

Data : TOLD sub-01 : post session (run1 & run2)

Contrast : spmT_0002 : LeftHand High vs Low, $p < 0.05$ FWE

Preprocessing : fmripreg

Template : MIIIRA (elderly) : voxel size = 2mm iso

Classical SPM smoothing (FWHM = 4mm)

8 conditions : 6 vibrations, 1 rest, 1 response

Nuisance regressors :

- 12 CSF_compcor
- 12 WM_compcor
- 24 mvts parameters
- N scans outliers ($N \leq 20$) : thresh_FD = 0.5 & thresh_DVARS = 2

Comparison of different types of denoising strategies :

A. “standard” : GLM with 8 conditions regressors + all nuisance regressors

B. “orthogonalize” :

1. Orthogonalization of “all nuisance regressors” versus “the 8 conditions regressors”
2. GLM with 8 conditions regressors + all orthogonalized nuisance regressors

C. “pre-denoising” :

1. For each run, GLM with only the nuisance regressors and extraction of the residuals
2. GLM with only 8 conditions regressors, applied to the previous residuals (pre-denoised data)

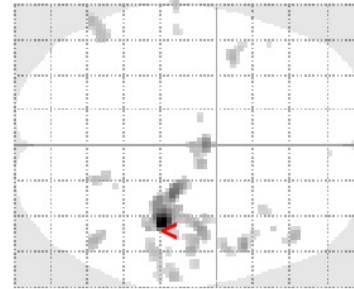
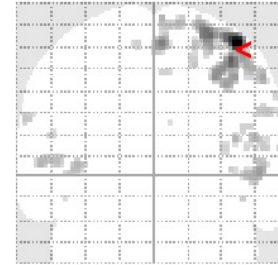
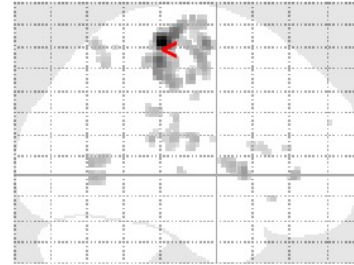
“standard”

N : Nuisance

Y : data

T : Tâche

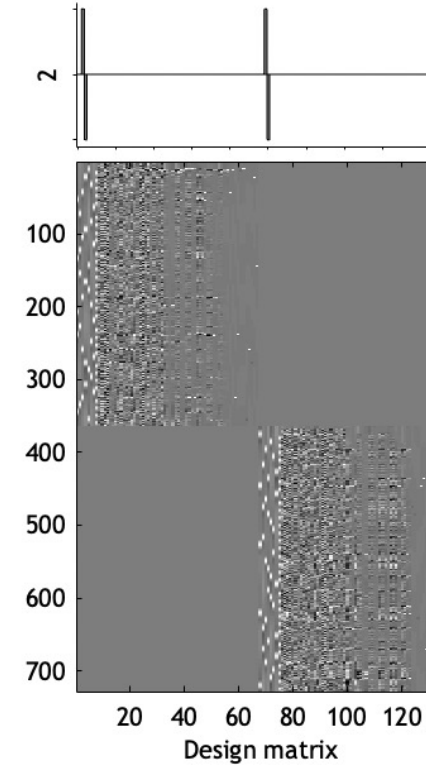
SPM_{mip}
[40.25, -27.75, 61.25]



SPM{T₅₈₁}

SPMresults: ./results_GLM_TOLD_smooth_SPM
Height threshold T = 5.072375 {p<0.05 (FWE)}
Extent threshold k = 0 voxels

