

# Prospective Harmonization

Thomas Nichols

# OHBM Committee on Best practice in Data Analysis & Sharing (COBIDAS) History

- Created at OHBM 2014
  - Prompted by "OHBM Council Statement on Neuroimaging Research and Data Integrity"
- Charged with
  1. Identifying best practices of data analysis and data sharing in the brain mapping community
  2. Preparing a white paper organising and describing these practices
  3. Seeking input from the OHBM community
  4. Publishing these recommendations

# COBIDAS Status

- Membership

Simon Eickhoff

Alan Evans

Michael Hanke

Nikos Kriegeskorte

Michale Milham

Russel Poldrack

Jean-Baptiste Poline

Erika Proal

Bertrand Thirion

David van Essen

Tonya White

BT Thomas Yeo

Thomas Nichols

- Will not prescribe practice (mostly)
- Rather focus on what to report
  - To support open and reproducible research

# COBIDAS Status

- fMRI
  - Task & rest
- Divisions of fMRI Practice
  - Experimental design reporting
  - Image acquisition reporting
  - Preprocessing reporting
  - Statistical modeling
  - Results reporting
  - Data sharing
  - Replication and reproducibility
- Produce white paper
  - To be commented on, and ultimately approved by OHBM members

# COBIDAS Document Form

- For each division
  - Principals of open and reproducible research
  - When feasible, recommendations for practice
  - Detailed tabular listing of what to report

## Best Practices in Data Analysis and Sharing in Neuroimaging using MRI

A report by  
Committee on Best Practices in Data Analysis and Sharing (COBIDAS)  
Organization for Human Brain Mapping (OHBM)  
June X, 2015

A Draft For Consideration by The Membership of OHBM

### 0. Introduction

The Organization for Human Brain Mapping (OHBM) Committee on Best Practices in Data Analysis and Sharing (COBIDAS) was created by OHBM Council in June 2014 on the basis of the "OHBM Council Statement on Neuroimaging Research and Data Integrity" [\[link\]](#). COBIDAS was charged with (i) identifying best practices of data analysis and data sharing in the brain mapping community, (ii) preparing a white paper organising and describing these practices, and (iii) seeking input from the OHBM community before ultimately (iv) publishing these recommendations. Dr. Nichols was named as chair and invited nominations from the OHBM membership in July 2015. From over 100 nominees Dr. Nichols selected a dozen experts from the membership that covered reflected the diversity of OHBM, with the final list approved by Council. The different constituencies considered included: Researchers focusing in cognitive applications, clinical applications, methods and database developers; different geographic areas; gender; representation of junior researchers; and, to facilitate communication within OHBM leadership, at least one member from Council and one member from the OHBM Program Committee. The panel of 13 members (including chair) met on a regular basis from October 2014 through May 2015, releasing a draft of this document to the full OHBM membership for comment in June 2015. After a comment period, during which input was solicited from members, a revised document was created and distributed to the membership for an up/down vote. In July XX 2015, an e-ballot was held which approved the document with a simple majority vote. It should be noted that while best practice white papers like this are not uncommon (see, e.g., [Alsop2014,Kanal2013,Gilmore2013]), they are generally authored by and represent the consensus of a small committee or at most a special-interest section of a larger professional body. Hence we are excited to present this work with the explicit consent of a plurality of the OHBM membership.

## Experimental Design Reporting

Aspect	Notes	R = Required r = Recommended
<b>Number of subjects</b>	Elaborate each by group if have more than one group.	
Subjects approached		r
Subjects consented		r
Subjects refused to participate	Provide reasons.	r
Subjects excluded	If any; provide reasons.	R
Subjects participated	Final number of subjects included in the statistical analysis, specifying if that number varies between different analyses.	R
<b>Inclusion Criteria and Descriptive Statistics</b>	Elaborate each by group if have more than one group.	
Age	Mean, standard deviation and range.	R
Gender	Absolute or relative frequencies	R
Race & Ethnicity	Per guidelines of NIH or other relevant agency	R
SES, Education	Specify measurement instrument used; may be parental SES and education if study has minors.	r

