

Analysis of Functional Magnetic Resonance Imaging (fMRI) Brain Activation – General Linear Model II

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April 9, 2019

Teaching Materials

- http://www.ym.edu.tw/~cflu/CFLu_course_fMRIana.html

- **Week 8: Brain Activation – General Linear Model II**

<Handout> [Lesson8_slides.pdf](#)

<Materials> [fMRIana08_materials.zip](#)

- **The same fMRI data in Week 6**

<Materials> [fMRIana06_materials.zip](#)

Employed Software

- MRICro

- <https://people.cas.sc.edu/rorden/mricro/mricro.html#Installation>
- <https://www.mccauslandcenter.sc.edu/crnl/mricro>

- Statistical Parametric Mapping (SPM 12)

- <http://www.fil.ion.ucl.ac.uk/spm/>

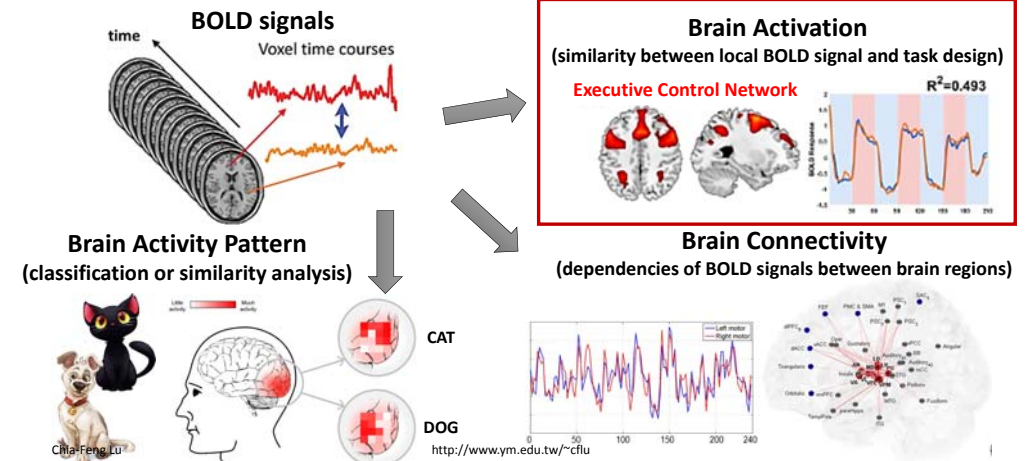


- xjView (A viewing program for SPM)

- <http://www.alivelearn.net/xjview/download/>

[Caution] File name\path contains Chinese character or space may cause error!