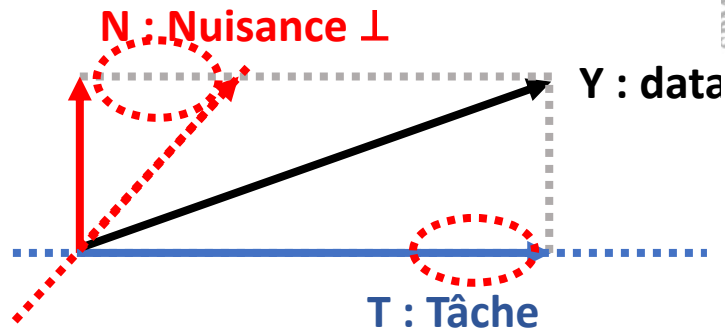
contrast



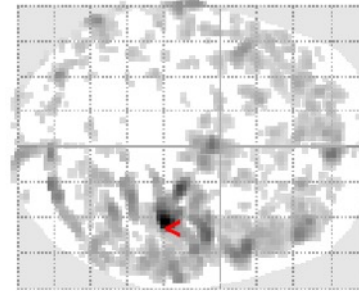
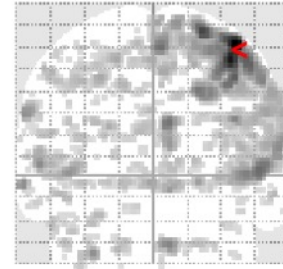
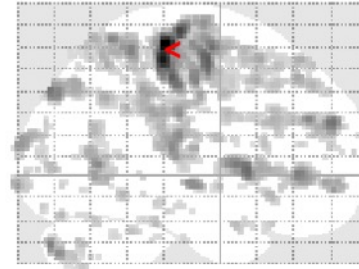
Statistics: *p-values adjusted for search volume*

set-level		cluster-level				peak-level					mm mm mm		
p	c	p _{FWE-corr}	q _{FDR-corr}	k _E	p _{uncorr}	p _{FWE-corr}	q _{FDR-corr}	T	(Z _E)	p _{uncorr}			
0.000	32	0.000	0.000	379	0.000	0.000	0.000	12.86	Inf	0.000	40	-28	61
						0.000	0.000	9.35	Inf	0.000	36	-30	53
						0.000	0.000	8.91	Inf	0.000	26	-24	65
		0.000	0.000	75	0.000	0.000	0.000	8.30	Inf	0.000	2	-8	61
						0.000	0.002	6.54	6.42	0.000	10	-10	71
						0.000	0.002	6.45	6.34	0.000	2	-14	73
		0.000	0.000	24	0.000	0.000	0.000	7.27	7.11	0.000	50	12	-1
		0.000	0.000	15	0.000	0.000	0.000	6.88	6.74	0.000	52	-14	45
		0.000	0.000	16	0.000	0.000	0.002	6.59	6.47	0.000	46	36	-3
		0.000	0.000	24	0.000	0.000	0.002	6.58	6.46	0.000	48	-62	-3
		0.000	0.000	21	0.000	0.000	0.002	6.56	6.44	0.000	48	-12	15

“orthogonalize”

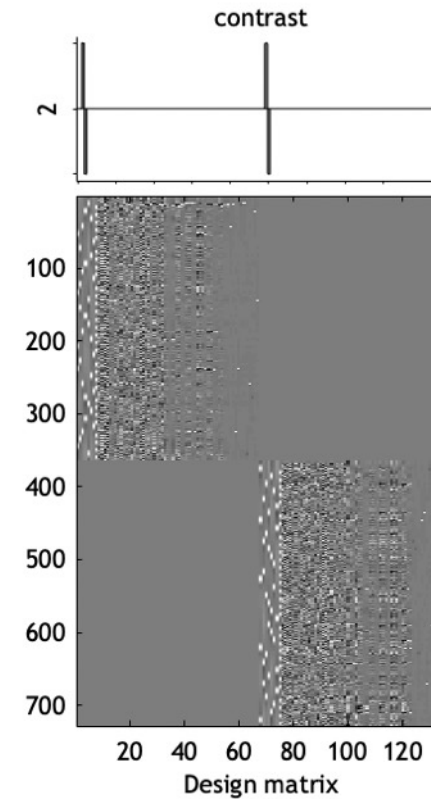


SPM_{mip}
[38.25, -27.75, 61.25]



SPM{T₅₈₁}

SPMresults:..ts_GLM_TOLD_smooth_SPM_ortho
Height threshold T = 5.072375 {p<0.05 (FWE)}
Extent threshold k = 0 voxels

