

SPM Course

Single Subject Analysis

Practical Session

Dr. Jakob Heinzle & Dr. Frederike Petzschner & Dr. Lionel Rigoux

Hands up:

- Who has programming experience with Matlab?
- Who has analyzed an fMRI experiment before?
- Who did the preparation for the practical session that was posted on the website?



Zurich SPM Course 2016
Practical session on 1st level analysis
Tutors: Frederike Petzschner, Lionel Rigoux, Jakob Heinzle

We assume that you have matlab installed and that you have downloaded the latest version of SPM (SPM12, release 6885).
SPM can be downloaded from <http://www.fil.ion.ucl.ac.uk/spm/software/spm12/>
Follow the instructions there.

Instructions for preparation to be performed prior to the session.

Step 1: Download the face-repetition data.
Goto http://www.fil.ion.ucl.ac.uk/spm/data/face_rep/
Download face_rep.zip
Download face_rep_spm12_batch.m
Download manual.pdf (for SPM 12, if you do not already have it).

Set up a directory on your computer that you will use for the tutorial.
Copy face_rep.zip to that directory. Unzip face_rep.zip into that directory and rename the directory face_rep as data. You should now have two folders (RawEPI and Structural) and two files (sots.mat and all_conditions.m) in the folder data.

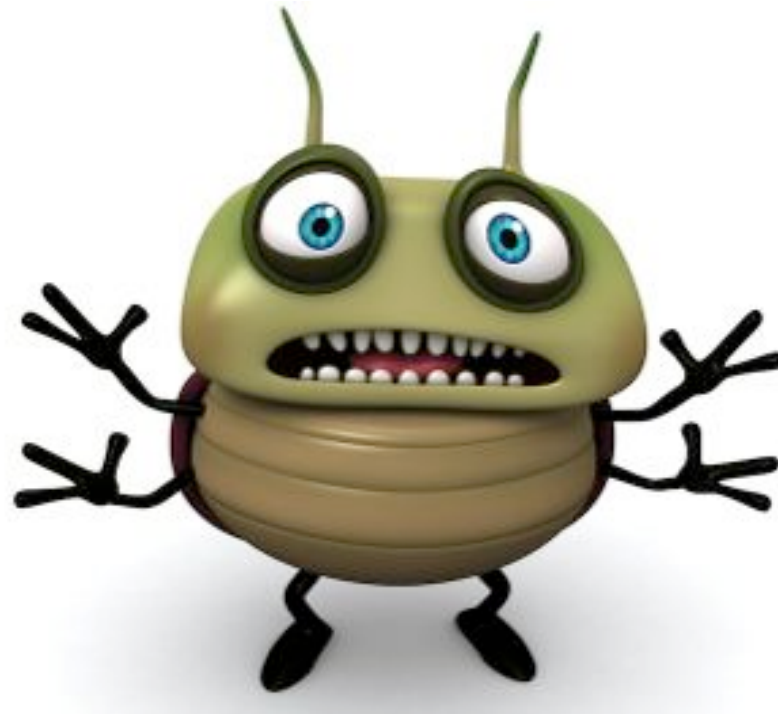
Make an additional directory "scripts" within your tutorial folder and copy the face_rep_spm12_batch.m file in there.
Also, copy the file face_rep_spm12_prepare4session.m into the script folder. You should have gotten this file together with the instructions you are currently reading.

Open Matlab, add the scripts folder for your tutorial to the matlab path (and of course also SPM). Edit line 15 of face_rep_prepare4session.m so that it points to your!! tutorial folder. Then let the file run. This will do a complete preprocessing of the data and will take a bit of time.

Everything has worked, if the last three lines on your matlab command window read:
Running 'Smooth'
Done 'Smooth'
Done

Now you should be ready for the tutorial. See you there!

There was a bug:



open `face_rep_prepare4session.m` in Matlab

change

```
matlabbatch{2}.spm.spatial.realign.estwrite.data{1} = cellstr(spm_file(f(1,:), 'prefix', 'a'));
```

to

```
matlabbatch{2}.spm.spatial.realign.estwrite.data{1} = cellstr(spm_file(f(:, :), 'prefix', 'a'));
```

Download and install SPM

http://www.fil.ion.ucl.ac.uk/spm/data/face_rep/



The image shows a screenshot of the SPM (Statistical Parametric Mapping) website. On the left is a vertical navigation menu with a filmstrip background showing brain slices. The menu has two sections: 'SPM Menu:' with links to Introduction, Software, Documentation, Courses, Email list, Data sets, and Extensions; and 'This page:' with a link to Back. The main content area features the SPM logo at the top, followed by the text 'By members & collaborators of the Wellcome Trust Centre for Neuroimaging' and a row of links: Introduction, Software, Documentation, Courses, Email list, Data, and Extensions. Below this is a header for 'Advanced Event-related fMRI - Repetition priming'. The 'Overview' section describes the study: 'Repetition priming for famous and nonfamous faces', created by R. Henson in 8/7/00 at WDCN & ICN, UCL. It mentions 'One subject's data from:' followed by a citation in a yellow box: 'Henson, R.N.A., Shallice, T., Gorno-Tempini, M.-L. and Dolan, R.J. (2002) Face repetition effects in implicit and explicit memory tests as measured by fMRI. Cerebral Cortex, 12, 178-186.' Below the citation is a disclaimer: 'For teaching purposes only - Please do not cite without permission.' This is followed by a bulleted list of experimental details: 2x2 factorial event-related fMRI, one session per subject, (Famous vs. Nonfamous) x (1st vs 2nd presentation) of faces against a chequerboard baseline, 2 presentations of 26 Famous and 26 Nonfamous Greyscale photos for 0.5s each, randomly intermixed, with a fame judgment task (one of two right finger key presses). The parameteric factor 'lag' is defined as the number of faces intervening between repetitions of a specific face + 1. The task uses Minimal SOA=4.5s with a 2/3 probability of a null event (1/3 null events). The acquisition is Continuous EPI (TE=40ms, TR=2s) with 24 descending slices (64x64 3x3mm²), 3mm thick, and 1.5mm gap. At the bottom is a 'Files:' section.

SPM Menu:

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- ▶ Documentation
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UCL SPM

By members & collaborators of the Wellcome Trust Centre for Neuroimaging

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Advanced Event-related fMRI - Repetition priming

Overview

Repetition priming for famous and nonfamous faces

Created [R. Henson](#), 8/7/00, WDCN & ICN, UCL.

One subject's data from:

Henson, R.N.A., Shallice, T., Gorno-Tempini, M.-L. and Dolan, R.J. (2002)
Face repetition effects in implicit and explicit memory tests as measured by fMRI. *Cerebral Cortex*, 12, 178-186.

For teaching purposes only - Please do not cite without permission.

- 2x2 factorial event-related fMRI
- One session (one subject)
- (Famous vs. Nonfamous) x (1st vs 2nd presentation) of faces against baseline of chequerboard
- 2 presentations of 26 Famous and 26 Nonfamous Greyscale photographs, for 0.5s, randomly intermixed, for fame judgment task (one of two right finger key presses).
- Parameteric factor "lag" = number of faces intervening between repetition of a specific face + 1
- Minimal SOA=4.5s, with probability 2/3 (ie 1/3 null events)
- Continuous EPI (TE=40ms, TR=2s) 24 descending slices (64x64 3x3mm²), 3mm thick, 1.5mm gap

Files:

Download and install SPM

Terminal

- `cd /Users/login`
- `unzip spm12.zip`
- `unzip -o spm12_updates_rxxxx.zip -d spm`
- Move spm12 to applications folder

Matlab

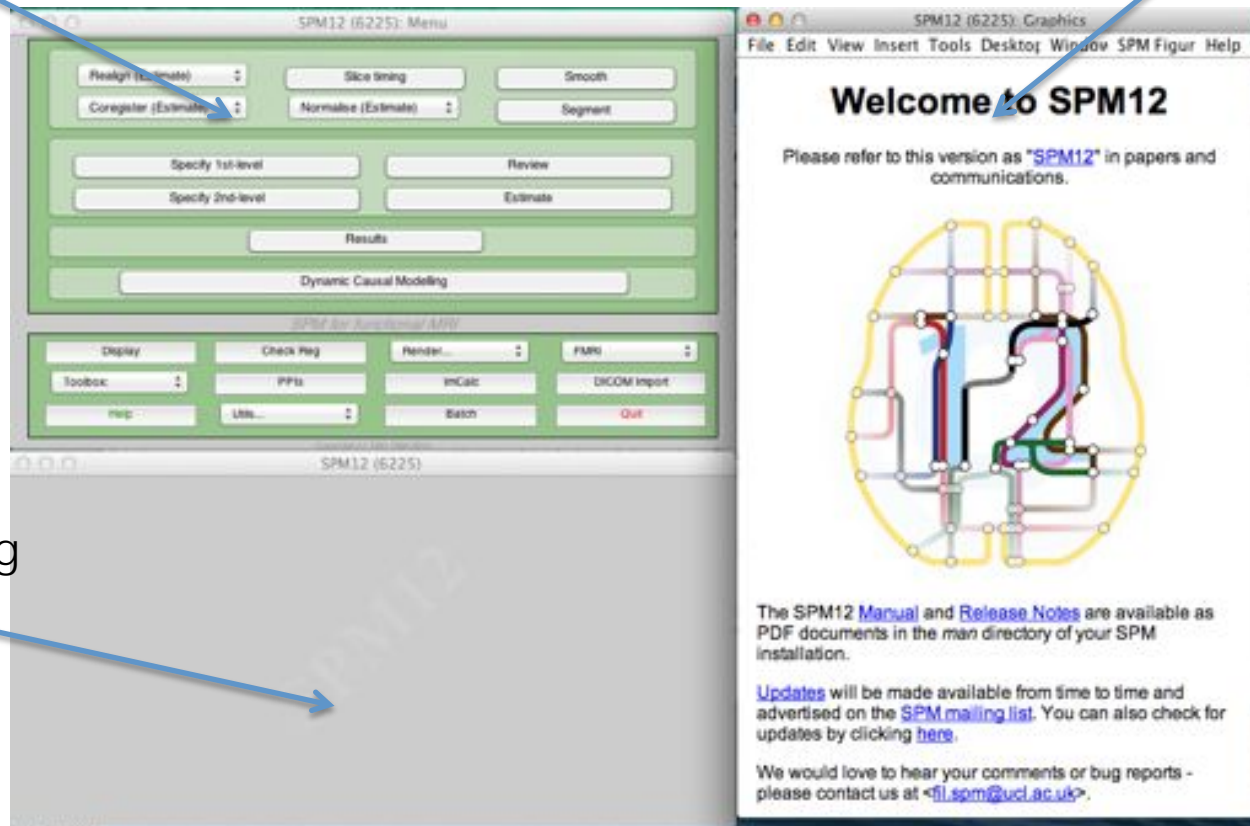
- Add path spm12 with subfolders
- Start SPM12: *spm fmri*