# Example: Experimental Design Reporting

<b>Aspect</b>	<b>Notes</b>	<b>R = Required r = Recommended</b>
<b>Number of subjects</b>	Elaborate each by group if have more than one group.	
Subjects approached		r
Subjects consented		r
Subjects refused to participate	Provide reasons.	r
Subjects excluded	If any; provide reasons.	R
Subjects participated	Final number of subjects included in the statistical analysis, specifying if that number varies between different analyses.	R
<b>Inclusion Criteria and Descriptive Statistics</b>	Elaborate each by group if have more than one group.	
Age	Mean, standard deviation and range.	R
Gender	Absolute or relative frequencies	R
Race & Ethnicity	Per guidelines of NIH or other relevant agency	R
SES, Education	Specify measurement instrument used; may be parental SES and education if study has minors.	r
IQ	Specify measurement instrument used.	r
Handedness	Absolute or relative frequencies; basis of handedness-attribution (self-report, EHI, other tests)	R
Exclusion criteria	Describe any screening criteria, including those applied to “normal” sample such as MRI exclusion criteria.	R

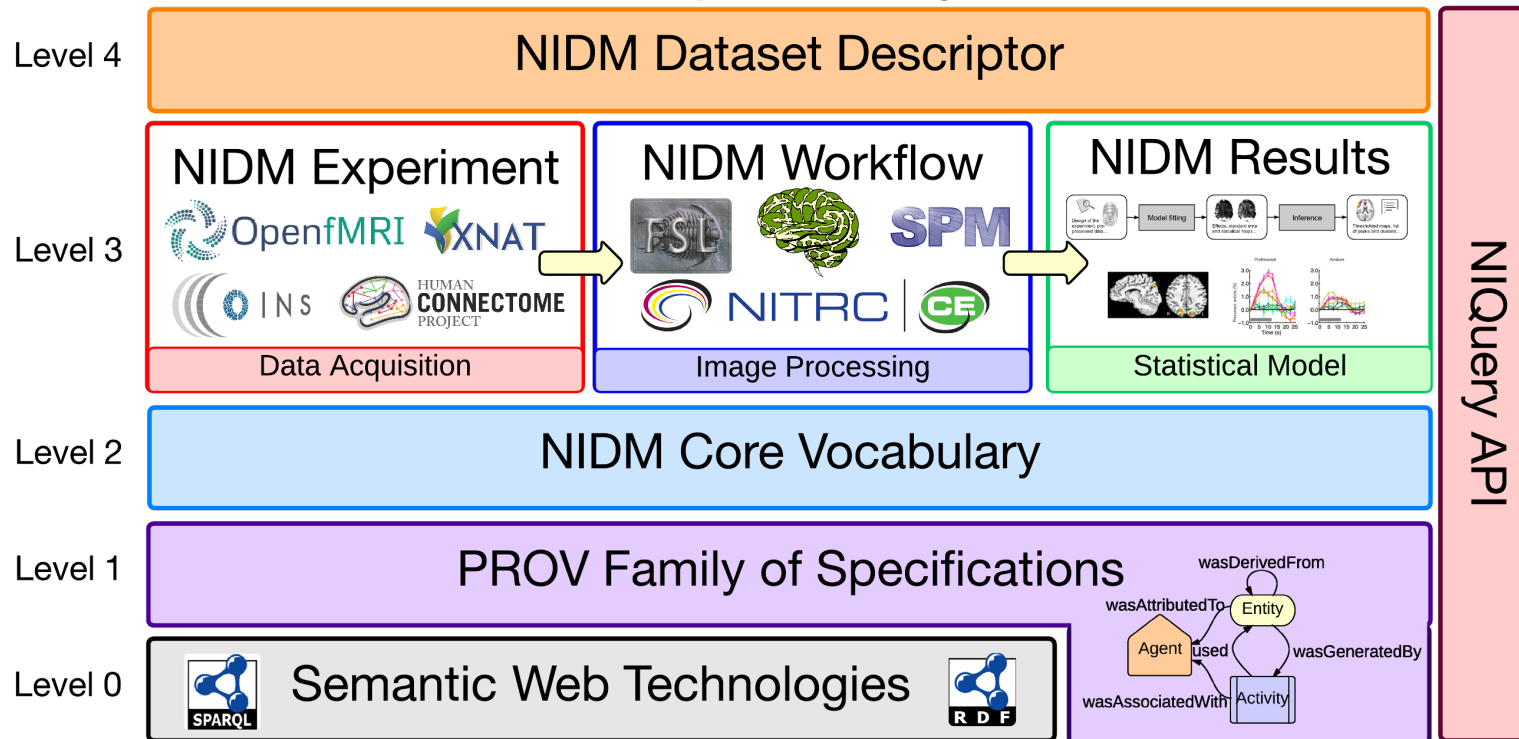
# COBIAS Status

- Now
  - Manuscript finalized, approved by Council
- Mid July
  - Manuscript posted on OHBM website
  - Open for comment for 30 days
- August
  - Member comments integrated
  - Final, approved by Council
- Sept
  - Finalized manuscript posted for up/down vote
  - Upon approval, submission for publication