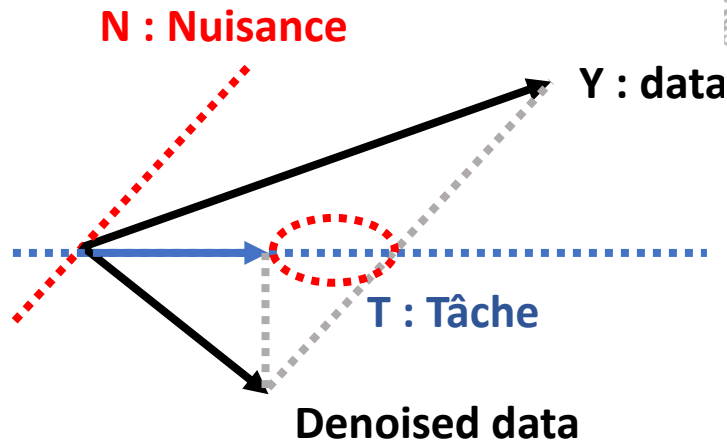


Statistics: *p-values adjusted for search volume*

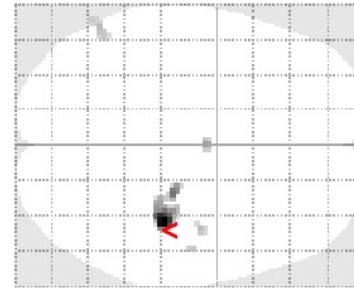
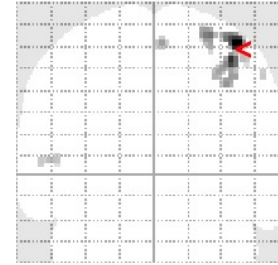
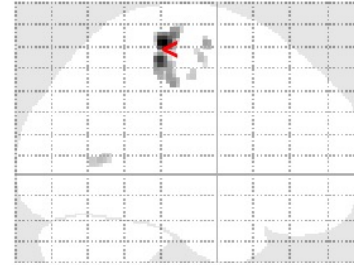
set-level		cluster-level				peak-level					mm mm mm		
p	c	p _{FWE-corr}	q _{FDR-corr}	k _E	p _{uncorr}	p _{FWE-corr}	q _{FDR-corr}	T	(Z _E)	p _{uncorr}			
0.000	181	0.000	0.000	2293	0.000	0.000	0.000	15.81	Inf	0.000	38	-28	61
						0.000	0.000	14.33	Inf	0.000	36	-30	53
						0.000	0.000	12.17	Inf	0.000	22	-22	67
		0.000	0.000	576	0.000	0.000	0.000	10.43	Inf	0.000	50	12	1
						0.000	0.000	9.40	Inf	0.000	44	36	-1
						0.000	0.000	7.91	7.70	0.000	20	38	-5
		0.000	0.000	80	0.000	0.000	0.000	10.13	Inf	0.000	6	54	23
		0.000	0.000	151	0.000	0.000	0.000	9.93	Inf	0.000	20	-86	39
						0.000	0.000	7.68	7.50	0.000	42	-72	41
						0.000	0.000	7.47	7.30	0.000	34	-80	39
		0.000	0.000	247	0.000	0.000	0.000	9.37	Inf	0.000	26	-46	59
						0.000	0.000	6.79	6.66	0.000	36	-34	37

→ Higher statistics
→ But add a lot of noise !!!

“pre-denoising”



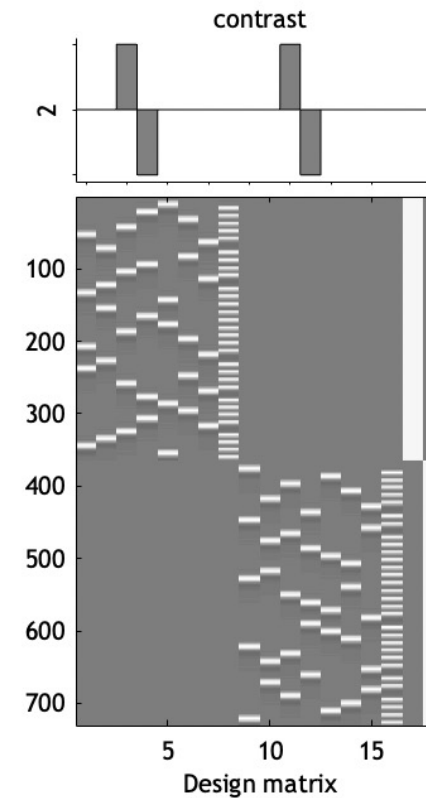
SPM_{mip}
[40.25, -27.75, 61.25]



SPM{T₇₁₂}

SPMresults:..TOLD_smooth_SPM_denoisefirst
Height threshold T = 5.061803 {p<0.05 (FWE)}
Extent threshold k = 0 voxels