Structure of SPM

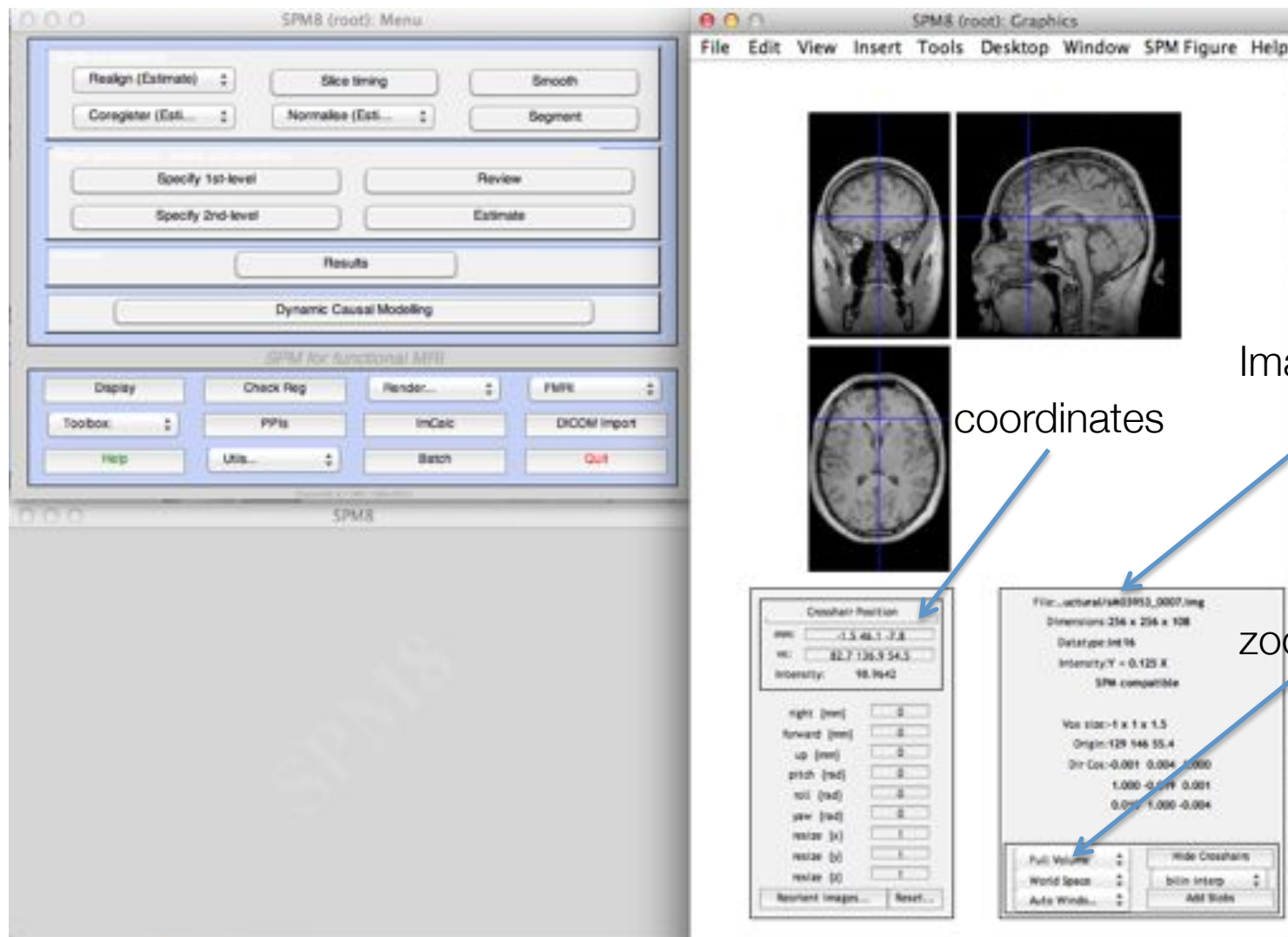
specification

display

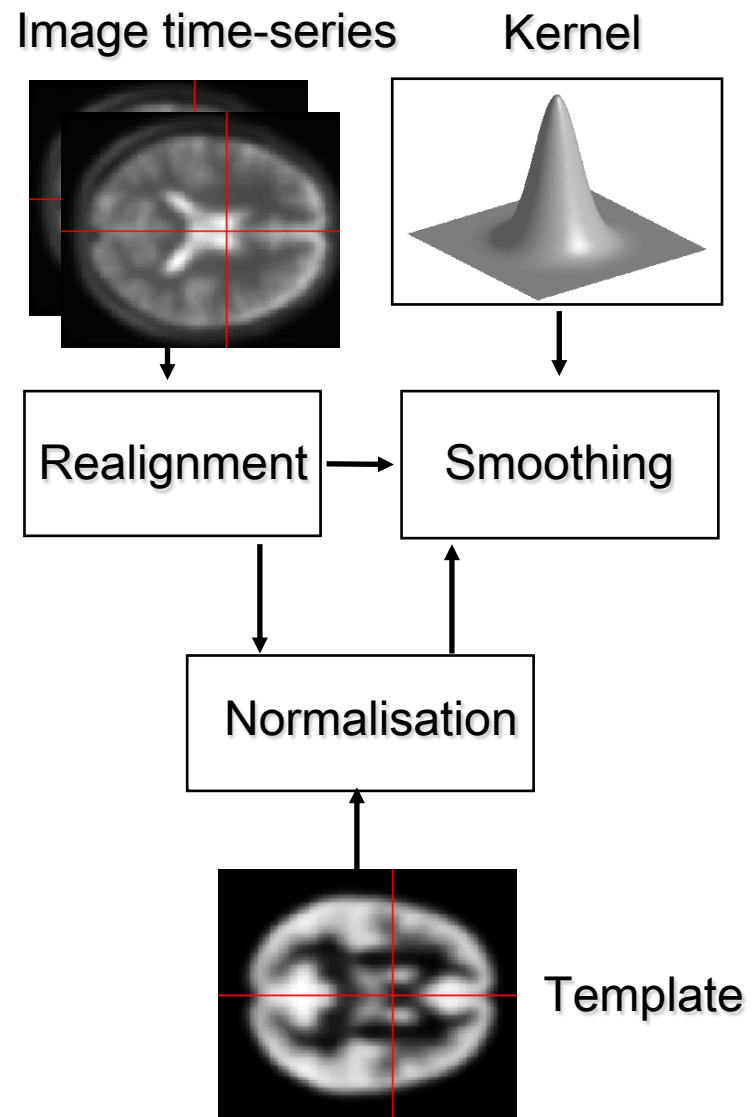
processing



Display

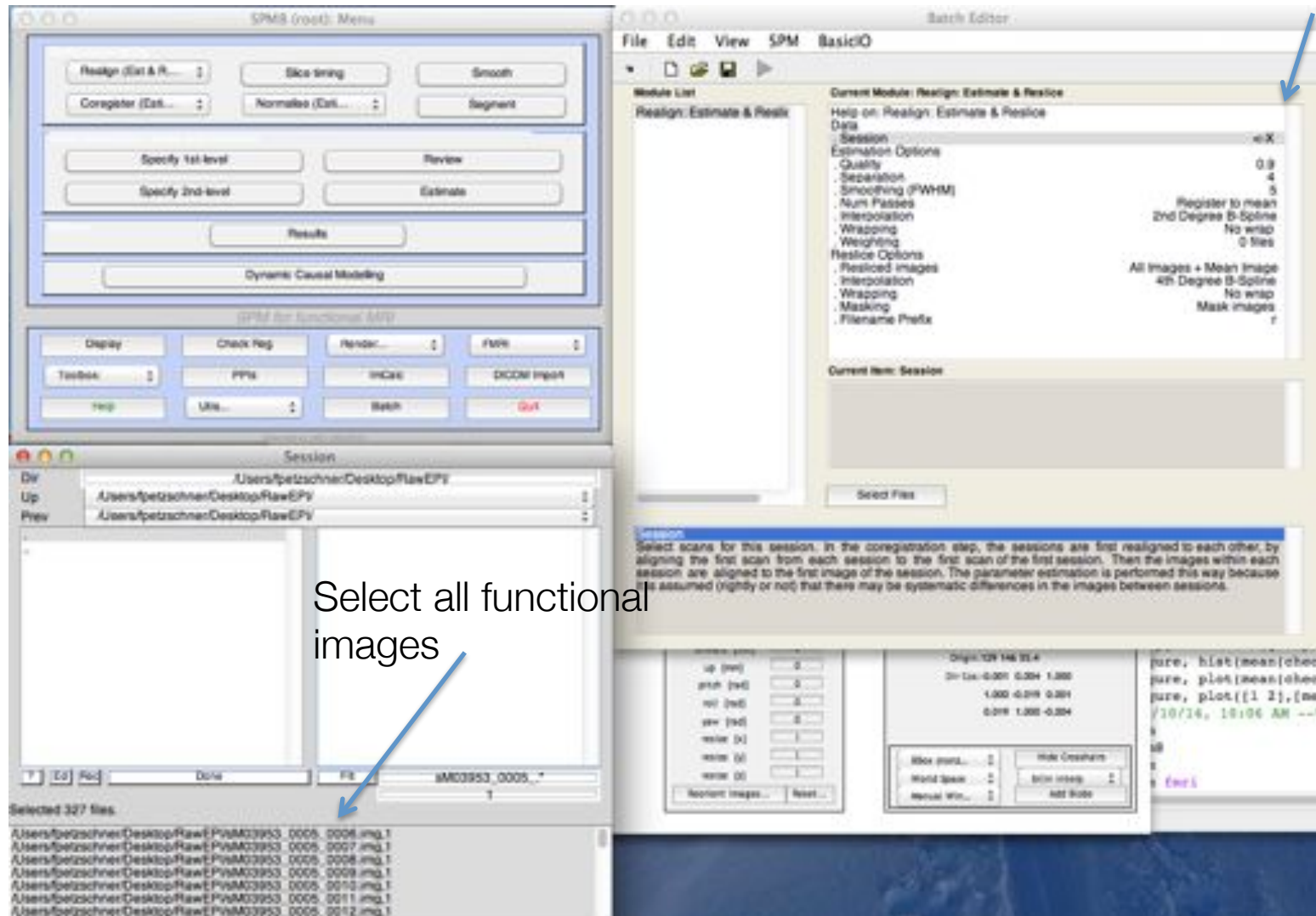


Preprocessing

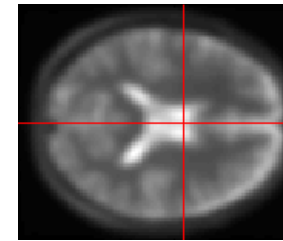


Realignment

Fill in
everything
with an X



Realignment

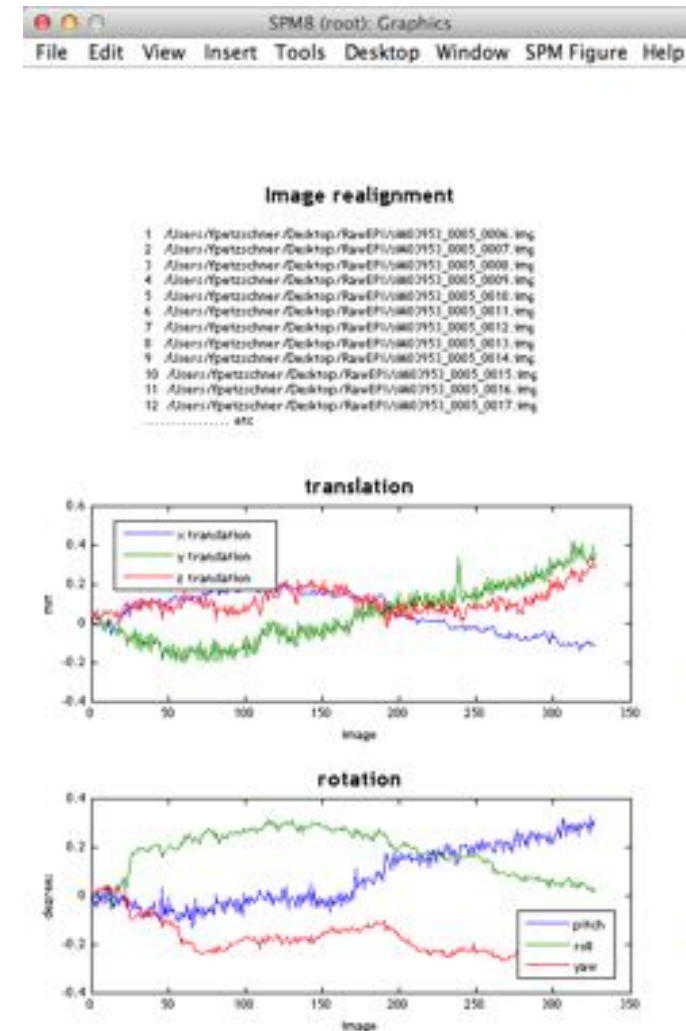


All images of a run will be aligned to the first image of the run

Images are then called **rp_sM.....txt**

Returns the movement parameters:
Problematic if more than a voxels worth of motion!