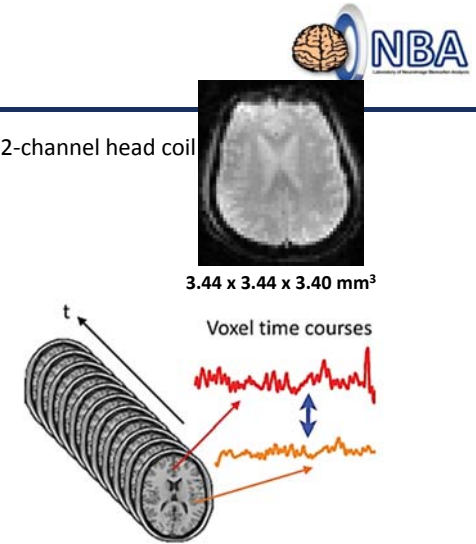
fMRI Analysis



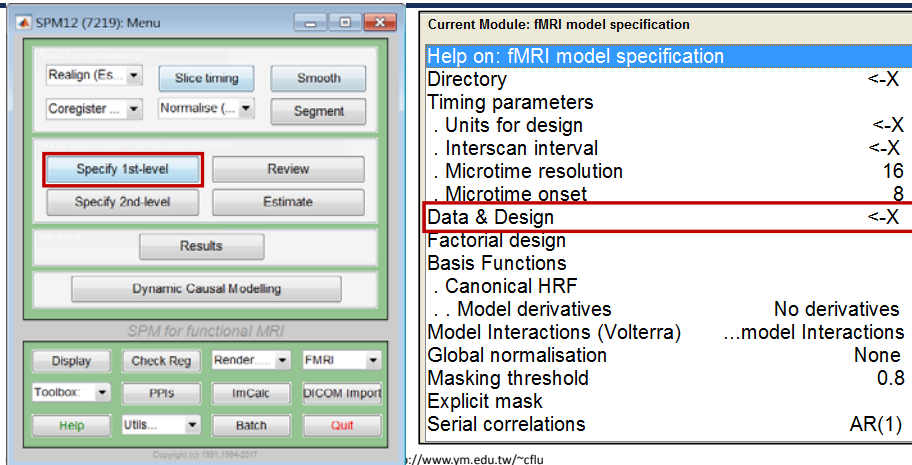
SPM Subject Analysis – 1st-level

fMRI Protocol

- Siemens 3T MAGNETOM Trio Scanner @ NYMU, 32-channel head coil
- Single-Shot 2D EPI (GRE-EPI), T2* weighting
- Repetition Time = 2000 ms
- Echo Time = 20 ms
- Flip Angle = 70~90°
- NEX = 1
- Slice thickness = 3.4 mm
- Field of View = 220 x 220 mm²
- Matrix size = 64 x 64
- Slice number = 40
- Volume number (**depends on experiment design**)



Specify 1st-level Model



SPM12 (7219): Menu

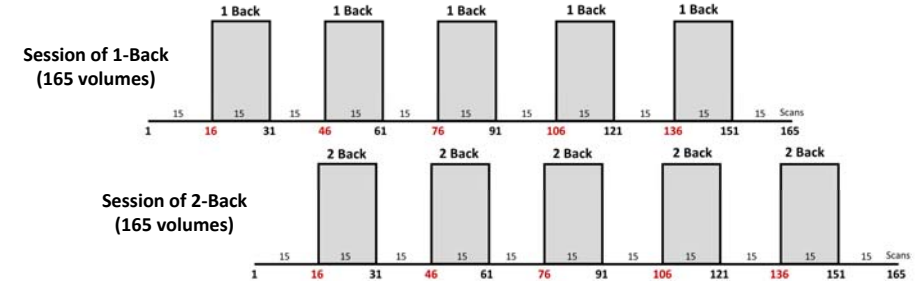
Current Module: fMRI model specification

Help on: fMRI model specification

Directory	<-X
Timing parameters	
. Units for design	<-X
. Interscan interval	<-X
. Microtime resolution	16
. Microtime onset	8
Data & Design	<-X
Factorial design	
Basis Functions	
. Canonical HRF	
. . Model derivatives	No derivatives
Model Interactions (Volterra)	...model Interactions
Global normalisation	None
Masking threshold	0.8
Explicit mask	
Serial correlations	AR(1)

Specify 1st-level Model

- Units for design = Scans
- Interscan interval = 2
- Microtime resolution = 40 (Slice number)
- Microtime onset = 1 (Reference Slice)
- Condition
 - Name = 1-Back or 2-Back
 - Onsets = [16 46 76 106 136]
 - Durations = 15
- Multiple regressors (rp_*.txt)



Specify 1st-level Model

- Data & Design
 - Subject/Session
 - Conditions

Current Item: Data & Design
 New: Subject/Session
 Replicate: Subject/Session (1)
 Replicate: Subject/Session (2)
 Delete: Subject/Session (1)
 Delete: Subject/Session (2)

Data & Design

Subject/Session (1)

Scans <-X

Conditions

Condition

Name 1-Back

Onsets 5x1 double

Durations

Time Modulation

Parametric Modulations

Orthogonalise modulations

Multiple conditions

Regressors

Multiple regressors

High-pass filter

Subject/Session (2)

