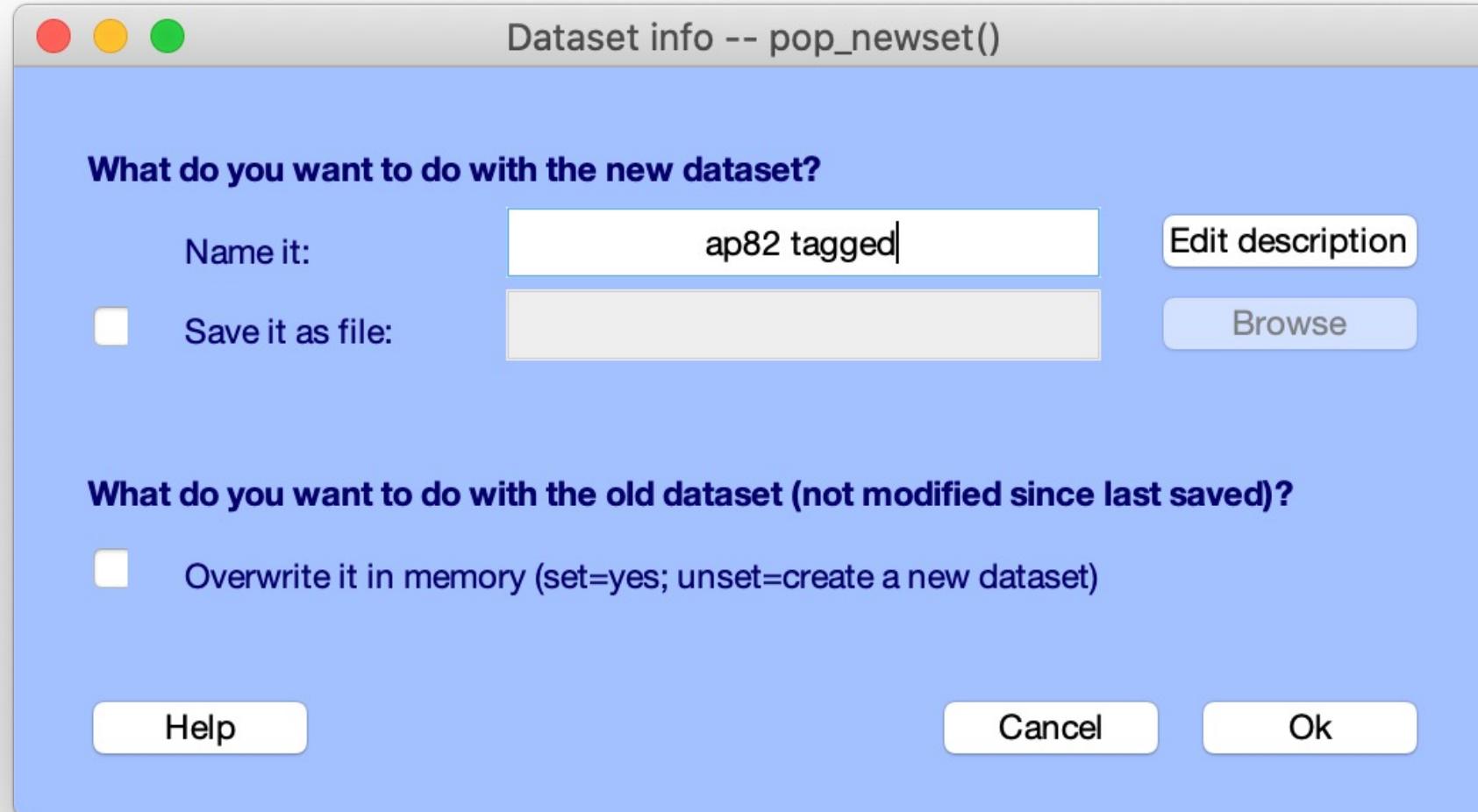
The annotation now is complete!



... but can be
later extended !!

Save the HED tagged dataset

Annotation can be saved for a single recording (as shown here) or for the entire EEGLAB STUDY



The HED-tagged dataset

Variables - EEG	
EEG	x
EEG.event	x
1x1 struct with 42 fields	
Field ▲	Value
ch setname	'ap82 tagged2'
ch filename	"
ch filepath	"
ch subject	"
ch group	"
ch condition	"
ch session	[]
ch comments	12x92 char
nbchan	71
trials	1
pnts	617076
srate	250
xmin	0
xmax	2.4683e+03
times	1x617076 double
data	71x617076 single
icaact	[]
icawinv	71x71 double
icasphere	71x71 double
icaweights	71x71 double
icachansind	1x71 double
chanlocs	1x71 struct
urchanlocs	[]
chaninfo	1x1 struct
ref	'common'
event	1x1400 struct
urevent	1x1400 struct
eventdescription	1x7 cell
epoch	[]
epochdescripti...	0x0 cell
reject	1x1 struct
stats	1x1 struct
specdata	[]
specicaact	[]
splinefile	"
icasplinefile	"
dipfit	[]
history	1x574 char
saved	'no'
etc	1x1 struct
datfile	"
run	[]

Variables - EEG.etc	
EEG	x
EEG.event	x
EEG.etc	x
Field ▲	Value
ch eeglabvers	'2020.0'
icaweights_bef...	71x71 double
icasphere_bef...	71x71 double
tags	1x1 struct

Variables - EEG.etc.tags.map		
EEG	x	
EEG.event	x	
EEG.etc	x	
EEG.etc.tags	x	
EEG.etc.tags.map	x	
Fields	ch field	ch values
1	'duration'	1x1 struct
2	'letter'	1x1 struct
3	'purpose'	1x9 struct
4	'type'	1x7 struct
5		
6		

The HED tagged dataset

HEDTools will assemble annotations for all field values of each event row (as shown) during epoching and analysis