Also creates a **meansM....img** that will be used in the coregistration



Slice Time Correction

TR = 2s

N = 24 slices

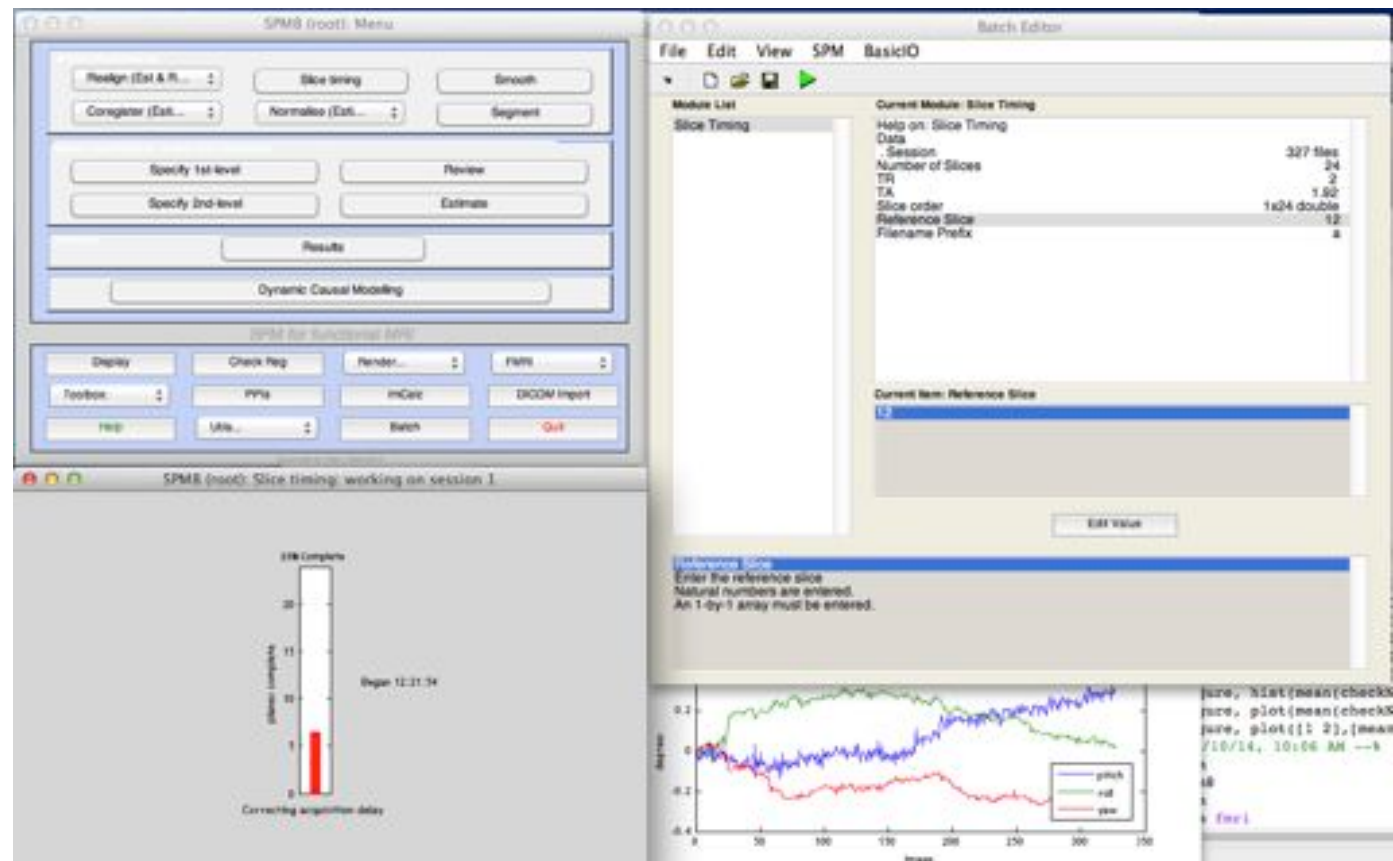
TA = TR - TR/N

Slice order: 24:-1:1

Reference Slice: 12

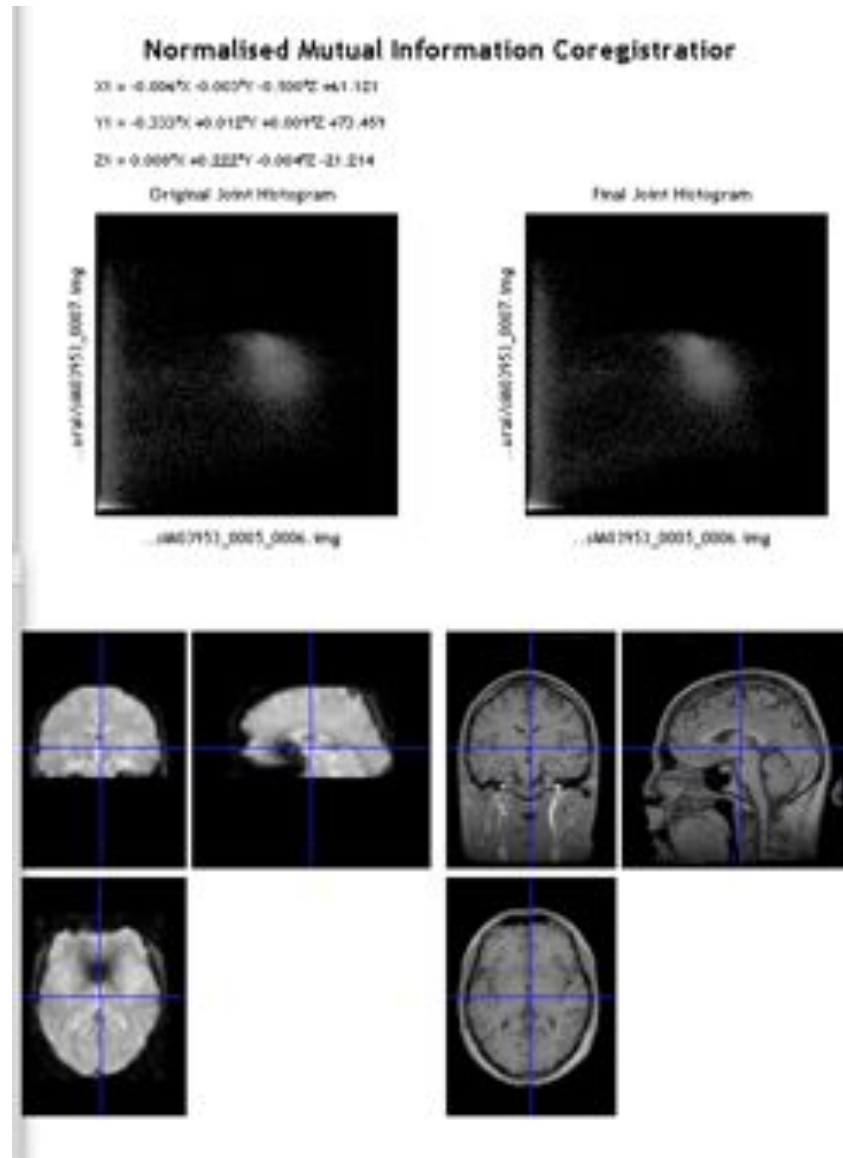
Use the **rp.....txt**

And create **a.....txt**



Coregistration

reference **means.....img**
source: structural **s.....img**



Segmentation

“Volumes” in “Data > Channels” and select the subjects coregistered anatomical image `sM03953_0007.img`.