Scans <-X

Conditions

Condition

Name 2-Back

Onsets 5x1 double

Durations

Time Modulation No Time Modulation

Parametric Modulations

Orthogonalise modulations Yes

Multiple conditions

Regressors

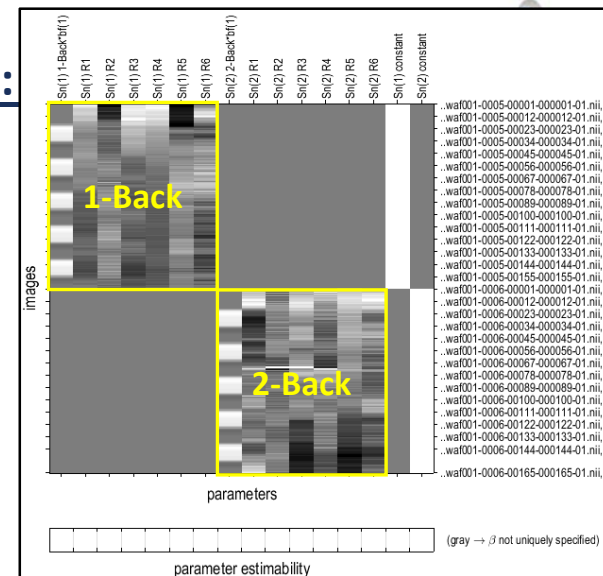
Multiple regressors

High-pass filter 128

Load Nback_fullmodel.mat

Statistical Analysis: Design

Including both 1-Back and 2-Back datasets.



Estimate Model

Current Module: Model estimation

Help on: Model estimation

Select SPM.mat ...process\NBACK\SPM.mat

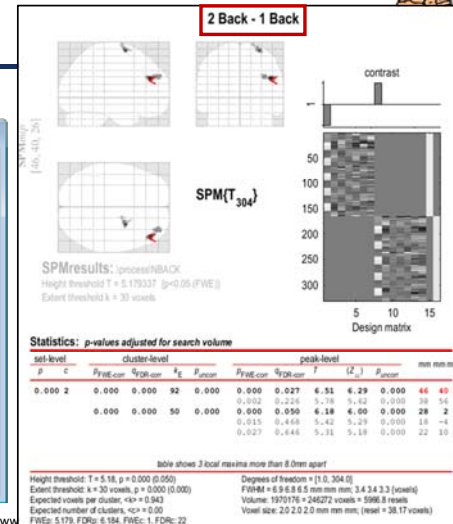
Write residuals No

Method

Classical

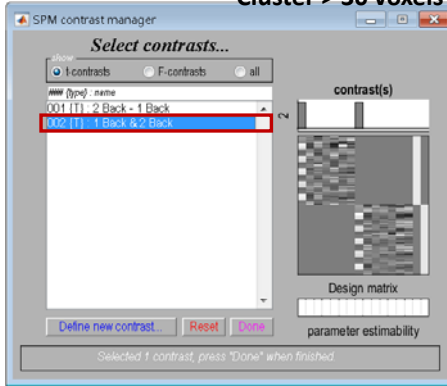
Review Results

FWE, $p < 0.05$
 Cluster > 30 voxels



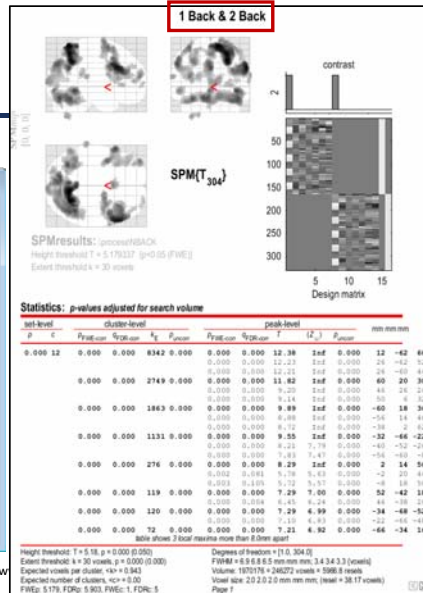
Review Results

FWE, $p < 0.05$
Cluster > 30 voxels



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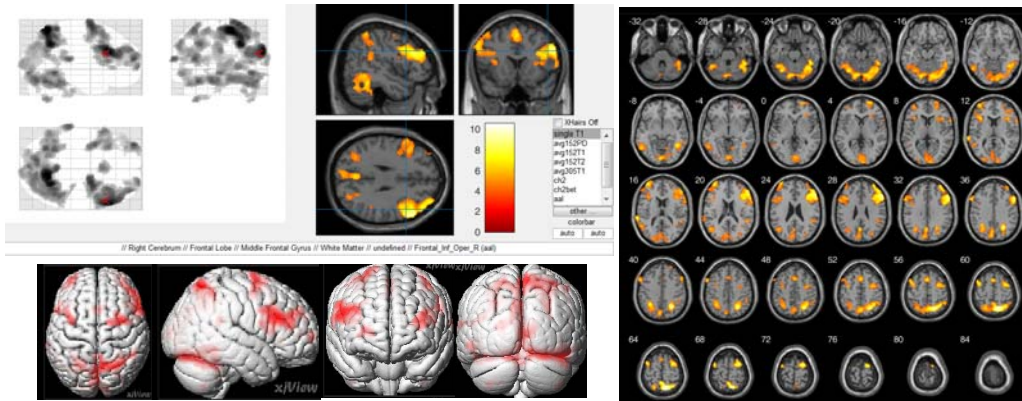
<http://www.ym.edu.tw/~cfu>