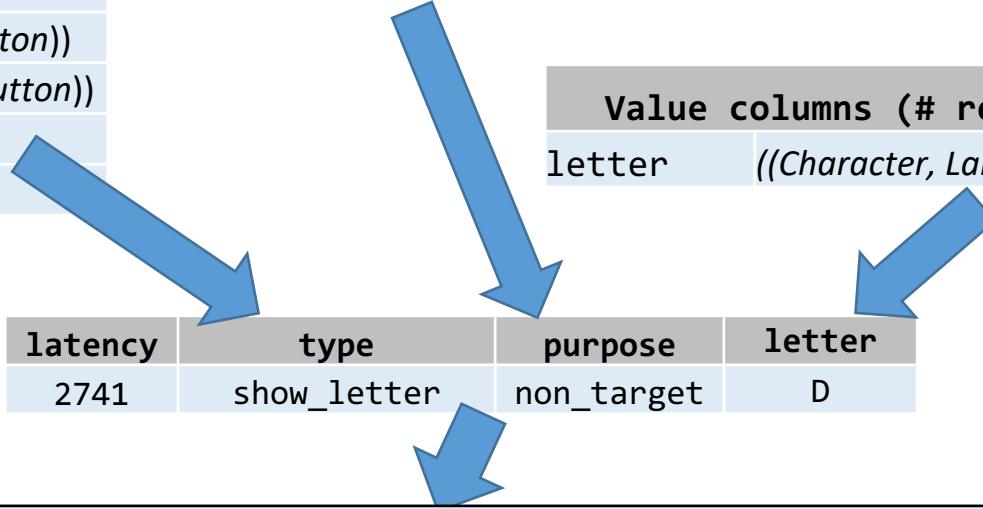
Variables - EEG.event

	EEG	EEG.event	EEG.etc	EEG.etc.tags	EEG.etc.tags.map		
	EEG.event						
Fields	ch type	latency	duration	urevent	ch purpose	ch letter	HED
1	'show_cr...	1430	50282		1 'fixation'	'n/a'	'Cross, Sensory-event, Visual, (Experimental-participant, Fixate)'
2	'show_let...	2741	12238		2 'non_target'	'D'	'Experimental-stimulus, Non-target, Sensory-event, Visual, (Center-of, Screen), (Character, Green), (Character, Label/D)'
3	'show_let...	3102	12229		3 'non_target'	'M'	'Experimental-stimulus, Non-target, Sensory-event, Visual, (Center-of, Screen), (Character, Green), (Character, Label/M)'
4	'show_let...	3462	12238		4 'non_target'	'B'	'Experimental-stimulus, Non-target, Sensory-event, Visual, (Center-of, Screen), (Character, Green), (Character, Label/B)'
5	'show_let...	3822	12238		5 'target'	'Y'	'Experimental-stimulus, Sensory-event, Target, Visual, (Black, Character), (Center-of, Screen), (Character, Label/Y)'
6	'show_let...	4183	12238		6 'non_target'	'H'	'Experimental-stimulus, Non-target, Sensory-event, Visual, (Center-of, Screen), (Character, Green), (Character, Label/H)'
7	'show_let...	4543	12228		7 'target'	'Q'	'Experimental-stimulus, Sensory-event, Target, Visual, (Black, Character), (Center-of, Screen), (Character, Label/Q)'
8	'show_let...	4903	12238		8 'target'	'C'	'Experimental-stimulus, Sensory-event, Target, Visual, (Black, Character), (Center-of, Screen), (Character, Label/C)'
9	'show_let...	5264	12236		9 'non_target'	'G'	'Experimental-stimulus, Non-target, Sensory-event, Visual, (Center-of, Screen), (Character, Green), (Character, Label/G)'
10	'show_da...	5624	33685		10 'working_...	'n/a'	'Cue, Dash, Experimental-stimulus, Sensory-event, Visual'
11	'show_let...	6521	12238		11 'probe'	'C'	'Experimental-stimulus, Query, Sensory-event, Visual, (Center-of, Screen), (Character, Label/C)'

Tag the event concepts ...then let tools assemble full event descriptions:

Type	HED tags
show_cross	Sensory-event, Visual, Cross
show_letter	Sensory-event, Visual
show_dash	Sensory-event, Visual, Dash
left_click	Agent-action, (Press, (Left-side, Mouse-button))
right_click	Agent-action, (Press, (Right-side, Mouse-button))
sound_beep	Sensory-event, Auditory, Beep
sound_buzz	Sensory-event, Auditory, Buzz

Purpose	HED tags
fixation	(Experimental-participant, Fixate)
non_target	Experimental-stimulus, Non-target , (Character, Green)
target	Experimental-stimulus , Target, (Character, Black)
working_memory	Experimental-stimulus , Cue
probe	Experimental-stimulus , Query
correct_feedback	Feedback, Correct
incorrect_feedback	Feedback, Incorrect
ready	Participant-indication
in_group	Participant-response, (Behavioral-evidence, Target)
out_group	Participant-response, (Behavioral-evidence, Non-target)



Sensory-event, Visual, Experimental-stimulus, Non-target, (Character, Green), ((Character, Label/D), (Center-of, Screen))

Then locate and collect events based on HED tags using *hedepoch*,
e.g., to find events tagged, ‘Experimental-stimulus AND Non-target’ ...



This works for BIDS datasets

Excerpt from the BIDS events.tsv file

onset	duration	sample	type	purpose	letter
19.6120	n/a	4903	show_letter	target	C
21.0560	n/a	5264	show_letter	non_target	G
22.4960	n/a	5624	show_dash	working_memory	n/a
26.0840	n/a	6521	show_letter	non_target	C
27.3960	n/a	6849	right_click	in_group	n/a
27.8720	n/a	6968	sound_beep	correct_feedback	n/a

Excerpt from the BIDS events.json file

```
{ . . .
  "type": {
    "Description": "Column giving general category of event... ",
    "HED": {
      "show_cross": "Sensory-event, Visual, Cross",
      "show_letter": "Sensory-event, Visual",
      "show_dash": "Sensory-event, Visual, Dash",
      "left_click": "Agent-action, (Press, (Left-side, Mouse-button),
      "right_click": "Agent-action, (Press, (Right-side, Mouse-button),
      "sound_beep": "Sensory-event, Auditory, Beep",
      "sound_buzz": "Sensory-event, Auditory, Buzz"
    }
  },
  "letter": {
    "Description": "Column giving the character presented... ",
    "HED": "((Character, Label/#), (Center-of, Screen))"
  }
}
```

Assembled annotation for first event in the excerpt:

