CRCNS.org fcx-2 data description

Version 0.61 (April 4, 2018)

Intracranial EEG recordings of medial temporal, lateral frontal, and orbitofrontal regions in 10 human adults performing a visuospatial working memory task.

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Summary

Species, brain region, recording method, and type of data:
Human intracranial EEG (iEEG) recording subdurally or stereotactically with 5 or 10 mm spacing between channels, sampled at 1 kHz or 512 Hz. Individual data for 10 epileptic patients (mean ± SD [range]: 37 ± 13 [22-69] years of age, 7 males) with channels in frontal and medial temporal lobes. Primary (filtered) and derived (fully preprocessed) iEEG data, and analysis scripts included.

Stimuli, behavior, and conditions of the participant:
Visuospatial working memory task. Each trial consisted of five phases: pretrial, encoding, pre-cue delay, post-cue delay, and response. Following a 1-s pretrial fixation interval, participants were cued to focus on either IDENTITY or RELATION information. Then, two common-shape stimuli were presented for 200 ms each on the in the center of the screen in a specific spatiotemporal configuration (i.e., top/bottom spatial and first/second temporal positions). After a 900- or 1150-ms jittered pre-cue delay fixation interval, the test prompt appeared, followed by a post-cue delay fixation interval of the same length. Working memory was tested in a two-alternative forced choice test, resulting in a 0.5 chance rate. In the identity test, subjects indicated whether the pair was the SAME pair they just studied (50% yes/no). In the spatiotemporal relation test, subjects indicated which shape fit the TOP/BOTTOM spatial or FIRST/SECOND temporal relation prompt (50% per stimulus). Participants completed 120 trials.

Methods, participants, and results are described in:

> Johnson, E. L., Adams, J. N., Solbakk, A.-K., Endestad, T., Larsson, P. G., Ivanovic, J., Meling, T. R., Lin, J. J., Knight, R. T. Dynamic frontotemporal systems process space and time in working memory. *PLOS Biology* 16, e2004274 (2018). doi:10.1371/journal.pbio.2004274

Conditions for using the data

Anyone wishing to publish results from this dataset should consult the lead researcher, E. L. Johnson (eljohnson@berkeley.edu) and cite the publication above (Johnson et al., 2018) and cite the data set using the following:

Johnson (2018); Intracranial EEG recordings of medial temporal, lateral frontal, and orbitofrontal regions in 10 human adults performing a visuospatial working memory task. CRCNS.org
http://dx.doi.org/10.6080/K0VX0DQD

Methods

Methods and participants are described in:

> Johnson, E. L., Adams, J. N., Solbakk, A.-K., Endestad, T., Larsson, P. G., Ivanovic, J., Meling, T. R., Lin, J. J., Knight, R. T. Dynamic frontotemporal systems process space and time in working memory. *PLOS Biology* (2018).

Data files organization

Summary files describing the subjects and channels analyzed are in the "docs" directory in files:

- File: summary_file.csv
- File: summary_channel_analysis.csv

Data files for each subject are stored in ".tar.gz" files inside the "data_indiv" directory. They are organized by individual subject ID, as follows:

- Directory: data_indiv
    - Sub-directory: s<<subject number>>.tar.gz. Contains:
        - File: summary_file_trial.csv
        - File: s<<subject number>>_MNI_grid.csv
        - File: data_primary.mat
        - File: data_derived.mat

> Note: The data in "data_derived" are fully preprocessed, including channel selection and bipolar montage re-referencing. Channel MNI coordinates are provided for the channels included in "data_primary" (i.e., all channels).

Custom-built analysis scripts are saved in the "analysis_scripts" directory, as follows:

- Directory: analysis_scripts
    - File: <<metric>>_compute
    - Sub-directory: subfunctions
        - File: <<function>>

> Note: Some scripts call functions in the "subfunctions" sub-directory.

Data format

Primary iEEG data files are in .mat (MATLAB) format, sampled at 1 kHz or 512 Hz. The file includes a list of named channels (elec_labels.mat) and a channel-by-sample matrix (gdat_clean_filt.mat) that are stored in s<<subject number>>/data_primary.

> NOTE: The data in gdat_clean_filt have been bandpass filtered between 1-200 Hz using a finite impulse response filter. Any datasets recorded at a sampling rate higher than 1 kHz have been down-sampled to 1 kHz.