LeftHand High vs Low



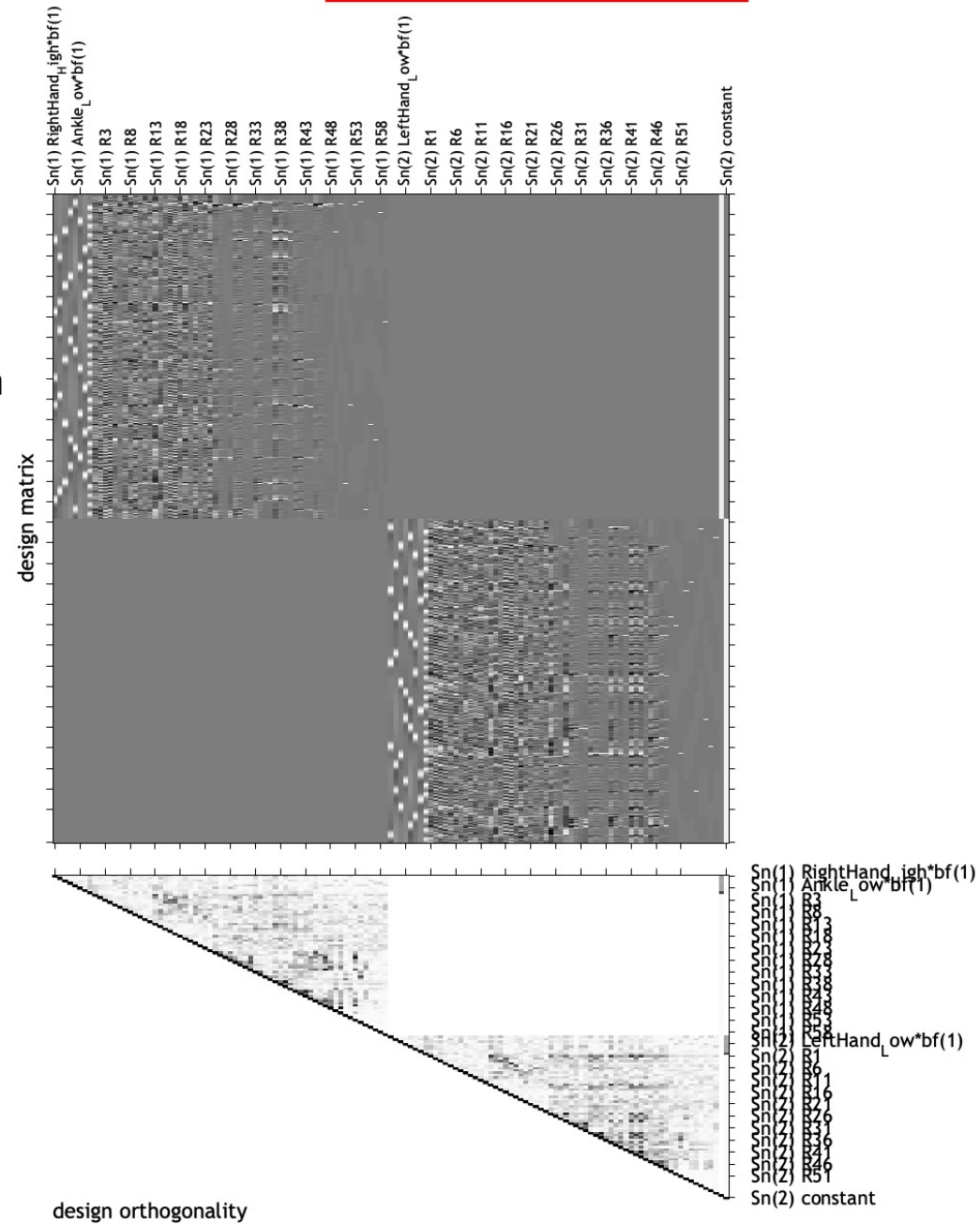
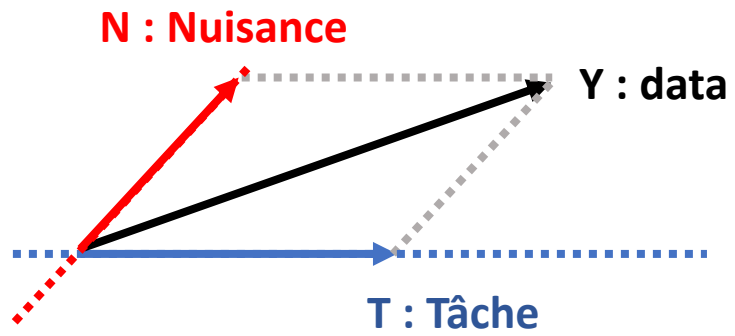
Statistics: *p-values adjusted for search volume*