Sensory-event, Visual,

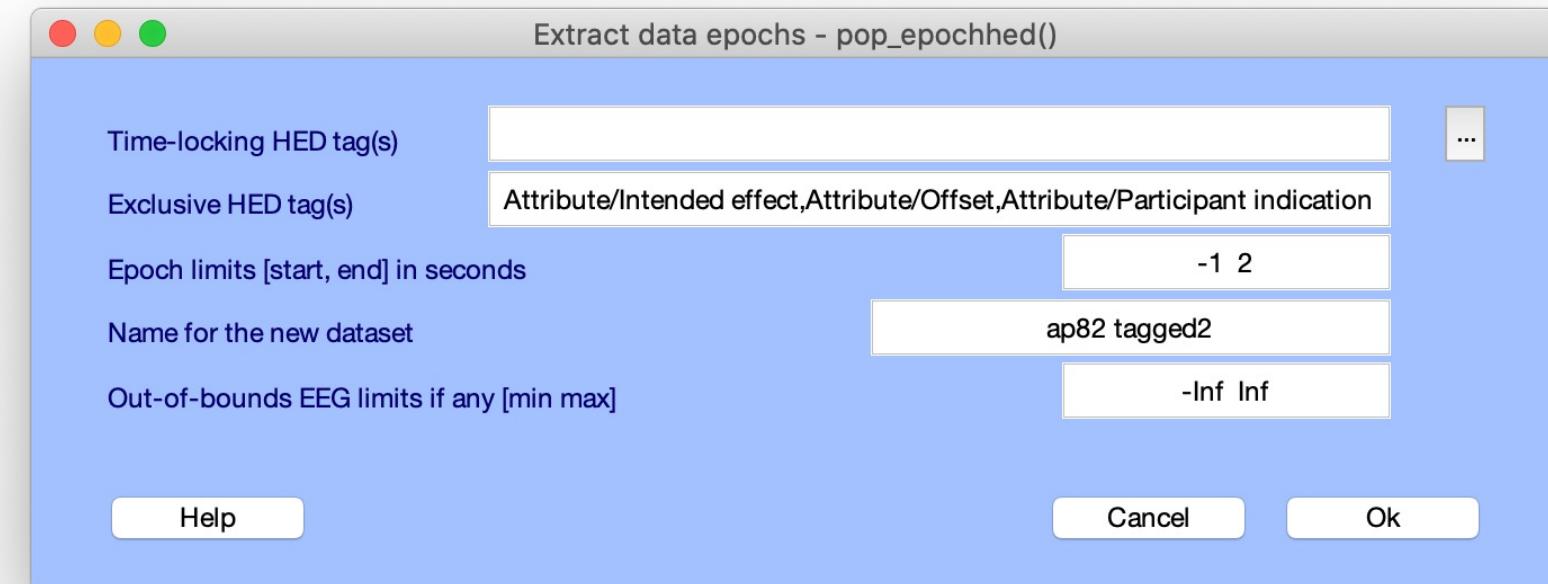
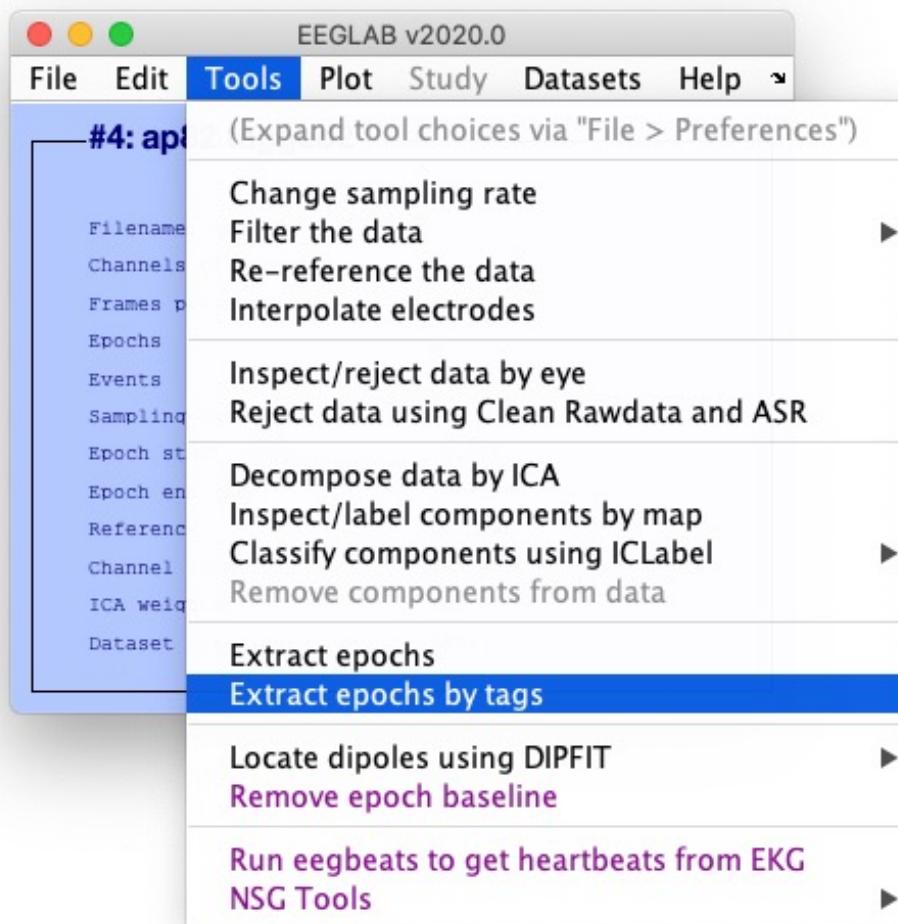
Experimental-stimulus, Target, (Character, Black),

((Character, Label/C), (Center-of, Screen))

A single JSON file, with term meanings noted... Tools do mapping during HED validation and subsequent data analysis.

