

EEG Study Schema (ESS)

We have developed an XML-based specification, ESS ('EEG Study Schema'), to hold all the information necessary to analyze an EEG study (e.g., task and paradigm description, recording parameters, sensor locations, gender, handedness, age and group associations of subjects, etc.) in a format that is both human- and machine-readable (meaning the XML file may be readily formatted into a readable description of the EEG study). ESS embeds HED descriptions (Hierarchical Event Descriptor or HED tags, see HED whitepaper for more details) of experimental events and tasks along with subject information such as handedness and gender, into an ESS XML document,. Together ESS and HED provide a metadata hierarchy for describing and documenting electrophysiological studies and their recorded data. ESS is designed from a user-centered viewpoint that emphasizes simplicity and ease of use. It is created to contain all the information a researcher unfamiliar with a particular EEG (or MEG) Study needs to further analyze the data. Some ESS definitions:

ESS file: An XML formatted file that contains all study metadata, either embedded in the XML file or referenced as external resources (URIs) with proper XML description.

ESS-formatted folder: A folder with data arranged in a specific structure (e.g., individual sessions under a top-level */session* folder, publications under */publications*) making it easy to share with other researchers and/or to upload to a HeadIT Store.

Each ESS file is associated with a single HeadIT Study and at least contains the following information:

- Study name.
- Text description of the Study.
- A summary containing useful information about the Study. For example:
 - Number of Sessions: 15
 - Number of Subjects: 8
 - Type of Subject Groups: normal
 - All subjects considered healthy and normal: Yes
 - Numbers of channels (min to max): 256 to 256
 - Recorded data modalities: EEG (BIOSEMI ActiveTwo)
 - Total Size: 14.3 GB
 - License Type: CC0
- Subject Tasks in the Study and their HED specifications. A HeadIT Task is defined as a portion of a Study with sufficiently similar experiment structure. For example, in one Study session there may be two Tasks. In one, the subject is to listen to certain words and press a button upon hearing a target word; in the other Task, the subject is to read aloud words displayed on a computer monitor.
- Names of experimenters involved in designing the Study and collecting the Study data.
- The type of license under which the study data is to be shared (e.g., CC0).
- A table of Study session and subject information (age, gender, handedness, group ID) for each session.

- A table that contains paths pointing to individual Study raw data files (EEG, behavior, and other data modalities) and clarifying their temporal relationships and associations to Study sessions, tasks, and subjects.
- Recording parameters and types of recording equipment.
- Institutional Review Board (IRB) identity and protocol number under which data were collected.
- A table containing numeric event codes (if any), with text descriptions and HED tags (see example below).

Event Code	Condition		
	Label	Description	HED Tags
1	non-target	satellite image of London without the white airplane target	Stimulus/Visual, Stimulus/Onset, Stimulus/Non-Target
2	target frames	satellite image of London with the white airplane target	Stimulus/Visual, Stimulus/Onset, Stimulus/Target

The ESS XML specification file is accompanied by an ESS style sheet that automatically formats XML content into a human-readable report for display in a web browser. To create an ESS-formatted study (without using ESS tools) an experimenter can:

1. Copy a provided ESS template folder into a new location and rename it to match the name of the new Study.
2. Create folders under /session subdirectory, with integer names (from 1 to the number of sessions in the Study).
3. Place all the files associated with each session into their associated /session folder.
4. Open the provided study_description.xml template file in any text editor with XML highlighting
5. Fill in the required file information under each XML node.
6. Look up HED tags for each event code and task in the provided HED specification using a HeadIT web application

The ESS-formatted Study is now ready to be shared with other researchers. The experimenter can now upload it to the HeadIT website for storage and sharing execution.