Dynamic causal modeling tutorial by Salvatore (Sam) Torrisi NITP Summer School, 7/15/13

(0) intro and context to the experiment

(1) open matlab
cd into DCM_tutorial/subject/design
type "spm fmri" to launch spm8

(2) review subject's 1st-levels:
click Results, choose SPM.mat, click Done. Choose 'Match vs Base', click Done. No masking, keep title, no p value adjustment, p=0.05 and 0 extent. Overlays... sections, navigate to /subject/raw, choose wmprage.nii.
type "SPM = changeBase(SPM);" to fix some filenames.

(3) choose inferior occipital gyrus (IOG) peak by first assigning cursor to group peak of [42 -82 -16]. Now find our subject's activity in relation to this. Jump to nearest local maxima and check distance moved in command window.

(4) extract:
click eigenvariate button, name it "IOG", adjust for effects of interest, 5 mm radius sphere. Another name for what you're doing is extracting from a "volume of interest (VOI)." The other 3 time series (amygdala, vlPFC and broca's) have been extracted already (from the 'ID vs Base' contrast). Manually move the new file into the /subject/design/DCM so all four VOI.mat files are together.

(5) Review the DCM-specific GLM design by cd-ing into /DCM/ and choosing *that* SPM.mat. Note the driving input regressor and lack of motion parameters.

(6) click the big "Dynamic Causal Modelling" button. Action: **Specify DCM**. Choose the SPM.mat that's within the /DCM/ folder. Name it "model1" and select the VOIs in this order: IOG, amyg, vlpfc, brocas. Yes, include faces. Yes include ID. No, don't include Match or crap. Slice timings, keep those values. Change TE to 0.025. Specify DCM flavor: bilinear, one state per region, no stochastic effects and no input centering.

Now specify the endogenous connections ("A matrix"). The diagonal (self-connections) are already selected for you. Hover mouse over radio buttons to translate the column-to-row structure. Now select them in this pattern (recall the "most minimal" endogenous architecture):

1	0	0	0
1	1	1	1
1	0	1	1

0 0 0 1

Now specify where the driving input enters the system (the “C matrix”). Our driving input regressor “faces” is composed of both conditions of our experiment. Direct it to the IOG region only and click ‘done’.

Now specify where our condition of interest (ID = identifying = affect labeling) modulates a particular region or connection (the “B” matrix). Here we specify that it only modulates the vlpfc *to* amygdala connection. From the available radio buttons select row 2, column 3:

0 0 0 0
0 0 1 0
0 0 0 0
0 0 0 0

This completes model specification. The file has now been saved in that /DCM/ folder. If you want you can load it in matlab and look at how sparse it is.

(7) Now **estimate model1**: click the Dynamic Causal Modelling button again. Action: estimate. Select “DCM_model1.mat” and click done. Besides the graphics look in the command window for number of EM iterations….

(8) After convergence, click the Dynamic Causal Modelling button a final time: **review**. Choose the model. Now explore aspects of the model and its estimation in the graphic window. Review: location of regions, fixed connections, effects of faces, effects of ID.

You can also load the “DCM_model1.mat” into your workspace and review (and perform statistical tests with) the values. Of particular interest are DCM.Ep.A, DCM.Ep.B, DCM.Pp.A, DCM.Pp.B, and DCM.F.

That’s it! Easy peasy. Also, everything we just did can be batched, since you’d likely have lots of subjects and more than one model. Write some loops around this script, customized for your study:
http://www.fil.ion.ucl.ac.uk/spm/data/attention/dcm_spm8_batch.m
But to understand what’s study-specific about that script check out, and do the tutorials for, chapters 32 and 34 of the manual:
http://www.fil.ion.ucl.ac.uk/spm/doc/manual.pdf