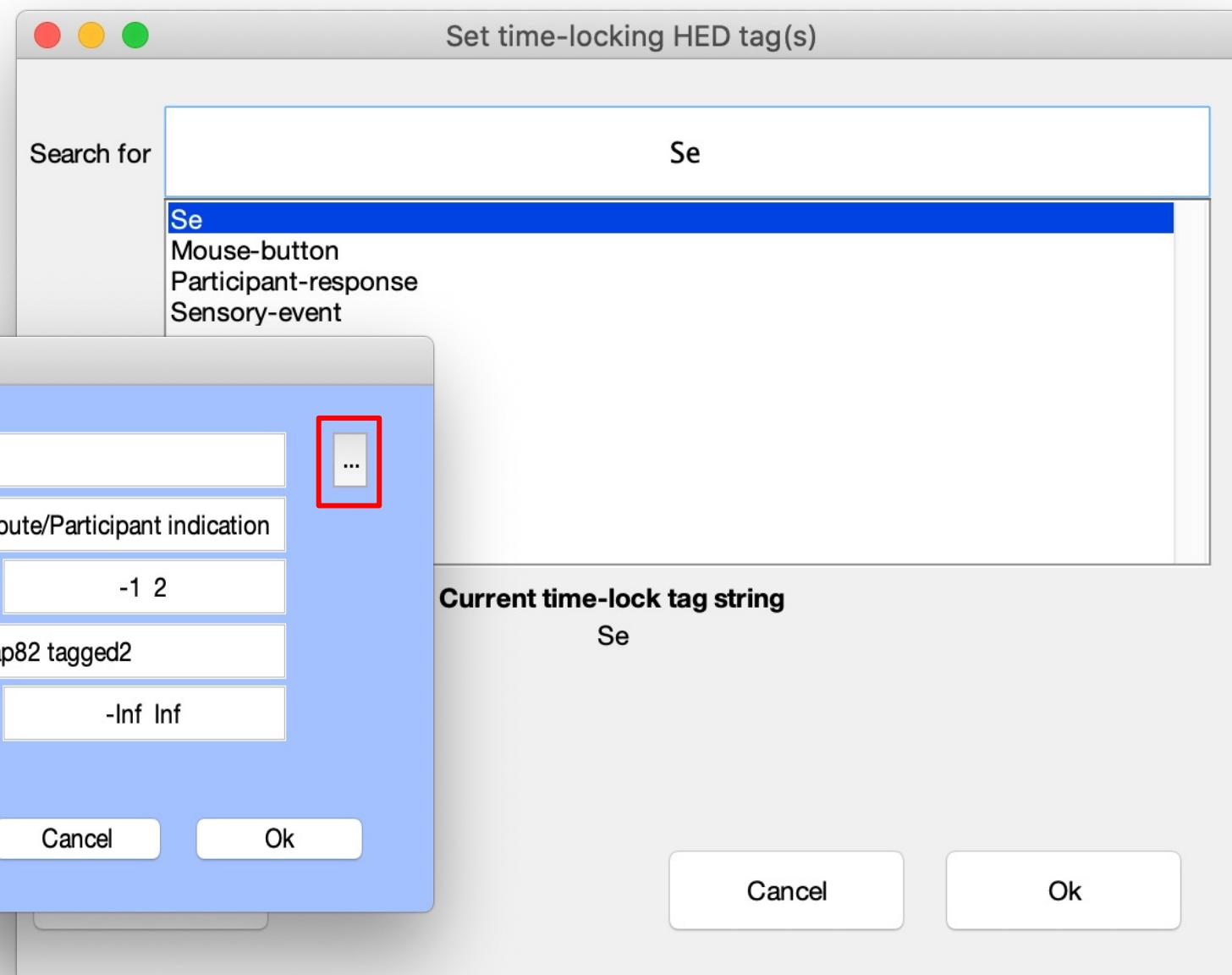
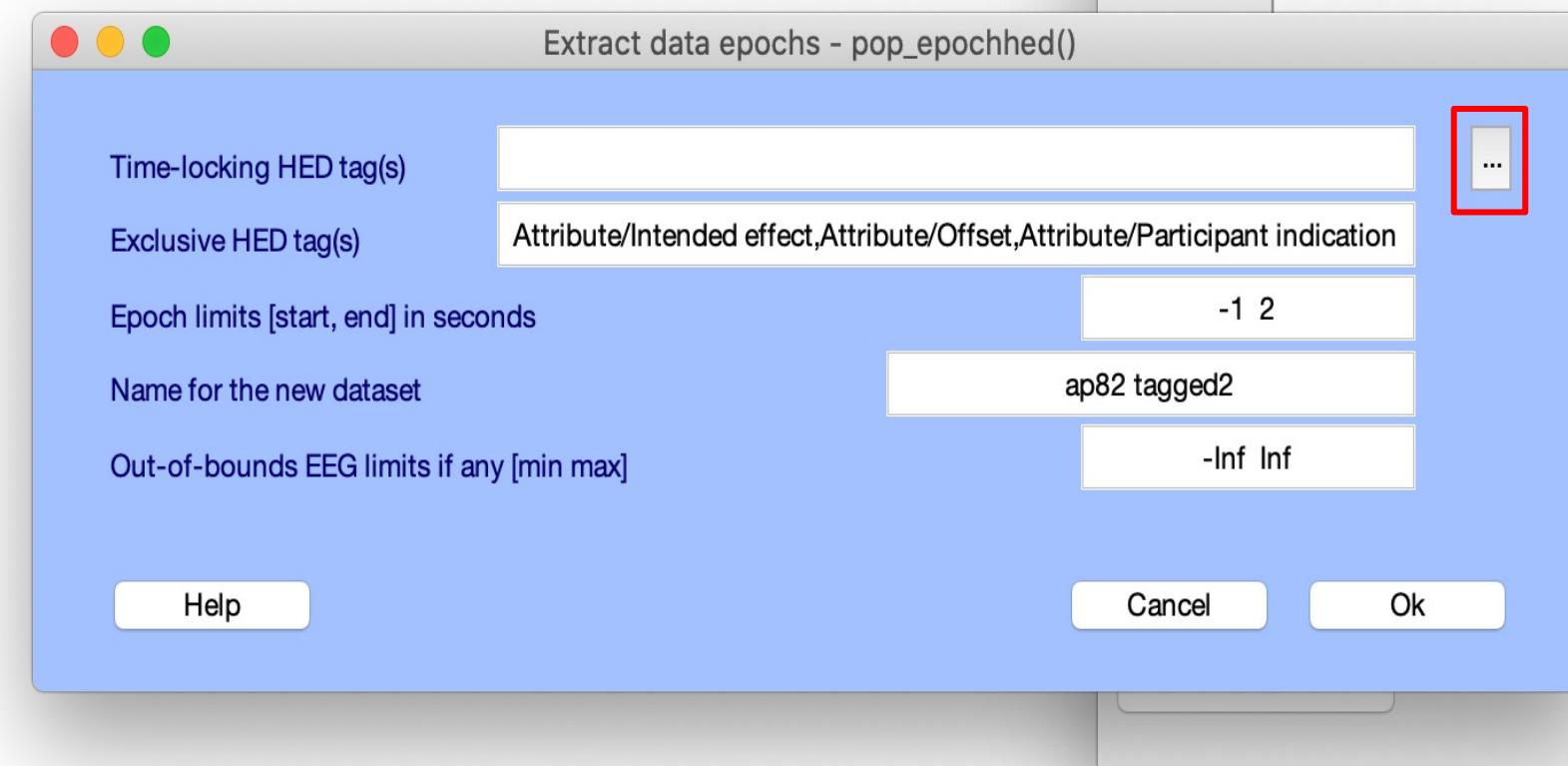
HED epoching