Change “Save Bias Corrected” so that it contains “Save Bias Corrected” instead of “Save Nothing”.

At the bottom of the list, select “Forward” in “Deformation Fields”

SPM will segment the structural image using the default tissue probability maps as priors. SPM will create, by default, gray and white matter images and bias-field corrected structural image. These can be viewed using the CheckReg

SPM will also write a spatial normalisation deformation field file eg. `y_sM03953_0007.nii` file in the original structural directory. This will be used in the next section to normalise the functional data.

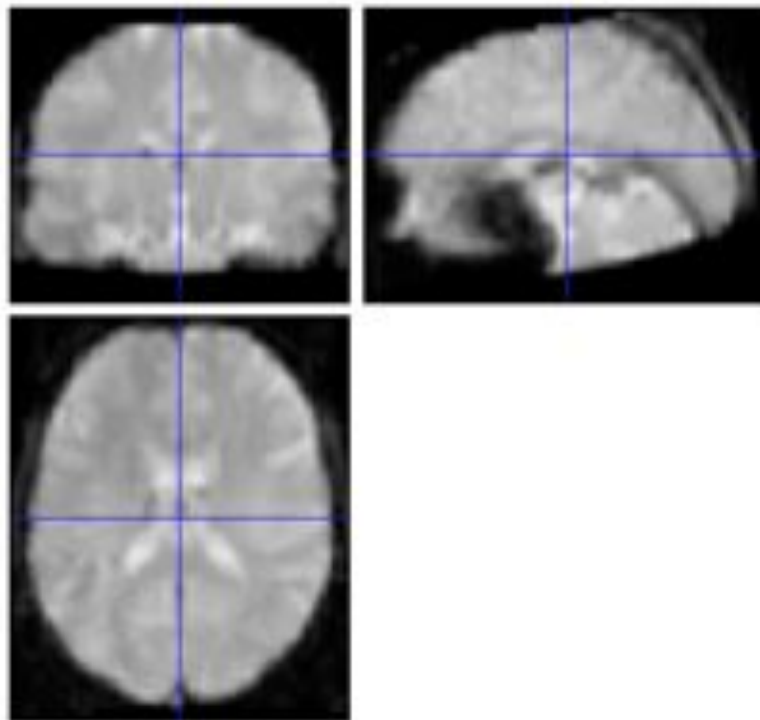
Normalise (Write)

Deformation field: **y....._nii**

Images to write: realigned functional images **ars.....img** and mean functional image **means.....img**

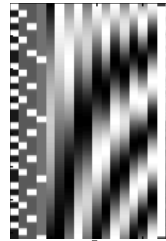
Voxel size [2 2 2] → [3 3 3]

Create normalised files **w.....mat**

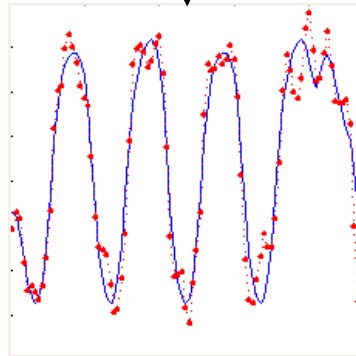


GLM

Design matrix

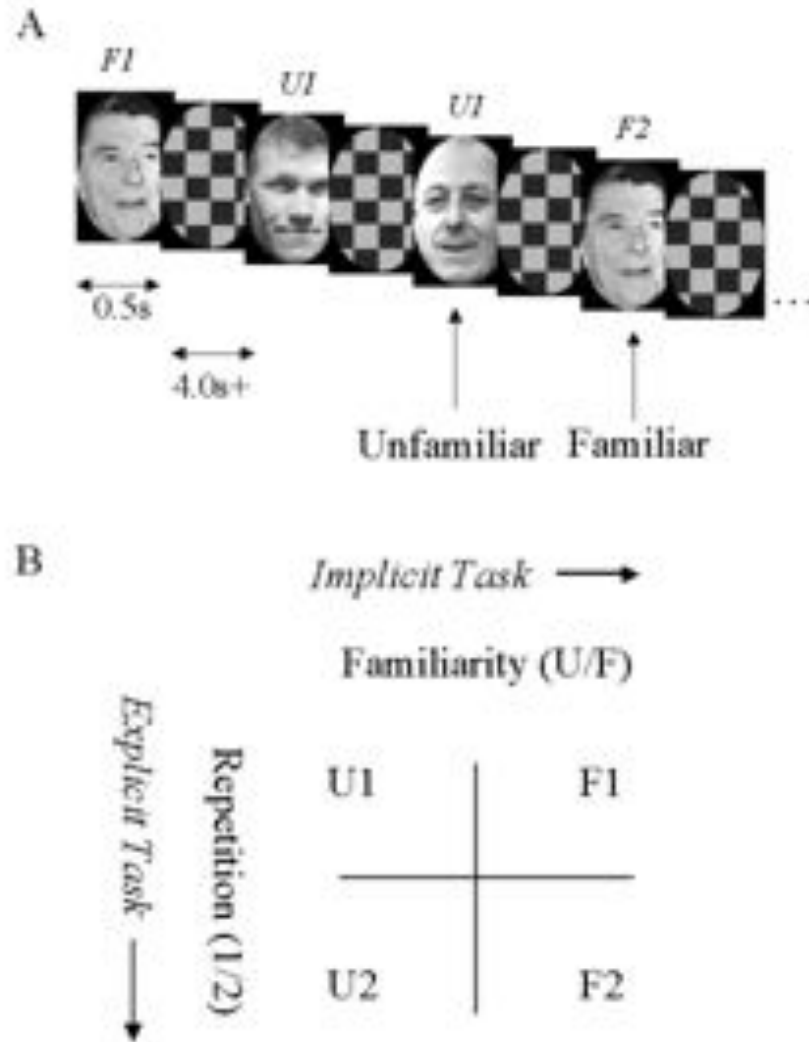


General linear model



Parameter estimates

The Task

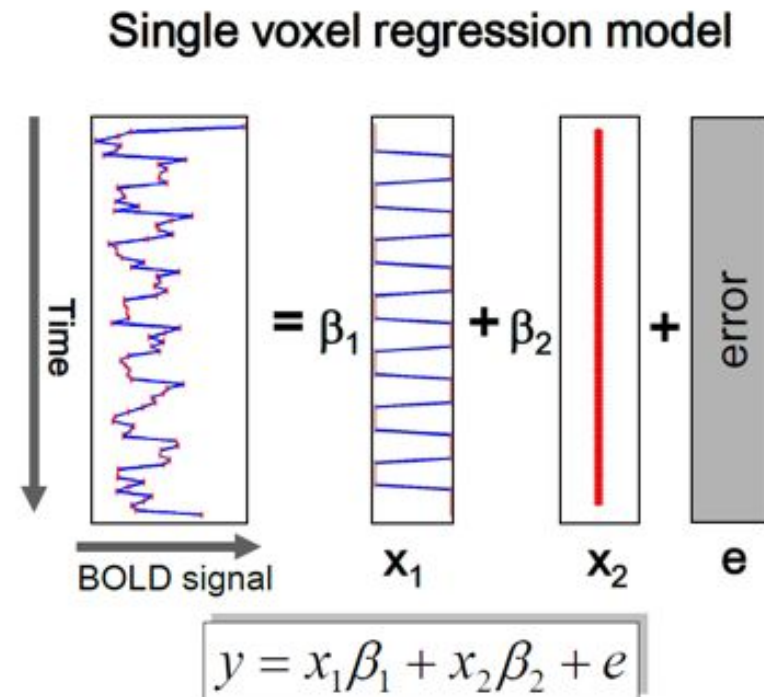
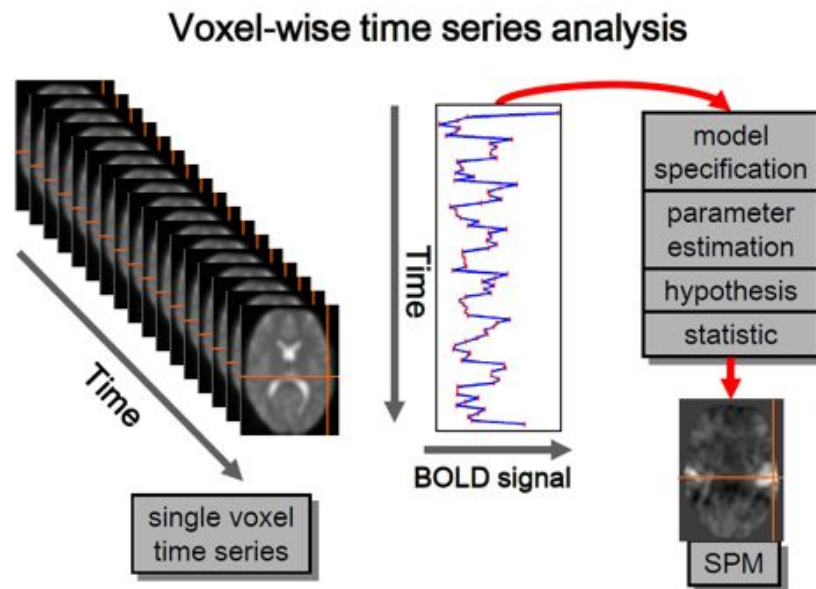


- Parametric factor "lag" = number of faces intervening between repetition of a specific face + 1
- Continuous EPI (TE=40ms, TR=2s) 24 descending slices (64x64 3x3mm²), 3mm thick, 1.5mm gap

Henson, R.N.A., Shallice, T., Gorno-Tempini, M.-L. and Dolan, R.J. (2002) Face repetition effects in implicit and explicit memory tests as measured by fMRI. *Cerebral Cortex*, 12, 178-186.