set-level		cluster-level				peak-level					mm mm mm		
p	c	p _{FWE-corr}	q _{FDR-corr}	k _E	p _{uncorr}	p _{FWE-corr}	q _{FDR-corr}	T	(Z _E)	p _{uncorr}			
0.000	7	0.000	0.000	128	0.000	0.000	0.000	8.66	Inf	0.000	40	-28	61
						0.000	0.000	7.78	7.62	0.000	36	-30	53
						0.000	0.007	6.25	6.17	0.000	34	-24	41
		0.000	0.000	22	0.000	0.000	0.001	6.72	6.61	0.000	26	-24	65
		0.000	0.001	11	0.000	0.000	0.014	6.06	5.98	0.000	2	-8	61
		0.000	0.004	7	0.003	0.003	0.113	5.61	5.54	0.000	42	-10	53
		0.000	0.000	16	0.000	0.003	0.113	5.58	5.52	0.000	-54	-60	5
		0.003	0.042	3	0.036	0.008	0.234	5.41	5.35	0.000	52	-14	45
		0.015	0.202	1	0.202	0.034	0.707	5.14	5.09	0.000	40	-12	57

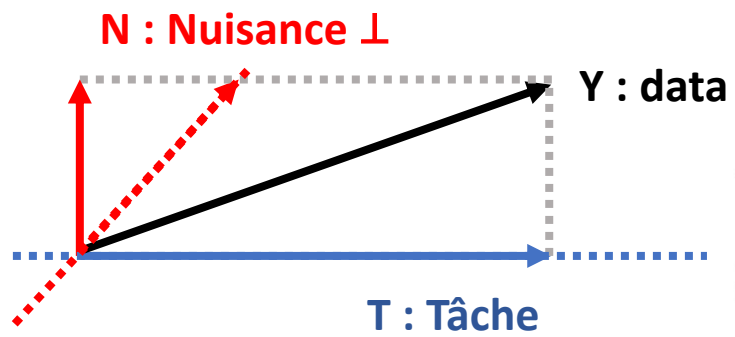
→ Lower statistics
→ Reduce activation !!!

“standard”

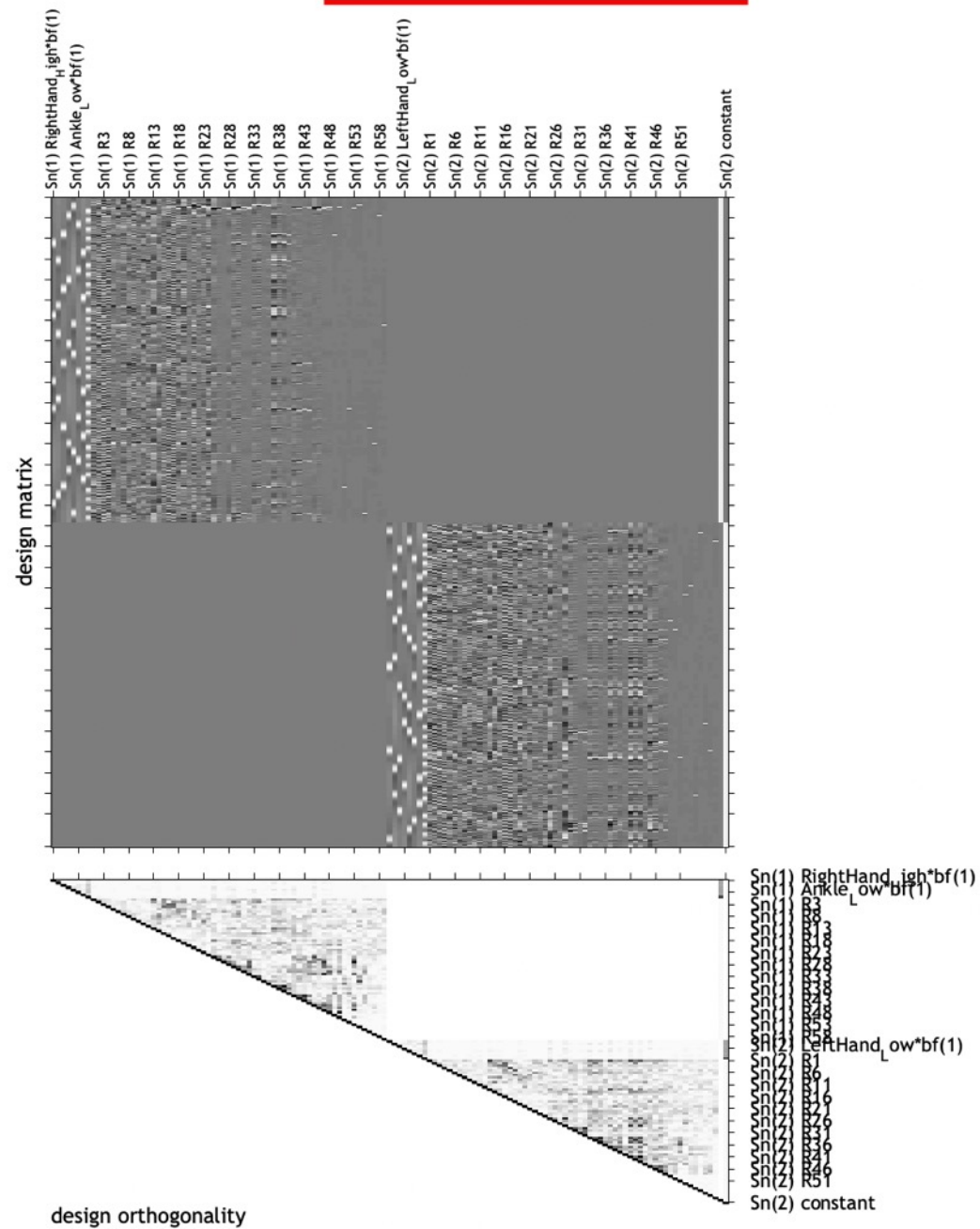
Statistical analysis: Design orthogonality