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xjview



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SPM Group Analysis – 2nd-level

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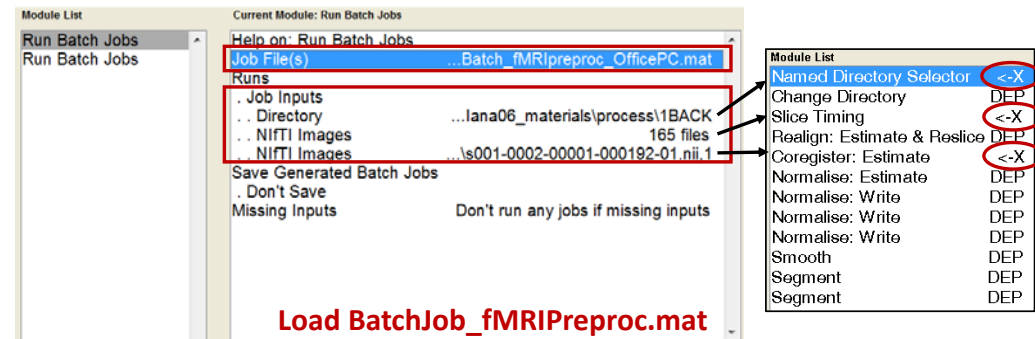
<http://www.ym.edu.tw/~cfu>

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SPM Batch Jobs

BasicIO → Run → Run Batch Jobs

Select the FILES for processing



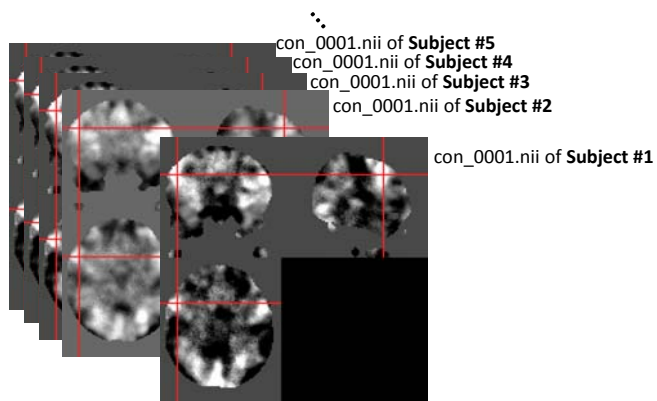
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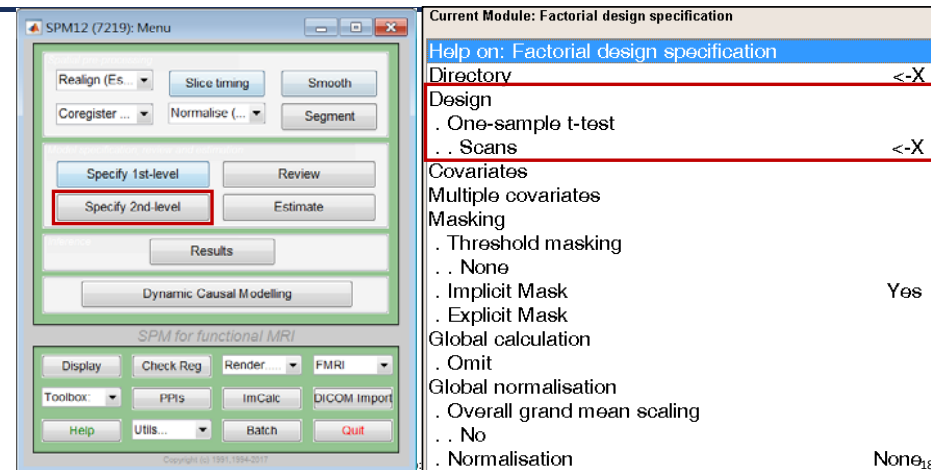