Figure 1. Schematic of the stimuli (A) and tasks (B).

Model Specification:



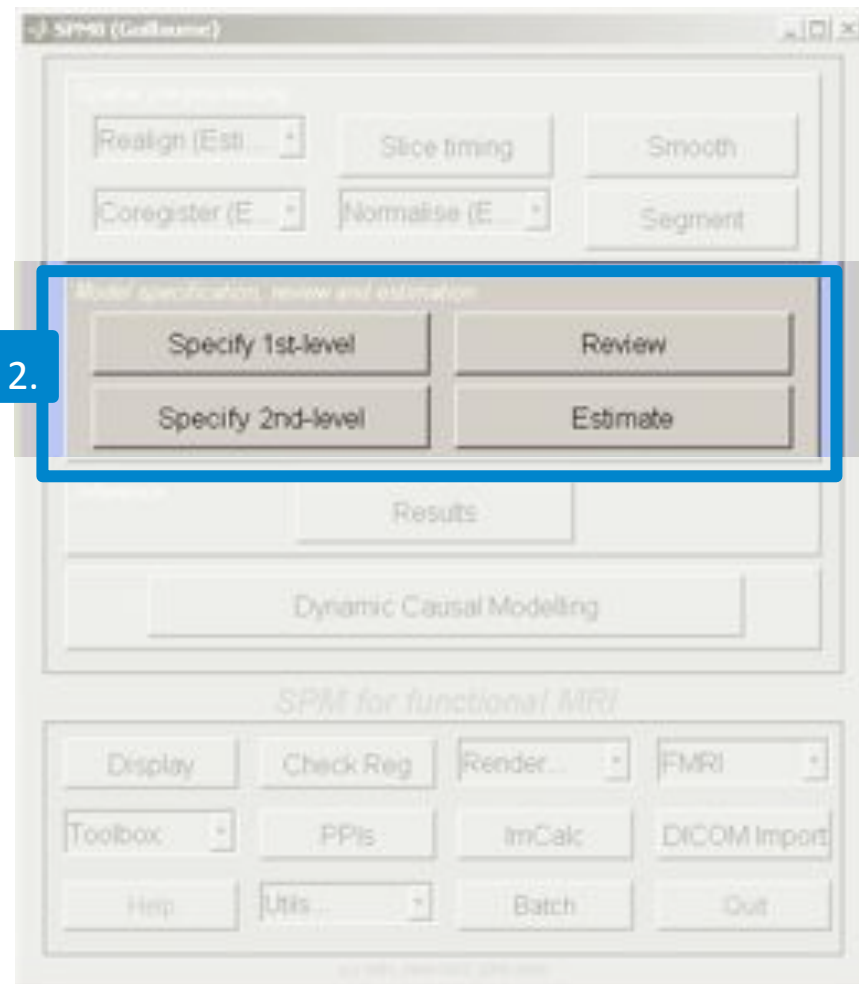
- What questions can we answer with this data set?
- How would your GLM look like?

→ 10 min Exercise



- What questions can we answer with this data set?
 - Difference between familiar and unfamiliar faces
 - Difference between repetition 1 and repetition 2
 - Difference between a repetition of a familiar face versus and unfamiliar one
- How would your GLM look like?
 - Regressors for familiar and unfamiliar and repetition 1 and 2
 - Regressors for motion

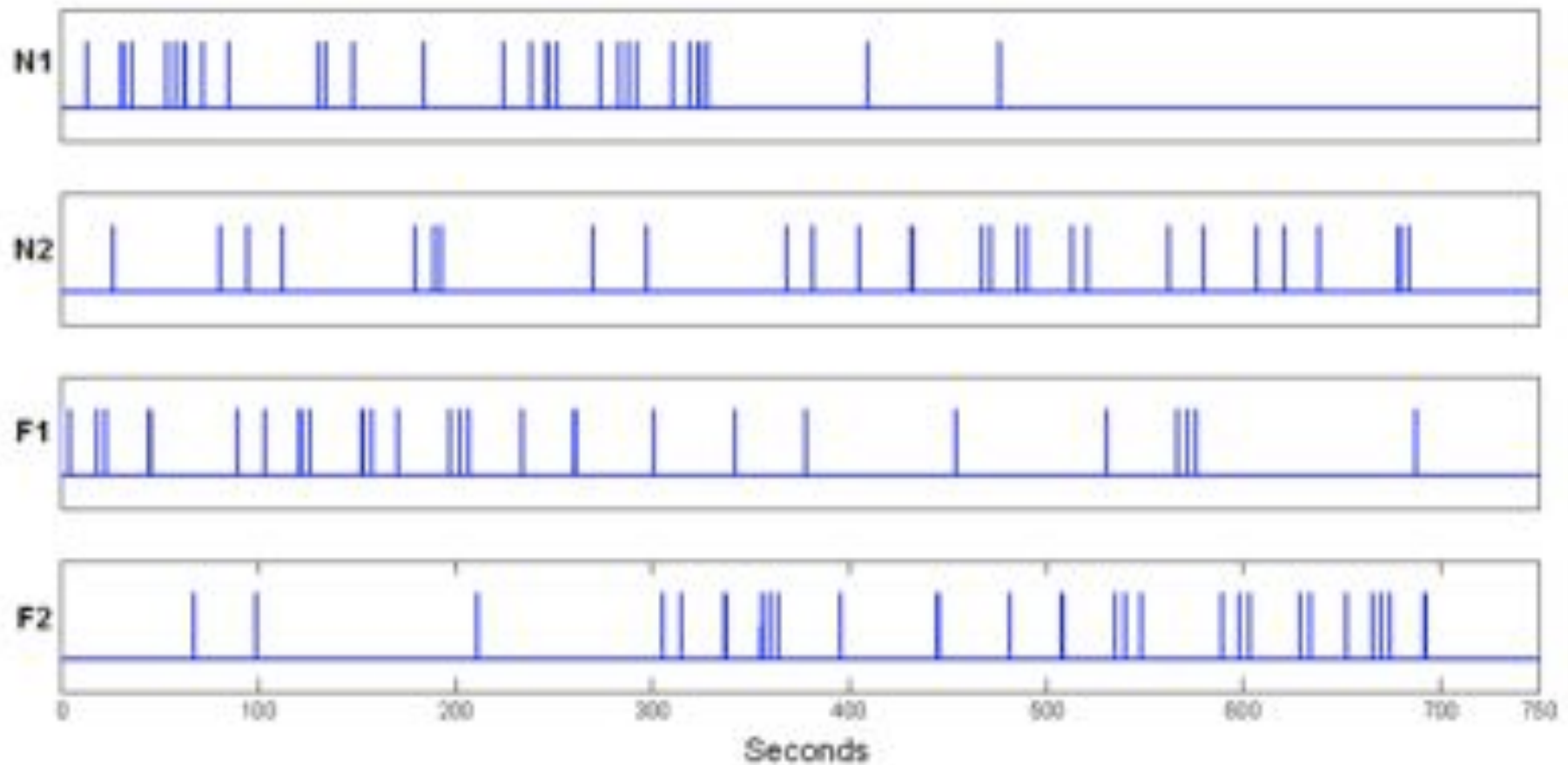
The SPM Graphical User Interface (GUI)