Tools → Extract epochs by tags lets users enter/choose HED tags as epoch-extraction indexes



The HED tag lookup tool

GUI tool lets the user search among existing annotations and choose tags to use as HED query





HED-based data epoch selection



Extract data epochs - pop_epochhed()

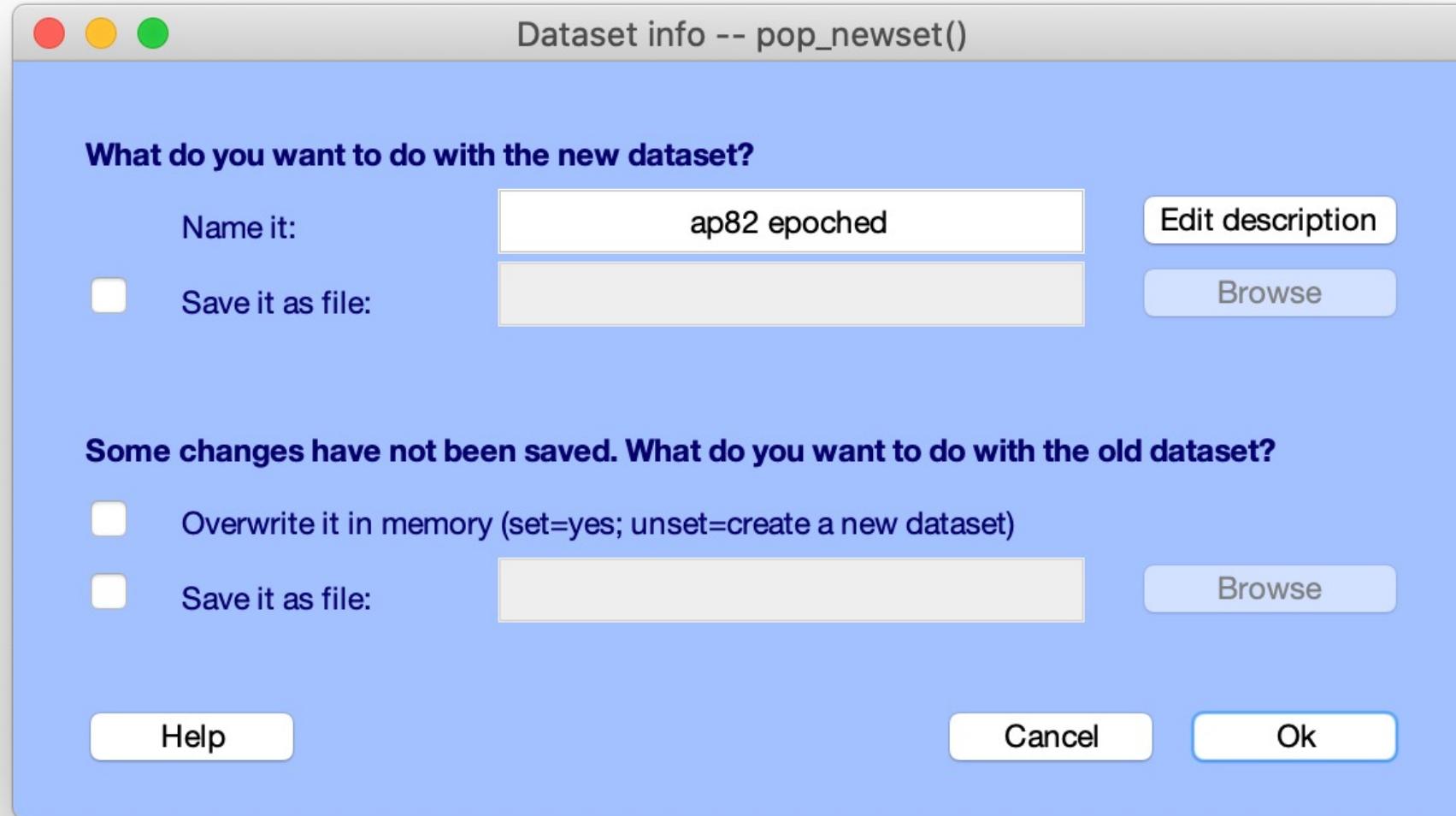
Time-locking HED tag(s)	Sensory-event, Target	...
Exclusive HED tag(s)	Attribute/Intended effect,Attribute/Offset,Attribute/Participant indication	
Epoch limits [start, end] in seconds	-1 2	
Name for the new dataset	ap82 tagged2	
Out-of-bounds EEG limits if any [min max]	-Inf Inf	