“orthogonalize”



Statistical analysis: Design orthogonality

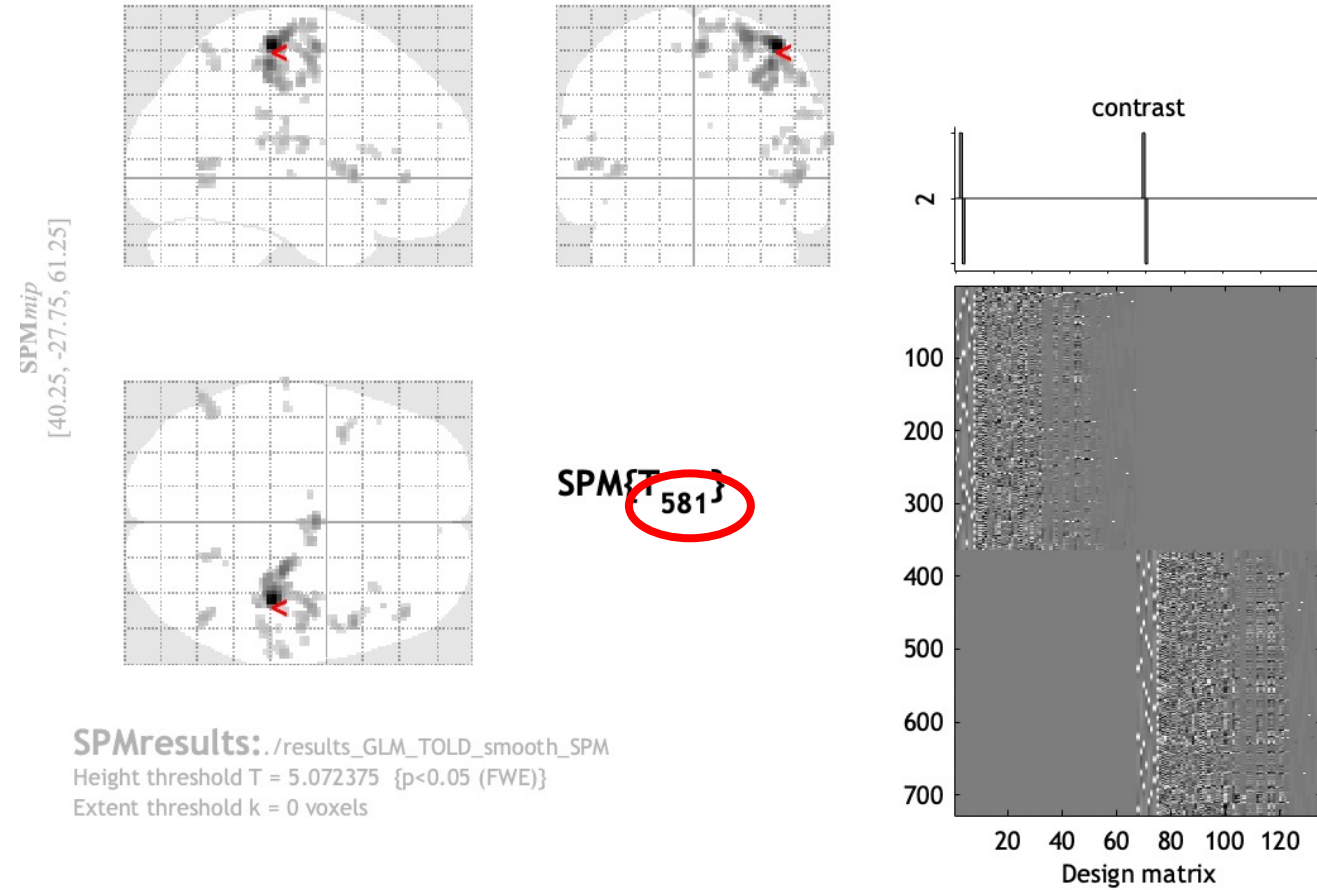


Comparison of different types of denoising strategies :

- A. “standard” : GLM with 8 conditions regressors + all nuisance regressors**
- B. “standard” : GLM with 8 conditions regressors + all nuisance regressors (but only 1 outlier regressor)**

“standard”