# INCF's Neuroimaging Data Model (NIDM)

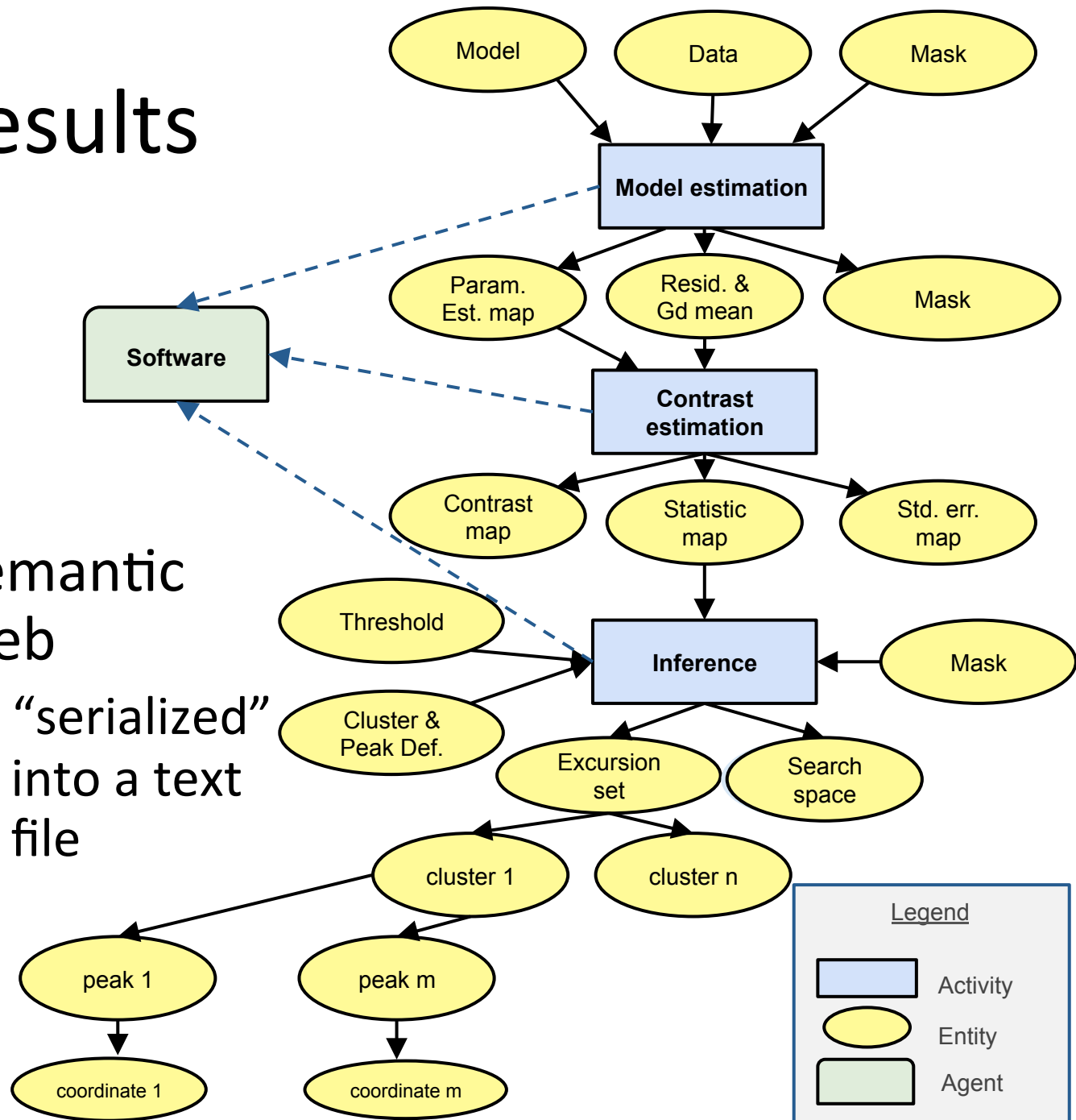
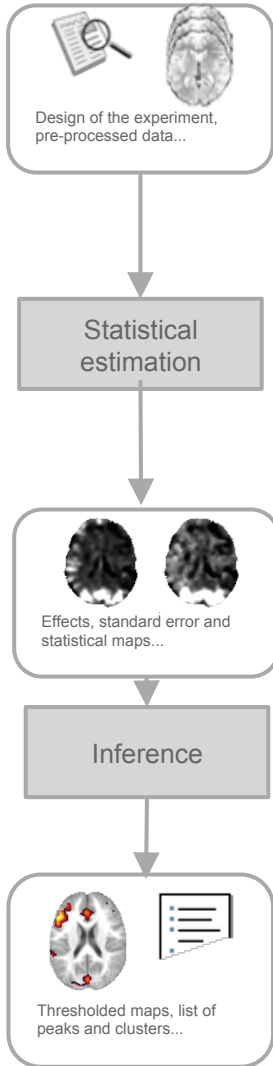
- Collaborative effort to represent all aspects of neuroimaging experiments, data collection & analysis in machine-readable form