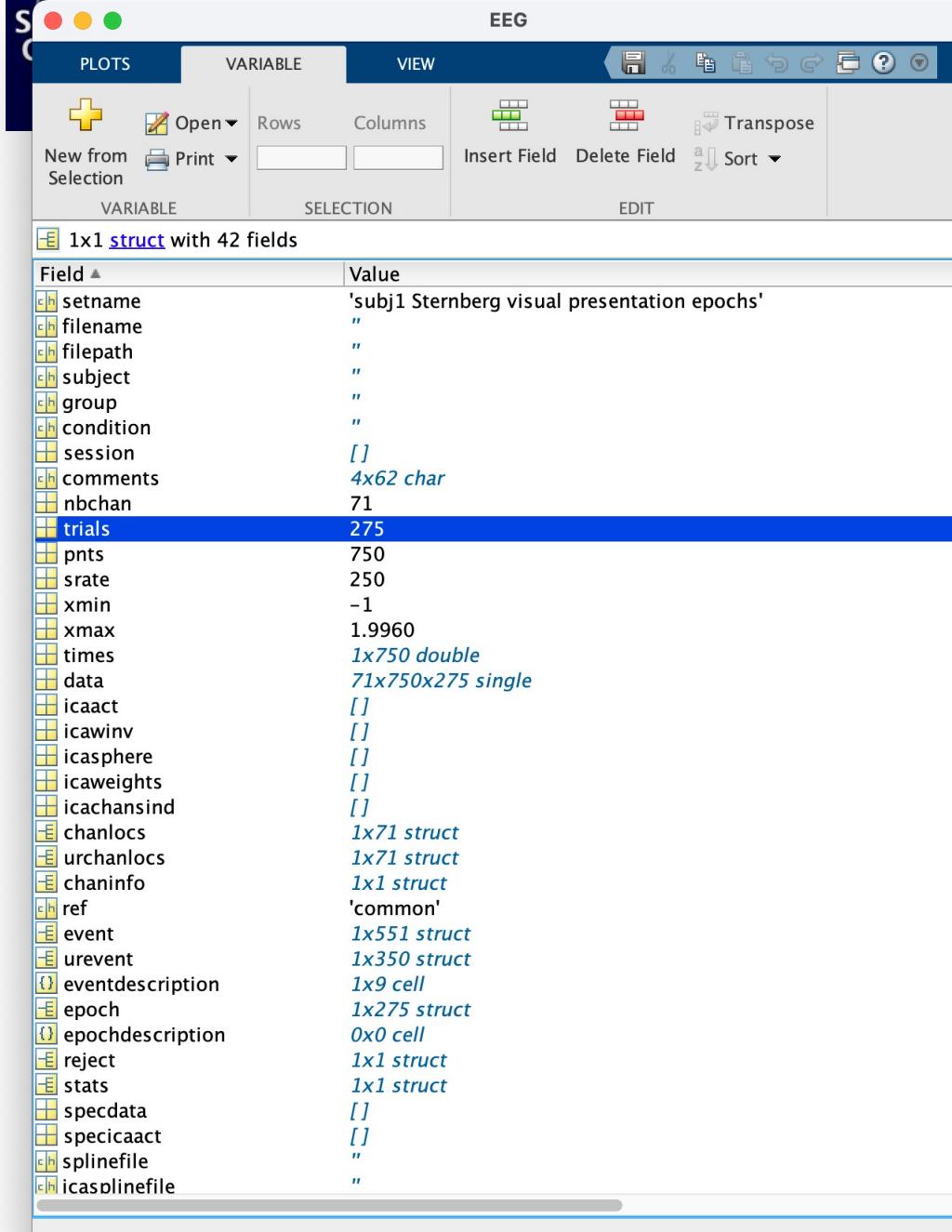
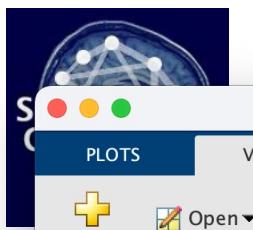
Help Cancel Ok

The ‘epoched’ dataset

The ‘epoched’ EEGLAB dataset (single recording) can be saved for further analysis.

NOTE: If processing an EEGLAB **STUDY**, epoching will be applied to *all* datasets in the STUDY.

