Computational Psychiatry Course (CPC) 2016: Exercises

UZH and ETH students wishing to obtain credit points need to complete the following exercises and submit the solutions until 21 September 2016 to cpcourse@biomed.ee.ethz.ch.

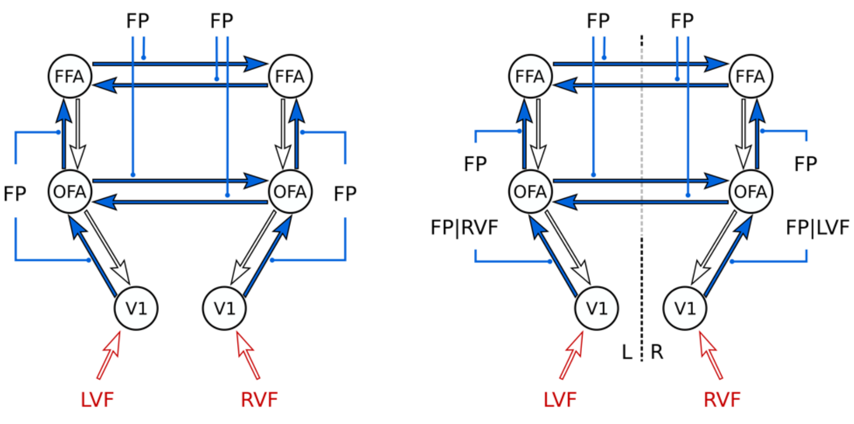
Exercise 1:
After the course, you will be given a set of simulated behavioural data (from 40 fictitious subjects: 20 patients, 20 controls). Your task is to

1. implement two models (Rescorla-Wagner, a standard HGF with three levels), in Matlab, using the HGF toolbox,
2. write your own Matlab script to perform a fixed effects group-level BMS analysis and report the group Bayes factor,
3. perform a random effects BMS analysis in order to report the posterior model probabilities and the exceedance probabilities, using spm_bms from SPM,
4. examine the maximum a posteriori parameter estimates: which of the parameters (if any) shows any significant differences between groups?

Technical details:
The files patients.mat and controls.mat contain the responses of 20 patients and 20 controls during an associative learning task with binary choices (the same kind of task as in Iglesias et al. 2013, Neuron; see http://www.cell.com/neuron/abstract/S0896-6273(13)00807-6). There are 420 trials. The file inputs.mat contains the sequence of binary cues that subjects see and whose predictive value they learn. The data were generated using the config-file tapas_hgf_binary_config.m.

Exercise 2:
You will be provided with some real fMRI data, from a set of regions of interest in a single subject. The data are from Frässle et al. 2016, NeuroImage (see http://www.sciencedirect.com/science/article/pii/S1053811915008770). Your task is to:

1. construct two alternative DCMs (the model structure is specified in the figure below; for abbreviations, see Technical Details below),



Model 1 Model 2

2. invert and compare these two models (reporting the Bayes factor), using SPM,
3. perform Bayesian model averaging (BMA), using SPM,
4. use the BMA results to compute the posterior probability, for each connection, that its strength exceeds zero.

Technical details:

- The data were acquired with an echo time (TE) of 25 ms (you need this information for specifying the DCMs).
- The two DCMs have identical endogenous connectivity (A-matrix) and identical driving inputs (C-matrix), but different modulatory influences (B-matrix).
    - A-matrix: Forward and backward intra-hemispheric connections between V1 and OFA, and between OFA and FFA. Reciprocal inter-hemispheric connections between bilateral OFA, and between bilateral FFA.
    - C-matrix: Left (LVF) and right visual field (RVF) modulated right and left V1, respectively.
    - B-matrix: Models differ with regard to the modulatory influence on the intra-hemispheric forward connections from V1 to OFA. These connections were either modulated by faces (FP) (model 1), or by faces but conditional on the visual field (model 2). The other connections shown in blue are modulated by FP in both models.

Pass/fail criteria

Pass/fail (no grading): at least half of the responses to 1.2, 1.3, 1.4, 2.2, 2.4 are required to be correct in order to pass.

Eligible students

The Computational Psychiatry Course is currently included as an elective course in the curriculae of the following degrees:

- BSc Biomedicine (UZH)
- MSc Neural Systems and Computation (UZH & ETH)
- MSc Biomedical Engineering (ETH)
- PhD Neuroeconomics (UZH)
- PhD Neuroscience (ZNZ, UZH & ETH)