LeftHand High vs Low

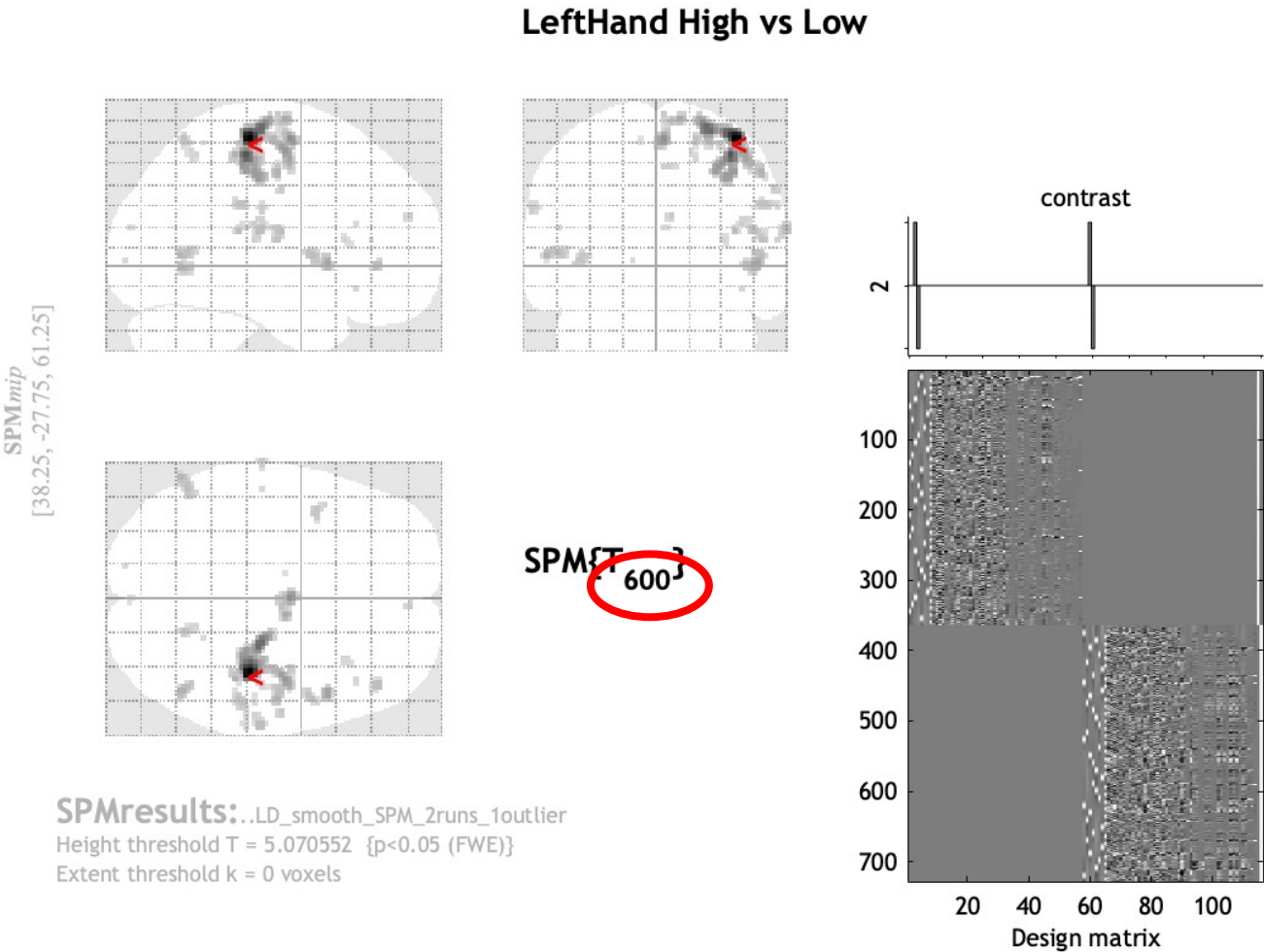


Statistics: *p-values adjusted for search volume*

set-level		cluster-level				peak-level							
p	c	$p_{\text{FWE-corr}}$	$q_{\text{FDR-corr}}$	k_E	p_{uncorr}	$p_{\text{FWE-corr}}$	$q_{\text{FDR-corr}}$	T	(Z_E)	p_{uncorr}	mm	mm	mm
0.000	32	0.000	0.000	379	0.000	0.000	0.000	12.86	Inf	0.000	40	-28	61
						0.000	0.000	9.35	Inf	0.000	36	-30	53
						0.000	0.000	8.91	Inf	0.000	26	-24	65
		0.000	0.000	75	0.000	0.000	0.000	8.30	Inf	0.000	2	-8	61
						0.000	0.002	6.54	6.42	0.000	10	-10	71
						0.000	0.002	6.45	6.34	0.000	2	-14	73
		0.000	0.000	24	0.000	0.000	0.000	7.27	7.11	0.000	50	12	-1
						0.000	0.000	6.88	6.74	0.000	52	-14	45
						0.000	0.000	16	0.000	0.000	0.002	6.59	6.47
		0.000	0.000	24	0.000	0.000	0.002	6.58	6.46	0.000	48	-62	-3
						0.000	0.002	6.56	6.44	0.000	48	-12	15

“standard”

But only 1 outlier regressor
per run (instead of 11 & 12)



SPMresults:..LD_smooth_SPM_2runs_1outlier
Height threshold T = 5.070552 {p<0.05 (FWE)}