- Model Specification
 - Specify 1st level
 - Review
 - Estimate

stimulus onset times

load sots.mat file



Modelling

Load **sots.ma**

Units of design: Scans

Interscan interval: 2

Microtime Resolution: 24

Microtime Onset: 12

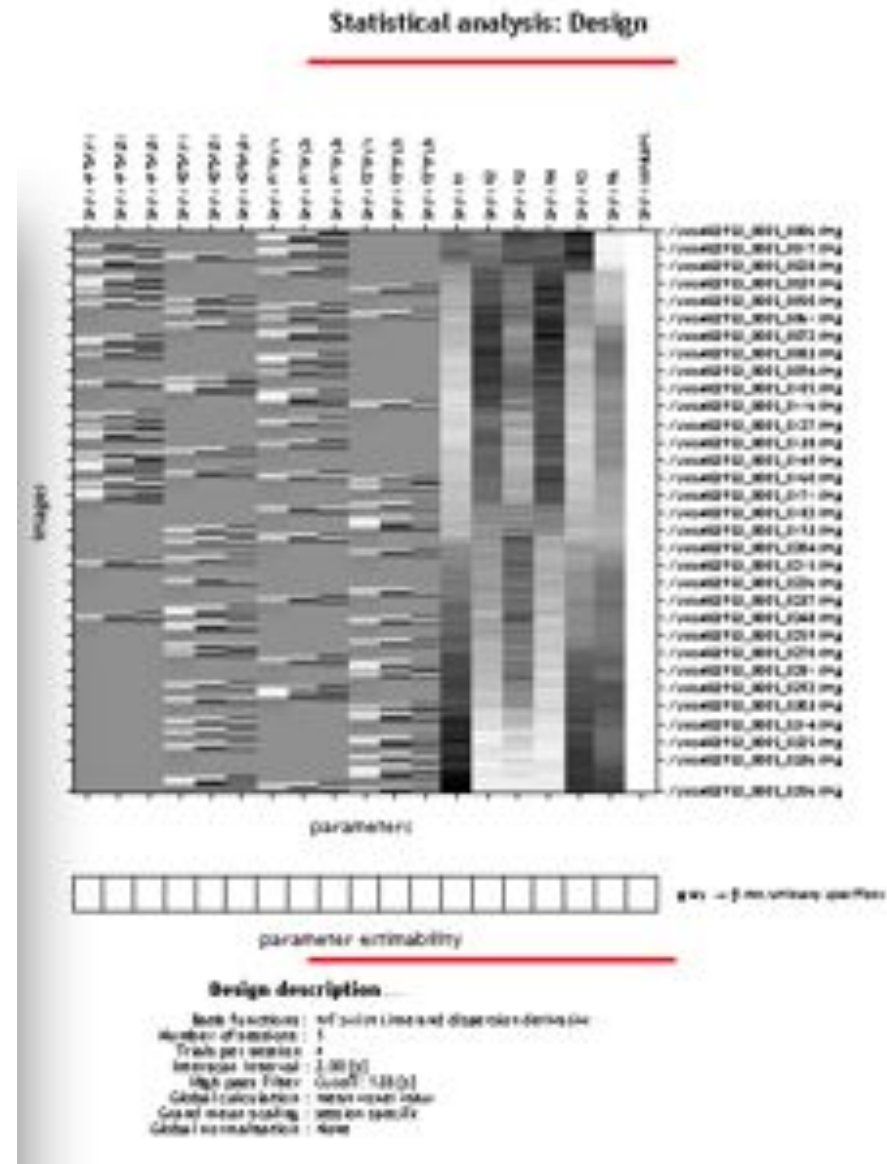
Use smoothed images: **swars...img**

Conditions: N1, N2, F1, F2

Multiple Regressors: realignment file **rp_.txt**

Factorial Design: Fam and Rep

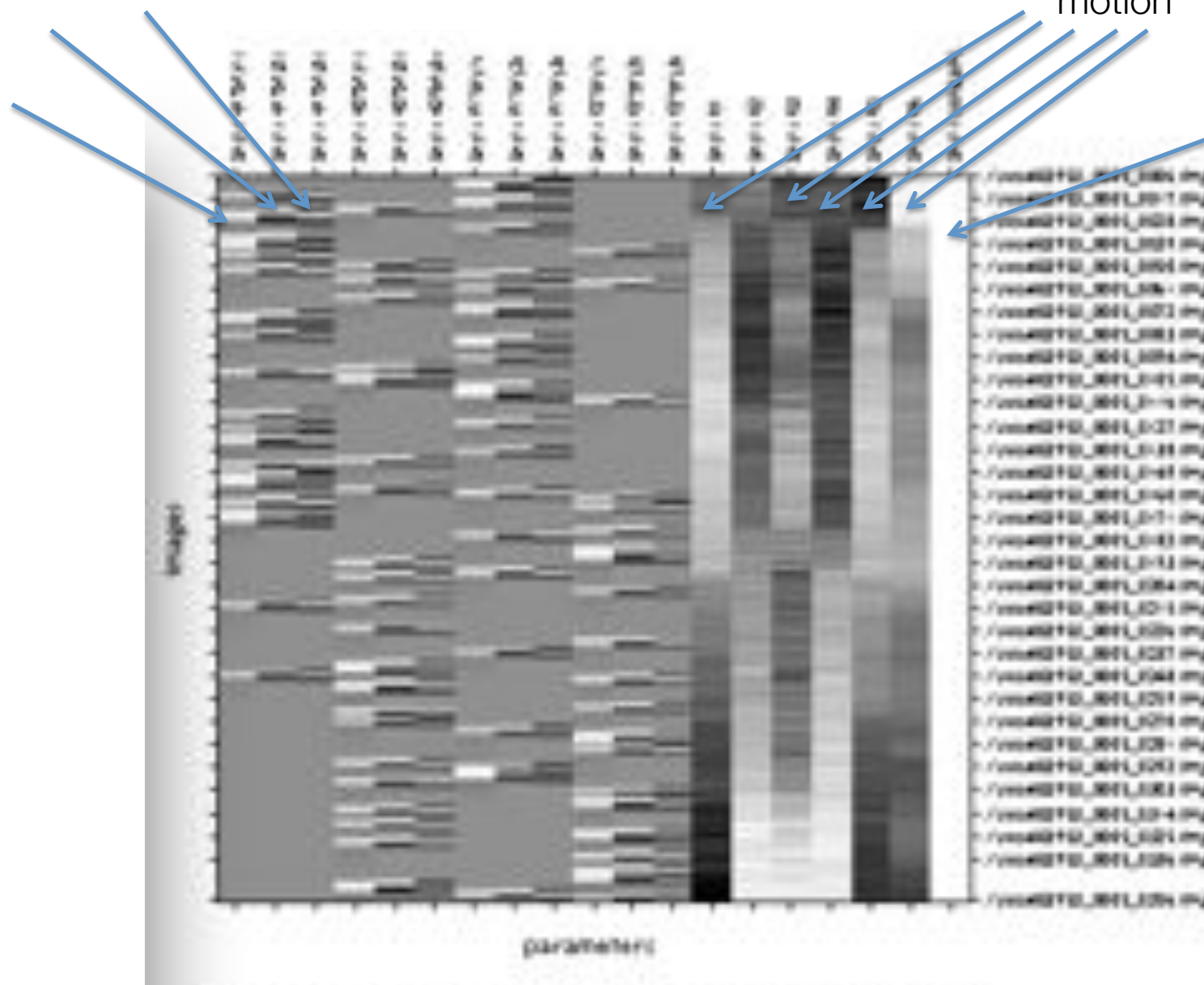
Canonical HRF: select all derivatives



HRF and derivatives

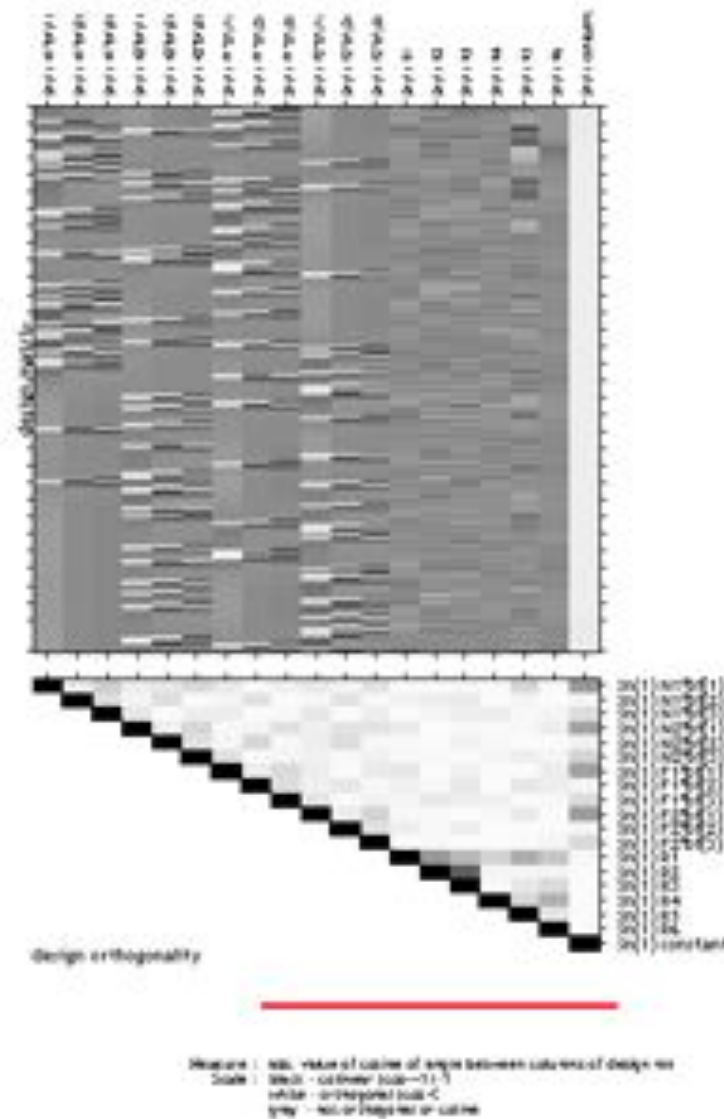
motion

baseline

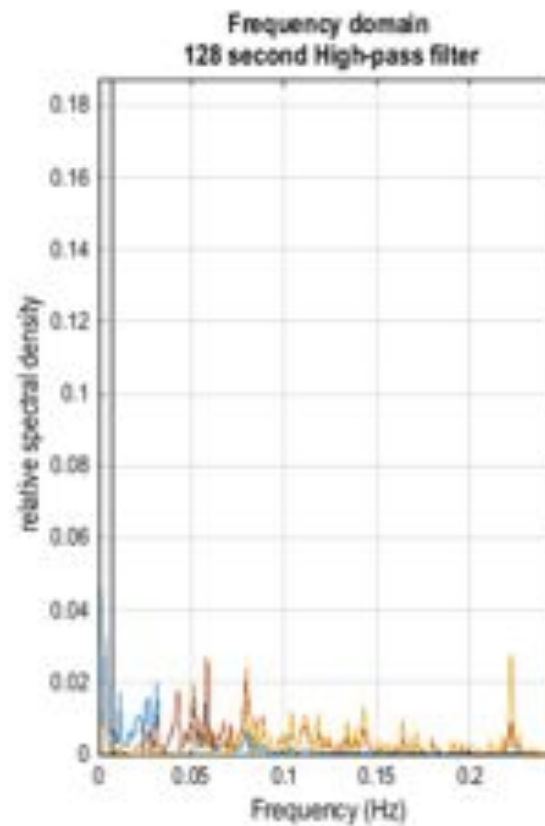
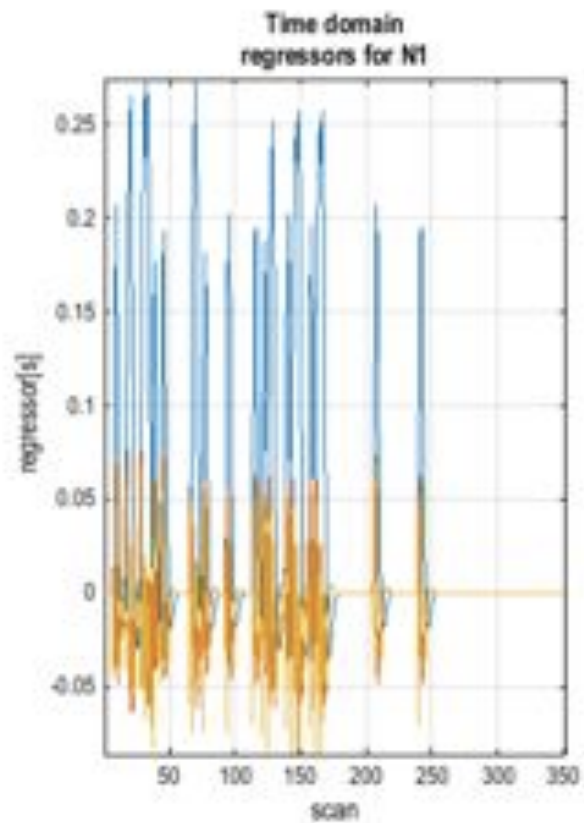