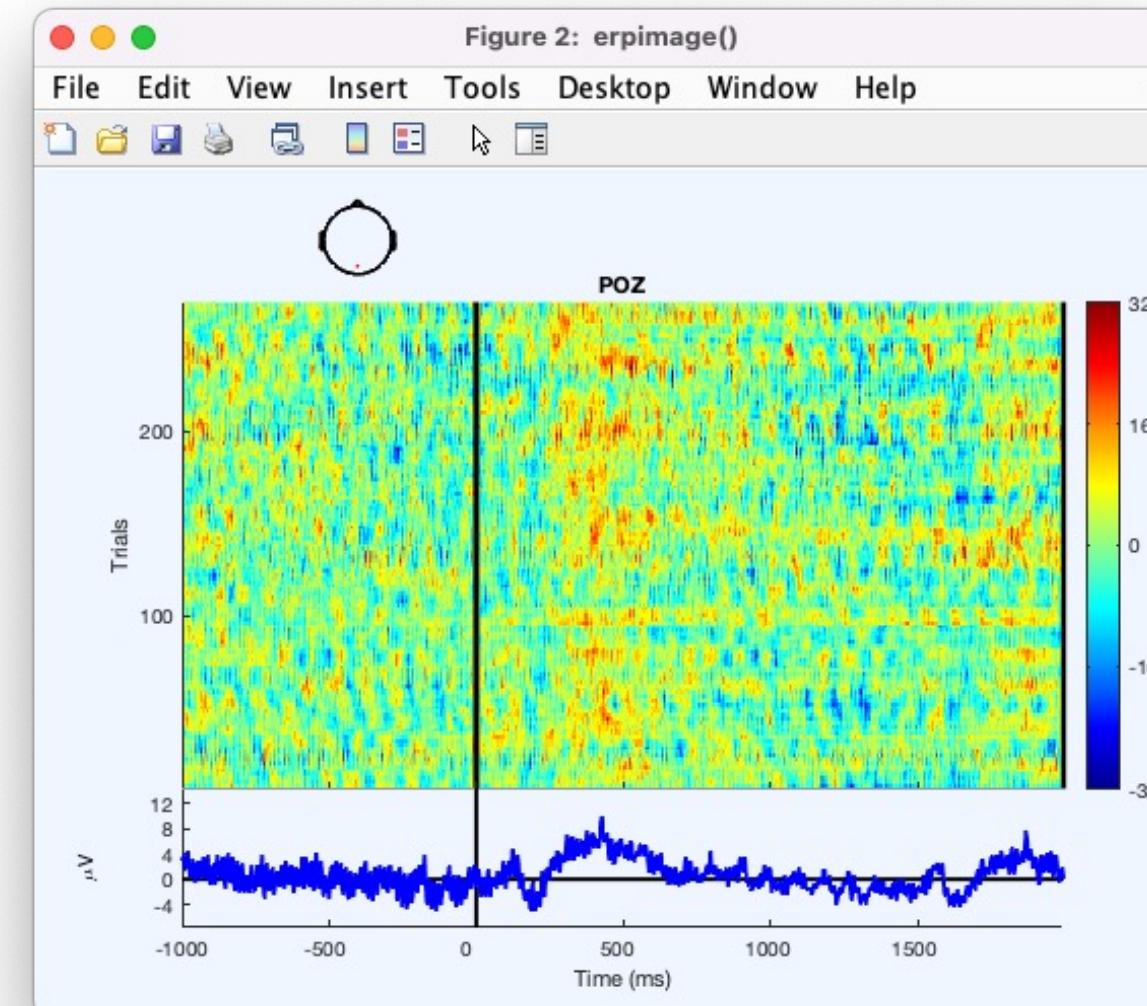




A HED-based ERP image

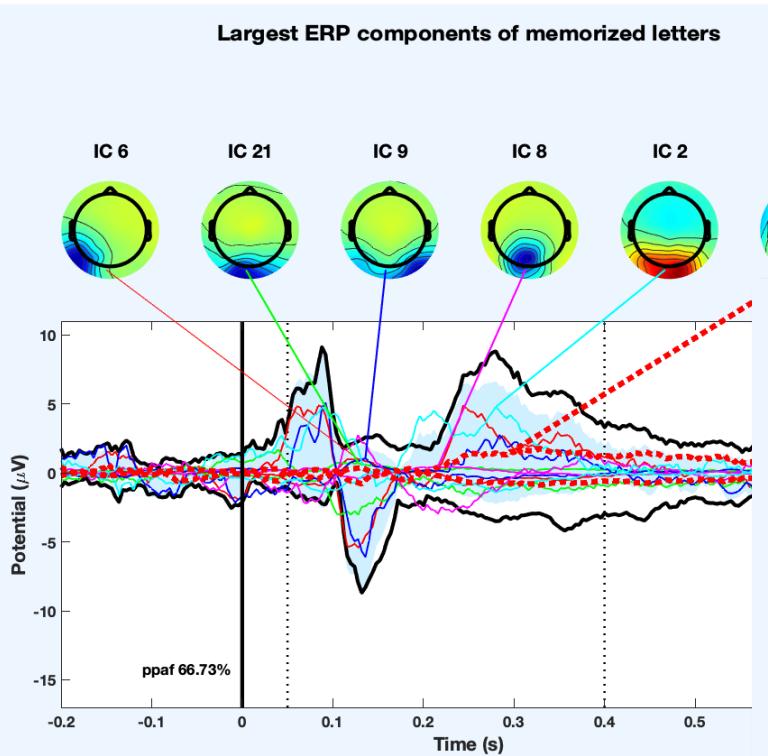


HED query: '*Visual-presentation*'



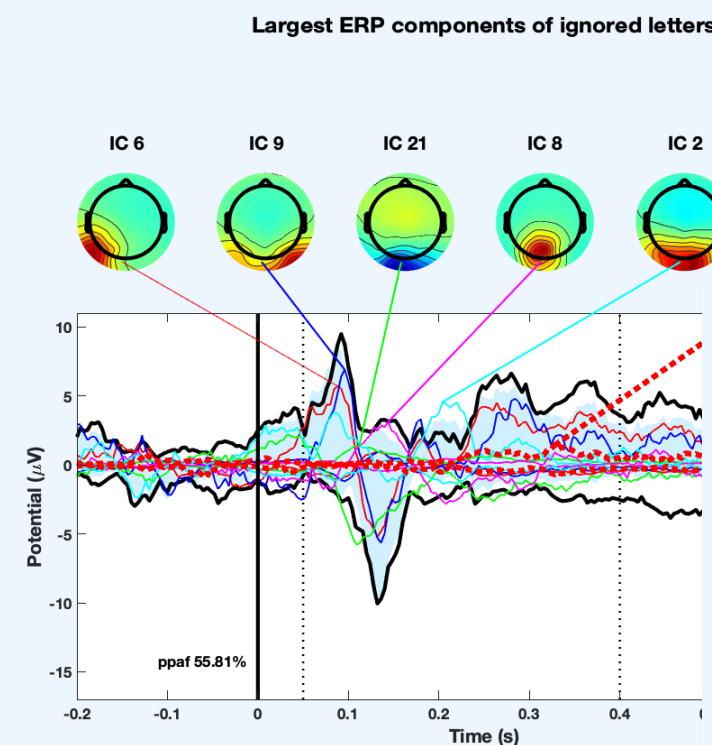
Applied to data

Letters to memorize (black)

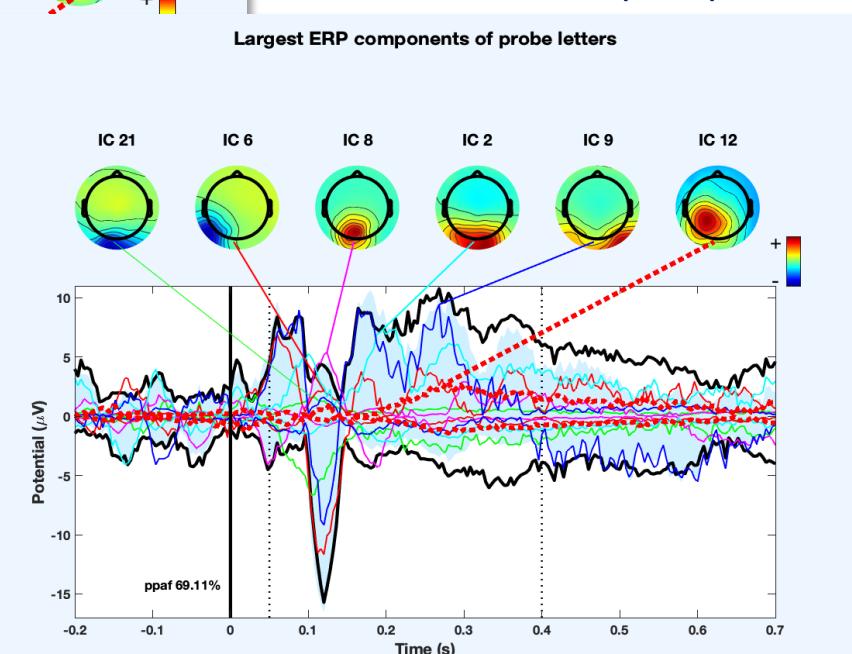


Independent Components (ICs)