Extent threshold k = 0 voxels

Statistics: *p-values adjusted for search volume*

set-level		cluster-level				peak-level					mm mm mm		
p	c	P _{FWE-corr}	q _{FDR-corr}	k _E	p _{uncorr}	P _{FWE-corr}	q _{FDR-corr}	T	(Z _E)	p _{uncorr}			
0.000	30	0.000	0.000	416	0.000	0.000	0.000	13.25	Inf	0.000	38	-28	61
						0.000	0.000	9.84	Inf	0.000	36	-30	53
						0.000	0.000	9.20	Inf	0.000	24	-22	67
		0.000	0.000	74	0.000	0.000	0.000	7.92	7.72	0.000	2	-8	61
						0.000	0.000	6.96	6.83	0.000	10	-10	71
						0.001	0.034	5.86	5.78	0.000	2	-14	73
		0.000	0.000	26	0.000	0.000	0.000	7.15	7.01	0.000	50	12	-1
		0.000	0.000	23	0.000	0.000	0.001	6.72	6.60	0.000	48	-62	-3
		0.000	0.000	13	0.000	0.000	0.001	6.72	6.60	0.000	52	-14	45
		0.000	0.000	38	0.000	0.000	0.001	6.56	6.45	0.000	-58	-64	3
		0.000	0.000	30	0.000	0.000	0.004	6.35	6.24	0.000	48	-12	15
						0.002	0.085	5.67	5.59	0.000	42	-26	19
		0.000	0.000	20	0.000	0.000	0.004	6.35	6.24	0.000	64	24	15

- A bit more noise
- Higher statistics at the 1st level
(more Degrees Of Freedom)