Orthogonality

Estimate **SPM.mat**

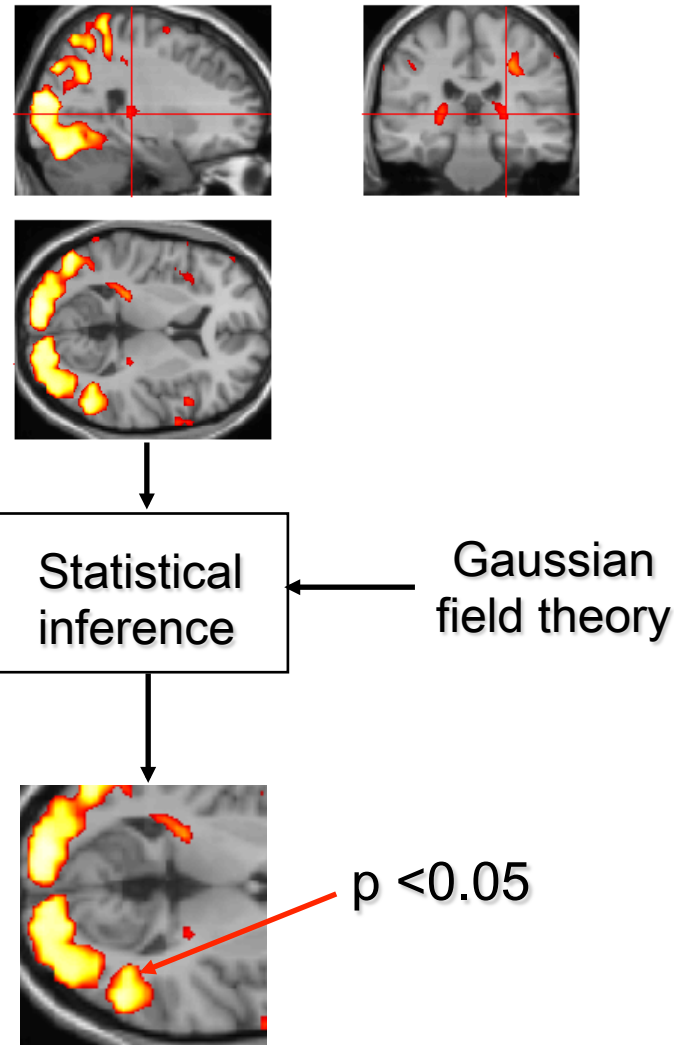


Regressors



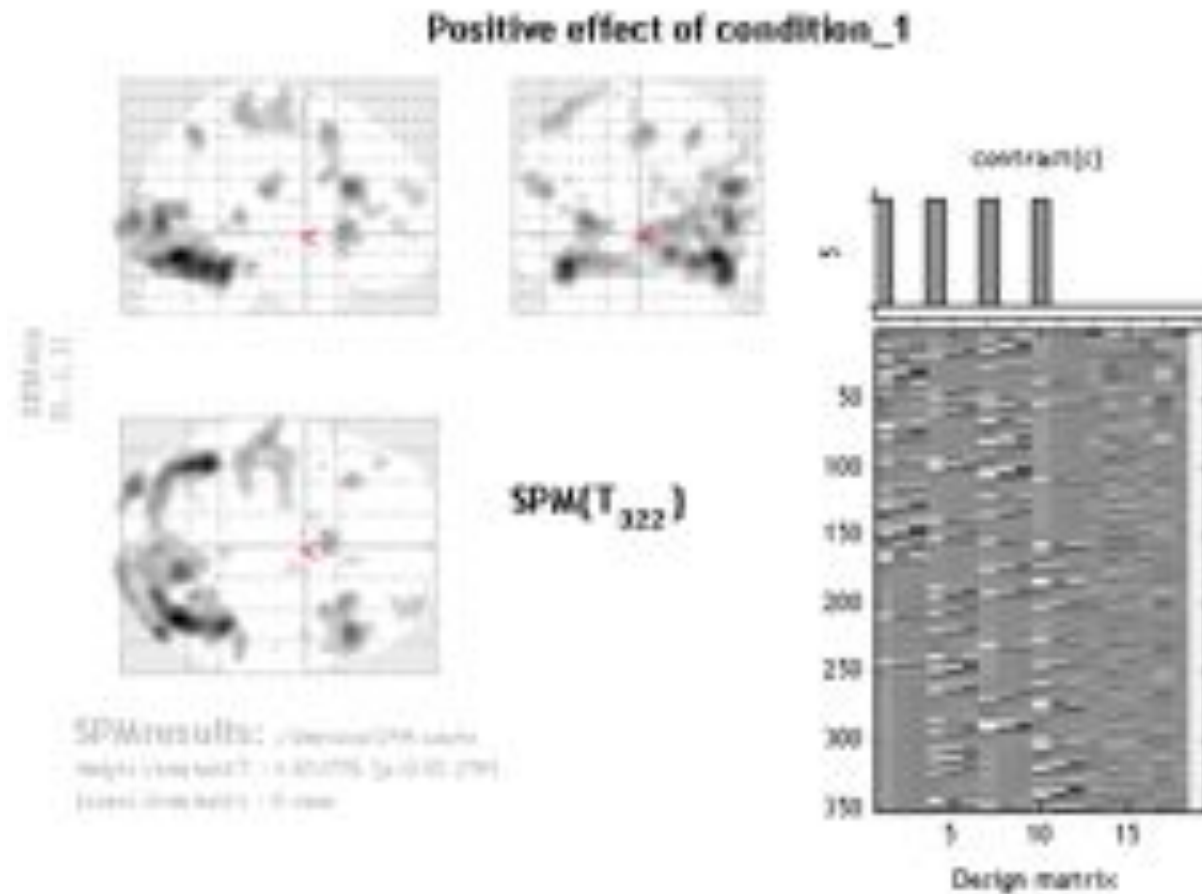
Statistics

Statistical parametric map (SPM)



T-Test

- Positive Effect of condition 1?

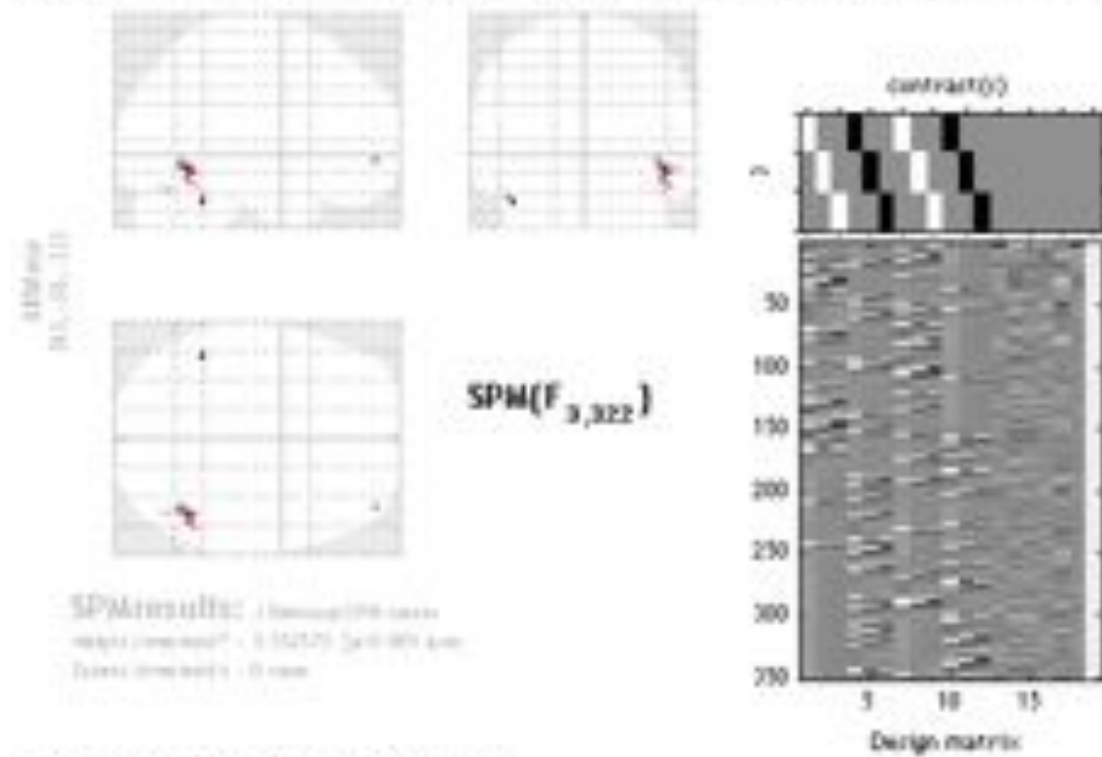


Levels

- peak-level: the chance (p) of finding (under the null hypothesis) a peak with this or a greater height (T- or Z-statistic), corrected (FWE or FDR)/ uncorrected for search volume.
- cluster-level: the chance (p) of finding a cluster with this many(k_e) or a greater number of voxels, corrected (FWE or FDR)/ uncorrected for search volume.
- set-level: the chance (p) of finding this (c) or a greater number of clusters in the search volume.