Letters to ignore (green)



Probe letters (red)

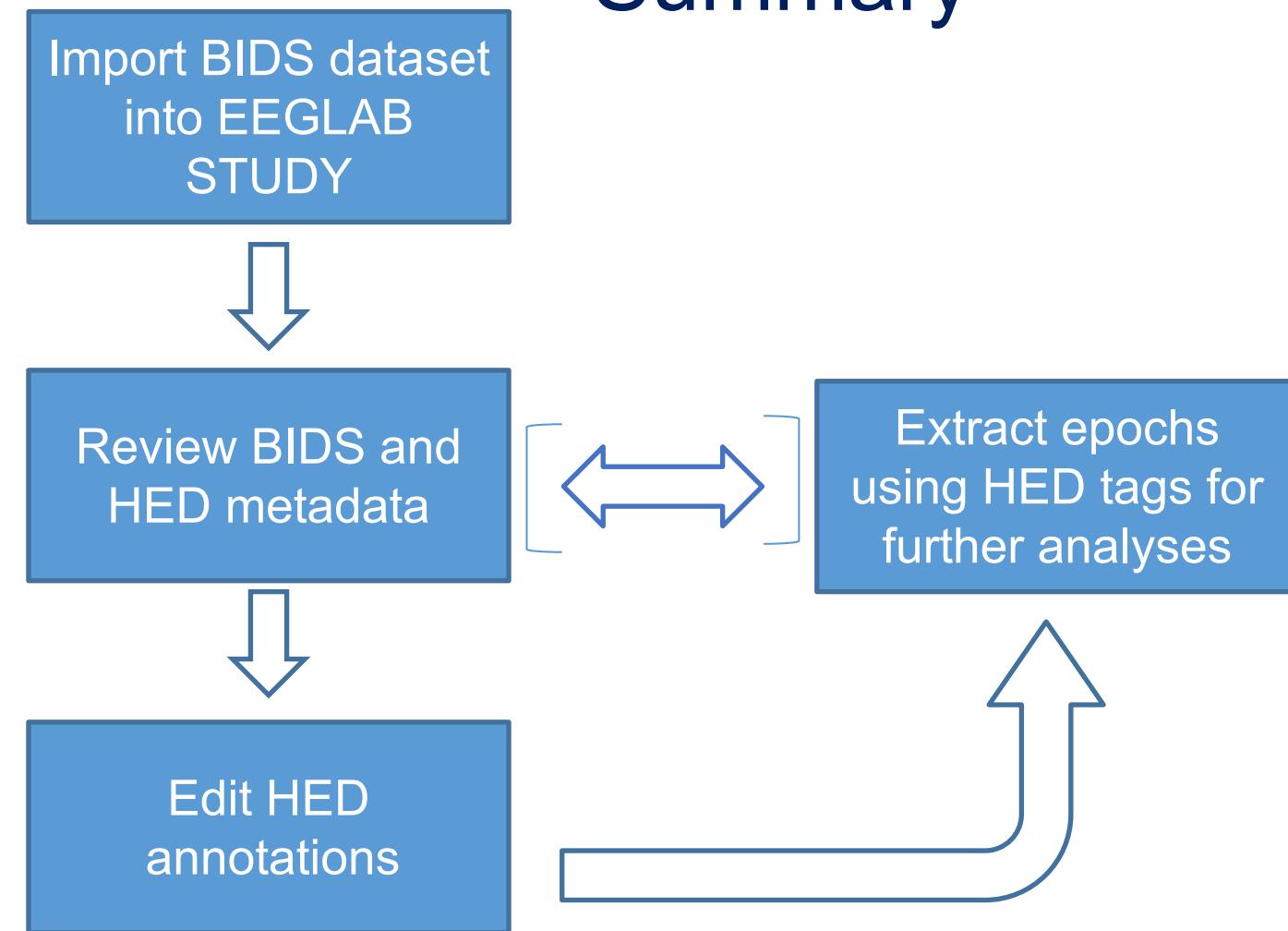


Annotation is an iterative process

Online documentation provides guide on how to approach your tagging:
<https://hed-examples.readthedocs.io/en/latest/HedAnnotationQuickstart.html>

① Standard HED tag selections for minimal annotation.				② Standard HED tag selections for minimal annotation.			
Event tag	Support tag type	Example tags	Reason	Data-feature	Data-source-type	Expert-annotation Computed-feature	Where did the feature?
Sensory-event	Sensory-presentation	Visual-presentation Auditory-presentation	Which sense?	Data-feature	Data-source-type	Expert-annotation Computed-feature	Where did the feature?
	Task-event-role	Experimental-stimulus Instructional	What task role?		Label	Label/Blinker_BlinkMax	Tool name? Feature type?
	Task-stimulus-role	Cue Target	Stimulus purpose?				
	Item	(Face, Image) Siren	What is presented?		Data-value	Percentage/32.5 Time-interval/1.5 s	Feature value or type?
	Sensory-attribute	Red	What modifiers are there?				
Agent-action	Agent-task-role	Experiment-participant	Who is agent?	Experiment-control	Agent	Controller-Agent	What is the controller?
	Action	Move Press	What action is performed?	Informational	Label/Stop-recording	Label/Stop-recording	What did the controller do?
	Task-action-type	Appropriate-action Near-miss	What task relations?				
	Item	Arm Mouse-button	What is action target?	Experiment-procedure	Task-event-role	Task-activity	What procedure?
Data-feature	Data-source-type	Expert-annotation Computed-feature	Where did the feature?	Experiment-structure	Organizational-property	Time-block Condition-variable	What structural properties?
Measurement-event	Data-source-type	Instrument-measurement Observation	Source of the data.	Measurement-event	Data-source-type	Instrument-measurement Observation	Source of the data.
				Label	Label/Oximeter_O2Level	Label/Oximeter_O2Level	Instrument name? Measurement type?

Summary



More documentation is available at:
<https://hed-examples.readthedocs.io>

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