The s<<subject number>>/summary_file_trial file is in .csv (comma-separated value) format, and contains information about each trial, which is used to epoch the continuous iEEG dataset into single trials. These files are organized with one row per trial, and the following columns:

A. Trial number
B. Accuracy: 1 = correct, 0 = incorrect
C. Trial type: 1 = identity, 2 = relation
D. Condition: 1 = identity, 2 = spatial relation, 3 = temporal relation
E. Delay jitter length in ms: 900/1150
F. Response time in ms
G. Pretrial epoch start time at the sampling rate (1000 ms before trial start)
H. Encoding and pre-cue delay epoch start time at the sampling rate (length: 600 ms + jitter)
I. Post-cue delay epoch start time at the sampling rate (length: jitter)

> Note: The response epoch starts at the end of the processing epoch (I) and lasts the length of the response time (F).

> Note: S1-7 and S10 are sampled at 1 kHz (ms). S8 and S9 are sampled at 512 Hz.

Derived iEEG data files are in .mat (MATLAB) format. The derived EEG data variables are stored as data structures with standard container, custom organizations according to the FieldTrip toolbox extension. There are three dataset variables in s<<subject number>>/data_derived, one for the pretrial interval (“pre”), one for the encoding and pre-cue delay interval (“encmain”), and one for the post-cue delay interval (“proc”). Each structure is organized with the format:

> hdr: [1x1 struct]
> label: {<<number of channels>>x1 cell}
> fsample: 1000
> trial: {1x<<number of trials>> cell}
> time: {1x<<number of trials>> cell}
> trialinfo: [<<number of trials>>x6 double]

The hdr field contains information from the primary data file. The label field contains the channel labels. The trial field contains the iEEG data, with one trial per cell in a matrix with the format: <<number of channels>>x<<number of samples>>. The time field contains the timestamps at the sampling rate in the fsample field, with one trial per cell. The trialinfo field contains information about each trial, with one row per trial, and the following columns:

1. Trial number
2. Accuracy: 1 = correct, 0 = incorrect
3. Trial type: 1 = identity, 2 = relation
4. Condition: 1 = identity, 2 = spatial relation, 3 = temporal relation
5. Delay jitter length in ms: 900/1150
6. Response time in ms

The summary_file file is in .csv format. It contains information about each subject, with one row per subject, and the following columns:

1. Subject number
2. Subject age in years
3. Subject biological gender
4. Accuracy, identity condition
5. Accuracy, spatial relation condition
6. Accuracy, temporal relation condition
7. Response time in ms, identity condition
8. Response time in ms, spatial relation condition
9. Response time in ms, temporal relation condition

Note: Accuracy is calculated per subject based on all trials, not the trials that remaining after preprocessing in s<<subject number>>/data_derived. Response time is calculated on all correct trials.

The summary_channel_analysis file is in .csv format. It contains the list of channels analyzed per subject (following bipolar montage re-referencing), subdivided into medial temporal, lateral prefrontal, and orbitofrontal regions of interest, by hemisphere.

How to get started

Anyone wishing to run the preprocessed iEEG data through the analysis scripts should simply open each analysis script and follow the instructions at the top of the script. Users must input the path to the appropriate derived iEEG data directory and then run the script. Following this protocol will reproduce the results in:

Johnson, E. L., Adams, J. N., Solbakk, A.-K., Endestad, T., Larsson, P. G., Ivanovic, J., Meling, T. R., Lin, J. J., Knight, R. T. Dynamic frontotemporal systems process space and time in working memory. *PLOS Biology* (2018).

Use of the custom-built MATLAB scripts (the above protocol) requires the open-source FieldTrip toolbox extension for MATLAB, which can be downloaded from http://www.fieldtriptoolbox.org.

Anyone wishing to work with the primary data must provide the scripts. The information needed to epoch the data into trials and perform analyses by trial type is provided in the s<<subject number>>/summary_file_trial file, as described above. All channel information is provided in the s<<subject number>>_MNI_grid file. This option is non-restricted and does not require MATLAB, except to open/covert the primary files.

How to get help

To get help with the data set, post any questions on the forum at CRCNS.org or contact the lead researcher, E. L. Johnson (eljohnson@berkeley.edu).

Change history

Version 0.6 (Feb 23, 2018) – Original version.
Version 0.61 (April 4, 2018) – Added DOI to PLOS *Biology* (2018) reference, updated script `psianalysis.m`.