## NIDM Component Layer Cake





# NIDM Results



- Semantic web
  - “serialized” into a text file

# Common Format for all software

### FEAT Report

Registration - Pre-stats - Stats - Post-stats - Log

**Stats**

**Analysis methods**  
 FMRI data processing was carried out using FEAT (FMRI Expert Analysis Tool) Version 6.00, part of FSL (FMRIB's Software Library, www.fmrib.ox.ac.uk/fsl). Time-series statistical analysis was carried out using FILM with local autocorrelation correction [Woolrich 2001].

**References**  
 [Woolrich 2001] M.W. Woolrich, B.D. Ripley, J.M. Brady and S.M. Smith. Temporal Autocorrelation in Univariate Linear Modeling of FMRI Data. Neuroimage 14:8(1370-1386) 2001.

**Design matrix**

**Model**

**Contrast weights**

### FEAT Report

Registration - Pre-stats - Stats - Post-stats - Log

**Post-stats**

**Analysis methods**  
 FMRI data processing was carried out using FEAT (FMRI Expert Analysis Tool) Version 6.00, part of FSL (FMRIB's Software Library, www.fmrib.ox.ac.uk/fsl). Statistical images were thresholded using clusters determined by  $Z > 2.3$  and a (corrected) cluster significance threshold of  $P = 0.05$  [Worsley 2001].

**References**  
 [Worsley 2001] K.J. Worsley. Statistical analysis of activation images. Ch 14, in Functional MRI: An Introduction to Methods, eds. P. Jezzard, P.M. Matthews and S.M. Smith. OUP, 2001.

**Threshold**

Thresholded activation images 2.3 5.7

**Contrast weights**

**Excursion set**

Co-ordinate information for cluster\_0001 - [Standard space version](#) (if present) - [back](#) to main FEAT report

### Cluster List

Cluster Index	Voxels	P	-log10(P)	Z-MAX X (vox)	Z-MAX Y (vox)	Z-MAX Z (vox)	Z-COG X (vox)	Z-COG Y (vox)	Z-COG Z (vox)	COPE-MAX X (vox)	COPE-MAX Y (vox)	COPE-MAX Z (vox)	COPE-MEAN		
4	1203	8.02e-24	23.1	3.79	41	17	13	34	4.7	14	1.31e+03	40	16	13	268
1	799	1.26e-12	11.9	3.51	41	41	23	43.4	40.3	23.9	851	47	38	21	336
2	117	0.000621	3.21	4.54	47	18	18	47.1	19.2	19.7	476	48	17	19	241
1	81	0.00094	2.05	4.61	35	38	51	32.3	39.2	51	367	52	38	51	222

**Cluster**

### Local Maxima

Cluster Index	Z	x	y	z
4	2.79	41	17	13
4	5.63	42	21	12
4	5.62	28	7	16
4	5.61	45	15	14
4	5.6	39	13	12
4	5.56	52	10	16
1	5.61	41	23	43
1	5.2	43	41	20
1	4.62	55	17	21

**Peak**

**Contrast weights** **passive listening > rest**

**Excursion set**

**Contrast weights** contrast[s]

**SPM(T<sub>84</sub>)**

**Statistic map**

**SPMresults** Data: chache/Data/ft0  
 Height threshold T = 4.852417 [p<0.05 (FWE)]  
 Extent threshold k = 0 voxel

**Threshold**

**Statistics:** *p-values adjusted for search volume*

Cluster-level				Peak-level			
P	FW-corr	FW-corr	FW-corr	P	FW-corr	FW-corr	FW-corr
0.0005	0.000	0.000	0.539	0.000	0.000	17.52	Inf
				0.000	0.000	13.00	Inf
				0.000	0.000	10.29	Inf
				0.000	0.000	13.54	Inf
				0.000	0.000	9.72	Inf
				0.000	0.009	8.56	8.55
				0.000	0.009	6.20	6.61
				0.012	0.152	5.27	4.89