Statistical Inference on Group Data

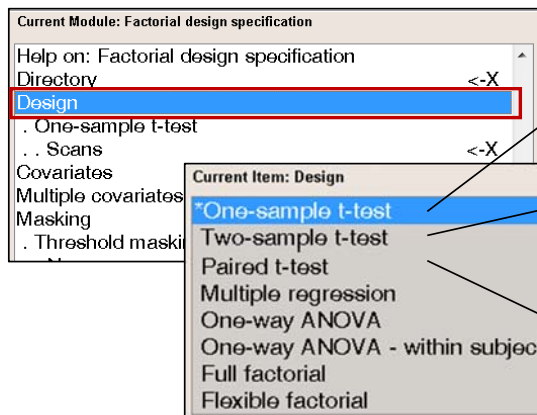


- fMRIana08_materials\Data
- BI_1Back
 - BI_2-1Back
 - BI_2Back
 - HC_1Back
 - HC_2-1Back
 - HC_2Back

Specify 2nd-level Model

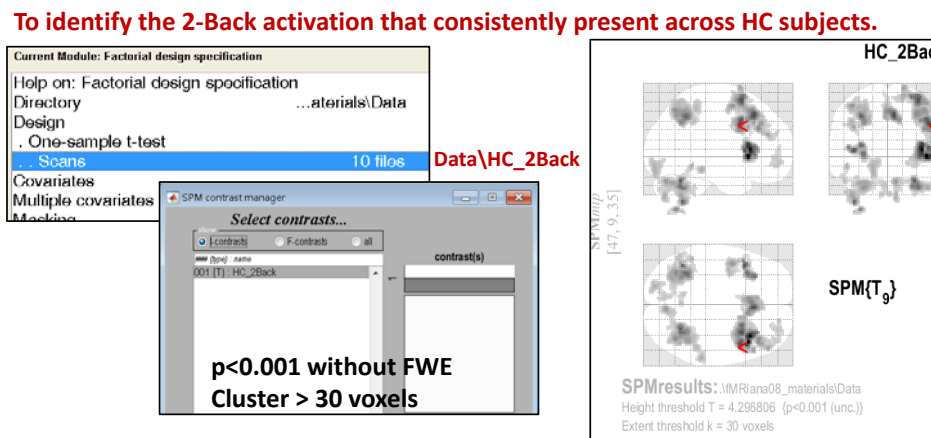


Specify 2nd-level Model



- To identify the activation maps that consistently present across subjects.
Ex: 2-Back brain activations in healthy controls.
- To identify the activation maps that significantly different between two groups.
Ex: Difference of 2-Back brain activations between healthy controls and brain Injury patients.
- To identify the activation maps that significantly different between two conditions.
Ex: Difference of brain activations between pre- and post-treatment conditions in brain Injury patients.

Specify 2nd-level Model – one sample



Specify 2nd-level Model – two sample



To identify the difference of 2-Back brain activations between HC and BI subjects.

Current Module: Factorial design specification

Help on: Factorial design specification <-X

Design

- .. Two-sample t-test
- .. Group 1 scans 10 files
- .. Group 2 scans 10 files
- .. Independence
- .. Variance
- .. Grand mean scaling
- .. ANCOVA

Covariates

Data\HC_2Back
Data\BI_2Back

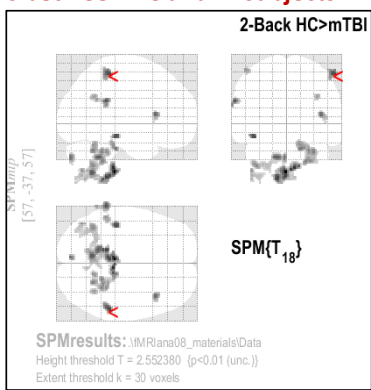
SPM contrast manager

Select contrasts...

contrast name	F-contrasts	T-contrasts
001 [T]: 2-Back HC>mTBI		<input checked="" type="checkbox"/>
002 [T]: 2-Back HC>mTBI		<input checked="" type="checkbox"/>

contrast(s)

p<0.01 without FWE
Cluster > 30 voxels



THE END

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