F-Test

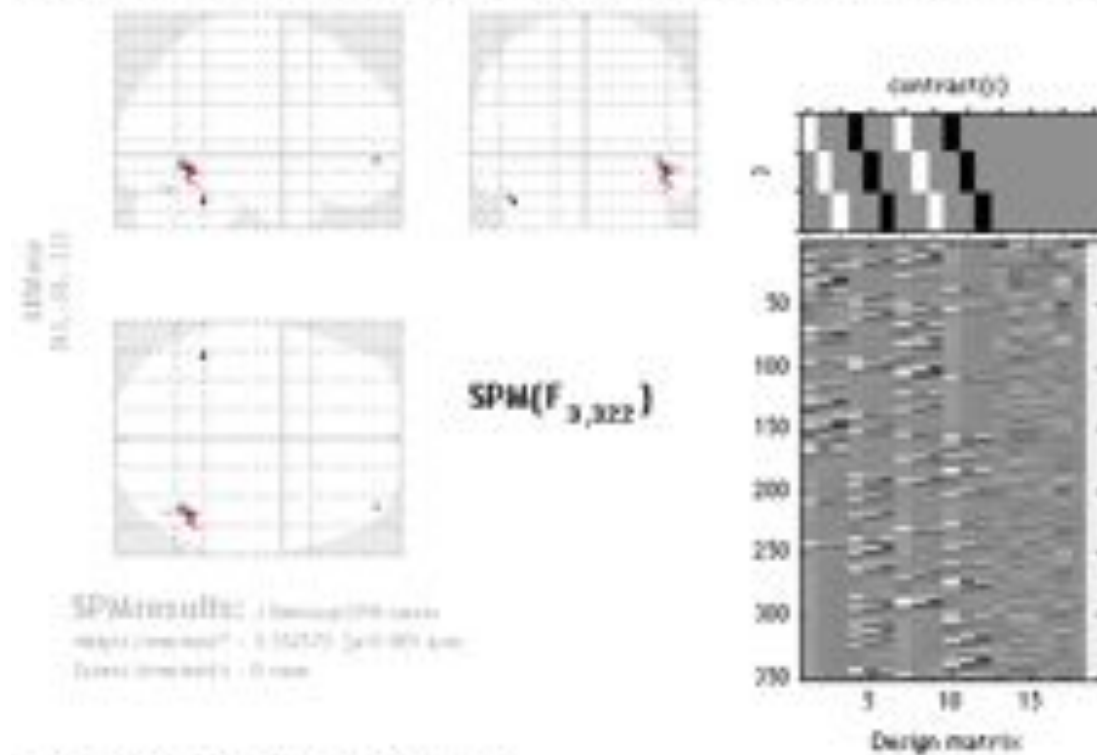
Main effect of Rep (masked [incl.] by Positive effect of condition_1 at $p=0.001$)



Statistics: <i>p</i> -value adjusted for search engines											
api control		cluster term				api t. term					sign. post. prob.
<i>p</i>	<i>t</i>	<i>V</i> _{cluster}	<i>V</i> _{term}	<i>V_t</i>	<i>V</i> _{term}	<i>V</i> _{term}	<i>F</i>	<i>(F₁)</i>	<i>V</i> _{term}		
1.000	0			0.0	0.000	0.000	0.00	0.00	0.000	500 < 0.001 < 0.0	
					0.000	0.000	0.00	0.00	0.000	500 < 0.001 < 0.0	
				0	0.000	0.000	0.00	0.00	0.000	500 < 0.001 < 0.0	
				0	0.000	0.000	0.00	0.00	0.000	500 < 0.001 < 0.0	
				0	0.000	0.000	0.00	0.00	0.000	500 < 0.001 < 0.0	
				0	0.000	0.000	0.00	0.00	0.000	500 < 0.001 < 0.0	

F-Test

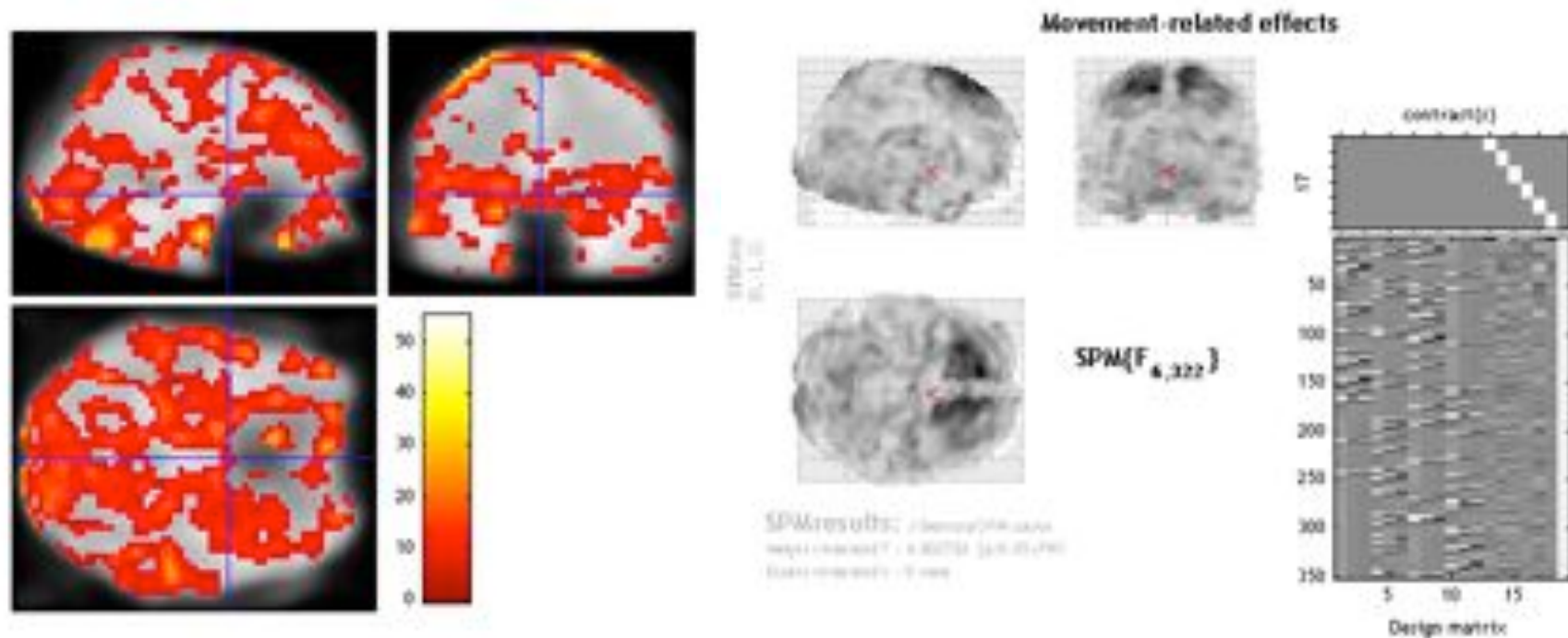
Main effect of Rep (masked [incl.] by Positive effect of condition_1 at $p=0.001$)



Statistics: p -values adjusted for search volume

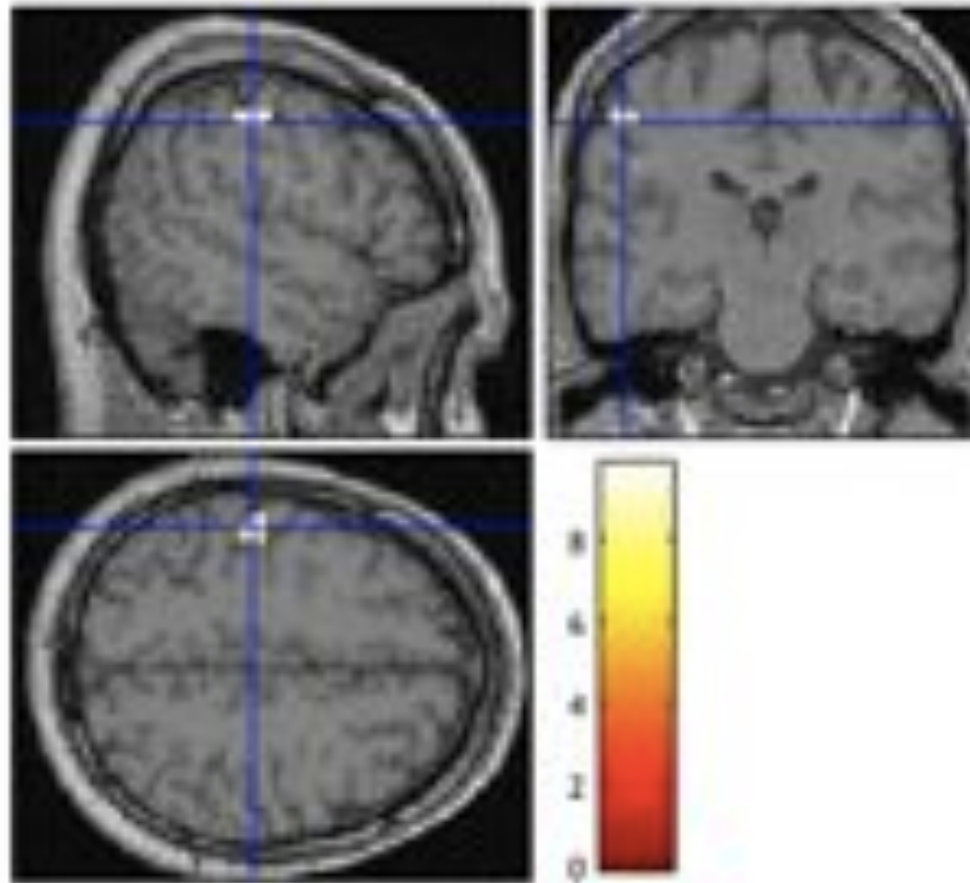
SPM results		cluster size		peak T -value		peak F -value		peak p -value		peak p -value	
x	y	V_{cluster}	V_{peak}	T	F	p	p	p	p	p	p
1,000	5			4.8		0.000	0.160	0.000	0.000	0.000	0.000
						0.000	0.000	0.000	0.000	0.000	0.000
				2.1		0.000	0.160	0.000	0.000	0.000	0.000
				2.1		0.000	0.160	0.000	0.000	0.000	0.000
				2.1		0.000	0.160	0.000	0.000	0.000	0.000
				2.1		0.000	0.160	0.000	0.000	0.000	0.000

F-Test on movement parameters



Parametric Modulation

Lag Effect



END