**Cluster**

**Peak**

**Excursion set**

**Threshold** Height threshold: T = 4.85, p = 0.000 [0.050]  
 Extent threshold: k = 0 voxel  
 Expected voxels per cluster: (k) = 4.029  
 Expected number of clusters: (c) = 0.05  
 TFWp: 4.852, FDRp: 5.764, FWE: 12, FDRic: 29

**Clust. & Peak Definition** Degrees of freedom = 11.0, 84.01  
 FWHM = 16.1, 16.1, 13.7 mm mm mm  
 Volume: 1071062 = 69306 voxels = 407.1 resels  
 Voxel size: 3.0 3.0 3.0 mm mm mm, (resel = 132.91 voxels)

**Search space**

**Statistic map**

[A] AFNI: AFNI\_data6/group\_results/FT\_anat+tlrc & ttest++\_result+tlrc

Order: RAI-DICOM  
 x = -11.000 mm [R]  
 y = 58.000 mm [L]  
 z = 46.000 mm [S]

Color: green  
 Gap: 5  
 Index: 1, 0

Define Overlay ->  
 Define DataMode ->  
 UnderLay: Edit Env  
 OverLay: NIML+PO  
 Control: SetFace

**Threshold**

T-t: 4.773  
 p = 0.010  
 q = 0.070

Ulay: #0 #0  
 Ulay #0 set0\_mean  
 Thr #1 set0\_tstat  
 Ulay: #0 7: 5406  
 Ulay: -10.74775: 10.21025  
 Ulay: -15.43421: 15.21406  
 autoRange: 10.74775 %  
 See: T1 Atlas Regions

[A] AFNI: AFNI\_data6/...

**Excursion set**

AFNI Cluster Results [A]

Voxels survived clustering = 3104  
 Voxels edited out = 409

Cluster & Peak Definitions

#	XYZ Peak	Size	X	Y	Z	Alpha			
1:	606 vox	+17.0	+95.0	+6.0	Jump	Flash	Plot	Save	N/Coin
2:	465 vox	-25.0	+71.0	-14.0	Jump	Flash	Plot	Save	N/Coin
3:	456 vox	-3.0	+87.0	+16.0	Jump	Flash	Plot	Save	N/Coin
4:	215 vox	-65.0	+35.0	+6.0	Jump	Flash	Plot	Save	N/Coin

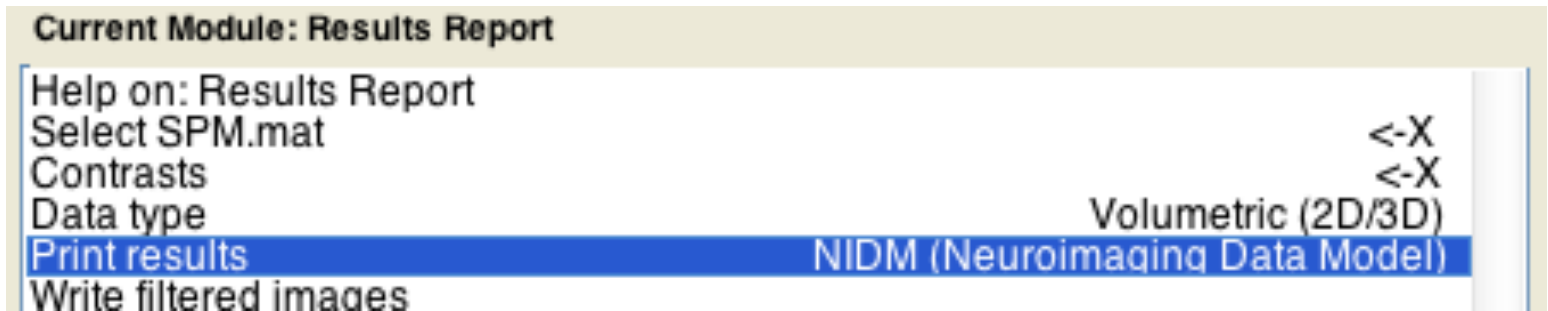
**Cluster**

**Peak**

# NIDM Exporters

- SPM12 done!

SPM 12 batch system: SPM → Stats → Results report



- SPM8 extension underway
- FSL – in beta testing
- AFNI
  - In planning stage

